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THE FIRST ISSUE IN THE CENTURY.

With the beginning of a new year and a new century, the ELECTRICAL WORLD AND ENGINEER hopes to be pardoned for taking advantage of the present moment to say a few modest words for itself. The journal enters the twentieth century with a record of successful achievement dating back, in the case of one component journal, to 1874, and of the other to 1882, the commencement of the former thus antedating, and that of the latter being almost coincident with, the creation of the larger electrical industries which have shed so much lustre on the final years of the departing century, and which are yet very far from reaching a culmination. The new century finds the journal thoroughly organized for its work—the adequate treatment of every aspect of the science and industry which it represents. For the fullest attainment of this end, neither effort nor expense will be spared. The pens of the highest authorities in the various departments of electrical science are enlisted in the service of its readers; engineering questions will be covered by those intimately acquainted with the subjects involved, and the news of the day, scientific, professional, industrial and financial, will be reported in minute detail and at first hand in every possible instance. An acquaintance of a quarter-century's growth with the field and the men, gives every assurance of the world-wide collaboration neccessary to fulfill these promises.

To one part of the editorial policy of the journal particular attention is directed. The remarkable series of articles printed elsewhere in this issue on probable electrical developments during the twentieth century, forecasts many radical developments in electrical science that may be expected to occur in the near future, developments that will have a train of practical applications likely to revolutionize the industry. Judging from the history of the past, several new arts will be led up to by isolated discoveries or evolutionary processes, and he, therefore, who keeps step with current progress will be in a position of vantage to benefit from nascent opportunities before they become generally recognized. In order that its readers may enjoy such superior facilities of observation, it is the aim of the ELECTRICAL WORLD AND ENGINEER to keep them fully informed of every phase of electrical investigation, giving the earliest possible announcement of discoveries in electrical science and of advances in technical development, accompanied by comment pointing out their true significance and value, and followed where desirable, by articles from informed sources discussing every aspect of their bearing. In the future even more than the past, the prizes in the electrical field will be theirs who follow most closely the trend of development, and the pages of the ELECTRICAL WORLD AND ENGINEER will offer ideal means for keeping in the closest touch with every branch of current progress.

AT THE DOOR OF THE MAGICIAN.

The century just begun brings a message of promise and a hope of achievement that mean much to the race of men. Far be it from us to make light of its possibilities or to decry the prophets of gladness. Let the century past bury its dead—the only pity is that the bells that rang in the new could not in that hour have tolled the passing of much that the world regrets in the old.

But there is a lesson in the change that mankind would do well to heed—the simple lesson that time flows smoothly on with a current unbroken by the change of a date in the calendar. All that is hoped and predicted for men and their works in the next hundred years may come in the fullness of its time, but that time it may not be our lot to see. Many things which seem near may be far away, and those that seem farthest may come before the new year is dead. The retrospect of the nineteenth century is glorious in progress of material things, but they came in their due season and with no hurried pace. The men who watched for the midnight stroke that sounded the beginning of the nineteenth century had for the most part gone to their rest before the first railroad train marked the commencement of a new era in transportation and the first telegraph key clicked its message of revolution. Fewer still were left when anesthetics first robbed the surgeon's knife of its terror, and even the little children who wakened at the summons of a hundred years ago were dim-eyed and feeble before those of them who were left saw the electric light and heard the earliest murmur of the telephone.

The epoch-making discoveries and inventions of the nineteenth century came slowly, many of them crowded into its last quarter. It took fifty years to establish firmly the mechanical theory of heat, more than half as long to bring to fruitfulness the germ theory of disease, and a decade to evolve the dynamo into practical usefulness. There is, therefore, no reason to expect that the present century will at once usher in profound changes in scientific doctrines or their commercial applications. However sure we may be of the great things to come, no man can tell the hour of their coming. Startling inventions may come and be developed to world-wide importance in a few years, as was the telephone, or the great result may be reached only by decades of patient building by many hands. It behooves one to be cautious in predicting, not great futures, but those immediately to be great. The glamour of the opening century is strong upon the world—it makes men prone to see visions and dream dreams. The next few years will be filled with the voices of would-be miracle-mongers, conjuring by the mighty name of the nineteenth century. Among them may be some new Archimedes, rushing naked from his bath with the frenzy of a great discovery upon his, but it will be hard at first to recognize him and to distinguish his voice among those of mere "barkers for the side-shows" of invention.

With all seriousness, science and invention are just at this particular epoch in a condition that makes the investigator and the inventor particularly liable to go off upon false scents, and it is going to take wonderfully fine discrimination to distinguish the false from the true. We may be upon the eve of tremendous generalizations and of brilliant discoveries, but it is a far cry to the conclusion that the next generalization will be tremendous or the next discovery brilliant. Scientific tolerance and cautious, painstaking investigation have never been more important than now. Many new things will come up in the next few years with the trademark of the new century upon them, and the mind must be trained to meet them and to examine them with swift precision for their right to bear it. Great inventions there will be, and great humbugs as well, and he will be keen-eyed indeed who shall not sometimes be deceived. The blue-glass cure and the telephone startled the world almost together twenty-five years since, but the one was taken and the other left. We shall see their like again, doubtless, and as many will be fooled by one as will have faith in the other. It is a fitting time for the wise to whet their wits.

Twenty-Five Great Names.

Elsewhere in this issue is printed the result of a vote by members of the American Institute of Electrical Engineers upon the twenty-five greatest names in electrical science and invention belonging to the century just closed. As the details of the balloting are given on the page opposite the printed lists, they need not be repeated here. It may be added, however, that additions to the vote from late budgets of ballots, as well as ballots received since the lists went to press, indicate a trend of opinion so remarkably regular that it is doubtful if even numerous additional votes would materially change the general list as printed. This view is further confirmed by the character of the two comparative lists, which were compiled to indicate the bias it was thought would be displayed by engineers toward the representatives of the industrial branch of electricity, and by teachers toward the theoretical branch. The result is somewhat surprising, for the lists on their face indicate, if anything, a tendency opposite to that which could reasonably have been expected; and no less surprising is the close resemblance of the two selected lists to each other and to the general list. It would be curious to know the result of similar balloting in Europe, and particularly as bearing on the extent to which, if any, selections made for the present lists were influenced by national bias.

From communications accompanying many of the ballots there was evidently, as might have been expected, considerable uncertainty as to the criteria to be applied in selecting names. Judging from these communications and from the character of the majority of individual lists, the criteria most often applied was that the work of those selected should be, first, of definitely intrinsic value and the result of high intellectual effort, as contrasted with achievements giving prominence to names merely from the owner's having been the first to seize a golden opportunity; second, that work conferring high distinction should be of a kind whose influence will extend through generations. In short, this implies taking the standpoint of one who endeavors to project his mind into the next century and predict its verdict. Others appeared to lay great stress upon mere priority of discovery, and others again to consider that great prominence at any epoch, however fugitive the prominence, is a claim for consideration.

While the lists undoubtedly reflect present opinion in electro-technical circles in this country as to whose names should be included in such a classification, it is needless to say that the verdict cannot be accepted as definite owing to the considerable number of names included of men yet living. Personality and lack of perspective are two factors apt to largely influence present judgment, and consequently, even if no other reason intervened, a discussion of the lists as a whole would not at the present time be opportune. Among the names of those, however, who have long passed away are two, the inclusion of which in the list may be challenged—those of Ohm and Oersted. So far as we have been able to discover by reference to authoritative sources, the only claim of Oersted to fame is the discovery of the connection between magnetism and electromagnetism, which consisted in observing that a magnet was deflected by current. This observation appears to have been entirely accidental, having been made one day during a class-room lecture. It is true that subsequently Oersted claimed to have predicted at the beginning of the century the relationship which his discovery established seventeen years later; but the work to which he refers is a metaphysical disquisition of the schoolmen type, which had no influence previous to 1820 and none after.

As to Ohm, the case is different from that of Oersted, for no one questions the great ability which he displayed in his mathematical investigation of the relation existing between current, resistance and electromotive force. This work, however, appears to have been, after all, merely a mathematical *tour de force*, for it proved nothing. Ohm's law expresses what must have been known by the earliest workers with electrical current, that an effect varies directly with the force producing it and inversely with the resistance encountered by the force. In his proof, Ohm, after laborious mathematical investigation, arrived at this axiomatic law, and his proof, though leading to correct results, was based upon a mistaken analogy between electricity and heat. The proof which Ohm's law requires and which was not given by Ohm, has not yet been offered. This consists in proving that the resistance remains constant for all values of current. As pointed out by Maxwell, Ohm's law must be considered a purely empirical one until this point is definitely settled. On the other hand, the law, as indicated by all experiments thus far made, is true within the limits of error of experiment. Assuming that this criticism of Ohm's work is well-founded, he nevertheless deserves some place in the roll of nineteenth century names of those who have influenced electrical advancement, through having introduced into the early science the definite idea of electrical resistance.

Electrical Industry.

When the old nineteenth century dawned there was no such thing in this world as an electrical industry, and all the great boons that electricity was to bestow on mankind were still to be created. We say "boons" advisedly and without emphasis, because Emile Zola inquires sceptically, What has the telephone, telegraph or electric light done to diminish the hunger of the hungry? Well, even if we conceded that they had done nothing toward filling anybody's stomach, we fail to see what difference that makes in a consideration of the subject, for, after all, we must look to the soil, the sea, the air, for food. Even if these "boons" had made no one happier, it would not be an argument for dropping them. Mankind in its onward march and its acquisition of new potentialities does not stop to ask whether plows or boats or tools make it happier, or whether they specifically fill its stomach. It welcomes all such new agencies because it has use for them and it never willingly lets one drop out of existence unless its utility is exhausted. The fact remains that we have these electrical inventions about which M. Zola groans so despairingly, and that they constitute no mean share of wealth and material comfort, besides making for happiness and sustenance. In spite of the fact that no one is in anywise compelled to use any of these latter day electrical appliances, their growing employment by the American public and the energy of American inventors and capitalists have created in less than a century values of over three billion dollars. The evidence as to the creation of such stupendous wealth of great earning power is given elsewhere in these pages, but it is apparent in every part of the country to one who will look around him.

The twentieth century begins with these electrical industries firmly established at home and reaching out for other spheres to occupy abroad. The export trade in manufactures, which was unknown a hundred years ago, has reached a total not far short now of $400,000,000 a year, and the amount is increasing. Of this value, a large part is electrical and mechanical, and the appreciation of American apparatus is really remarkable. No good reason can be found for doubting an expansion of this export trade, for while the growth of electrical industries has been enormous, it is the fact that the possibilities have been barely touched as the new century begins.

Measuring the Resistance of Rail Bonds.

A convenient method of measuring the resistance of rail bonds is in terms of the equivalent length of continuous rail, and such a method has been practically in use in this country for at least ten years. A useful apparatus for enabling this to be carried out has recently been described in a foreign contemporary. A differential galvanometer is employed, and one of its two coils is connected across the bond to be tested, and the other across such a length of rail, in which the same current flows, that the deflection of the galvanometer is brought to zero. The method has the advantage that it does not require any electrical source to be supplied by the observer and operates by virtue of the electric currents always to be found circulating in the return circuit of a traction system. The practical difficulty is of course to obtain good contacts between the terminals of the galvanometer and the parts of the rail to be tested. Hardened steel points are generally employed for this purpose and with some pressure a fairly good contact can usually be secured with their aid. The wear and tear on such points in frequent service is, however, usually sufficient to require their resharpening at frequent intervals.

Symbols for Physical Quantities.

We publish in this issue a new edition of the table which we have previously printed, containing the revised symbols for units and physical quantities as recommended by the Committee on Notation of the International Electrical Congress of Chicago in 1893. Three new names are printed in Roman type in the column of units; namely the barie, the gauss, and the maxwell, all of which have been adopted by the Paris Congresses of 1900. It is quite important that this table of symbols and units should be universally adopted by electrical writers, partly for the sake of convenience and ease in reading algebraic expressions written upon electrical engineering subjects, but principally for the sake of international uniformity of usage. It is, of course, quite impossible to maintain a symbol such as *R* exclusively for resistance in all branches of exact science—that would be displaying an exclusiveness unworthy of technology—but it is not too much to ask the specialists in electrical science and engineering practice to use this symbol for electrical resistance in preference to any other, because the conventional use of such a symbol means so great a simplification of the algebraic text.

Nothing is more important to clearness of thought and mutual understanding in electrical matters than a clear appreciation of the meaning and names of electrical units. Every electrical quantity requires a unit for the expression of its magnitude, and looseness of thought concerning the nature of these units and their relations to each other is apt to beget inaccuracy and misunderstanding.

The units in this table are defined according to the existing system of electro-magnetics. There is a discrepancy in the dimensional values of these units in terms of length, mass and time, owing to our ignorance of the nature of permeability and specific inductive capacity. Thus permeability is expressed as a mere numeric, whereby magnetizing force appears as the same kind of quantity as the magnetic induction which it produces. It is known that this cannot be correct and that the flux produced differs from the magnetizing cause or force as essentially as electric current intensity differs from electromotive intensity. In the absence of more precise knowledge, however, it is necessary to follow the conventions of existing text books, and the discrepancy is after all merely academic and is not likely to introduce any error in practical engineering work.

High-Tension Alternators.

It is a rough and ready rule for determining the pressure in kilovolts at which the most economical electric transmission of power can be carried, to take the distance of transmission in miles. Thus, for a distance of one mile 1000 volts is a common pressure, for 10 miles 10,000 volts, and 40 miles 40 kilovolts. There is, of course, no accurate basis for such a generalization, and no definite rule can be stated for determining the pressure, since the question is one of economics involving the cost of power, conductors, and also other factors in lesser degree. But as a rough approximation, the above rule is a useful one, when not carried too far. Thus it does not necessarily follow that to transmit power economically to a distance of 100 miles requires a pressure of 100 kilovolts. It might be accomplished at 50 kilovolts or even less. The effective range is, however, just as much determined by the pressure of transmission as the effective range of a projectile is determined, other things being equal, by the initial velocity of transmission. A premium is thus placed upon the pressure of generation in alternators designed for long-distance transmission.

If the pressure of, say, 50 kilovolts could as readily and safely be generated in an alternator as 50 volts, it would clearly save the use of step-up transformers at the transmitting end of the line. In practice, however, the difficulty of insulating high electric pressures renders it necessary to use less copper and more insulation in the armature as the pressure rises, until finally the output per pound of generator is seriously diminished, and the insertion of step-up transformers begins to be economical. This limit of direct high-pressure generation is, of course, a variable quantity, depending upon the type of alternator, skill in construction and other factors, but at present it seems to be placed at about 10 or 12 kilovolts. Below this pressure, direct generation can be secured in stationary armatures without too great a sacrifice of material. Above this pressure it is found necessary to use the step-up transformer, and when the step-up transformer is decided upon, the pressure of generation usually falls to about two kilovolts. This pressure does not require excessively heavy armature conductors, and is also convenient for short-range transmission.

The Dawn of the Twentieth Century.

It is fitting that on entering the twentieth century we mark the progress of electrical arts and sciences at so fitting an epoch in the progress of time. In this issue we have, therefore, devoted considerable space to a review of the past and to a consideration of the future so far as it lies within our power to prognosticate. The nineteenth century has been essentially the century of the engineer's success. Steam engineering, mechanical engineering and electrical engineering have made giant strides and have changed the faces of countries, the relative conditions of classes, and the mutual relations of nations. There is every reason to believe that the triumph of engineering in general, and electrical engineering in particular, will be yet greater in the time to come. Our electrical branch of the engineering industry is the youngest of all, but already has a great duty and power. It would be practically impossible for a country of the size of the United States to be kept intact and united without the electric telegraph and telephone. It would be practically impossible for cities to spread and grow without the ubiquitous electric trolley car. In all probability the applications of electricity to practical life will be more widespread and more marked in each succeeding year.

The only electrical directions in which the United States is notoriously backward, are, first, in a national laboratory for standardization, and, second, in submarine telegraph cables. In the electric transmission of power, in electric illumination and in electric lights, telegraphs and telephones, the United States leads the world in the magnitude of the work. But there are almost no American submarine telegraph cables, although there is considerable American capital invested in foreign submarine telegraphs. This deficiency is really due to the absence, until very recently, of American foreign possessions, and of an American merchant marine. Now, however, that American merchant shipping may be expected to develop rapidly, and also that American foreign possessions are found both in the Atlantic and in the Pacific, we may reasonably expect American submarine cables to come into existence.

As regards a National Standardizing Laboratory, England, France and Germany possess such institutions, the Germans leading the way. It is well known that German technical research has created for that country technical industries in which she takes a leading part, and there can be no doubt that technical industrial development in this country is being hampered to some extent by the absence of a standardizing bureau, through the work of which technical operations can be fostered and corrected. It is, therefore, greatly to be hoped that the Government of the United States will soon recognize the importance of such an institution and take steps to establish one, even if the commencement be but unpretentious.

Problems of the Century.

The series of articles printed elsewhere in this issue under the general head of "Electricity in the New Century" forms probably the most important contribution of its kind ever made to periodical electrical literature. Every important department of the electrical field is represented in this series, with the single exception of the electric railway, the article on this subject having been unavoidably crowded out and will appear in the following issue. In general plan the articles include a résumé of development to date, a discussion of present status, and a forecast of future development. It will thus be seen that the series affords an admirable opportunity for readers who wish to start on the new century with a good general idea of the electrical status at the beginning, and to be informed concerning the developments to be reasonably expected.

Of the fifteen articles in this series, those of Professors Thomson, Trowbridge and Fessenden and Dr. Kennelly, deal more particularly with the great problems set for the twentieth century—electricity direct from carbon, light without heat, and developments in electrical theory. As concerns the first of these, a forecast cannot be considered very encouraging if based upon radical development along present lines. As pointed out by several of the writers, the only hopeful means of utilizing by electrical processes a larger amount of the energy of carbon than can be utilized in heat engines, lies in the direction of transferring the combustion energy of carbon to some substance capable of use in voltaic combination. This, it will be recognized, is a solution far from the ideal one. Looking into the immediate future, the best prospects for increased economy in the utilization of the energy of carbon appear to lie within the province of the heat engine, and Prof. Thurston in his article expresses sanguine views as to a considerable increase in economy likely soon to be secured from further perfections in the steam turbine and the gas engine. Still less hopeful are the views concerning the electrical production of light without heat. In fact, at the present moment it would appear that the solution of this great problem lies rather within the domain of the chemist than that of the electrician.

The very important fact should not be lost sight of, however, that a radical discovery comparable to those made by Faraday and Roentgen may instanter give a simple solution to problems which in the light of our present knowledge appear almost hopeless. By far the most promising path from which to expect such radical discoveries to appear—or at least from which to expect the clues upon which they will depend—is that leading from the laboratory and study of the electrical physicist. During the past several years the department of electrical theory has been the scene of an activity which, from its possible consequences, is comparable with that of the period of Faraday. Prof. J. J. Thomson and other workers have put forth hypotheses based upon physical investigation which not only threaten the entire fabric of established electrical theory, but from their radical nature give rise to hopes of most important consequences. The recent ideas, in fact, have led to the creation of a new branch of physical science—that of physical chemistry—dealing principally with electrical action in molecular and atomic phenomena. Should the mystery of the mechanism of these phenomena be discovered, it can reasonably be assumed that the problems of light without heat, and electricity direct from the combustible, will receive simultaneous solutions; and even a partial disclosure of the mystery of the hidden mechanism might be sufficient to this end. In the phenomena of electrical discharges in vacua, the physicist has been given a powerful means of approaching the study of molecular constitution, and it would be only a fair return if the solution of the several important electrical problems facing the new century were the first fruit.

The New Station of the New York Electric Vehicle Transportation Company—I.

By R. A. Fliess.

The Twentieth Century—the much heralded horseless age—is here and its advent has been happily commemorated in the City of New York by the opening of the new station of the Electric Vehicle Transportation Company, at Forty-ninth Street and Eighth Avenue.

It is probable that the opening, at this particular time, of the largest automobile operating, charging, storage and repair station yet constructed emphasizes more strongly than would otherwise be the case the remarkable progress that has taken place in methods of transportation on land during the century just closed.

When one recalls the fact that at the beginning of the nineteenth century the only practical method of transportation available on land for commercial or pleasure purposes was the lumbering stage coach or a horse's back, the wonderful advance that has been made in this branch of human industry alone during the short period of the last one hundred years is truly marvelous and causes speculation on the possibilities of the twentieth century to carry one irresistibly far into a field which to our great grandfathers would have been the realm of wonders.

In this connection it may not be uninteresting to note that it is just one hundred years since the first attempt to construct an automobile in America was made. To some this may appear surprising, but it is on record that one Oliver Evans—a mechanic, born at Newport, Delaware, in 1755—in the year 1801, started to build a horseless vehicle to operate on common roads. Owing to the inability of the inventor to find a single one of his contemporaries who was willing to speculate to the necessary extent in the experiments which he desired to make or even to lend him the benefit of moral support, he gave up his attempt to build his automobile, but not before he had made considerable progress towards the construction of a steam carriage designed to be driven by a non-condensing engine of his own design. This farsighted inventor predicted, however, at the time he gave up his attempt to construct a horseless carriage, that eventually vehicles would be propelled on common roads without the aid of horses, and that the time would come when people would travel in vehicles, moved by steam engines from one city to another, almost as fast as birds can fly. How fully this predicton, made just one hundred years ago, has been fulfilled, the thousands of miles of railroads and the rapidly increasing number of horseless vehicles now operating on our common roads bear eloquent testimony.

It was, however, only in the latter years of the last century that the great strides which have brought horseless vehicle locomotion on common roads to its present advanced stage of development, were made. Especially is this true in the case of electric vehicles, for it is only the developments that have taken place within the last twenty years that have made the electric automobile a commercial possibility. In fact, less than four years have elapsed since the first electric vehicle, built in this country to compete commercially with horse traction on common roads, was placed in operation. Since then the rapid strides that have been made in the development of this infant industry have been remarkable.

Perhaps, at the moment, no better idea of the magnitude of the development that has taken place in four short years can be obtained than is furnished by the brief history of the growth of the Electric Wagon and Carriage Company, from its small experimental beginning into the present Electric Vehicle Transportation Company, the new station of which has just been placed in operation.

HISTORICAL.

On the evening of Jan. 20, 1897, the American Institute of Electrical Engineers devoted its 112th meeting to a topical discussion on "Electrically Driven Vehicles," during the course of which it was stated that the Electric Carriage & Wagon Company was equipping a station in New York City, for the purpose of running a dozen or more electric carriages for public and private service. It was said at the time that at first the service would be more or less selective, as the impossible or impracticable was not to be attempted. It was also said that, as this station was the first of its kind that had probably ever been equipped, a number of new problems was constantly arising, and that it would be some months before it would be known, with any degree of accuracy, what the probable results would be. Looking back from our present point of vantage it would seem as though even the most sanguine of the promotors of that pioneer company could hardly have foreseen the rapid expansion which it was destined to ensue in such a short space of time.

In its issues of August 14 and 21, 1897, the *Electrical World* described the station of this company. The single room, 40x100 ft., which constituted its ground floor, was utilized as battery-charging room, vehicle-loading room, battery-switchboard room, washing room for vehicles and rental office, all in one.

The building, which was situated in Thirty-ninth Street, just west of Broadway, was a three-story one, and occupied a ground space of about 40x100 feet. Its total available floor space was 12,000 square feet, which, it may be interesting to note, is less than 10 per cent of that available in the Forty-ninth Street station. This pioneer station was equipped with 20 battery-charging stands, each of which would accommodate a battery of 44 cells. The new Forty-ninth Street station is equipped at present with charging racks enough to accommodate 640 batteries of 44 cells, and has been so planned and laid out that the battery-charging room can be extended in two directions, when desired, until it can be made to accommodate over 1000 batteries.

The rolling stock equipment of the Thirty-ninth Street station consisted of 12 hansom cabs and 1 brougham. The Forty-ninth Street station can accommodate 540 vehicles, with ample space left for their proper and easy manipulation, while over 700 vehicles could be crowded into the building, should the necessity arise. In fact, the Electric Vehicle Transportation Company expects to have the 300 vehicles, which make up its rolling stock equipment at present, in full operation in from thirty to sixty days, provided they can get enough competent drivers in that time.

Not long after the Electric Carriage & Wagon Company began to operate its pioneer station, it became evident that its Thirty-ninth Street quarters would soon become inadequate. In fact, in less than nine months after its first service had been inaugurated the company, which in the interim had changed its name to the Electric Vehicle Company, moved its station to a building, situated between Fifty-second and Fifty-third Streets, the main entrance to which was on Broadway. This building occupied a ground space of about 75x185 ft., of which part was given up to offices. A space, about 36x130 ft., was partitioned off as a battery-charging room, the ceiling of which was 11 ft. high. This room could accommodate some 200 battery-charging stands. The space above this room, some 4600 sq. ft., was used as a storage loft for vehicles. In the Forty-ninth Street station the battery-charging room occupies a floor space of 42x302 ft. and its ceiling is 20 ft. high. When enlarged to accommodate 1000 batteries, it will have a length of 474 ft. The storage room for vehicles in the new station is over 63,000 sq. ft.

As an indication of the growth of the business of the Electric Carriage & Wagon Company in its first months of business, the following data is interesting: During the month of March, 1897, the company had 8 vehicles in actual operation. No record was kept in this month of the number of calls received, but the number of passengers carried was estimated at about 300. Two more vehicles were placed in operation towards the end of the month. In April, 11 vehicles were kept in operation. The company received 280 calls for vehicles and carried 650 passengers, the 11 vehicles aggregating 1976 miles in that month. In May, 10 vehicles were kept in operation, 400 calls were received and 950 passengers were carried 2876 miles. In June, 11 vehicles were kept in operation, 632 calls were received, and 1580 passengers were carried 4603 miles. During the first year of its operation the vehicles of the company made a total of 45,833 miles, and as there were never more than 10 vehicles in actual operation on an average during the year, each vehicle must have made about 4500 miles during that time.

The result of the first few months of operation of the Electric Carriage & Wagon Company's station, as has been shown, was very encouraging, and doubtless prompted its removal to the Fifty-third Street station.

A very good description of the old Fifty-third Street station was published in the Sept. 3, 1898, issue of the *Electrical World*. In that issue it was stated that "the construction of the most elaborately equipped charging station for electric vehicles in the United States, and probably in the world, had just been completed in New York City." Yet in a little over three years it has been found necessary to abandon it for the new Forty-ninth Street station, which is so much superior to it in every respect. In fact, even before this last move was made the increase in the business of the Electric Vehicle Transportation Company—successor to the Electric Vehicle Company—had made an addition to the Fifty-third Street station necessary. So some eighteen months ago a branch station was opened at Fiftieth Street and Eighth Avenue, in a building almost directly opposite the present Forty-ninth Street station.

The following table gives, it is thought, in a concise form, a very good idea of the remarkable growth and development that has taken place in the electric vehicle transportation field in New York City during the four years that have elapsed since the opening of the first commercial electric vehicle operating station.

TABLE I.

Year and Month in which Each Expansion Took Place.	Amount of Floor Space available in buildings Occupied as Operating Stations.	Approximate No. of Vehicles that Could Be Accommodated in Buildings.
March, 1897	12,000 square feet	25
November, 1897	24,700 square feet	100
July, 1899	71,812 square feet	200
December, 1900	128,600 square feet	700

From the table it can readily be seen that in the City of New York alone a great expansion has taken place. When it is remembered, however, that the above represents only one company and that there are now a number of electric vehicle transportation companies operating in several of our large cities, of which no account has been taken, the rapid growth of this infant industry is even more forcibly brought out and makes the prophecy, that the twentieth century will witness the elimination of the horse from commercial fields, if not its extinction as a species, seem less improbable than it otherwise would.

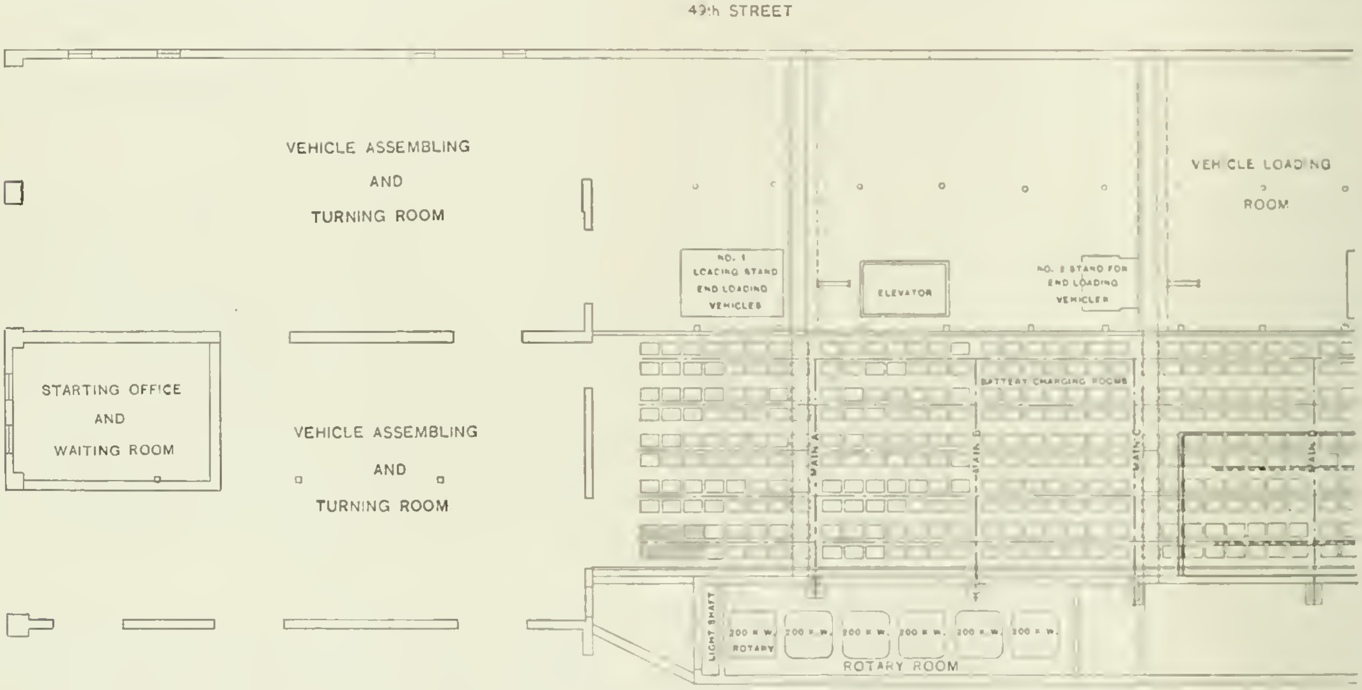

49th STREET
VEHICLE ASSEMBLING AND TURNING ROOM
8th AVENUE
STARTING OFFICE AND WAITING ROOM
VEHICLE ASSEMBLING AND TURNING ROOM
NO. 1 LOADING STAND END LOADING VEHICLES
ELEVATOR
NO. 2 STAND FOR END LOADING VEHICLES
VEHICLE LOADING ROOM
BATTERY CHARGING ROOMS
MAIN A
MAIN B
MAIN C
MAIN
LIGHT SHAFT
200 K.W. ROTARY
200 K.W.
200 K.W.
200 K.W.
200 K.W.
200 K.W.
ROTARY ROOM

FIG. 1.—PLAN OF GROUND FLOOR OF STATION. (*See also page 7.*)

Perhaps no more appropriate illustration of the present tendency toward the substitution of mechanical traction for horse traction in all fields can be cited, at the moment, than is afforded by the opening of the new station of the Electric Vehicle Transportation Company.

Not many years ago the three-story brick building which occupies nearly two-thirds of the entire block, bounded by Eighth Avenue on the East, Ninth Avenue on the West, Forty-ninth Street on the South, and Fiftieth Street on the North, was used as a horse-car stable. To-day, however, its roof shelters only mechanically propelled vehicles. The building is divided in the center, nearly its entire length, by an open court into two halves. The northern half is used, at present, by the Metropolitan Street Railway Company as a car house for its Eighth Avenue electric surface cars. The southern half has recently been transformed by the Electric Vehicle Transportation Company, at a cost of over $175,000, from an old, dingy, odoriferous, and somewhat ramshackle horse car stable into a modern, clean, spacious and airy automobile operating, charging, storage and repair station, a description of which follows.

THE BUILDING.

As was noted above, the building is a three-story brick one, situated on the northwest corner of Forty-ninth Street and Eighth Avenue, and has a frontage on the avenue of one-half a block. It extends towards Ninth Avenue, on Forty-ninth Street, 475 ft. A plan of the ground floor of the building is shown in Fig. 1. It will be seen from an inspection of this that the first floor is divided into five sections. The section bordering on Eighth Avenue is used as an assembling, starting and turning room for vehicles that have been supplied with freshly charged batteries and that are otherwise ready to respond instantly to calls. In this part of the building, which occupies a floor space about 102 ft. square, is a commodious waiting room and starters' office and two stairways lead from different parts of it to the main offices.

Fastened to and ranged along the walls of this room are a number of charging sets, each charging plug fastened by suitable flexible connections to a rheostat placed on the wall. These are connected to the Edison three-wire system, which supplies power for the lighting and auxiliary motor service in the building. Though not intended for regular use they have been installed to provide against any contingency that may arise through which the main battery charging outfit is made inoperative, thereby, it is hoped, eliminating, as far as possible, the chance of a complete shutdown of the plant.

Situated directly behind the assembling room, and communicating with it by wide doorways, is the central portion of the building, some 300 ft. long, which is occupied by the vehicle loading, washing and inspection room; the battery-charging room; rotary sub-station room and battery assembling and repair room. In the rear of this section a space about 70 ft. long by 100 ft. wide is used as a charging room for pleasure vehicles. Part of this space is occupied by the boiler room and necessary appurtenances for heating the building.

The second floor is divided into three sections. That facing on Eighth Avenue, a space about 102 ft. sq., is devoted to the main offices, store rooms, etc. The central section, 300 ft. long by 90 ft wide, is used as a storage loft for vehicles for which there is no immediate call. This section is reached from the first floor by means of three electric carriage elevators and by several stairways placed, as may be seen in Fig. 1, in the vehicle loading room. On the northern side of this room, conveniently located with respect to the battery charging room below it, is a room about 24 ft. wide by 88 ft. long, in which the battery room charging switchboard is located. The walls, ceiling and floor of this room are constructed of fireproof brick. The third section, a space about 70x100 ft., is used as a carriage body, repair and paint shop.

The third and top floor of the station, a loft some 400 ft. long by 90 ft. wide, is given up entirely to the storage of vehicles that are not needed or that are slightly out of repair, except a section at the west end, about 45x125 ft., reserved for a machine shop.

As the batteries are taken out of the vehicles before they are sent from the vehicle-loading room to the second or third floor, provision had to be made by which they could be operated other than by manual power. To provide the required power, trolley lines were strung along the ceilings of the battery-loading room and second and third floor storage lofts to which flexible trolley connections are fastened by means of which power is supplied to operate the vehicles after their batteries have been removed.

From what has been said, it is thought, that a fair general idea can be obtained of the very extensive and elaborate scale on which the Electric Vehicle Transportation Company have laid out their new station. There are a number of interesting details, however, that have been incorporated in the construction of this station which will bear further description.

Probably the most important and vital part of an electric vehicle operating and charging station is its source of current supply. For on the regularity and constancy of this supply the success of the station mainly depends. Therefore, it is a consideration of the first importance, when designing a station for the operation of electric vehicles for commercial purposes, to make sure of a constant, regular and sufficient supply of current for the needs of the station.

THE CURRENT SUPPLY.

The current required to operate the station is obtained from the Edison Illuminating Company, of New York, which latter company has established a rotary sub-station in a section of the building occupied by the former.

The portion of the building in which the rotary sub-station has been established, as may be seen in Fig. 1, occupies a space about 16x65 ft. at the extreme eastern end of the open court, spoken of above, which has been roofed over and altered to accommodate the machinery required.

The present equipment of the sub-station is more or less a temporary one and will be added to or changed later as the necessity appears. At present there are installed four 200-kw General Electric 8-pole rotary converters. Space has been provided, however, for two more rotaries of the same size. These will be installed later.

Three-phase currents are delivered to the sub-station at 6300 volts and 25 cycles by means of a 250,000-cm three-conductor paper insulated cable. This cable has a capacity of 2500 kilowatts. An additional cable of the same size will be installed later as a reserve. The cable is brought to the rotary room through a conduit leading from the street and is carried to the second floor of the sub-station through a light shaft, seen in Fig. 1. A stairway leads to this floor from the western end of the room.

A high-tension switchboard is placed close to the eastern wall of the rotary room on the second floor. To this the high-tension cable is connected. On each of the two panels, which at present comprise the high-tension switchboard, are mounted the usual quick-break snap switches and fuse blocks. Also the terminals from the static transformers. Each high tension panel is connected to a set of three General Electric 145-kw air-cooled transformers mounted on a steel platform supported by the I-beams which hold up the second floor. This platform is airtight and is used as an air duct as well as a cable runway for the secondary connections of the transformers. A blower, directly connected to an electric motor, is mounted on the platform at its western end. This supplies the circulation of air.

The ratio of transformation is from 6300 volts to about 70. Each set of transformers feeds two rotaries. The two independent sets of secondary connections are fed in multiple from the same set of transformers, and each set is connected to an I. R. T. three-phase voltage regulator. Each regulator is capable of varying the impressed e. m. f. about 30 per cent. Three secondary alternating current connections pass from each regulator to a temporary switchboard situated on the first floor of the sub-station, as shown in Fig. 2. This board will eventually be placed on a raised platform at the western end of the room. On each A. C. panel is mounted a triple-pole single-throw 2000-ampere switch, a Thomson alternating current ammeter and receptacles for pilot and synchronizing lamps. Also the field rheostats for the rotaries. Cables are carried from the A. C. panels to the collector rings of the rotaries. From the D. C. end cables go to D. C. panels on the low-tension board. From here the cables are carried to an auxiliary regulating panel, on which arrangements have been made by means of several cross-connected switches, by which any one of six bus-bars, placed in the battery switchboard room on the second floor, can either be connected directly to a D. C. machine panel on the low-tension board or through an auxiliary storage battery which boosts or crushes the voltage of the machine depending upon the way the battery is connected to the line. The present auxiliary battery equipment is four sets of three G 21 elements, each element placed in a lead-lined tank. The tanks have a capacity some 60 per cent greater than is required at present. The normal capacity of each element is 1600-ampere-hours, at a 200-ampere-hour rate, or it can give 400 amperes for 3 hours. By this arrangement a number of different voltages can be obtained in the battery-charging room without the use of rheostats, for each rotary can be regulated by its I. R. T.-voltage regulator to give a different pressure from that of any of the other machines, while by the use of part of the present auxiliary storage battery, as a booster battery and part as a crusher battery, four more variations, differing by about 6 volts, can be obtained. When the full equipment of six rotaries has been installed, it will be readily seen that by the use of a booster and crusher battery with each machine, 18 different bus-bar voltages can be obtained, if desired. With the present installation, 8 different voltages are possible. In fact, the 6 different bus-bar voltages, for which the battery switchboard is wired, can be obtained when any two of the rotaries are running by means of the auxiliary storage battery already in place. It will be seen that a very flexible system of variable potential current supply has thus been provided and that this has been accomplished without the use of a single rheostat, in which the C^2R loss is appreciable, even when the battery load is heavy. The — side of the

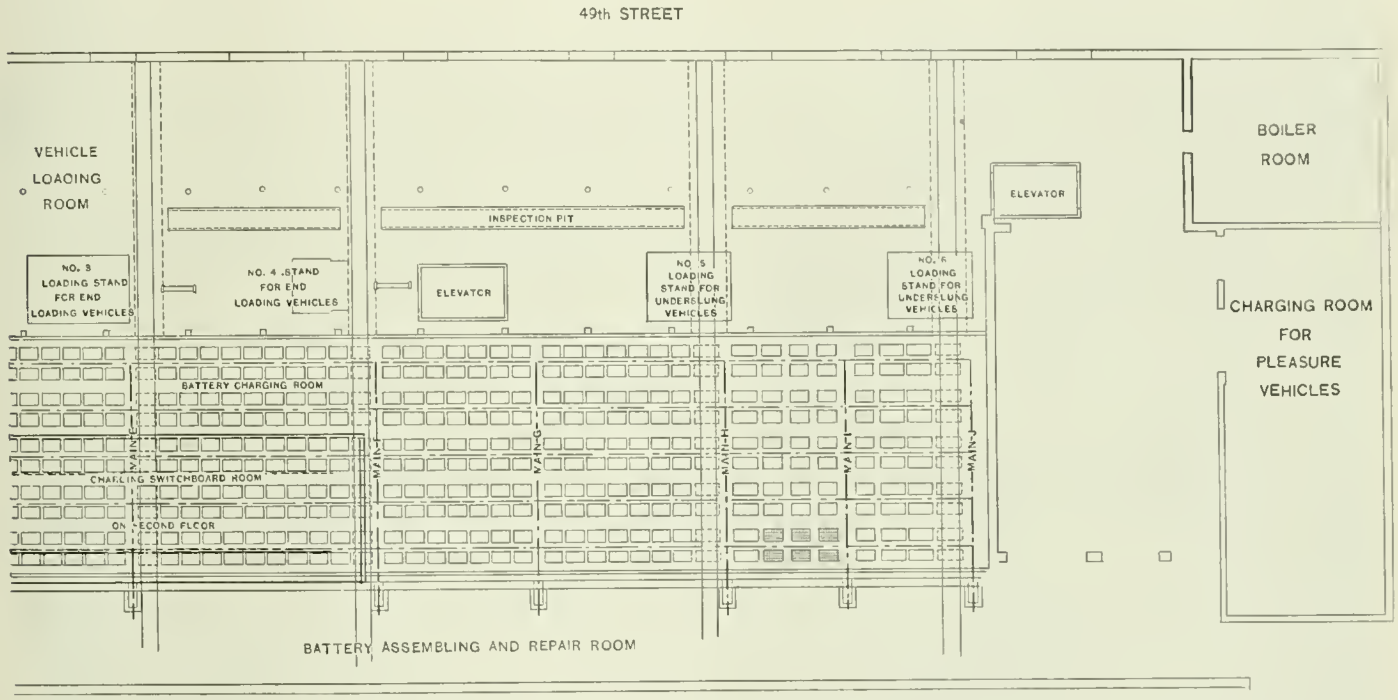

49th STREET
VEHICLE LOADING ROOM
NO. 3 LOADING STAND FOR END LOADING VEHICLES
NO. 4 STAND FOR END LOADING VEHICLES
INSPECTION PIT
ELEVATOR
NO. 5 LOADING STAND FOR UNDERSLUNG VEHICLES
NO. 6 LOADING STAND FOR UNDERSLUNG VEHICLES
ELEVATOR
BOILER ROOM
CHARGING ROOM FOR PLEASURE VEHICLES
BATTERY CHARGING ROOM
CHARGING SWITCHBOARD ROOM ON SECOND FLOOR
MAIN
MAIN
MAIN
MAIN
MAIN
BATTERY ASSEMBLING AND REPAIR ROOM

Fig. 1.—Plan of Ground Floor of Station. (*See also page 6.*)

battery room charging circuit is tied together by means of common return cables and is brought to the direct-current panels on the low-tension board in the rotary room.

The 250,000-cm cable which carries the high-tension current from the central station to the rotary sub-station, is connected to the Thirty-ninth Street station of the Edison Illuminating Company through which it can be connected to any one of the other central stations operated by this company in New York City.

An independent supply of current for lighting the building and for operating the crane and other auxiliary motors is supplied directly from the mains of the low-tension three-wire system of the Edison Illuminating Company by a cable which enters the building through a conduit, which opens into the light shaft back of the rotary room.

The direct current, used to charge the batteries, and which, as has been noted, is obtained from the direct end of the rotaries, passes by means of a number of 1,000,000-cm cables from the low-tension switchboard to the battery-charging switchboard.

THE BATTERY-CHARGING SWITCHBOARD.

This board is laid out according to the floor plan of the battery-charging room. The board is made up of sections, formed of iron channels and Ts, on each one of which are ten charging panels, placed one above the other, as is shown in Fig. 3. Each panel represents a battery-charging stand, and is composed of slate, boiled in paraffin, on which is placed a double-throw double-pole switch, one side of which is connected directly to the battery-charging stand. The other side is connected to the battery-charging stand through an ammeter fastened to the top part of the section.

By this arrangement one ammeter is made to serve for ten batteries. Each switch is provided with two 100-ampere fuses, one in each of its two circuits. Just above the switch and connected to each side of it is a plug-switch arrangement, by means of which the battery rack can be connected to any one of the six bus-bars fastened to the back of the switchboard by the insertion of a metallic plug in the one of the six holes which represent the voltage desired. Fig. 4 shows the arrangement of the wiring and the position of the bus-bars back of the switchboard.

From the back of each panel a No. 6 wire extends to each bus-bar and one No. 6 wire is carried from each panel by means of suitably supported Alberine stone insulators to the battery room, where it is carried in channels in the floor to the battery-charging rack which the panel represents. The operation of this board is very simple. When a battery is placed on a charging rack its weight automatically connects it to the charging circuit. The switchboard attendant is notified that the battery has been placed on a certain rack and is ready to be charged by means of a little check, which has the number of the rack on it. This check hangs on the battery rack when no battery is on it. As soon as a battery is placed on the rack the check is sent up to the switchboard room by means of a small lift and the switchboard attendant takes it, goes to the panel, which is connected to that rack, sees that the plug is in the hole that represents the lowest bus-bar voltage, then closes the circuit through the ammeter. The reading on the ammeter shows him at a glance the condition the battery is in and experience tells him whether to leave the battery on charge on the low bus, whether to plug in a higher bus or take it off-charge altogether. Suppose a battery is in proper condition to be left on the low bus when first put on charge. As soon as the switchboard attendant has noted the current the battery is taking, he reverses the switch, thus cutting out the ammeter, which is then available for use with another battery. After a certain time the switch is again thrown, so that the ammeter reads. If the c. e. m. f. of the cell has risen sufficiently to cut down the current below the charging rate desired the plug is inserted in the hole which represents the next higher voltage. This process is continued until the current drops below a certain number of amperes, when the battery is connected to the bus-bar, which represents the highest voltage. The battery is then charged, in so far as the switchboard attendant is concerned, and he takes it off-charge and sends the little check back to the battery room man, who places it on the battery box. This indicates to the crane-man that the battery is ready to be placed in a vehicle.

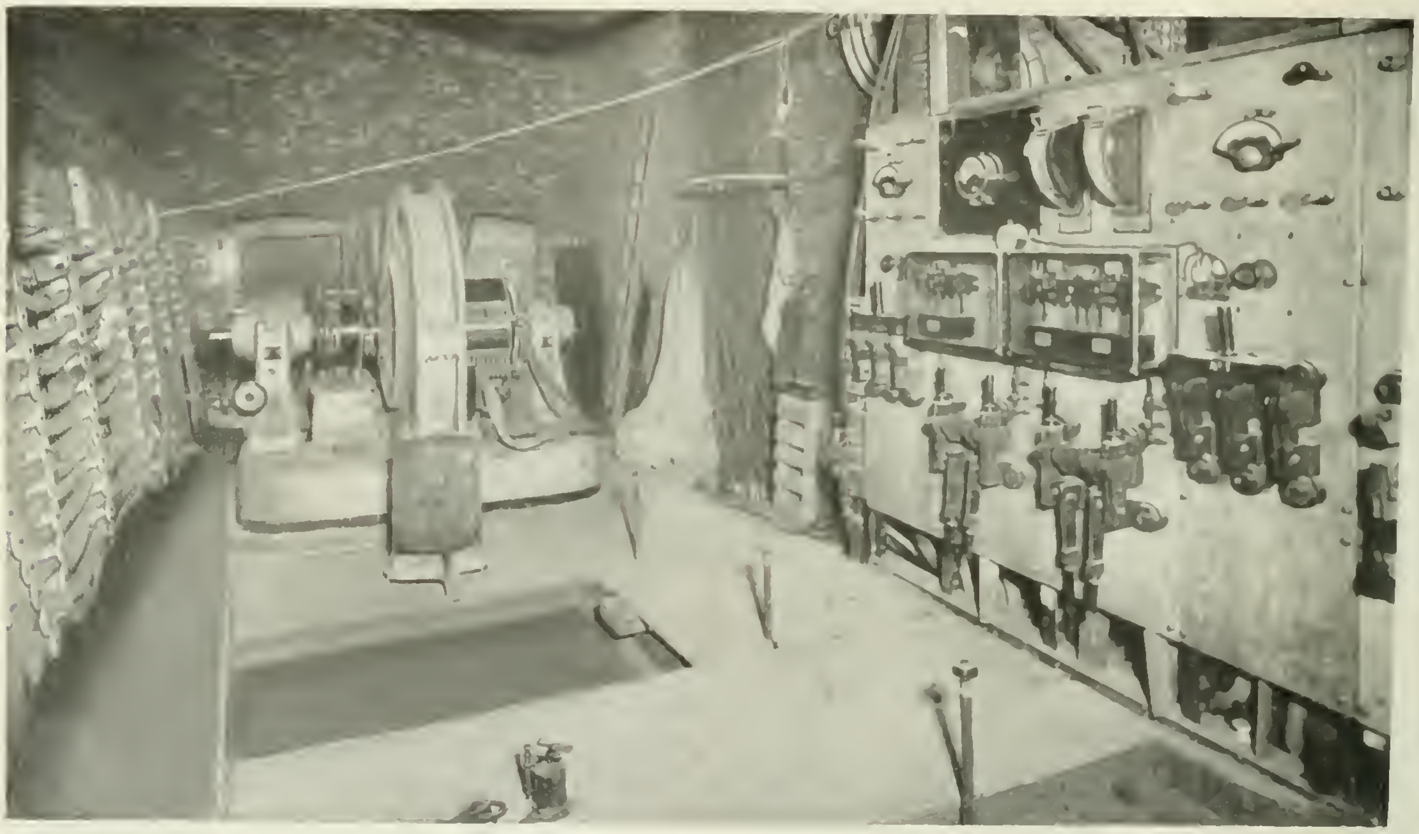


Fig. 2.—A Corner in the Rotary Room.

As will be noted, the charging process is carried on without the use of a voltmeter in the battery switchboard room. The only voltmeters necessary are those employed in the rotary room where the different bus-bar voltages are regulated.

Forty sections of the battery-charging switchboard are already installed, this represents 400 battery racks. As the necessity arises, other sections will be added, until the full capacity of the battery-charging room is reached, which is 1000 batteries. Fig. 3 shows a few sections of the battery-charging switchboard. From the switchboard room the charging current, as has been said, is conducted to the battery-charging room.

THE BATTERY-CHARGING ROOM.

This is a room 302 ft. long, 42 ft. wide and 20 ft. high, separated from the vehicle-loading room by a substantial partition of wood and glass.

The floor in this room is made up of a series of rectangularly shaped spaces, formed by brick walls 8 ins. thick. These spaces are filled in with sand to a uniform level. A light layer of concrete is placed on the sand in which the cast-iron pedestal that supports the battery-charging racks are set. Above this comes a finished floor of acid-proof concrete in which the pedestals are firmly embedded. Ten channels or conduits, in which the wires from the battery switchboard are carried, extend the width of the room at varying intervals, as may be seen in Fig. 1. From each of these, five smaller channels branch at right angles. These channels, or conduits, are formed by the spaces left between the walls of the rectangularly-shaped floor spaces spoken of above. Fig. 1 shows the arrangements of these channels very clearly. It may be noticed that the channel marked main A carries all the wires required to charge the batteries placed in the racks which line each side of the branch channels numbered 1, 2, 3, 4, 5, and which are on the eastern, or Eighth Avenue, side of main A.

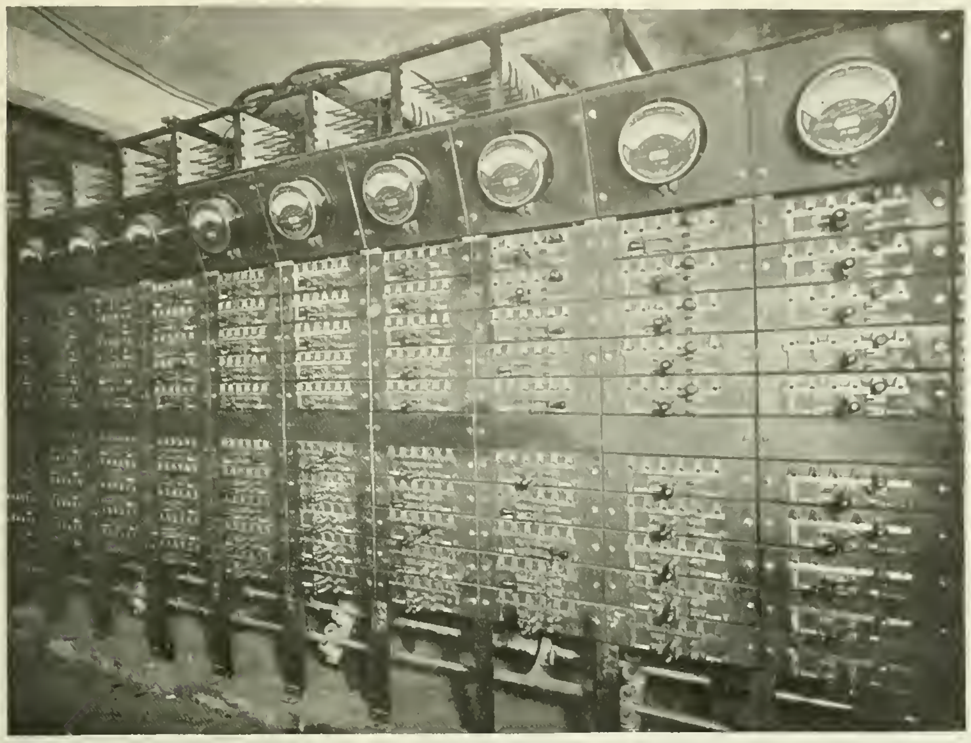


FIG. 3.—BATTERY-CHARGING SWITCHBOARD—FRONT.

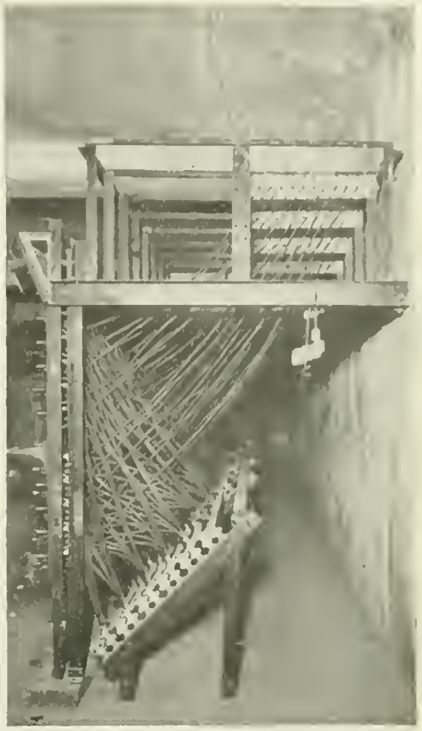


FIG 4.—BATTERY-CHARGING SWITCHBOARD—BACK

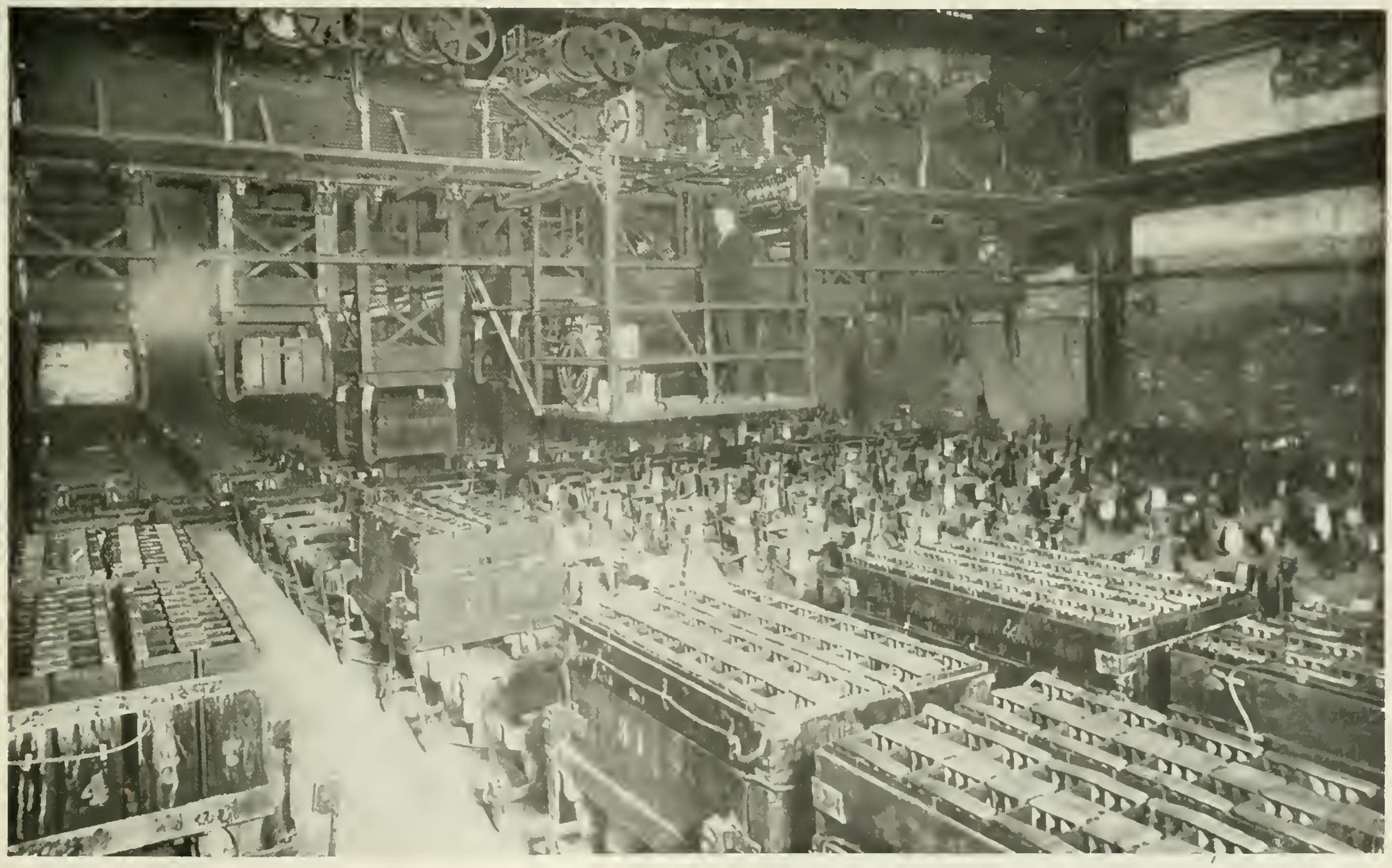


Fig. 5.—Battery Room and Crane.

The same arrangement is followed in the wiring of the other sections, each main channel feeding the branch channels, which are situated on its eastern side. The main and branch channels are lined with acid-proof concrete and the wires carried in them are kept in proper position and well separated by Alberine stone insulating slabs, placed vertically in the channels at convenient intervals. The wires pass through equally-spaced holes in the insulating slabs. By this arrangement, though in many of the main channels more than 70 separate wires are carried, each individual wire can be quickly and accurately traced from its switchboard panel to its battery rack.

A system of drainage for the battery floor is provided; each branch channel drains into its main channel and each main channel is connected, at its lowest point, with a pipe which runs the length of the battery room and finally discharges into the sewer.

The main and branch channels are covered with a wooden floor, laid in small sections to facilitate its removal for inspecting the wires. In this way a clear floor space is obtained, hardly a wire being visible to the casual observer.

Each battery rack, of which there are at present 640, consists of 4 cast-iron pedestals, 12 ins. high, firmly supported by the concrete floor. On each of these is placed a porcelain insulator, 7x4½ ins., held in place by cement. Resting on these insulators are two cast-iron racks—each independently supported on two insulators. Two U bolts, as shown in Fig. 6, hold these racks in place. Fig. 6 also shows the details of the contact-making arm which automatically connects the batteries to the charging circuit when they are deposited on the rack. There are four of these arms connected to each rack. The I-shape cast-iron arms, pivoted as shown, have fastened to their outer end a straight piece of hard wood, 15½ ins. long, covered with an acid-proof paint. At the free end of each wooden arm a contact block of hard wood is fastened. On the contact face of each block is placed a piece of brass, to which the charging wires, from the source of current supply, are connected. The operation of these arms is very simple. The weight of the descending battery depresses that portion of the arm which, when no battery is in place, protrudes slightly above the rack. Thus the brass-faced wooden blocks are forced against the contacts placed at the four corners of each battery box. The natural spring in the 15½-in. wooden arms assures a good contact. Each battery is connected in two groups of 22 cells, in such a way that by cross-connecting two diagonally opposite contact arms, the battery charges in series. The distance from the floor to the top surface of the charging rack is just one foot. The average height of a battery box is 1 ft. 6 in. Hence the top of each battery is on a convenient level for inspection of the cells, for filling them with acid and for reading their specific gravity, as seen in Fig. 5.

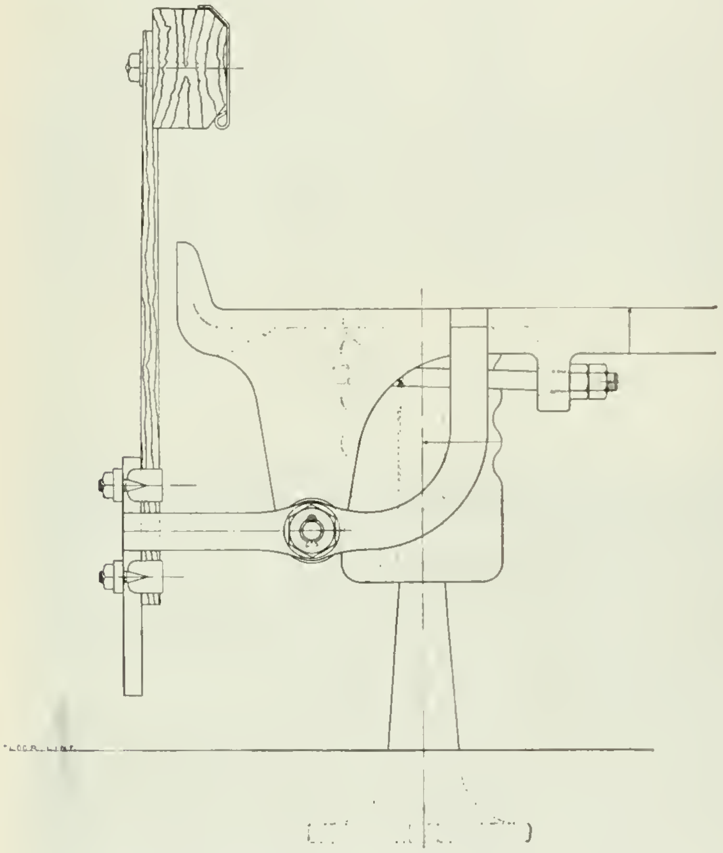


FIG. 6.—AUTOMATIC CONTACT ARM ON BATTERY RACK.

Each battery rack is connected to its special panel on the battery switchboard by a No. 6 wire, as has been explained. In each branch channel is a 400,000-cm common return cable to which each charging rack is connected. This in turn is fastened to two 1,000,000-cm cable, two of which are placed in each main channel. These are connected, as has been noted, to the direct-current panels on the low-tension board in the rotary room.

In a succeeding article, the apparatus for handling the batteries will be described in detail.

Electric Plant of the Manhattan Elevated Railway. I.

While the electrical equipment of the Manhattan Elevated Railway will not be completed in all of its details for some months yet, the work has progressed far enough to enable us to present an account of the main features of the installation. At present the steam and electrical machinery is in process of construction, the power house is approaching completion, and a great part of the third-rail conductor is installed. The first generating units are expected to be ready for use about June of this year, when they will supply current for the Second Avenue line.

When completed, the Manhattan plant will be by far the largest steam-driven electrical generating plant in the world, the only other coming within measurable distance being that of the Metropolitan Street Railway system. Its duty will be to supply current to 75 miles of third-rail, aggregating over 70,000 amperes, at 625 volts at the period of maximum load. The generators to supply this enormous amount of energy will be eight in number, each of 5000-kw normal capacity. Each machine will be 42 ft. high and weigh no less than 445 tons, the revolving field alone weighing 185 tons. While the mere magnitude of the plant renders it of especial interest, this is further enhanced to the electrical engineer by a number of the technical features involved, perhaps the most striking of which is the direct generation and distribution of current at 11,000 volts, almost twice the voltage of such modern plants as those of the Metropolitan Railway and the latest additions to the New York electric light and power central station system.

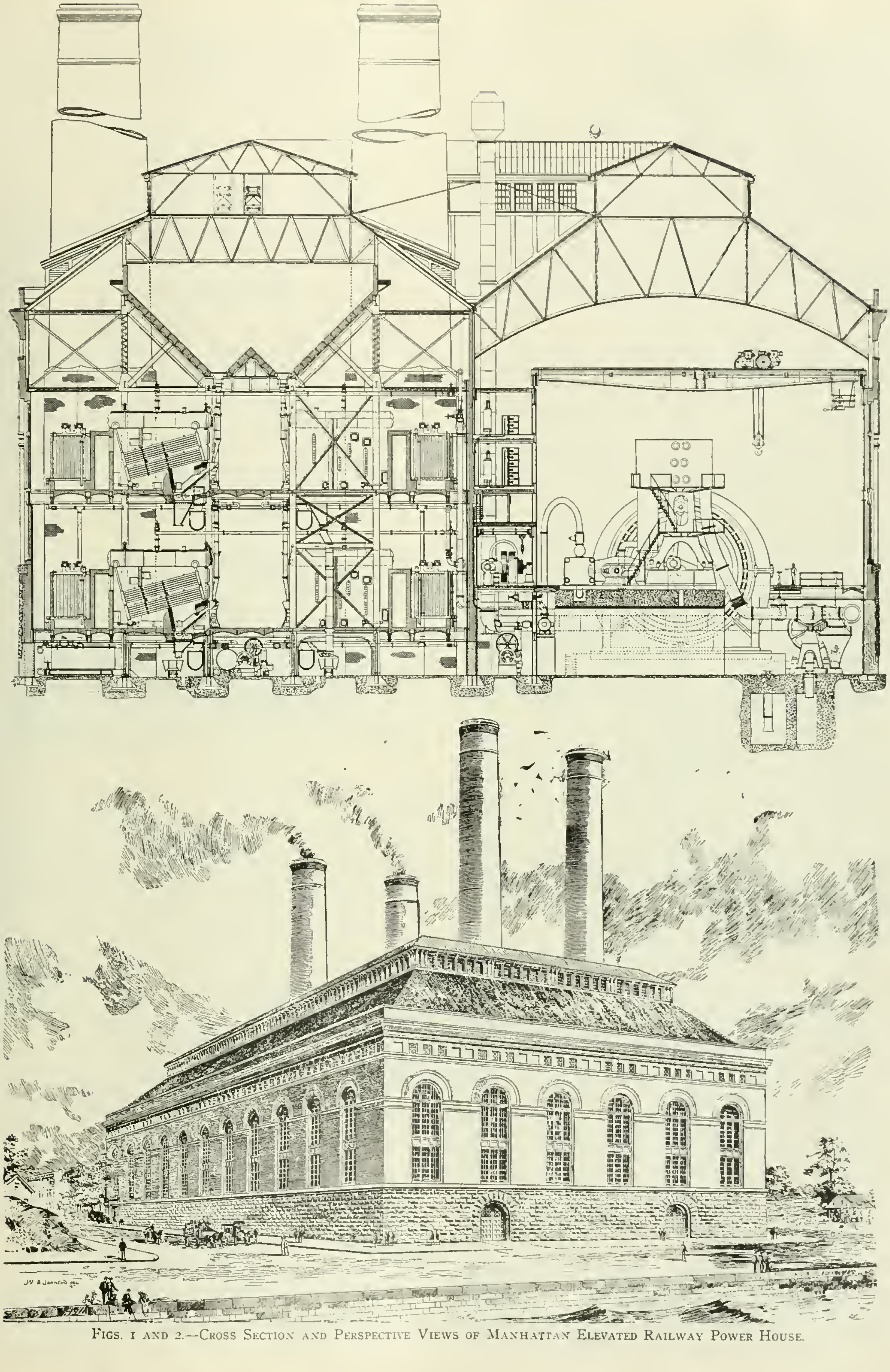
Another indication of the magnitude of the service which the plant will supply is given in the statement that the lighting of the power station, sub-stations, passenger stations, etc., will require 15,000 incandescent lamps and 250 arc lamps, this incidental use thus corresponding to the electric lighting demands of, for instance, Troy, N. Y.

The power house is located on the East River between Seventy-fourth and Seventy-fifth Streets. All the current is here generated at 11,000 volts and transmitted at this pressure to seven sub-stations, where it is transformed to a voltage of 390, and by means of rotary converters is converted to direct current at 625 volts. The generating station is designed for a maximum capacity of 100,000 horse-power which may, however, be extended to 150,000 horse-power by constructing an addition on a part of the plot left unoccupied.

A view of the power house as it will appear when completed is given in Fig. 2, and a cross section of the same in Fig. 1. As will be seen by referring to the latter figure, the building is divided by a longitudinal wall into two parts, forming a boiler house 104 ft. wide and a generator house 96 ft. 6 ins. wide. The length of the building is 395 ft. on Seventy-fourth Street and 413 ft. on Seventy-fifth Street. The boiler house contains a basement, two boiler floors and coal pockets located immediately under the roof. The height from the basement to the top of the monitor is 128 feet. The basement is divided into three compartment by two longitudinal walls, in the central one of which are located the pumps, the ashes being handled from the compartments on either side. The coal pocket has a capacity of 15,000 tons.

There are four chimneys, each 17 ft. inside diameter and 270 ft. high above the basement floor. These chimneys, which are the largest of the kind in this country, are built of "Custodis" brick, perforated with rectangular holes about 1 in. square in the direction of the height of the stack, thus making the cell walls about 1 in. thick. These holes serve to bond the bricks in the nature of tenon joints by flushing the mortar into them. The four chimneys contain no less than 30,000 cubic feet of concrete and 204,000 cubic feet of brickwork.

A bridge 20 ft. wide and 12 ft. high extends from the front of the boiler house at an elevation of 60 ft above the street, to a coal and ash tower, built at the water's edge, in which is located a coal crane. The tower contains a line of ash storage pockets extending along its length for 65 ft., from which the ashes will be dumped into barges by gravity, being guided by aprons folding up against the face of the tower when not in use.



FIGS. 1 AND 2.—CROSS SECTION AND PERSPECTIVE VIEWS OF MANHATTAN ELEVATED RAILWAY POWER HOUSE.

The coal will be discharged from barges at the dock and delivered into the bunkers, situated above the boilers, at the rate of 150 tons per hour by means of Mead coal conveying apparatus. In its passage the coal is passed through crushers and weighing hoppers.

After leaving the furnaces, the ashes pass through chutes to the basement and are conveyed to an ash pit at the river end of the building by means of dump cars, hauled by an electric locomotive. From the ash pit the ashes are carried to storage bins on the river front by a bucket conveyor.

The boiler equipment consists of 64 Babcock & Wilcox horizontal water-tube boilers of 500 horse-power each, arranged in batteries of two boilers each in four lines, as shown in Fig. 1. The boilers are capable of sustaining safely 200 lbs. working steam pressure and are fitted with Roney mechanical stokers capable of burning either hard or soft coal, either separately or mixed. It is interesting to note that to handle this boiler plant by flat grates and hand firing would require a force of about 270 men, which the employment of mechanical stokers reduces to 90 men.

Sixteen Sturtevant blowers will be used for furnishing forced draught. These are installed as an emergency provision for such contingencies as a sudden increase in load, unusually low barometer, combined with bad coal, neglect or bad judgment on the part of the fireman, or accident to some part of the plant requiring forcing of the remaining units. It was considered that the stoppage of the plant even for a few minutes would entail such loss and inconvenience to so many persons that no reasonable provision should be omitted to ensure continuous operation. Two blowers will be located on each boiler floor, one opposite each chimney, and each blower will supply two batteries of boilers. The blowers are 9 ft. in diameter, 4½ ft. wide, and will be driven by a direct-connected alternating-current motor running at 180 r. p. m.—alternating current motors being employed in this instance for the reason that the blowers will never be called for when the main generators are not in operation.

Sixteen Green economizers, located as shown in Fig. 1, are employed, each serving two batteries of boilers. The use of economizers in this plant is more than usually advantageous from the fact that all the auxiliary machinery is electrically driven; there is, therefore, no waste steam which could be utilized in auxiliary heaters for raising the temperature of the feed water.

Eight triplex, single-acting Goulds boiler-feed pumps will be electrically driven by means of 500-volt direct current motors.

The engines are being constructed by the E. P. Allis Company and will differ considerably from the types heretofore used in railway power plants. They are of the compound horizontal and vertical cross-compound type, and each unit consists of two compound engines working at either end of a generator shaft. The disposition of the two cylinders is shown in Fig. 1. The high-pressure cylinder, which is horizontal, is 44 ins. in diameter, and the low-pressure or vertical cylinder is 88 ins. in diameter, the stroke being 60 ins. and the speed 75 r. p. m. The normal rating corresponds to 8000 horse-power and the maximum to 10,000 horse-power. There thus being four cylinders to each shaft, the turning effort is very uniform—a great advantage in the parallel operation of alternators.

The eight engine foundations are approximately 40 ft. square and 21 ft. high, and have an archway through the middle 4½ ft. wide.

Under one side of the engine room are condensing tunnels which are of concrete in a rectangular excavation of bed-rock extending 20 ft. below the engine room floor. The intake tunnel is 8½ ft. wide from the rear of the building to the front, from which point it increases to a width of 14 ft. at the river, where the screen chamber is placed. The outlet tunnel is 5 ft. wide.

The Worthington condensers to be used are in several particulars of unusual design. Owing to the present uncertain state of the art as regards the extraction of cylinder oil from the water of condensation, and the possibility of radical improvements in this direction, it was decided that the installation should consist of jet condensers, so arranged that each can be changed or modified into a surface condenser hereafter, and at a minimum expense. One of the condensers is shown in Fig. 3. The air pumps are of the vertical triplex type, driven by a geared direct current motor at 30 r. p. m. when operating in connection with the jet condensers. By changing the ratio of the gearing they may be run at 10 or 15 r. p. m. when operating in connection with a surface condenser. The circulation of water through a surface condenser will be by means of a centrifugal circulating pump to be directly connected to the free or outer edge of the electric motor. Whenever it may be decided, therefore, to change this system to a surface condensing system, this may be accomplished by the mere addition of the necessary apparatus, the only portion of the present condensing system to be discarded being the condensing chamber of the jet condenser. Condensing water is supplied by the tunnels above referred to.

Feed water will be obtained from the city mains, but a centrifugal motor driven pump will be installed to supply river water to the boilers in case the city water is shut off for any cause. In the latter case salt water will, of course, be supplied, but the occasions when it will be necessary to resort to this measure will be very rare, as storage and surge tanks will provide a supply of fresh water sufficient to run the boilers for four hours at their maximum load. There are eight surge tanks, corresponding to the eight units, which receive the condensation from the steam pipes and reheaters of the engines, and all the water used in the water jackets around the engine bearings.

The steam piping consists of eight sections, each section connecting four batteries of boilers to one engine. Eight boilers are arranged in a group opposite an engine, and there is thus secured the shortest distance for the steam to travel. A steam reservoir 36 ins. in diameter and 24 ft. long is installed at each engine, from which a steam pipe runs to each of the two high-pressure cylinders of the engine. The steam reservoirs all connect together through headers. The design of this piping permits of alteration or repairs without any interruption in the operation of the plant. A 42-in. exhaust pipe is placed in the basement on the south side of the engine room, and in the centre of the building a branch runs below the engine room floor and is connected to a riser ending in an exhaust head above the roof.

The engine room is supplied with a 50-ton electric traveling crane and two small cranes, the latter for the purpose of handling the exciter engines and generators.

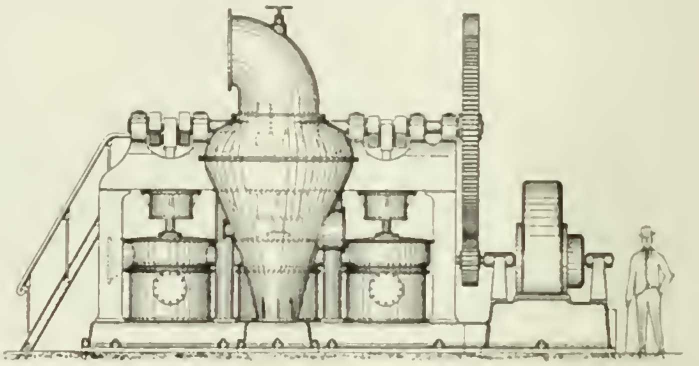


FIG. 3.—ONE OF THE CONDENSERS.

The engines driving the four exciters of this plant are of the tandem-compound piston-valve type, made by the Harrisburg Foundry & Machine Works, and have a nominal rating when running at 150 lbs. steam pressure, condensing, of 300 horse-power at 200 r. p. m. They are direct connected to 200-kw Westinghouse multipolar generators.

As stated above, all auxiliary machinery is electrically driven. For the purpose of starting the plant when the main engines are for any reason temporarily stopped, auxiliaries which are required to operate before the main engine can be started are provided with electric motors wound for 500 volts direct current. The current from the main generators being alternating, it is transformed for this purpose by means of transformers and rotary converters. A small storage battery is provided for the power station from which the electric auxiliaries can be driven should the main engines be shut down.

As previously stated, the lighting of the power station, sub-stations, passenger car stations, yards and miscellaneous buildings owned by the company, will require the use of 15,000 incandescent lamps and 250 arc lamps, corresponding to an output of about 1000 kilowatts. Since the current generated in the power station has a frequency of 25 p. p. s., it is necessary to provide apparatus for transforming this frequency to 60 p. p. s. in order that both arc and incandescent lamps can be operated on the same circuit. This will be done by the use of motor-generator sets located in the power house and in the several sub-stations. Each motor generator set will consist of a 25-cycle, 400-volt, three-phase induction motor driving a three-phase alternator generating current at 60 cycles and 2300 volts.

Each sub-station is made an independent center of distribution for the lighting load in its vicinity and distributes to the transformers along the line through triple conductor lead-covered cables. Two hundred transformers in two sizes, 3.2 kilowatts and 6.4 kilowatts, will be used to reduce the voltage from 2300 to 110 volts for incandescent lamps. About 100 16-cp incandescent lamps will be used at each station, thus producing a brilliant illumination.

Before entering into a description of the generating and sub-station plants, a brief account will be given of the third-rail installation.

The third rail used on the Manhattan Railway weighs 100 lbs. per yard and is rolled in 60-foot lengths. Each section is the standard section of the Lackawanna Iron & Steel Company. An investigation as to the composition of iron giving the best conductivity, resulted in the adoption of the following formula: Carbon, .073 per cent; manganese, .341 per cent; sulphur, .073 per cent; phosphorus, .069 per cent.

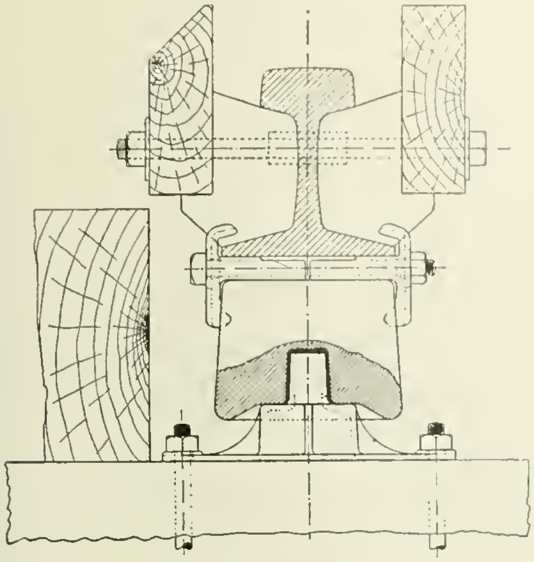


FIG. 4.—THIRD-RAIL INSULATION.

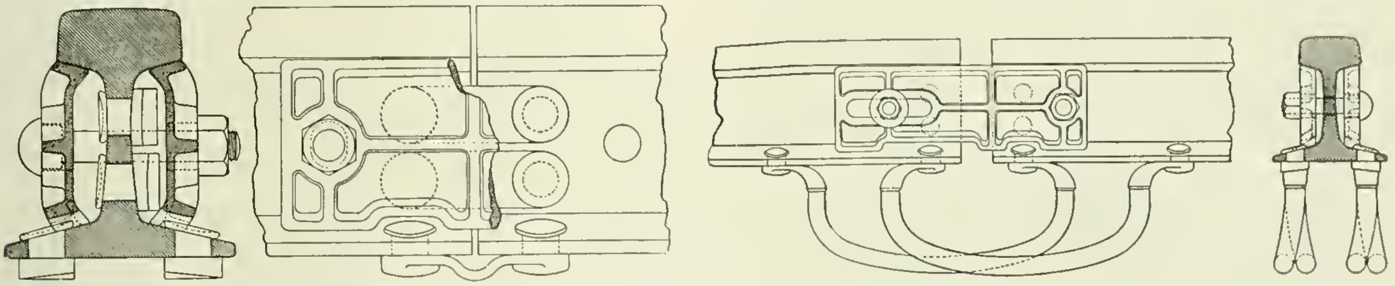


FIG. 5.—METHOD OF BONDING.

While the use of this formula gives a rail so soft as to be unfit for ordinary railway service, its conductivity is only about 1/8 that of copper, while the conductivity of the traffic rail, used by the Manhattan Company, is only from 1-10 to 1-12 that of copper. The third rail has a cross-sectional area equivalent to about 1,560,000 circular mils of copper. Where the length of the track between stations does not exceed 6500 ft, and with car trains running on a fifteen-miles-per-hour schedule at one minute headway, the third rail alone is sufficient to maintain at the end of a section the voltage to within about 10 per cent of the sub-station voltage under average load conditions. The method of insulating the third rail from the track ties is shown in Fig. 4. A casting bolted to the tie supports an insulating block to which the rail is secured by a clip. The design of the rail clips is such as to allow the rail to expand lengthwise, and a sufficient clearance is provided to prevent undue strain on the insulators from deflection in the structure girders and jarring of the ties.

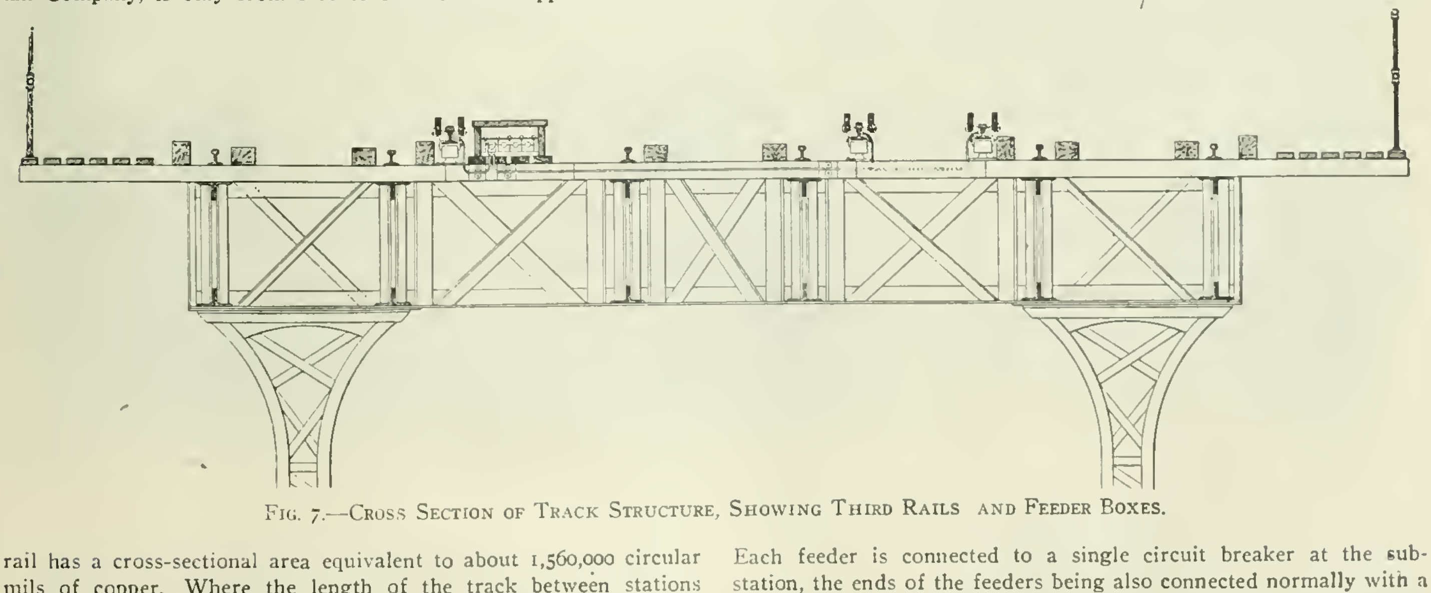


FIG. 7.—CROSS SECTION OF TRACK STRUCTURE, SHOWING THIRD RAILS AND FEEDER BOXES.

In order to provide for the expansion of the third rail it is divided into sections of five-rail lengths of 300 ft. each. These 300 ft. sections are securely anchored at the center by sectional anchor clips and the ends are connected by means of expansion bonds and expansion splice-bars, as shown in the right of Fig. 5. The bonding of the intermediate joints is illustrated at the left of Fig. 5. The cross-sectional area of copper in all of the third-rail bonds is 1,750,000 circular mils, or a little in excess to the equivalent section of the rail. The third rails, for two and three-track structures are cross-bonded at 300 ft. intervals with cable of 250,000 circular mils section. As will be seen by reference to Fig. 4, there are wooden guard pieces secured to each side of the rail. These guards extend two inches above the rail and act as a safeguard against accidental shocks and burns to employes, and also to prevent fallen wire from causing short circuit between the third rail and the traffic rails or other ground connection.

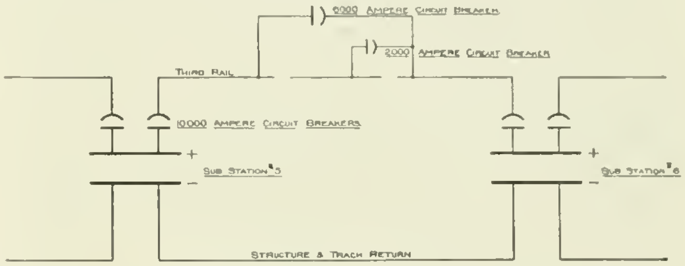

6000 Ampere Circuit Breaker
2000 Ampere Circuit Breaker
Third Rail
10000 Ampere Circuit Breakers
+
Sub Station #5
−
+
Sub Station #6
−
Structure & Track Return

FIG. 6.—DIRECT-FEEDER CONNECTIONS.

When supplementary feeder cables are required to keep the terminal voltages within economic limits, they are installed in a wooden box and supported on porcelain or vitrified clay insulators. The direct-current feeder sections are arranged as indicated in Fig. 6. Each feeder is connected to a single circuit breaker at the substation, the ends of the feeders being also connected normally with a 6000-ampere circuit breaker. In order that a short circuit on one feeder section may not affect an adjoining section through the wiring of a motor car, a 2000-ampere circuit breaker is provided, as also shown in the diagram. This circuit breaker supplies current to an isolated section of the third rail of such length that a motor car cannot span from one section to the next.

Feeder sections are designed so as to have approximately the same terminal drop in voltage, so that normally the current from one section to the next section is small. In emergencies, however, one substation may be shut down and the train service still maintained. though at a lower speed and with an increased drop in the voltage.

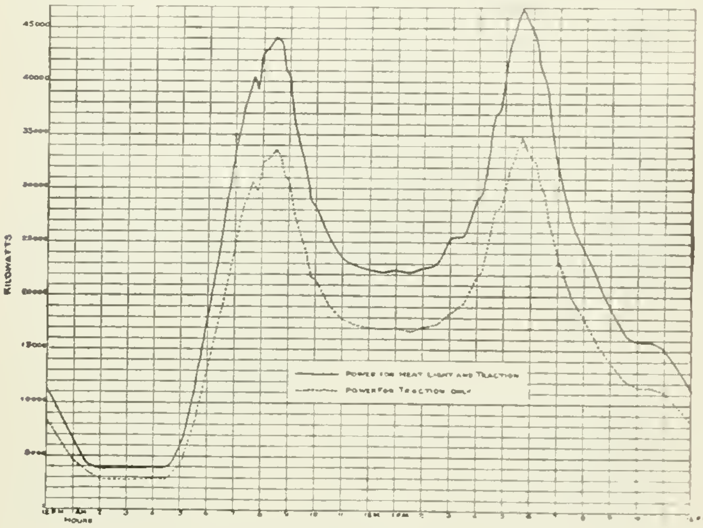


FIG. 8.—POWER CURVES.

The return circuit is through the track rails and the elevated structure. The rails are bonded around the splice-bars with flexible bonds made up of No. 4-0 stranded cable welded to copper terminals. Holes in the rail are reamed and the terminals riveted by hydraulic compression. The track rails are bonded to the structure at intervals of 90 ft., and the longitudinal girders of the structure are bonded with from two to four No. 4-0 flexible bonds.

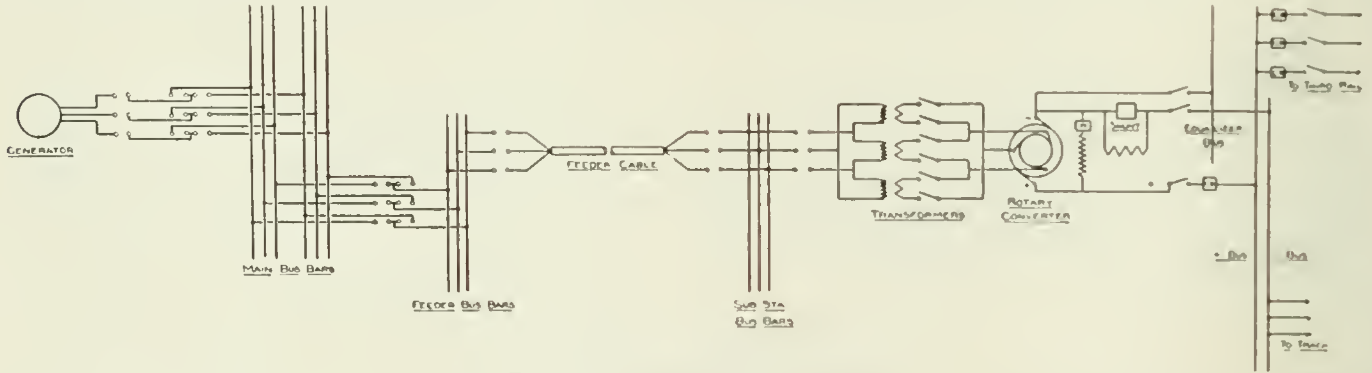


FIG. 9.—DIAGRAM OF DISTRIBUTION

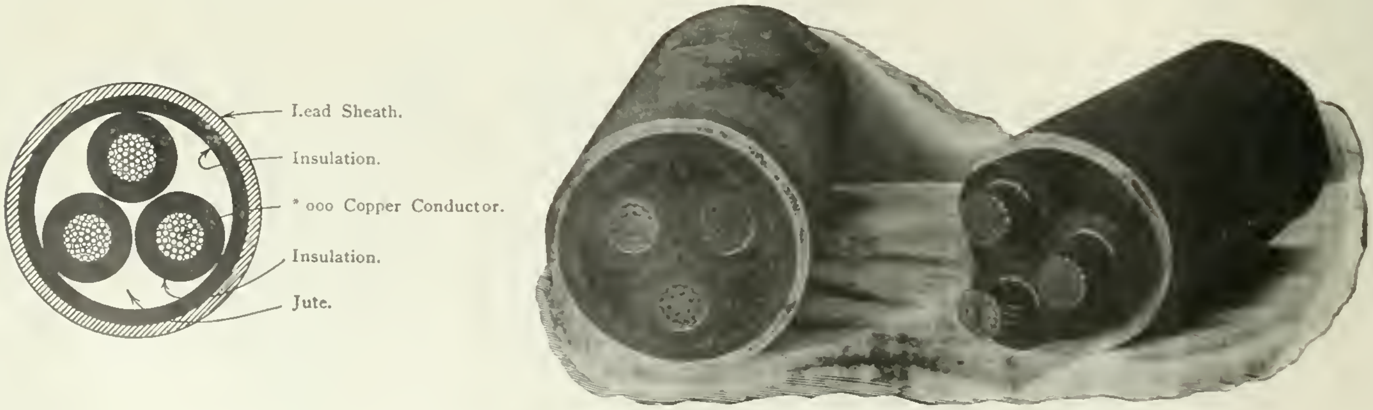


FIG. 10.—THREE-PHASE CABLE.

THE GENERATING PLANT.

The generators of the power plant—eight in number—were designed and are being constructed by the Westinghouse Electric & Manufacturing Company. Each generator is nominally rated at 5000 kilowatts, but is capable of delivering, during the hours of maximum traffic, 7500 kilowatts. As previously stated, the height of each of these machines is 42 ft., the calculated weight 450 tons, the diameter of the revolving part about 32 ft. and its weight 185 tons. The great weight of this revolving part enables the engine flywheel to be dispensed with, its effect combined with the approximate uniform effort due to four cranks angularly displaced on the generator shaft producing an extraordinarily uniform rotation.

The amount of power that will be required from the generators is indicated by the curves of Fig. 8, reaching a maximum of 60,000 electrical horse-power under the improved schedules by which trains will operate when the electric system is fully installed. The minimum power will be 5000 horse-power from 1 A. M. to 5 A. M., the average for 24 hours being nearly 30,000 horse-power. One alternator will be sufficient to carry the load from 1 A. M. to 5 A. M., but between 5 A. M. and 8 A. M. at least five additional generators must be connected to the circuits. After the maximum is reached at 8:30 A. M the number of alternators rapidly decreases until 11 A. M. In the afternoon there is another peak in the load curve requiring the rapid connection of additional alternators, which later are again disconnected from the circuits. In the diagram, Fig. 8, the full curve represents the power for heat, light and traction, and the dotted curve the power for traction alone.

The generators are three-phase alternators delivering power at a voltage of 11,000. Three conductor cables distribute this power to step-down transformers in seven sub-stations, which lower the voltage to 390 volts, the alternating current then being converted to direct current at 625 volts. The three-conductor cables, illustrated in Fig. 10, are nearly 3 ins. in diameter and weigh about 9 lbs. per lineal foot They will be installed in underground conduits, consisting of 28 vitrified clay ducts laid in cement and surrounded by concrete. A single-conductor cable will be used to transmit the 625-volt-direct current from the sub-station to the third rail.

The system of distribution is very clearly shown in Fig. 9. From the generator the current passes to the main switchboard, the arrangement of which will be described in detail in a following article. Thence it proceeds to the feeder switchboard, from which it is conveyed to the sub-station switchboard by the three conductor cables. After being lowered in potential by transformers and converted into direct current by rotaries, the current is conducted to track feeders and thence to the third rails.

The Steam Turbine—III.

(Concluded.)

As has been already stated, a jet of steam issuing through a properly-constructed orifice has as much energy as the same steam performing high ratios of expansion behind a piston. In both cases the work to be theoretically abstracted from a given weight is the same; however, there are some practical reasons for expecting better results in the case of the turbine.

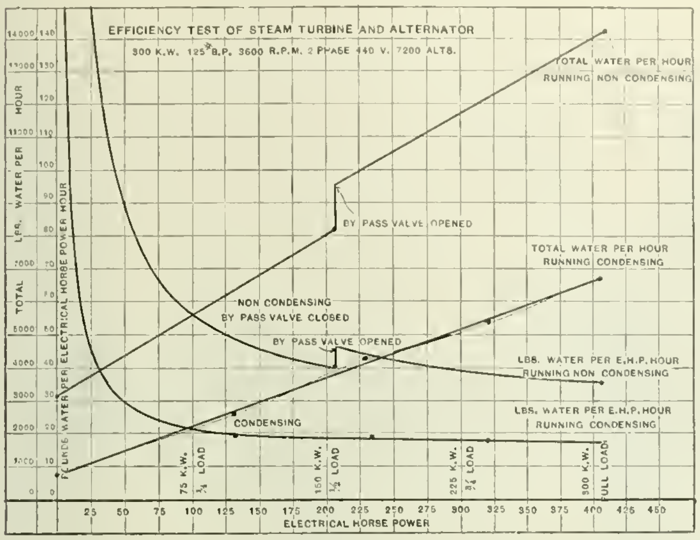


FIG. 15.—CURVES OF TURBINE TEST.

In the design of a three or four-stage compound condensing reciprocating engine it is found that there is no gain in economy by expanding the steam in the low-pressure cylinder beyond a terminal pressure of about 5 or 6 lbs. absolute. To do this means increasing very much the volume of the low-pressure cylinder, thus increasing the friction of the engine and the weight of the reciprocating parts. Moreover, the temperature of saturated steam, as these low pressures are reached, falls off much more rapidly, and hence there are greater losses, due to condensation and re-evaporation than would be gained by a more complete expansion. In the steam turbine no such limits exist. The extra volume of the low-pressure end does not add to the friction. The temperature conditions, from end to end, remain always the same, and hence such losses as condensation and re-evaporation are not in evidence.

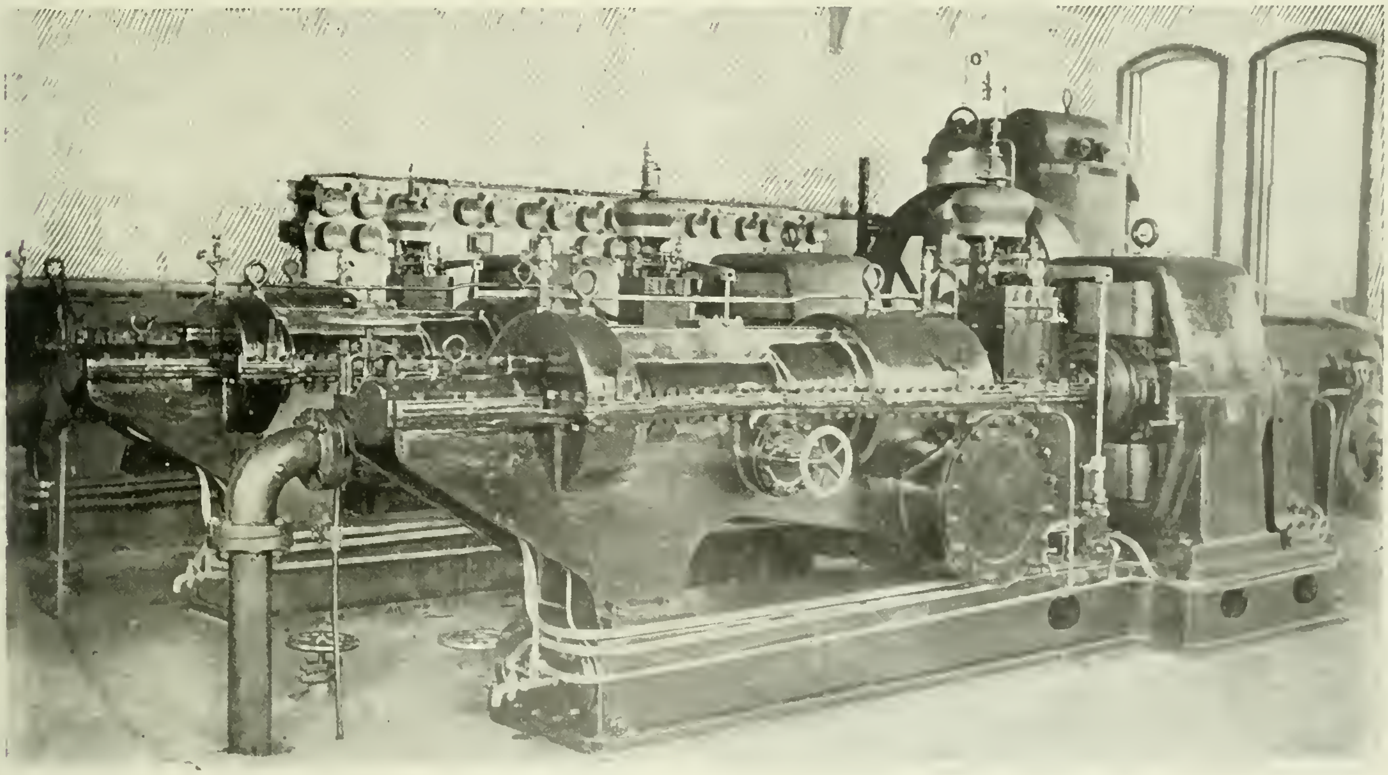


Fig. 16.—Turbine-Driven Power Plant.

Turbines are constructed to utilize the energy of the steam down to the utmost limits. A condensing steam turbine, when in operation affords a striking example of the conversion of heat into energy. The temperature of the walls of the cylinder at the high-pressure end, about 365 degs. F, falls in the distance of three or four feet, to a temperature of about 126 degs. at the low-pressure end.

Some economy curves, developed from tests made on one of the 300-kw turbines, now in operation at the Westinghouse Air Brake Company's Works, are shown in Fig. 15. The results may be summarized as follows:

Full load, 16.4 lbs. steam per ehp-hour; three-quarter load, 17 lbs.; half load, 13.2 lbs.; quarter load, 22 lbs. The vacuum was 26 to 27 ins., the boiler pressure 125 lbs. per sq. in., and the speed 3600 r. p. m.

The consumption of 16.4 lbs. of steam, at full load, is in itself remarkable, but such results as at the light loads have never been approached before. It may be said that the consumption at half load is only 10 to 12 per cent greater than at full load.

It must not be lost sight of that these results are per electrical horse-power. It is usually the custom of engine builders to publish their results, per indicated horse-power, which means very little to the power user. He is chiefly interested in the economy of steam per unit of power he gets out of his power plant, not the steam per unit of power he has to put into it.

To make a comparison with a reciprocating engine and assume the efficiency of transmission from the steam cylinders to the switchboard to be 85 per cent, which is about the very highest attainable, would bring the full load water rate on the turbine, just described, to 14 lbs. per indicated horse-power. The tests were made under ordinary conditions, so far as dryness of steam is concerned, the boilers being some distance away, and no allowance made for wetness of steam.

In Fig. 15 is a set of lines showing the efficiency when running non-condensing. These results are somewhat inferior by reason of this particular turbine being designed essentially for condensing. Nevertheless, the results are not so bad as to preclude it being operated under these conditions, should at any time the condenser be out of order. A turbine, designed for running non-condensing, gives proportionately as good results as the condensing curves shown on the diagram.

By this set of curves may be observed the function of the by-pass valve. When running non-condensing the by-pass valve remained closed until about half load was reached. Upon being opened the efficiency fell off, as shown, and continued to improve from there on as the load increased. The overload capacity of the engine is obviously more flexible than that of most engines.

Superheating may be made use of with considerable gain in economy and without the usual difficulties. There are no internal rubbing surfaces and no packing glands to become injured by the high temperature. Sixty to 70 degs. of superheat improves the economy by some 20 per cent.

In this connection Prof. Thurston has lately recorded some experiments with a de Laval turbine. For every 3 degs. F. of superheat 1 per cent of gain in economy was attained. With 37 degs. of superheat the capacity of the turbine was doubled. This gain he attributes almost entirely to the reduction of skin friction.

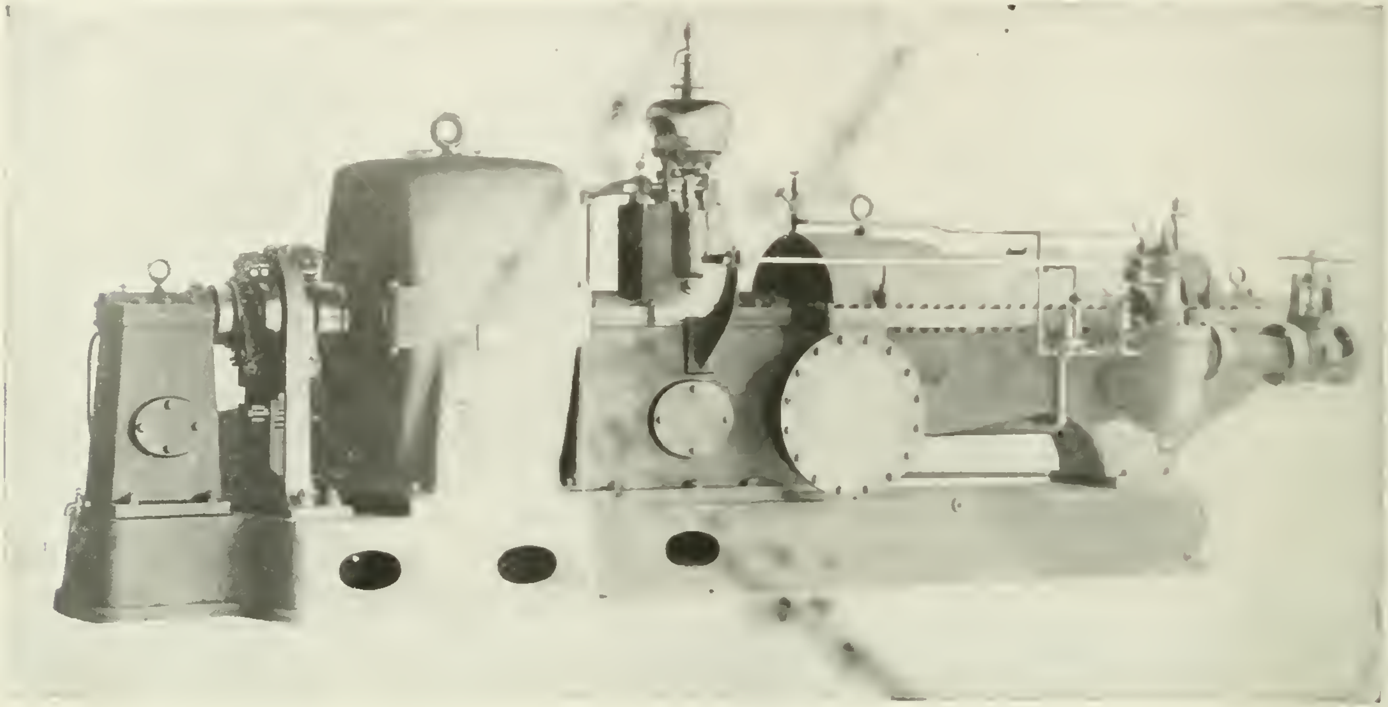


Fig. 17.—500-hp Steam Turbine.

The practical efficiency of a turbine power plant may be gathered by some tests made by the Westinghouse Air Brake Company. After the plant had been installed some nine months the whole plant was shut down, and the steam engines, which had been previously doing the work, were connected up again, put in service and were kept running a week, during which time careful measurements were taken of fuel and water. After this the turbine plant was again put in operation and similar measurements were made with the electrical transmission. The saving in coal averaged 35.7 per cent during the day and 36.4 per cent during the night in favor of the turbines. The saving in feed water averaged 29.8 per cent. during the day and 41.4 per cent during the night. In round numbers this means a saving of 40,000 lbs. of coal in 24 hours. The gain is, in a great measure, due to the economy of the turbines, but also to some extent to the elimination of the condensation in long lengths of steam pipe and to the advantages of electrical transmission.

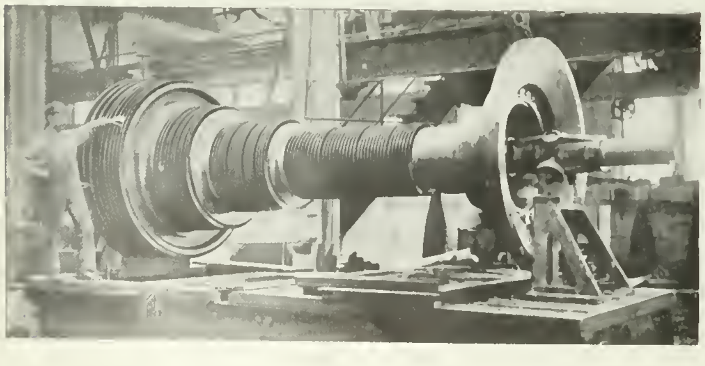


FIG. 18.—REVOLVING PART OF 3000-HP TURBINE.

Fig. 16 gives a view of this power plant. The whole outfit of three turbines and generators, aggregating 1500 horse-power, occupies a floor space of 24 ft. square, and allows ample room for access to the turbines. The turbine and generator are shown separately in Fig. 17. The total weight is about 25,000 lbs.; total length, 19 ft., and width, 4 ft. 3 ins.

Lately a 1000-kw outfit has been built by C. A. Parsons & Company for the Elberfeld Corporation, in Germany. At 1200 kilowatts, 130 lbs. boiler pressure, 18 degs. F. of superheat, the turbine driving its own air pump, etc., an electrical horse-power was produced for 14.025 lbs. of steam. This is probably the highest economy ever attained in any steam engine.

Fig. 18 shows the complete revolving part of a 3000-hp turbine. Its weight is 28,000 lbs.; length over all, 19 ft. 8 ins., and 12 ft. 3 ins. between bearings; the largest diameter is 6 ft. The turbine, of which this forms a part, is shown in Fig. 19, and is being set up in the power-house of the Hartford Electric Light Company. It is direct-connected to a 1500-kw generator, the total outfit having the following dimensions: Thirty-three ft. 3 ins. long; 8 ft. 9 ins. wide; 175,000 lbs. total weight, including generator. This is the largest steam turbine in one integral part ever built.

As there are no rubbing surfaces in the turbine, no internal lubrication is necessary. This enables surface condensers to be employed and the condensed water used for boiler feed without fear of getting grease into the boilers. The turbine is entirely automatic in all its functions, and requires remarkably little attention. The only real working part is the spindle revolving in its bearings. These bearings are found to wear, but little, if at all, so the cost of renewals and repairs is very small.

In 1897 the Newcastle & District Electric Lighting Company of England published its costs in this regard. The power-house contained 11 turbines of 75 to 150 kilowatts each. The cost for repairs and renewals amounted to 26 cents per kilowatt per annum, and included all repairs to boilers, turbines, condensers, pumps, generators, cables, fittings, etc.

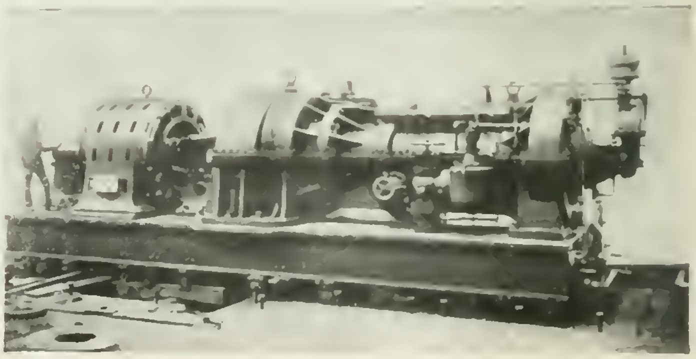


FIG. 19.—1500-HP TURBINE.

By reason of the turbine making use of the last available expansion of the steam there is considerable advantage in employing the highest vacuum. For instance, considering the 300-kw turbines described, and assuming the steam consumption with 27 ins. vacuum to be 16.35 lbs. per electrical horse-power, it may be reasoned upon a thermodynamic basis that with the same machine designed for 25 ins. vacuum the consumption would be 18 lbs. per ehp-hour. On the other hand, by designing the same turbine to suit an exhaust pressure of, say, 29 ins. vacuum, the consumption would come down to 14.12 lbs. per ehp-hour.

The applications of steam turbines are perhaps not so universal as for ordinary steam engines. They are pre-eminently suitable for driving electrical machinery, particularly alternating current dynamos. Some difficulties are, however, experienced with the commutation of continuous current generators of fairly large powers.

There is nothing remarkable in the design of generators for this purpose, except the modification necessitated by the high speed. For this reason they are remarkable for their small weight and dimensions and the absence of crowded pole pieces.

Builders of electrical machinery have for some years been working in the direction of reducing speeds from the old bolt-driven rigs to admit of direct-connection to slow-going reciprocating engines. The condition for steam turbines is, however, a step in the reverse direction. Turbines have been used with good success in England for driving fans and blowers.

Although the type of bearing employed is capable of successfully dealing with about any reasonable error in balance, at the same time it is very essential that the revolving parts be very accurately balanced, in order that the collector rings and commutators may run true, and that the clearance between the tips of blades and walls of the turbine cylinder may be maintained as fine as possible; thus balancing forms quite an important stage of the construction and has many interesting features. The usual method of balancing, which consists of rolling the piece on ways and thus locating the heavy side, is sufficiently accurate for ordinary slow-speed work, but no degree of real accuracy can be attained.

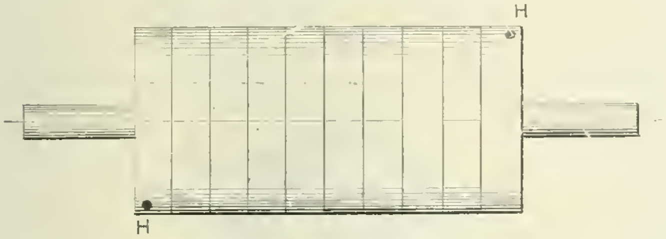


FIG. 20.—ILLUSTRATING ONE METHOD OF BALANCING.

Attempting to balance a body, such as that shown in Fig. 20, by this method, might result in a heavy spot at two opposite sides and two opposite ends, as at *H* and *H*, which would be anything but a condition of good running balance. It is, therefore, found desirable to split this up into comparatively narrow rings and balance each separately, when the above error would become negligible. For balancing such rings the Westinghouse Machine Company has devised a machine which performs the work with remarkable accuracy. A turnable is pivoted on a beam, which is in turn hung on two knife edges. Below the turnable is rigidly attached an adjustable counterweight. The turntable, of course, is free to turn independently of all this. Means are provided to slide the whole turntable and counterweight in the beam and in a direction at right angles to the line of the knife edges.

The counterweight is adjusted to bring the combined center of gravity in a plane close to the knife edges. Then by sliding the mass in the beam the table may be made to rest horizontally. Then by giving the turntable one-half revolution the table will fall over by twice the amount it is out of balance. Readings are taken in two opposite directions and the exact location and the amount of the error may be immediately figured. Balancing by this method may be done very rapidly and with surprising accuracy. A ring weighing 6000 lbs has been balanced within 2 oz., and rings weighing 200 or 300 lbs. within ⅛ oz.

In the case, however, of the revolving parts of electric generators the final winding, etc., is liable to throw it out of balance, and then there is no alternative but to balance it in its entirety. The shape is generally of the nature of a long cylinder with a journal at both ends. The only way then to do this balancing is to deliberately mount it on bearings which are preferably set on springs and running it up to speed by belt or any available means. While running, it is marked with a colored pencil at different points, which serve to indicate where to add weight. In the case of a small body revolving at 5000 or more r. p. m., the light side is always the side that comes outward, so that weight should be added just where the marks come. In some cases the marks are opposite at each end, when weight needs to be added on one side at one end and on the other side at the other end. These facts show that when high speeds are reached the body ceases to revolve on the geometric axis and takes the axis of gravity.

On its way up to speed there is generally some point at which there is considerable vibration. This is termed the critical speed, and seems to come at the time when the body is changing its axis of revolution. These crtical speeds become lower as the bodies are heavier and of greater radius. In the cases of heavier and bigger bodies, which also would have a lower rotative speed, the marks do not come just on the light side. They may come sometimes as much as 90 degs. ahead of the light side. The exact angle can only be found by experiment, and at best this is only a cut-and-try method. With experience, however, work may be put in very accurate balance.

The application lately of steam turbines to marine propulsion is well known. Some particulars of the vessels equipped may be interesting. The first vessel, named the "Turbinia," was built with a view of exploring the possibilities of turbines for this purpose. It was, therefore, built as small as possible, and at the same time not so small as to preclude the attainment of high speed should the experiments turn out a success. The dimensions selected, therefore, were 100 ft. long, 9 ft. beam, 3 ft. draught, and 44 tons displacement. It will be noted that the ratio of beam to length is unusually small, 9:100, while 10:100 or 11:100 is the more usual practice for this class of boat.

To begin with, the boat was fitted with one single turbine and propeller. The result was disappointing, the chief trouble being due to cavitations in the propeller, resulting in excessive slip. This was verified by experiments in a tank of water subjected to vacuum. The appearance of the action of the propeller in the water was observed by looking through a slot in a disc which was made to revolve in synchronism with the propeller under observation.

It was then considered necessary to make several changes. New engines were built in three sections, the steam expanding through them in series, each section driving an independent shaft, and each shaft three propellers. Very soon 32¾ knots were attained and eventually 34½ knots at the naval review at Spithead in 1897. About 2300 ihp were developed. The boiler, a Yarrow type with small tubes, had 1100 sq ft of heating surface and an evaporation of about 28 lbs. of water per sq. ft. heating surface at 34½-knot speed. About 600 hp were developed per ton of machinery and 50-hp per ton of total weight of vessel in full equipment.

These successes resulted in a contract with the British Admiralty for a torpedo boat destroyer named the "Viper." The dimensions were the same as the 30-knot destroyers of her class, 210 ft. long, 21 ft. beam, and 350 tons displacement. The engines consisted of two independent sets, each consisting of one high-pressure turbine driving a shaft, and one low-pressure turbine driving its shaft. On the same shaft as the low-pressure was permanently connected a small turbine for reversing purposes. When running ahead the reversing turbine was in connection with the condenser, so that the frictional losses, due to this turbine running idle, were very small. The same fact applies to the go-ahead turbines when running astern.

There were, therefore, four propeller shafts, each fitted with two propellers, the one ahead having a slightly lesser pitch than the after ones. The Yarrow type boilers have 15,000 sq. ft. heating surface, grate surface 272 sq. ft.; condensers have 8000 sq. ft. surface. The speed attained was 35 knots to begin with, and later 36.858 knots were reached.

It is generally conceded by engineers that but little more may be anticipated in the development of the reciprocating engine. Any improvement that we can imagine would not very materially improve its efficiency as a heat engine. On the other hand, the turbine is capable of development in many ways, particularly in the use of superheated steam, to a degree hitherto prohibitive, so that the day may not be very far distant when the turbine will replace the reciprocating steam engine for most purposes.

"Duplex Telephony."

The Chicago Telephone Company a few days ago sent out a circular urging its customers to have their telephone business double-tracked—one instrument for outgoing business and one for incoming. Some smart local reporter who got hold of it thought it was a plan for "duplex" telephony and so heralded it to a startled public. General Manager Hibbard has been kept busy explaining the thing to his telephonic friends in different part of the country.

Twenty-Five Great Names in Electrical Science and Invention During the Nineteenth Century.

The lists which appear on the opposite page were compiled from individual lists received in response to invitations sent to the membership of the American Institute of Electrical Engineers for an expression of opinion as to what names connected with electrical science and invention during the century just closed, should appear on a list of twenty-five greatest names; and an indication by numerals of the names which, in their opinion, should be assigned first, second and third rank, respectively.

FARADAY

MAXWELL

KELVIN

EDISON

In response to this invitation 277 ballots were received and from these the general list on the opposite page was compiled. In order that an interesting comparison might be made with the general list the two other lists printed with it were compiled as follows: From the 277 ballots those of twenty-five professors of electrical engineering were selected; also twenty-five ballots signed by leaders in various branches of electrical application and others whose opinions were thought to have particular weight. From these two sets of selected ballots the comparative lists, "A" and "B" were prepared.

The closeness of the vote of the first thirty names on the tally sheets was quite remarkable; in a number of cases the vote was a tie and this is indicated on the lists by braces opposite the names. On the general list tally sheet there was a difference of but seven votes between the twenty-fifth and the thirty-first names, and had the list been extended to the latter number it would have included the following names in the order given: Weston, Hopkinson, S. P. Thompson, Weber, Ferraris and Gray. Similarly, the tally sheet of the ballots cast by twenty-five professors of electrical engineering, if extended to thirty names, would have included Gauss, Wheatstone, Ewing, Röntgen and Rowland, the three last mentioned having but three votes less than the twenty-fifth on the list. Had the selected engineers' list been extended to thirty names it would have included Hopkinson, Marconi, Heaviside, Pacinotti and Steinmetz—the difference between the vote of the last mentioned and number twenty-five on the list being also three.

On the general list, there were practically but seven selections for the first, second and third places, and in the following order: Faraday, Kelvin, Edison, Maxwell, Henry, Morse and Bell. Faraday received almost twice as many votes as any of the others, and the vote of the next three names was largely in excess of the final three. On the professors' tally sheet, Henry stood fourth, the other names below his receiving but a few votes each. On the engineers' list Edison was fourth, the subsequent names also receiving but a few votes each.

The name Siemens should be accepted as standing for the family rather than for any particular member thereof.

Result of Vote Upon Twenty-five Greatest Names in Electrical Science and Invention During the Nineteenth Century

SELECTED LIST A Compiled from Ballots of 25 Professors of Electrical Engineering. (Exclusive of Ballots in List B)	GENERAL LIST Compiled from Ballots of 277 Members A. I. E. E. (Inclusive of all Ballots)	SELECTED LIST B Compiled from Ballots of 25 Prominent Members A. I. E. E. (Exclusive of Ballots in List A)
FARADAY	**FARADAY**	**FARADAY**
KELVIN	**KELVIN**	**MAXWELL**
MAXWELL	**EDISON**	**KELVIN**
EDISON	BELL	HENRY
HENRY	MORSE	BELL
HERTZ	HENRY	EDISON
E. THOMSON	TESLA	AMPÈRE
BELL	E. THOMSON	MORSE
MORSE	MAXWELL	OHM
AMPÈRE	AMPÈRE	DAVY
SIEMENS	SIEMENS	HERTZ
DAVY	OHM	SIEMENS
HELMHOLTZ	HERTZ	TESLA
OHM	DAVY	GRAMME
TESLA	BRUSH	HELMHOLTZ
HOPKINSON	WHEATSTONE	WHEATSTONE
BRUSH	HELMHOLTZ	PLANTÉ
OERSTED	GRAMME	E. THOMSON
FERRARIS	STEINMETZ	ROENTGEN
GRAMME	ROENTGEN	BRUSH
PLANTÉ	SPRAGUE	GAUSS
STEINMETZ	PLANTÉ	WEBER
JOULE	MARCONI	JOULE
SPRAGUE	OERSTED	OERSTED
WEBER	JOULE	FERRARIS

XIX

ELECTRICITY
IN THE
TWO CENTURIES

XX

Retrospect and Forecast

Electricity in the Coming Century.

By Elihu Thomson.

THE rôle of a prophet is certainly a very difficult one, and he treads dangerous ground who attempts to say in what direction future advance will take place. New discoveries may at any time change the course of events and open up paths of development now unknown. Whatever is said of the future of our science must of necessity be based upon present indications, as well as upon our imagination, and, it may even be, upon our hopes. There are certainly problems enough still unsolved; plenty of work for the young, fresh and bright minds, the deft and painstaking experimenters of the future. In the past, valuable resources have been shamefully wasted and they are still often used without much regard to economy. If necessity be really the mother of invention, the future higher cost of fuel must force the adoption of economical means for utilizing heat. Without doubt the gas engine, the steam engine using superheated steam, and the secondary engine using a volatile fluid boiled by the heat of exhaust steam will grow in importance in the immediate future. We must see that America is not backward in these advances, even though she may not feel the fuel scarcity for a long time. That electrical energy can give a higher yield of light than it now does in the usual electric lamps is abundantly proved. The Nernst lamp and the discharge in gases under proper conditions may produce 1 candle per watt. It is well known that the condensed spark discharge in air is a more efficient light producer than the electric arc, but as yet no thoroughly practical means for utilizing these more efficient light sources has been developed. With lamps of 1 watt per candle and with large gas engines of efficiencies ranging up to 30 per cent, started and stopped readily and kept under efficient loads, the future of electric lighting would be brilliant indeed.

The solution of the problem of obtaining luminous rays unaccompanied by low or invisible heat rays is, to all appearances, yet remote. Perhaps it will come through the chemist and not through the electrician, perhaps from a combination of the efforts of both of them. What nature has done in the various light-giving insects may possibly be imitated by man; the substance secreted by the firefly and oxidized most efficiently for light production may indeed be capable of being cheaply manufactured.

Any one who has had the lesson of the almost deserted streets and avenues of a large city, brilliantly lighted during the small hours of the early morning, brought forcibly home to him, must deplore the necessity for wasting the fuel resources of the world while nearly all the people are asleep. The solution of the problem of light without heat by some electric means would furnish the same illumination at about 1-20th the expenditure of power, and if this were furnished by an engine of 50 per cent fuel efficiency, only 1-100th of the fuel now used would be required. Manual labor may be wastefully used and the new-born generations make good the loss, but the loss of valuable minerals, such as coal, oil and natural gas is a veritable world impoverishment, worse indeed than the terrible destruction of forest timber to be worked up into paper for the many useless prints, such as medicine advertisements, or to be compared with the burying of the beautiful metal, nickel, in the iron of armor plate, never to be recovered and possibly eventually to reach the sea bottom.

We need not dwell here upon the manifest revolution which the electric motor is making for isolated powers located so as to be fed from a central power plant. The past few years have shown a continually increasing use of electric power, and this development will doubtless long continue in an increasing ratio.

The problem of the production of electricity from the potential energy of carbon and oxygen, at high efficiency and in some direct way, is one the solution of which is a hope of the future. The problem is not an easy one to solve, and its solution may not, after all, be direct. It is conceivable that the reducing power of carbon may be employed to rejuvenate exhausted materials such as those from a battery. In other words, the chemical energy of the carbon may be brought into use to prepare other materials for the evolution of electric energy. Even if this could be done at high efficiency and with the use of fuel only, the more direct use of the fuel might cease to be so eagerly sought. We would need for this solution of the problem materials easily recoverable from an exhausted battery and capable of reduction on the large scale by carbon. Other materials reduced in the battery and capable of oxidation by the air at some selected temperature would be needed. We may be permitted to picture the electric station in such case as a huge battery house, coupled with an immense chemical factory. But it may never come

Electro-chemistry in the coming century has an assured future of great importance. Electro-chemical operations are peculiarly adapted to the utilization of water powers, as they may use the electric energy developed under full load conditions night and day, or may be shut down during periods of water scarcity without much loss. The power of the water may thus replace in its effects those of costly chemical reagents. Moreover, the electro-chemical factory may be run as a means for utilizing surplus energy which would otherwise go to waste in systems of electric lighting or power transmission, where conditions are favorable.

As a matter of pure science, great interest now centres upon the newer ideas in relation to the constitution of the chemical atom, its relation to the ether of space and to other atoms. Faraday perceived clearly that electric and magnetic forces and phenomena were intimately connected with the ether, and subsequently physicists, such as Maxwell, Lord Kelvin and many others, developed the theory from the mathematical side, Maxwell arriving at the conception that light and heat radiation were electromagnetic waves in the ether. This splendid theory received its experimental confirmation in the brilliant researches of Hertz and others following him. What we know of the ether concerns its electric and magnetic behavior. It can be polarized magnetically; it can be stressed electrically; it can be periodically stressed and polarized by atoms of matter and electromagnetic waves such as those of light and heat so set up in it, conveyed at the enormous velocity of nearly 200,000 miles per second, which is the same as the rate of propagation in free ether of the other electrical disturbances. Electromagnetic field or induction and electrostatic induction take place in the ether as the medium. Electric energy is transferred in the ether surrounding a conducting wire, the wire being only the guiding core, so to speak. The ether is an electric medium; its properties are electromagnetic. Has it any other properties? Has it need of any others? It appears to be universal, fundamental. If so, do not its properties and actions lie at the basis of what we call matter? The various chemical elements are related by what is called the periodic law; they are not separate entities created or existing alone; they have been born of conditions. They are probably being formed in some of the distant stars. These are ideas which have suggested themselves from time to time to thinkers for many years past. We know that an electric charge existing anywhere in a perfect insulation cannot be lost, and we know also that an electric current in a perfect conductor is permanent and its magnetic field permanent. May not the fundamental properties of matter, such as mass, inertia, elasticity, cohesion, gravitation, be in some way dependent upon and explainable by the electric properties of the ether? To these inquiries and others like them much thought is now given by able men.

Chemical affinity may be explained by the electric forces due to atoms possessing electric charges, and it appears probable that electric theories will be found to explain the other fundamental properties mentioned. In fact, ideas of great promise are not wanting in this connection. Prof. R. A. Fessenden, after showing that a relation exists between the velocity of sound and electric conductivity, thus connecting elasticity and density with electric resistivity, proceeded by ingenious methods and experimental researches to find, if possible, the density and elasticity of the ether itself. Recently he has also proposed electric hypotheses for cohesion, inertia and gravitation. These involve such properties as rigidity, momentum, mass and weight. Time and space is wanting to give any proper outline of these extensions of electromagnetic theories, and reference should be made to Prof. Fessenden's papers, some of which have appeared in the columns of this journal.

Briefly, cohesion is explained by the electrostatic attraction of the charged electrons in the atom, inertia is the inductance of the large number of charged corpuscles constituting an atom of matter, and gravitation is due to a density change in the ether around the charged corpuscles or electrons, owing to the electrostatic stresses existing. Upon this theory, as Fessenden points out, the relation between the masses and the weights of various bodies under like conditions is constant for each body. Whether these ideas will stand the test of future research cannot be determined now. That these hypotheses and others of like nature will furnish groundwork for investigation in proof or disproof is unquestionable. It will be noticed that the ideas themselves are based upon the very latest results of physical research.

The recent studies of electrons, or electric charge-carrying corpuscles much smaller than the chemical atom, have formed the needed basis. The advanced physicist has no hesitation in decomposing the hydrogen atom into more than a thousand electrified corpuscles or electrons. Some carry negative charges, others positive. Moreover, the interesting conclusion is reached that the electrons of all the chemical elements are probably of the same size and possibly identical. Beginning with the study of electrolysis as due to free ions in the solution, the conclusion was long ago reached that the action of dissolving a salt in water resulted in partial dissociation and formation of free ions with electric charges. It was found that gases fresh from a flame contained free ions, that they were produced in silent electric discharges, and that air and gases could be ionized in various ways. Ions are produced by ultra-violet light, by Roentgen rays and by those from uranium or radium, while the cathode rays in a vacuum tube are believed to be due to negatively charged corpuscles. Beginning with the work of Lenard, investigation into the nature and properties of cathode rays has been carried on by many able investigators and with the result of great enrichment of science in the few closing years of the century. Prof. J. J. Thomson has been an indefatigable worker in this field, and his deductions are far reaching. The field itself is a veritable fairyland of science, but the results, however they may be eventually interpreted, are of great importance to future work. If matter be reduced to assemblages of electrons or charged corpuscles, thousands of which make up a single chemical atom, the nature of the charges themselves remains still a great mystery and the real nature of the ether in which they exist remains unsolved. But if the electromagnetic ether theory succeeds in supplanting many unexplained things by a fewer number more evidently fundamental, a real advance into the unknown has certainly been made. Just as a conception of infinite space is not possible with us, so we may only approach without ever reaching the ultimate solution of the mystery of the physical universe. A world without new problems might indeed be a dull one to live in, lacking the stimulus arising from prospective conquest of the unknown.

Franklin's Sagacity.

No part of the writings of Franklin exhibits his sagacity and his power of scientific generalization in a more conspicuous light than his theory of electricity. The talent to discover isolated facts in any branch of science, although possessed by few, is comparatively inferior to that characteristic of mind which leads to the invention of an hypothesis embracing in a few simple propositions whole classes of complete phenomena.—Joseph Henry.

Electrical Theories.

By Prof. John Trowbridge.

The professor and the electrician of middle age were taught in their youth—perhaps forty years ago—the two-fluid theory of electricity. This and the one-fluid theory of Franklin were the only ones even mentioned in the text books of that time, while in the standard text books of to-day they are discussed only because of their historical interest. With Caloric and Phlogiston they have been buried in a common grave. No one to-day believes that the electric current can be explained by the movements of two fluids in opposite directions, or by the excess or lack of one fluid. The destruction of the fluid theories is due to Maxwell, who by his great electromagnetic theory of light, showed that light, heat, electricity and magnetism could be ascribed to periodic movements in the ether which differ only in wave lengths. This theory followed the doctrine of the conservation of energy so closely, and proved so rich in possibilities of reasonable explanation of electrical phenomena, that it drove the fluid theories out of the growing literature of electricity, and is the parent of all the theories with which we begin the new century.

The close student of Maxwell's treatise on electricity and magnetism is constantly surprised at the wealth of suggestion contained in that work. He does not treat the subject of periodic currents on metallic conductors, but his general equations need only slight modification to embrace even this subject, and he has laid the foundation of the study of periodic movement in the ether. Hertz's work is entirely based upon Maxwell's equations, and may be considered the experimental illustration of the great Scotchman's theory. It is said that Helmholtz considered that Hertz's great contribution was the micrometer spark gap and the manner of using it to show electrical waves. He, however, who reads Hertz's exhaustive mathematical discussion of his results is lost in admiration of its German thoroughness and scholarship.

The results of Hertz show conclusively that the velocity of electricity in free space is the same as the velocity of light. Forty years ago it was supposed that the velocity of electricity could be measured on telegraph lines, and little was known of the effects of self-induction and of distributed capacity. The theory of Maxwell is constantly receiving accessions of experimental evidence in its favor. One of its fundamental postulates, that of displacement currents in insulators, however, has never been supported in a conclusive manner by experiment. Another postulate, that of the magnetic effect of moving electrical charges, underlies the new electrical theories of the present. This magnetic effect of moving electrical charges is calculated by Maxwell in the second volume of his treatise, where he shows that a moving electric charge is equivalent in its effects to an electric current, and Rowland has tested the conclusions of Maxwell by a carefully devised experiment. This experiment was repeated and its results confirmed by Himstet. During the past year Cremieu, a French investigator, has tried the experiment in a novel way and has failed to confirm Maxwell's idea. The Frenchman's methods do not seem above criticism, but the reading of his paper at the meeting of the British Association for the Advancement of Science last August awakened great interest, for the hypothesis of the magnetic effect of moving electrical charges is the keystone of the new electrical theories with which we begin the next century. Several investigators are now busy in the repetition of Rowland's experiment and in the study of Cremieu's methods. If the experiments are shown to be faulty, the two hypotheses, that of displacement currents and of the magnetic effect of moving charges will still hold their place in the electrical theories of the future, until Maxwell's entire theory is overthrown, which seems unlikely to happen. Our experimental methods may be too crude to detect these effects, and we may be compelled to believe in their reality from a cumulation of indirect evidence.

The theory of Maxwell naturally has drawn attention to the hypothesis of the existence of an ether of space, for upon this hypothesis rests our entire conception of the mechanism by means of which electromagnetic waves are sent to this earth from the sun. The Germans, in their recent electrical theories, give a preponderance to the study of wave motions in the ether, while the English appear to have returned to a consideration of molecular motion.

The electrical theory which is now attracting the most attention is that of Prof. J. J. Thomson in regard to the size of the negative ion and to its combination with aggregates of positive atoms. From numerous experiments with the cathode and X rays, he has concluded that the negative ions are much smaller than ordinary atoms. The ionization, therefore, of a gas consists in the separation of the negative ion from the atom. This negative ion is the same for all gases, and its mass is about one-thousandth of the hydrogen atom. Prof. Thomson thinks that this negative ion is the fundamental quantity in terms of which all electrical process can be expressed, for its mass and its charge are invariable and independent of the processes by which electrification is produced, and of the gases from which it is set free. He regards the atom as a collection of bodies which he calls corpuscles. The mass of a corpuscle is the mass of a negative ion in a gas at low pressure, about 3 × 10 — 26 grammes. The electrification of a gas is due to the detachment of a corpuscle from some of the atoms. The remainder of the atoms forms the positive atom. Immediately following the papers by J. J. Thomson come very suggestive articles by Drude on what he terms the electron theory of metals. Drude uses the term ion for the combination of electric particles and ponderable masses found in electrolytes, and he calls the particles which probably play a part in metallic conduction electrons or electric nuclei. Every moving electron produces an electric current and establishes magnetic lines of force in the surrounding ether, and therefore all forces which alter the direction or velocity of an electron produce opposing forces, due to a change in the number of magnetic lines of force due to self-induction of the electron. There are bound electrons as well as freely moving electrons. The latter obey the kinetic theory of gases. In order to explain why positive and negative nuclei do not combine to a neutral point, the author refers to the case of a comet which on account of its high kinetic energy does not return to the solar system. Drude's papers on this subject are not yet concluded, but he believes that all galvano and thermomagnetic effects can be explained and calculated by aid of the electron theory. These electrons apparently have their play in the ether surrounding the metallic particles of the conductors, for if the electric charges resided on the metallic molecules it is difficult to understand how the charges could be maintained inside the metallic mass. The theory evidently demands an etheric atmosphere around each molecule of the conductor.

One of the most remarkable of the recent investigations bearing on electrical theories is that of Zeeman, who found that certain spectral lines of gases, when examined in a strong magnetic field, show circular polarization at their edges, and are resolved into doublets and triplets. In studying this effect he found that he had verified the theoretical conclusions of H. A. Lorentz, who, in a remarkable mathematical paper, had proved that the effect studied by Zeeman should take place. Lorentz's reasoning is based upon the fundamental laws of electromagnetism laid down by Maxwell in which it is assumed that an atom carrying an electric charge is not affected in moving along a magnetic line of force, but is very much influenced in directions at right angles to such lines. Lorentz in a late paper enters into a more exhaustive mathematical discussion of the effect predicted by him, which, by a courtesy which is admirable and finds few parallels, he calls the Zeeman effect, he shows that the mechanism of the emission of light on the electromagnetic theory can be much elucidated by a further study of the effects on luminous particles of a magnetic field, and makes the suggestion that a charged sphere, deformable by certain mechanical stresses, could, by changes in electrical distribution, produce the effects observed. To the student of the electromagnetic theory of light, the papers of H. A. Lorentz are perhaps the most suggestive of any that have appeared since Hertz's epoch-making investigations.

The electrical theories, therefore, with which we begin the century are based upon Maxwell's electromagnetic theory. He can be said to have considered vast movements in the ether of space, while we are looking closely into minute actions far beyond the resolving power of the strongest microscope. Still, these infinitesimal actions can be expressed by Maxwell's equations.

The discovery of the Roentgen rays may be said to have led to the new electrical theories which deal so largely with corpuscles and electrons, for these rays exert a remarkable effect on the passage of electricity through rarified gases and upon the accumulation of electrical charges on conductors. It is through the cathode rays and the X rays that Prof. J. J. Thomson has been led to his hypothesis of the electrical ion, which is the smallest entity in the electrical world. This ion is weighed against the hydrogen atom, and the study of hydrogen is therefore of great interest to the electrician and the physical chemist. It perhaps can be maintained that no electrolytic action can take place without the presence of aqueous vapor—that is, of oxygen and hydrogen. It is a question also, whether all chemical actions are not controlled by the presence of this vapor. I believe that I have shown that the various substances introduced into the X-ray tubes to control the degree of rarefaction and therefore to control the production of the rays, act through the liberation of their water of crystallization.

Prof. Dewar has shown that liquid hydrogen is an insulator of electricity, and that an electric spark in it shows the line spectrum of hydrogen. How is the electric current transmitted through the gas? The results of Prof. Dewar certainly show that he cannot claim that it approximates to the character of a metal, and it is difficult to explain the passage of a current by any dissociation or ion theory unless we suppose that the hydrogen contains oxygen.

The electrical theories of the future will be greatly influenced by the growing subject of physical chemistry, which will be principally the study of electrical action between atoms and molecules. I believe, moreover, that we are destined to greatly change our conceptions of the great source of all our electrical energy, the sun. With the aid of very powerful discharges through glass tubes filled with rarefied gases, such as oxygen, nitrogen and hydrogen, all of which gases had been dried with every possible care, I always obtained the spectrum of aqueous vapor. This vapor probably came from the glass walls or from the metallic terminals of the vessels. It seems impossible to conduct experiments in electricity in spaces free from this vapor. It is largely concerned in the phenomena of the production of the X rays. When an X-ray tube is connected to a storage battery of 20,000 cells, at the moment of the liberation of aqueous vapor in the tube there is a powerful manifestation of these rays.

It seems a great step from the study of these comparatively feeble rays to that of the source of all our electrical energy, the sun, yet the contemplation of them tempts one to believe that we shall yet frame a theory of the constitution of the sun which will rest upon electrical laws rather than upon considerations of heat phenomena—that is, light and heat will be merged in the grander generalizations of electromagnetism. Count Rumford, at the beginning of the nineteenth century, left a fund for a medal which is to be given from time to time for notable contributions to the subject of light and heat. In the coming century the committee having charge of the award of this metal of the distinguished founder of the doctrine of the conservation of energy must necessarily include also investigations in electromagnetism. It seems not unlikely, also, that gravitation will fall into line, and that in another hundred years we shall have a reasonable theory which shall connect all of nature's physical agencies in one vast relationship.

Electrical Energy Direct from Carbon.

By Dr. A. E. Kennelly.

It is well known that a piece of good coal contains enough energy, when burned with oxygen, to lift its weight against sea-level gravitation a vertical distance of 2000 miles. Otherwise stated, a pound of good coal, when burned in air, liberates about 5.7-hp-hours of energy, or at the rate of 0.175 lb. per horse-power-hour.

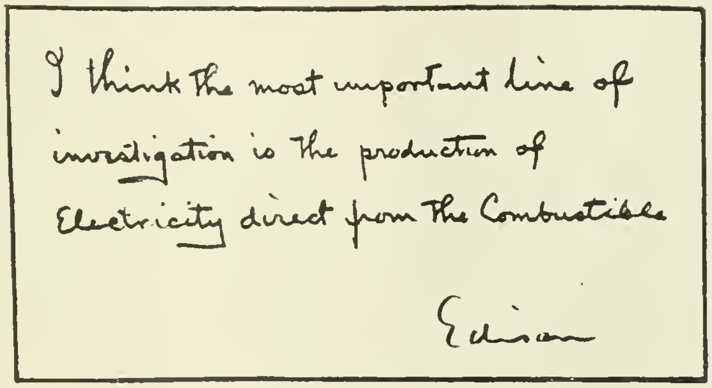
The best known means of securing this energy in mechanical form is the heat engine, which is in practice, on a large scale, the steam engine, and in the best steam engines the consumption of coal instead of being one-sixth of a pound per brake horse-power-hour is about 1¼ lbs., while in ordinary fairly large good engines it is between 2 and 3 lbs.

This inefficiency of the steam engine has been known and striven with for many years. The best steam engines of the year 1801 had a net efficiency of about 4 per cent, so that the progress made during the nineteenth century has been to increase the net or total efficiency of the best engines from 4 per cent. to 14 per cent.

The great source of waste in the steam engine is a consequence of the apparently definite law of nature that if we deliver up to any working substance, such as hydrogen gas, a certain quantity of heat, at the temperature say of melting lead, in a heat-tight cylinder from which all thermal waste could be eliminated, and allow the gas to do mechanical work in strokes or cycles by expanding and pushing out a piston, with a subsequent retraction, we cannot obtain the full mechanical equivalent of the heat energy unless the expansion goes on indefinitely, with a simultaneous depression of the temperature of the expanded gas down to the theoretically absolute zero of -273 degs. C. at which there would be no heat left in it. The ratio of the working range, to the total ideal range of temperature down to absolute zero, represents the thermodynamic efficiency, and the limitations of the heat engine. It would seem that any heat engine or energy-converting apparatus that involves a rejection of heat at a lower temperature must be subject to this limitation and disastrous waste.

The question has therefore often arisen whether the energy cannot be extracted from coal without having recourse to the thermodynamic process, and, therefore, without having to pay such heavy tribute to the absolute temperature of 300 degs. C., or 300 degs. above absolute zero, at which we happen to live, and below which we are unable to carry our expansion.

If, for example, coal were converted into coke, which conversion could be carried on commercially without loss, and perhaps even at a profit, on account of the value of the distillation products; and if the coke could be consumed in a galvanic battery in the same manner that zinc is ordinarily consumed, there would be no such necessary waste of energy, and theoretically almost all of the energy of combination between coke-carbon and oxygen could be liberated in the electrical circuit of the apparatus. This would represent the direct generation of the energy of coke-carbon into electrical energy. Unfortunately, however, carbon refuses to behave like zinc and burn in a voltaic cell. The only known means by which carbon could be made to give out its energy in a voltaic cell, in competition with the use of coal in the steam engine, is by the formation of either carbon monoxide or carbon dioxide; in other words, the same oxidization which yields the energy of carbon in the process of combustion must take place electro-chemically. The oxygen for this purpose must be obtained from some cheap electrolyte containing oxygen, and cannot, so far as is known, be obtained from the atmosphere directly. In other words, it is necessary to rob an electrolyte of oxygen in order that the carbon shall combine with it electrolytically. If the oxygen of the electrolyte were but feebly held, that is to say, if the electrolyte consisted of a chemical combination with oxygen so unstable as to require but a negligibly small amount of energy to tear the oxygen away, and if, moreover, the substance or substances with which the oxygen was unstably linked were capable of entering into combination with the other plate of the voltaic couple, with but little absorption of energy; then it might be possible for the voltaic cell to work with a power output theoretically approaching that of the combustion value of carbon and oxygen. The union of carbon and oxygen in the cell would take place without sensible elevation of temperature, the electrolyte would give up its oxygen for the formation of carbon dioxide, and the products of the cell would have to be chemically eliminated in some continuous manner, to be replaced by fresh electrolyte. All this requires the existence of an electrolyte possessing the properties of small chemical stability, together with the capability of forming suitable chemical combinations at both plates of the couple. Moreover, the electrolyte must be so abundant as to be very cheap.


I think the most important line of investigation is the production of Electricity direct from the Combustible

Edison

EDISON: JANUARY 1, 1901.

Unfortunately all the electrolytes that are abundant are very stable combinations, which require a large amount of energy to tear the oxygen away from them, and if, as commonly happens, the energy required to abstract their oxygen is greater than the energy which carbon will yield on combining with their oxygen, it is evident that the voltaic cell so constituted would not work. The amount of energy which is necessary for the chemical disunion of oxygen from all the ordinary electrolytes is fairly well known by thermo-chemical measurements. An examination of thermo-chemical data confirms the results of the very large amount of experimental enquiry made during the past century, and leads to the conclusion that there is no cheap electrolyte available for the burning of carbon in a voltaic cell, at ordinary temperatures, with an efficiency that can compete with the steam engine. Apparently nothing short of an epoch-making discovery can help us in this direction.

Turning now to the voltaic cell worked at high temperatures, instead of at ordinary temperatures, although the prospects from thermo-chemical data seem equally unfavorable, yet there is some hope of success in this direction, if only from the fact that there is less experimental knowledge of hot voltaic cells than of cold voltaic cells, and there is always hope so long as any reasonably available combination has been left untested. The electrolyte would now be a fused salt instead of a solution, and must give up oxygen to the carbon for the production of carbon monoxide or dioxide. The remaining constituents of the electrolyte must be suitably provided for, and eliminated at the opposite plate, without serious loss of energy.

The hot voltaic cell is complicated to some extent by the introduction of thermo-electric phenomena, which inevitably accompany the contacts of dissimilar materials at markedly different temperatures. If the cell is a mere thermo-electric couple, it must do work in the circuit by receiving heat, at a high temperature, at one contact, and rejecting heat, at a lower temperature, at another contact, thereby coming under the thermodynamic law of temperature limitation, just as does a heat engine, besides being subject to additional limitations imposed by purely thermo-electric conditions. Consequently, not only is the thermo-electric method of obtaining energy from carbon, by allowing its combustion heat to operate thermo-electric couples, likely to be a failure in competition with the steam engine, owing to the temperature range limitation, but any real voltaic action in which carbon is oxidized in a hot electrolyte can succeed only in spite of, and not by reason of its accompanying thermo-electric actions.

In other words, it would seem that a hot voltaic cell can only be a successful competitor with the steam engine on account of its voltaic action, and such thermo-electric actions as inevitably occur therein must be wasteful for the same reason that the steam engine is wasteful: namely, because the temperature range, instead of being between the high temperature and absolute zero of temperature, is actually between the high temperature and a convenient moderate temperature. While, therefore, the prospects are not encouraging for the production of a hot voltaic cell-burning carbon, yet there is hope that it may be found, whereas, with the cool voltaic cell, the case seems to be almost hopeless for the near future.

If the energy of burning carbon with oxygen cannot be liberated electrically in a direct manner, as above outlined, yet it may be possible to use its chemical potential energy to perform purely chemical change in other combinations, and use the resulting products of that chemical change for the final development of electrical energy in the circuit of voltaic cells. Such exchanges of chemical energy at high temperatures are not subject to the thermo-dynamic law of temperatures, although incidentally much heat energy is usually wasted by the furnaces in which such substitution takes place. Theoretically, the exchange of chemical energy from carbon to some other substance in this manner does not necessarily require a wasteful expenditure of heat, and it is conceivable that the furnaces in which the exchange occurs might be made so nearly heat-tight, by gradual improvement, as to waste but little energy.

Such indirect processes of obtaining energy from carbon are already in use and are illustrated in the ordinary voltaic cell burning zinc. The zinc is originally taken in the form of oxide, and heated in a closed furnace with carbon; the energy necessary to tear the oxygen from the zinc, or reduce the metallic oxide to the metal, is supplied by the energy of combustion of carbon with the oxygen, and if the retort could be made heat-tight, and the waste of heat in raising the temperature of the active substance prevented, the energy of carbon would be transferred to the zinc in a fairly considerable proportion. Owing, however, to the fact that in practice very considerable thermal waste does occur, the metallic zinc, when prepared for the voltaic cell, carries but a very small fraction, usually less than 1 per cent of the energy originally possessed by the carbon used in the process. Moreover, the labor involved in the operation of exchanging the energy between the carbon and the zinc increases the expense. The result is, therefore, as is well known, that the voltaic battery employing zinc cannot possibly compete with the steam engine as a developer of power.

In this indirect method of transferring the combustion energy of carbon to some substance capable of use in a voltaic combination. there is probably much more hope of exceeding the efficiency of the steam engine, than in obtaining the energy by a direct voltaic method. if only for the reason that the experimental field is so much more extensive. If, however, a substance or combination of substances were found in which, with the aid of carbon, combustion energy in an improved voltaic cell could be developed so as to attain a final efficiency exceeding that of the steam engine, it might readily happen that the cost of the labor involved in the supply of the active substance and in conducting the process might be prohibitively great, so that unless the substance were very cheap and the process of energy exchange and subsequent voltaic release very simple, no commercial realization could be expected.

There are consequently two broad avenues in which improvement may be looked for in utilizing the energy of coal. One is by improving the heat engine. and the other is by finding a suitable substance to burn in the voltaic cell, either hot or cold, transferring the chemical energy of carbon to that substance by purely chemical means in a retort as nearly heat-tight as possible.

So far as the heat engine is concerned, it is reasonable to expect improvement in the apparatus whereby the energy thermodynamically convertible may be better conserved, or the efficiency of the machine improved, when debited with all the energy that its temperature range will permit of being converted from heat into mass motion. But with the modern steam engine, if these wastes were entirely prevented, the efficiency would still be only about 20 per cent, and the real difficulty lies in the range of working temperatures. What is needed is a greater range of temperature, a lower temperature of the condenser, and a higher initial temperature of the working substance, the latter requirement being much the more important of the two. In the case of the steam engine, this means higher steam pressure, and improvements during the past century have been steadily made in this direction. A greater difference of temperature in one and the same engine, however, tends to increase the thermal waste by leakage conduction from the hot parts to the cool, and so to diminish the relative actual efficiency. This has been, to some extent, overcome by coupling three or four seperate engines to one common driving shaft and expending the steam successively in the successive engines, thus producing the multiple-expansion, compound engine. The limits of temperature and pressure elevation seem to be almost reached for the present in this direction, partly owing to the increased difficulties in lubrication at high temperatures.

In the gas engine, however, the initial temperatures are considerably higher, and for this reason the thermodynamic efficiency of gas engines attains nearly 30 per cent or is considerably above that of the steam engine. All that can be said for the future of heat engines is that any marked improvements in their efficiency must come from an increased range between the limits of the initial and final temperatures, whether this be effected in one engine, or in a plurality of associated engines. Improvement in lesser degree may, of course, be expected from the diminution of heat wastes in boiler and engine, as well as in the reduction of mechanical friction. The steam-turbine principle, if successfully adapted to large sizes of engines, would introduce a great simplification of parts, reduction of weight, with, perhaps, some diminution of these losses. But the steam turbine must be as much limited by the temperature range, as the ordinary reciprocating heat engine.

Apart from the solution of the problem by improvements in heat engines, or by the discovery of a suitable working substance in the voltaic cell, there is always the possibility of finding some new mechanism by which the heat energy of carbon atoms can be converted into the energy of mass motion. We are still so profoundly ignorant of how the energy of carbon is stored relatively to that of oxygen, that a discovery of the hidden mechanism of the storage principle might lead to a discovery of a new means of releasing it. In other words, there is something in a lump of carbon in conjunction with a lump of oxygen, which corresponds either to a bent spring or to the motion of the gyrostat. All we know is that when the two substances are brought into sufficiently intimate contact, with the aid of a high temperature, either the spring is released, or the gyrostatic motion is arrested, with the production of jostle-energy among the molecules of the substance, or of that particular kind of rapid oscillatory molecular motion which we assume heat to be. It is conceivable that if we had a clearer idea of the nature of the invisible springs, or invisible gyrostats, we might discover some means by which the springs might be released or the gyrostats arrested, without the production of jostle-energy, and with the direct production of some kind of utilizable force.

The mere fact that by chemical processes we are able to transfer at least a part of the energy of carbon to a different substance in chemical form, without first liberating it in heat, should encourage the hope that we may find a means of transferring it in some form other than chemical or thermal, and not until we have a clear knowledge of the mechanism involved, and a clear conception of its necessary limitations, will that hope be destroyed. When we consider that the world's annual consumption of coal is roughly 500,000,000 of tons, the enormous importance of improving upon the means of obtaining the energy from coal is sufficiently apparent. Perhaps the most important ultimately, of all problems before the human race, is the discovery of an available power supply when the world's coal shall have become exhausted some hundreds of years hence. Every waste of this substance, diminishes to that extent the time in which the problem must be solved, if the future of the race is to be unchecked Meanwhile, however, there is every reason to expect that improvements will take place in heat-engines, and there is reason to hope that if their improvement is not sufficiently rapid, a more efficient means of utilizing the energy may be found either indirectly in a voltaic cell, or in some manner not at present conceived of.

Light without Heat.

By Prof. R. A. Fessenden.

APPARENTLY the most self-suggesting way of getting light without heat would have been to have developed eyes which could see all the rays. But with an extremely aggravating indifference to the waste of grey matter thereby to be entailed upon their descendants, flabby one and backboned one went placidly along. developing eyes which would only respond to a quite limited range of vibrations. And if this apparent lack of business foresight had been pointed out to any particular specimen of wiggling iniquity, he might possibly have replied, "Do not tinker with development. In years to come, one with a backbone will call your attention to the fact that, 'in the long run, the will of the people is, for the people, better than that of the wisest individual. If we developed such eyes for you, they would not be of use, for what you saw with heat rays would be blurred, and ultra violet rays don't go very far. And besides, as regards X-rays, with the morality of the community in such a rudimentary state, I have serious objections to my neighbors being able to see when I have anything extra good to eat inside me. Consider our economical friend, the firefly, who serenely oblivious of the meterman's threats to turn off the gas, titillates at will his abdomen up to any desired candle-power, and go and do likewise."

But we have been a long time trying to do likewise.

How much the sky meant to our predecessors, we can never know. Sometimes a long stretch of camp life goes far to give one a faint conception and to make him realize, that as we have extended our knowledge, we have contracted our firmament. No one now looks up, and we have forgotten the array of the stars.

From resinous knot to the flame of burning oil cannot have been a far step, but for more than forty centuries (how much longer we do not know) we rested at this stage. And it is a wonderful thing to contemplate, that the generation now passing has been the first, since the world began, to be able to neglect the waxing and the waning of the moon. And since gas itself is merely a light hydro-carbon, of the same general nature as that used for lamps and candles, being thus rather an improvement in the means of distributing the material than a new method of lighting, we may say that it is only within the last twenty-five years that new methods of lighting have come into use.

These may be divided into the following classes, (not fundamentally, but merely for the purpose of dealing with them.)

First—Light produced by heat.

Second—Light produced by heat combined with chemical action.

Three—Light produced by chemical action.

To consider the advances already made, and which we may expect to be made in the first of these.

The evolution of the incandescent lamp was a labor so tremendous that no one man could have accomplished it. The method of obtaining a light by heating a wire or rod by the electric current was long unsuccessful. Then Crookes invented his methods of producing high vacua, and the method of leading in current through glass by means of pieces of platinum wire sealed into it. Sawyer showed that carbon, especially that produced from organic matter of a fibrous nature, was the best material for the filament. Then Maxim introduced the flashing process, and the incandescent lamp, *as a lamp*, was complete. It still was not, however, a commercial success, for the alternating current transformer not having been then perfected, there was no available means of using the lamps; they required too much copper in the mains, prohibitive in price, or else had to be worked in series, which led to other difficulties. But in the meantime Edison had discovered the correct principle of distribution, *i. e.*, to make lamps of high resistance and burn them in parallel. His filaments were at first made of metal wires, and in a number of public interviews, he stated that Sawyer, in using carbon, was on the wrong track. But the metal-wire lamp proved a failure, and incandescent lighting was finally brought to a practical form by a combination of the Crookes-Sawyer lamp and the Edison principle of distribution.

Since that time advance has been slow. The general adoption of Maxim's flashing process has considerably increased the life and efficiency, and the cost of manufacture has been greatly reduced, by systematized methods, the use of very fine platinum terminals, and, lately, by the adoption of my suggestion of using phosphorus vapor in exhausting the bulbs.

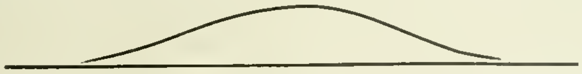
As to improvements to be expected in this line, one would be the use of much larger bulbs. The present bulb is absurdly small, and I have experimentally found that much better life and candle power can be obtained with large bulbs. It was for this reason that I suggested large-bulbed incandescent lamps as secondary standards, in the Standards of Light and Illumination Committee of 1893-4. It remains for some manufacturer to ascertain with what size of bulb the increase of cost of glass overbalances the gain in efficiency and life.

Another possible point of improvement would be the combination (not mixture) of the carbon filament with some substance which would give it a more decided emission band spectrum. Nichols has shown that carbon does not radiate as a purely black body, but has a maximum in the yellow. This is very fortunate. But possibly this maximum might be increased, by the addition of a slight amount of some other substance, (I say slight,) just as in color photography we change the position of the maximum absorbtion band by adding traces of dye stuffs. Suppose we make up, for example, a thio-cellulose, and then substitute in that compound traces of iron, or suppose we flash in an iron compound of gasoline. Theoretically there should not be any insuperable difficulty in manufacturing a compound of carbon, which should be nearly pure graphite, but yet have a strongly marked emission band.

It must, however, be a compound, and not simply a mixture. Simple mixtures, hundreds of which have been tried and patented, will be of no use, and, a priori, one would expect that the percentage of added substance should not exceed, at most, 1 or 2 per cent.

The coating of filaments with the rare earths cannot, I believe, yield any permanent increase of efficiency, for reasons given later. In 1891 I made a number of experiments for Mr. W. Stanley, at Pittsfield, coating filaments with Welsbach materials, but found, on making photometric and energy measurements, that there was no appreciable gain.

If we examine the spectrum of a black body, we find it something like this,



with a hump in the middle, and the position of this hump, and its size, varies with the temperature. Formulæ connecting the radiation with the temperature have been given by Stephan, Boltzmann, Wien, Planck, Rayleigh and others. Of course we cannot get an absolutely black body, but Kirchoff has shown that if we coat the interior of a sphere with any approximately black substance then the radiation from any small hole cut in the sphere will be of very nearly that of the ideally black body. Wien has extended this theory. If, however, the body be not spherical, but cylindrical, say, and the hole be not small, this will not be true. Theoretically the number of internal reflections, before passing out, must, for any given wave length, vary inversely as the absorption, so that if there is no absorption there is no ideally black emission. But practically all bodies have some absorption, so that by making the hole small enough, the rule holds. The rule, however, fails if there is any emission elsewhere than through the small hole, so that a thin tube with a hole cut in it would not obey the law even approximately, unless the hole was extremely small, or the absorption very great.

Both theory and experiment show that as we increase the temperature, the emission of any visible wave length of such a body increases. Consequently we must get as high a temperature as possible, within limits, for our incandescent lamp.

But carbon cannot be raised above a certain temperature. Consequently inventors have been seeking other substances. Many years ago Le Roux heated magnesia and similar materials, and then kept them at incandescence by passing a current through them. Later Jablochkoff used such rods, which he heated, either by passing high potential sparks over them, or else by heating them in a flame, or by coating them with a film of carbon. Other experimenters made similar lamps. heated by an arc, and one of these came into practical use for a time In 1890 I made some lamps by heating glass and passing a high potential current through it, giving a brightly incandescent ribbon of light in the glass, but they did not last, and the glass became opaque, presumably through electrolysis, and very brittle. Quite recently Nernst has revived the Le Roux lamp, heating it, however, in a slightly different method, *i. e.*, by radiation from an electrically-heated wire. This, however, has not yet been made a success, as the rods take too long to heat, and has been largely abandoned in favor of Le Roux's original method, but I have seen lamps of the Le Roux type which, lit by another method, worked practically instantaneously, *i. e.*, in but little over a second, and there is no doubt but that in a few years the Le Roux-Jablochkoff lamp will come into practical use. This. for two reasons—first that they permit of higher voltages, and hence more economical current distribution, and secondly, that owing to their much higher temperature, they are considerably more efficient. Still another type of Le Roux lamp, lit by smearing a thin film of some conducting substance, usually a grease-like compound of one of the rare earths, across the terminals, which gives off, on the current passing, a minute trace of pure water and vapor and carbonic oxide, and leaves a very thin film of the rare earth which acts to renew the surface of the pencil, has been tried with good results, and as it gives some light instantaneously, may possibly have a future. In any case, the Le Roux lamp has probably come to stay, and any remaining difficulties will no doubt be overcome soon, and our next most important advance in incandescent lighting will probably be in this direction.

The arc lamp may possibly be considered a pure heat lamp, for though there is some increase of luminosity when burning in air, yet this may not be due to chemical action, (except, of course, where the carbon is actually *burnt* in the air,) but to the effect of the presence of air on the passage of the current. Its temperature is apparently that of the vaporization of carbon, hence its efficiency is very high, but it varies somewhat with the carbon and has hence been found unsuitable for photometric standards. Practically very little advance has been made in this as a light producer, and in fact many of the old Thomson-Houston and Brush machines were running quite recently, and some are working even now. But the enclosed arc lamp, though much inferior as regards efficiency, is rapidly supplanting the old type, on account of its saving in cost of trimming and carbons, to be itself probably supplanted by the Le Roux lamp. Little or no further advance is to be expected in this direction, unless possibly (and indeed this is a rather promising field) by combining the carbons, as suggested in the case of incandescent lamps, with a small percentage of substance which will give a better emission spectrum. This is more promising, because the light of the arc is already too blue, whilst that of the incandescent lamp is too red, and it has been found easier to produce a low band in the spectrum than a high one.

Many experiments have been made on admixtures of substances, aside from combinations, with the carbons. Magnesia, for example, would be very beneficial, and has already been tried, but apparently the fact has not been appreciated that not all kinds of magnesia will do, as it is only when freshly prepared in a proper manner, that this substance has its great light-producing power. It, and similar solid substances are, however, barred, as the enclosed arc will be probably become the universal type, and such substances would cloud the globe.

Of vacuum tube lamps, many have been suggested. It must be nearly thirty years ago that the first attempt was made to light a mine with vacuum tubes and induction coils. Since then we have had many types, as, for example, Crookes' cathode bombardment lamp, and others which, surrounded by a cloud of non-luminous verbosity, have not done much actual illuminating. The only approach to success, of which the writer is aware, is the admirable work of Macfarlane. I know of no reason why his lamp should not ultimately prove a success for certain classes of work, where very long tubes and high potentials are not objectionable. In 1890 I made measurements on the efficiency of vacuum tube illumination, by passing the current a certain time, measuring the candle power of the tube, due to the light from the gas, and then dropping the whole tube into water. (I was fonder of glass blowing then than I am now.) From the energy put in, (for an ammeter I used a hot wire voltmeter, with silver instead of platinum; this is a good instrument for such work) the heating of the water, and the candle power, the efficiency was determined. It came out quite high, slightly less than 1 watt per candle-power. Most of the loss was found to be in the heating of the anode and cathode, and this it was attempted to overcome in two ways. First, by lengthening the tube, which gave good results, though not commercial, and secondly by making the gas itself the secondary of a transformer. This failed because of too great hysteresis loss in the iron, though one type was not so unpromising.

One trouble with such lamps has been the fact that in most cases they gave a line spectrum. Again, in many cases, where the spectrum was not line, but more or less banded or continuous, the character changed, after running for a time, to a line one. The cause of this is probably that connected with the theory suggested by J. J. Thomson to account for the continuous spectrum of his oxygen tubes, i. e., polymerization, the ability to polymerize being lost on continued heating. It is possible that some of the new gases would work much better in a Macfarlane tube. Helium, for example, at ordinary temperatures, will carry a spark about 30 times as far as air, but unfortunately is little, if any, better than lower pressures. I have sometimes thought that possibly an exact determination of the spectrum of the aurora and a subsequent search for the gas, if it is a gas, and not ice crystals, (improbable, though,) concerned in this phenomenon, in the results of the fractionization of liquid air might lead to a possibly valuable discovery. But, promising as the vacuum-tube lamp may be, it is probably not to be developed by any one man, however industrious, and as in the case of Crookes and the incandescent lamp, must wait for results obtained by workers along quite other lines.

Among combination, chemical and heat sources of illumination we may place the Welsbach lamp, acetylene and the magnesium lamp. This classification may be objected to. But I make use of it because, though there is no need of assuming, for example, in the Welsbach lamp, any peculiar catalytic action, the heat being sufficient, (even an ordinary candle flame is hot enough to melt platinum, in fine wire,) yet, as Nichols has shown, all such light-giving compounds, as zinc, oxide, magnesia, etc., fall off rapidly in their luminous emissive powers, and from this there seems to be but little doubt but that there is some chemical change taking place, and that, for instance, when magnesium wire is burnt, the greater part of the light is due to some change in the formation of the magnesia, for most kinds of magnesia have a different spectrum and do not give out so much light.

The magnesium lamp is at once barred out by reason of the solid products of its combustion. Acetylene is better, but I doubt if it has come to stay as an illuminant, though no doubt it will be used for some time in small towns. The Welsbach has now been so improved that its light is by no means disagreeable, and it is highly efficient. Unless important improvements are made in electric illumination in the near future, I look to see Welsbach lights, fed by fuel gas, this same gas piped into the houses for heating, largely supplant electric light and every other means of illumination in all cases *where economy is the prime consideration.* Were large fuel gas companies to be formed, its advantages, *i. e.*, only one set of pipes for fuel and light, and its extremely low cost, would be bound to drive everything else out of the field. And this is a danger which it is not at all unlikely the electrical companies will soon have to face, for the cheap production of fuel gas from bituminous coal cannot be many years in reaching a commercial development.

So far, no signs of light without heat, unless by the production of the absorbtion bands mentioned above. But coming now to chemical methods, is it not here that we must find the solution of our problem? Why should we electricians expect to be the light producers of the world? Must we not ultimately take as our proper sphere the production and transmission of energy for its various uses? This seems to be our natural field.

Though a few experiments had been made along this line, I never thoroughly realized the possibilities in this direction till my attention was called to them by Prof. Elihu Thomson. It was while discussing the present subject that he pointed out to me the fact that certain aldehydes could be oxidized at low temperatures, with luminous phenomena accompanying the process. This he considered a promising field, and his idea is certainly worthy of the very closest attention. Is it not in this direction that we must look for a solution of our problem? Since, according to the instructions I have received from our ever-esteemed editor, I am at a certain point to cloak myself with the mantle of the seer and to exercise a merely nominal suzerainty over my prophetic pen, let me obey at this point.

Can we imagine some worker, equipped with a prism spectroscope of great dispersion and still greater light-gathering power, himself a good organic chemist, to take up the work. He begins by taking photographs, after exposures possibly days long, (for here we have no diffusion from the sky to limit our time,) of the scores of light producing organisms, fireflies, glow worms, phosphorescent wood, etc. He determines the flutings of the emission bands and makes volumetric measurements of efficiency. He determines the effects of different gases, when combined with the light-producing matter, and notes how the bands are shifted. Possibly by observations on the Fiévez effect (obtained with great difficulty) he determines the approximate mass of the corpuscular groupings involved. Finally, from similar researches on the oxidation of inorganic substances, he finds that all such phenomena as, for example, the rusting of iron, the oxidation of magnesium, the oxidation of sugars to alcohol or vinegar, are accompanied by emission bands. By combination of other substances he finds out how to raise or lower the position of these bands so as to place them in the most efficient position of the spectrum. Finally he presents us with a crystal globe, which, hung from the ceiling, by the slow circulation of air through it, controlled by a valve at its lower end, becomes luminous to any desired extent and fills the room with a pleasant and stimulating perfume. And with slight changes of composition the materials in these softly-glowing globes are made to give us all the colors of the rainbow, or, thrown as dust far up into the air, to make a falling splendor such as we cannot now conceive.

The Steam Engine of To-Day

IN THE FIELD OF ELECTRICAL ENGINEERING PRACTICE.

By Dr. R. H. Thurston.

A "HISTORY of the Steam Engine," added to the International Series about a quarter of a century ago having attracted some attention, its author, the writer, was asked by the editor and founder of the then new periodical *The Electrical Engineer*, 1882, to furnish its readers with a summary of the principal features of the stationary engine of the time, especially as adaptable, or actually employed, for the special work of the electrical engineer in power and light distribution. In the series of articles running through the year 1883 which was prepared in response to that request, the endeavor was made to exhibit the evolution of the modern engine from its earliest beginnings, and especially, in its later stages, those forms of development which were particularly necessary to fit it for the impulsion of high-speed machinery like the dynamos then usually constructed. At the time, however, the distribution of power by the electric wire had hardly begun and the work of practitioners was substantially all in the department of electric lighting; the dynamo was usually of the bipolar type and its speed of revolution necessarily high. The day of large powers, for street railway purposes, and of the multipolar direct-connected dynamo had not then arrived, although it was just about to appear and the writer was even then gathering plans of direct-connected engines which were beginning to be built abroad, and especially in Germany. Those articles were later published in book-form, with accessions in successive editions, by the Messrs. Wiley.*

The editors of the Electrical World and Engineer, at the beginning of another quarter century, at the opening of the twentieth century, desire a statement of the progress in this field during the later period of development of prime movers for the dynamo-electric machinery of the day, exhibiting the modifications of construction and the economic applications which have marked the adaptation of the steam engine to the most recent developments of this now enormous and important as well as magnificently impressive industry. The earlier articles were intended to give a consistent, chronological and philosophical account of one of the most interesting scientific and mechanical evolutions that the world has seen, and one pregnant with a larger influence upon the world's progress than any other product of the inventive power and constructive talent of the race—one which has effected a greater advance in material civilization, and in all that is dependent upon progress in civilization, during a single century than had been observed in all preceding time. The present article has far less scope and can only briefly study and describe the culmination of that mighty progress as illustrated during the later years of the nineteenth century.

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* Stationary Steam Engines; N. Y., Wiley & Sons; Lond., Chapman & Hall.

Hero, or some older Greek mechanician, a hundred years and more before the Christian era, invented a steam turbine and a "steam fountain" and showed his contemporaries numerous applications of the powers of heat-energy and of the heat motors in crude forms. Then the world of mechanics stood still, or nearly so, for centuries. In 1600 to 1629, revivals of Hero's apparatus occurred, and, in the latter year, Branca invented, or at least published, a new form of steam turbine. Hero described the "reaction wheel," Branca the "impact turbine" actuated by steam. During that century the Marquis of Worcester and Captain Savery perfected Hero's steam fountain sufficiently to make it practically available for its primary work, the raising of water; but the opening of the seventeenth century saw the introduction of a new type and the evolution of the steam fountain practically ceased.*

Newcomen and Calley, in 1707, invented the steam engine, the train of mechanism familiar to engineers of the nineteenth century; the system of mechanisms consisting of a steam cylinder and piston converting the stored heat-energy of steam into useful mechanical energy and work and applying that energy and work to its appointed purpose through a distinct mechanism, a pump with its cylinder and piston or plunger, also completely differentiated from the driving mechanisms. They were the inventors of the steam engine as we know it, in the essential features and principles of construction which constitute it a distinct type, and Watt was the great refiner and improver—not the inventor of the modern steam engine, as he is usually thought to be by the popular mind and asserted to be by his biographers. Newcomen's engine exhibited the distinctive and fundamentally primary elements of the modern construction, and, as improved by Watt, it became suitable to do all the work of the world just as soon as he had brought it to the point of turning a shaft. The commencement of the nineteenth century found the modern world mover ready for any duty falling to it to perform; the inventors of the century found their task one of simple adaptation to specific and special tasks, or the improvement of the details of construction in such a manner as to secure a closer approximation of the real to the ideal heat motor. Thus, Sickles invented his detachable valve gear; Corliss and Greene and Wright and others modified it in such a manner as to permit the steam distribution to be made practically perfect, as illustrated by the indicator diagram; Porter and his companion genius, Allen, devised constructions making it capable of retaining the virtues of the contemporary low-speed engine while driving its shaft at a speed of 200 revolutions a minute and more; Stephenson fitted the machine to the locomotive; Fitch and Stevens and Fulton adapted it to steam navigation; Armington and Sims and their many successors redesigned it for use with the dynamo; Westinghouse and Willans brought out peculiar and original and valuable types for a similar purpose, as well as for general employment, and our own time has seen a great forward movement in the successful endeavor of our inventors and designers to meet the demand of the day for power on an enormously large scale, including adaptation of the engine to driving correspondingly immense dynamos of the multipolar type by special constructions of engine in units of several thousands of horse-power capacity each, grouped in single stations supplying 50,000 and 75,000 horse-power to hundreds of miles of street railway and operating half as many thousands of cars, employing current generated at as high as 6600 volts pressure and transmitted at 20,000 from generators of 3500 to 37000 kilowatts capacity at the former tension, and with a periodicity as low as 25 per second.

Meantime the scientific side of the engineer's problem has not been neglected. The progress of the development of what Hirn called the experimental theory of the steam engine has been important, but more in its application than in great results of experimental research. Numberless exact determinations of the quantity and rate of flow of the energies through the machine have been made by skilled investigators and in every field of employment of the motor; the chart of the steam from the boiler to and through the machine to the point of delivery has been laid down in admirable form by Sankey and our scientifically trained and carefully drilled graduates of the engineering colleges are constantly adapting their scientific learning and their laboratory methods to the purposes of the designing and constructing engineers, seeking guidance toward the goal pointed out a hundred years ago by James Watt, and are supplying new expressions for thermodynamic and thermal and dynamic law, and constants for the equations of energy, utilized and wasted, as dealt with in the heat motors and especially in the steam engine.

The limitations obstructing the application, literally and completely, of the principles of scientific theory in the design of the machine are now well recognized and to-day even the fundamental fact is admitted that the nature of the problem compels the engineer to subordinate everything in design and construction to the demands of the treasury and that the problem is, almost invariably: How shall the machine be designed, constructed and operated in order that the required quantity of power shall be delivered, continuously and with certainty, at minimum cost as shown in all the accounts on the treasurer's books? It is the acceptance of this latter principle by the engineer that marks the completion of his theory of the problem.

The practical corollary of this proposition is thus simple. It asserts that among costs of production of power is to be recognized, in its proper proportion and distribution, the capital account and its current fluctuations, principal and interest. This infers that every waste of energy and of capital—which is, in fact, energy, potential energy, stored energy—is to be studied and reduction of waste is to be effected down to a limit at which the costs of further reduction will be greater, in sum of all accounts, than the additional saving; while increased efficiency is to be secured in every direction possible up to a limit at which the further gain is compensated by equal added cost. It has come to be recognized that the older method of constructing specifications, which called for a certain maximum practicable "duty" of engine and minimum practicable consumption of fuel, was wrong and often the source of enormously costly financial errors; the true system being that which specifies that the stipulated amount of power shall be supplied at a certain minimum cost per unit, on *all* accounts, capital, running expense, insurance and all other accounts aggregating on the treasurer's books and chargeable to that power account. It is now known and is recognized by all intelligent and well-informed engineers, whether designing, constructing, purchasing or operating motors, that concentration of power into small space, weight and costs, is the task set for all, and that the ultimate gauge of success is the outgo on all accounts per unit of power supplied. This has made the compound engine standard where otherwise the triple-expansion machine would have been adopted, and has dictated smaller cylinders and lower ratios of total expansion, often very much reduced, as compared with the proportions derived by a study of the duty problem alone. It is seen that it often happens that we cannot afford to pay for increased efficiencies and economies of fuel consumption, whether at engine or boiler. Exact methods are familiar to the well-informed engineer which enable him to determine precisely what proportions of boiler and what type and size of engine he can best adopt in solution of the financial problem under specified conditions and in stated localities, the market being known. The interests of the client, not the inclinations of the designer, have come to be studied and secured; or, rather, the purpose of the engineer is identical in source with the best interests of his client. Rivalry in increasing "duties" of *fuel* is coming to be superseded by rivalry in seeking increased "duties" of *capital.*

Finally, the new century opens with some indications that we may be about to see, in some directions at least, a tendency to what the biologist calls "atavism," a recurrence to earlier types, and, in this case, with a possible permanent change in the line of progress of the last century. The steam turbine, the toy of early centuries and never before seriously entering the field, is revived, and with its absolute limit in simplicity and low cost of construction and its closest approximation to the thermodynamic ideal, it seems likely to find place in the market, even if it does not ultimately, as perfection proceeds, permanently displace some forms of standard heat motors of our time. It is suited for use with any possible steam pressure that our boilers can supply; it can usefully employ as highly superheated steam as our materials of construction can bear; it is a motor of maximum thermodynamic efficiency and of already high actual economy of both fuel and funds, and, once the difficulties coming of its necessarily high speed of rotation, as now constructed, can be overcome, its extensive employment with corresponding displacement of its comparatively enormously complicated and costly rival, the reciprocating engine, is assured. It offers us one of the most seductive problems of the new century.

In practice, the steam boiler has come to be in increasing proportion a water-tube steam generator, partly on the always familiar ground of safety against disastrous explosions, largely of late because of the greater ease with which it can be adapted to the requirements of modern high-pressure practice. It is now supplied without hesitation for a pressure of 225 pounds by gauge, and can be furnished as a special construction for much higher tensions. A pressure of 175 pounds per square inch by gauge may be to-day considered as well accepted a standard for advanced construction as was 125 lbs. 25 years ago, or as was 50 lbs. at the middle of the century, and 10 or 15 lbs. at its beginning. It is to-day a steel boiler; and here, as in all other departments of engineering, iron is coming to be a rejected material and seems likely ere long to become unknown.

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* The steam fountain was later improved by Hall and, under the designation of the "pulsometer," is still doing an important work where simplicity of construction and portability are more important than economy in operation.

Superheating is once more coming into use, the adoption of high-temperature mineral oils for cylinder lubrication doing away with the difficulties of utilization of moderate degrees of superheat in the engine, and various constructions of superheater proving comparatively satisfactory at the boiler. Something still remains to be accomplished to insure safety and durability in this apparatus; but in Europe, where superheating has persisted continuously from earlier days, and in the United States and Great Britain, where it has for many years been almost unknown, alike, success seems promised soon, if not already attained, in this essential element of economical steam-engine operation. This practice has probably returned to stay with us.

There have been no important changes in general practice and design in the construction of valve gearing. The Corliss and other earlier devices appear to meet all requirements. The only changes of late have been in the adaptation of certain types, old in themselves, but new in this field, to this line of power development. Thus, the vertical marine type of engine has secured a footing in electric light and power station work, and, provided with a good system of regulation and proportioned directly to its environment, it has come to be the most usual form for large powers in all our great stations, although European constructors seem to continue to employ the older type of horizontal engine for such work, even up to the largest powers. At the Paris Exposition of 1900, for example, the foreign builders exhibited a large proportion of engines of the older types in all the sections devoted to light and power distribution, while practically all the later contracts in the United States for large stations include contracts for the vertical engine in units of several thousand horse-power each. Regulation is effected by the shaft governor wherever the speed of revolution permits and usually by the loaded governor of the Porter type and Corliss gear in other cases. No marked change is observable in this direction since the earlier date when the subject was discussed in the columns of the pioneer journal. The changes brought about in the interval have been mainly at the engine in the adaptation of the machine to the delivery of larger quantities of work from the single unit at minimum cost and with uniformity of current and tension at the dynamo.

In illustration of this later practice it is well to compare the condition of the steam engine industry at the beginning of the era of transmission of light and power electric currents with the industry of to-day, the changes of a quarter of a century or less. Then the stationary engine was usually a Corliss, a Greene or some equivalent form, operating under 60 to 75 lbs. of steam, a horizontal engine, with a maximum speed of about 60 revolutions and a speed of piston of about 450 ft. a minute, regulated by a fly-ball governor and consuming about 2½ or 3 lbs. of good fuel, 20 to 25 lbs. of steam, when condensing, per horse-power-hour. The boiler was a plain low-pressure fire-tube construction, but it was as economical a steam producer as the boiler of to-day. The dynamo was usually of the two-pole type, delivering a continuous current at low voltage and with some uncertainty as to steadiness of operation, and was belted to the engine. The "plant" occupied large floor area, extensive bunker capacity was required, and costs of current were what would be to-day thought very large in the then largest stations, and most extravagant in smaller plants. The tendency to force economy in all departments coming of the competition which always marks the introduction of new and important advances in the industries, especially in this country, calling for higher steam pressures, safer boilers, more economical engines, generators for high tension, and especially the high pressure practice coming in with the alternating current, have forced a revolution in engine construction and operation, as in every other department of the business. Steam pressure, for a long time held by the builder of boilers and by the conservatism of users at about 125 lbs. as a maximum, suddenly broke over its earlier bounds, and 150, 175, and, of late, 180 and 200 lbs. pressure have come to be accepted as good practice, while engine speeds have increased and speeds of piston have risen to 600 and 750 ft. per minute; economy has been gained until 15 lbs. of steam per ihp per hour, and 1½ to 2 lbs. of fuel are as usual as were twice those figures 25 years ago. A total cost of as little as $10 to $12 per horse-power per annum is now sometimes reported from the modern engine room. Regulation, formerly thought good when variations from the mean did not exceed 2 or 3 per cent, was brought, by improved governors and adjustments, especially with the "shaft governor" and inertia effects, to 1 per cent variation; high speeds of rotation permitted the variation within the revolution to be made imperceptible with moderate weights of fly-wheel, an essential in alternating current work.

The law of this progress and the record of its achievements cannot be given in detail in a short study like this, but, fortunately, graphical methods of exhibition of these changes may be made to tell, in a single line, often, more than pages of description and historical disquisition. It is known that the gain by increasing pressures, *properly utilized*, should be proportional nearly to the logarithms of the pressures employed. Thus, the consumption of steam and fuel should be measured by some such function as $W = a / \log p$; where a is a constant derived from study of current practice and is equal to about 30 lbs. for good work in engines adapted to the pressure.

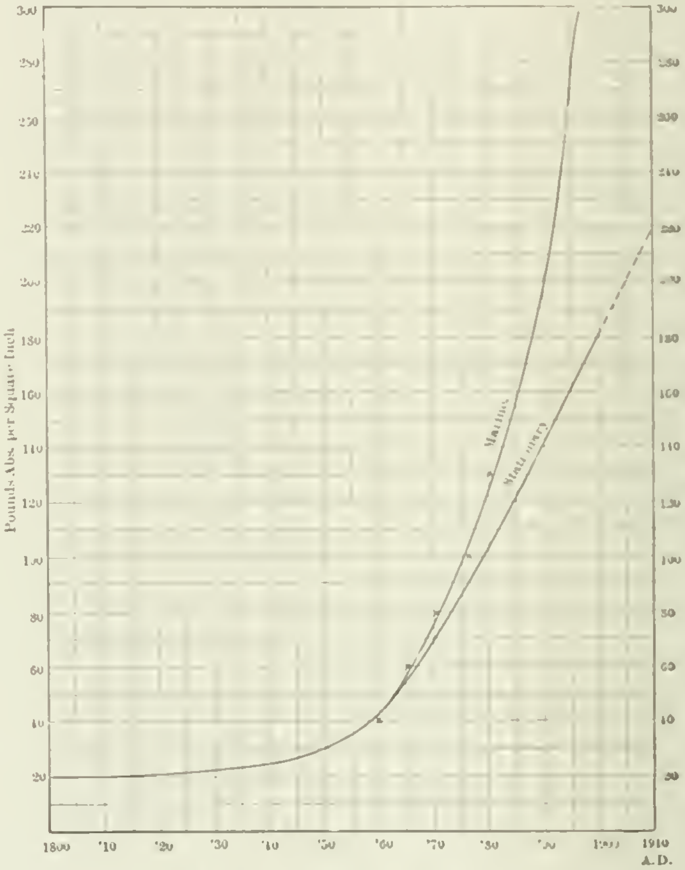

FIG. 1.—RISE IN STEAM PRESSURES, 1800-1900.

The accompanying diagram shows the progress in rising pressures, through the century, for marine and for stationary work by recognized leaders in the business of engine construction, and it is seen that the progress of the past two decades, the period with which we are especially interested at the moment, is about, as shown on the chart, from 90 to 180 lbs., just doubling, and with promise of rising to 220 in the next few years, although probably no one would be surprised, now that boilers may be had for practically any pressure likely to be desired, to see a more rapid rise to the height and growth observed in marine practice of the most radical sort as exhibited in the companion curve. The rise in economy, as measured above by weights of steam, or thousands of B. T. U. per ihp per hour, would thus be as follows:

RISE IN ECONOMY.

Pressures	100	200	300	500	1000
Expansions	15	30	45	75	150
Steam or B. T. U. per ihp	13-15	11-13	10-11	9-10	8-9

In the rise from 90 to 180, or from say 100 to 200 lbs., absolute, the gain should be expected to be about 15 per cent from this cause alone. Accessions of efficiency due other improvements, as the more general and intelligent use of the multiple-cylinder engine, the employment of superheating, reheating, condensation and the principles of finance have conspired to effect gains which cannot be so well illustrated as the above.

The next diagram, however, in which gains are exhibited as measured by the "duty" attained—work per 100 lbs. of fuel—and by B. T. U. per horse-power-hour, may aid the mind in the endeavor to perceive what has been accomplished. The last decades have raised the duty from about 120,000,000 to 160,000,000 foot-pounds per 100 lbs. fuel of best grade and with best engines under most favorable conditions, while the heat consumption has correspondingly dropped from 15,000 to 11,000 B. T. U., or from about 15 to about 11 lbs. of dry steam per ihp per hour. The thermal wastes have, meantime and complementarily, fallen off from their amounts two decades ago in full proportion.* The two sets of figures also exhibit the difference between good and the best work.

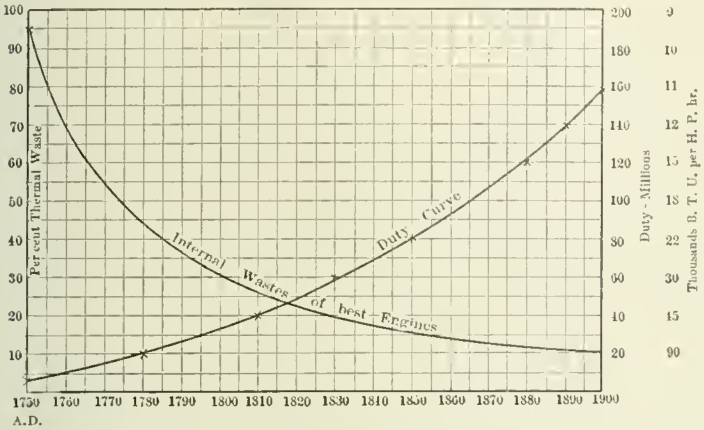

FIG. 2.—PROGRESS IN STEAM ENGINE EFFICIENCY.

The twentieth century comes in with threatenings of a possible new catastrophic break in the line of progress. The steam turbine, the steam engine of "maximum simplicity and of highest thermal efficiency,"† in its ideal, at least, is now rapidly coming into sight, and its principles of design and construction are as rapidly becoming recognized. Its promoters are confident that it is to find some extensive and important place, displacing the reciprocating engine, and its first and most successful market has been found in the field of electrical engineering.

Still another possible break in the smooth curves of progress of the century, to date, is seen as a coming event by some authorities: the replacement of the steam engine by the gas engine, already successful in many fields and on a small scale, now beginning to perform larger tasks, to deliver hundreds of horse-power and to meet every requirement of the engineer, scientific and practical, successfully, including that of finance.

As illustrating the best work of the century and its progress through a hundred years of invention and of evolution of its scientific foundations, the following table may be studied in comparison with the diagrams of duty and efficiency already given and the figures earlier supplied. They may be taken as exhibiting the best work of the nineteenth century and the figures with which we enter upon the twentieth. They are largely pumping-engine records, as in that field the load is practically always constant and conditions are steadily those which permit best work, but the stationary engine for factory and power plant and electric lighting work, if not attaining these figures in regular and usual operation, may at least be made to approach them under the most favorable conditions of mean load.‡

The world's records are better shown diagrammatically, in illustration of their real value, actual and comparative, by entering them as data upon a diagram exhibiting the method of variation of efficiency with increase of steam pressure as in the next figure. Here the co-ordinates are steam pressures and heat consumption and the curves are logarithmic, exhibiting the graphic reproductions of the logarithmic equation of efficiency, as already written, with differing constants. The curve corresponding to minimum values of the constant and of the abscissas is the curve of efficiency of the ideal, purely thermodynamic machine, with rising pressures as measured by heat consumption. That at the extreme right is the curve corresponding fairly well to the actual reported performance of the average simple engine of moderate size and good construction, while the intermediate curves correspond to cases illustrated by multiple cylinder engines, with varying steam pressures under favorable conditions otherwise. The data entered on the diagram in form of crosses distributed over half the full area of the plate are the records of the world's "record breakers" of the last decade.*

MINIMUM STEAM CONSUMPTION, 1900.

End of the XIXth Century. Best Records.

	I.H.P.	Steam Pressure	Speed of Piston. Feet per Minute.	Per I.H.P. per Hour. Pounds Limited.	B.T.U.	Foot-Pounds Duty per 1,000,000 B.T.U.
Simple Engine.						
Sulzer	284	87	372	18.4	20,250	88,000,000
Corliss	137	62	...	17.5	19,250	92,630,000
Compound.						
Dujardin	548	90	570	13.46	14,800	120,400,000
Sulzer	247	85	493	13.35	14,700	121,100,000
Wheelock	590	160	612	12.84	14,100	126,400,000
McIntosh & Seymour	1,076	125	800	12.76	13,000	137,000,000
Leavitt	643	135	371	12.16	13,400	133,000,000
Triple Expansion.						
Sulzer	615	141	516	11.85	13,000	137,000,000
Reynolds	574	120	203	11.68	13,056	140,817,000
Leavitt	576	185	240	11.22	12,242	141,855,000
Snow	773	156	215	11.26	.....	150,100,000
Quadruple.						
Hall & Treat.....	16	300 400 500	220	10.80 9.65 9.75	13,500	132,000,000
Nordberg	712	200	250	12.26	11,158	162,948,824

It is seen at a glance that the simple engine has been made to give a better performance than that indicated by the curve set as its criterion, while the compound engine does relatively better, thus tested, than the triple. The quadruple has not yet reached its standard line. The compound engine, in other words, is the most perfected of all the types, and in one case at least ranges in actual value directly beside the best quadruple, allowance being made, as here, for difference due variation of steam pressure.

Financial rather than thermodynamic considerations, however, control, and properly, the design of every steam engine as of every other construction in the whole realm of the industries and of industrial engineering, and it is by no means the fact that the best engine, from the thermodynamic point of view, is the best engine from the standpoint of either the engineer or his client. The latter is compelled to measure efficiency by the amount of power delivered for his special purposes and usefully applied per unit of total operating costs, including all interest accounts. This fact makes it often advisable to design, to construct and to use an engine of very different proportions from that which would be employed where, as is so usual for pumping engine construction for public works, specifications are written from the point of view of the coal pile alone. This fact is well exhibited in the accompanying diagram which the writer devised and has been accustomed to use in illustration and enforcement of this principle.

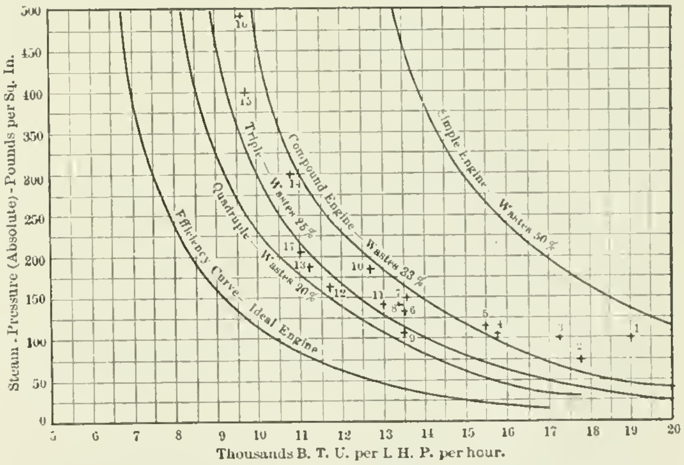

FIG. 3.—PERFORMANCE OF BEST TYPES OF ENGINE.—1900.

1, Simple. 2, Simple. 3, Compound, 3 to 1. 4, Compound, 3 to 1. 5, Compound, 7 to 1. 6, Compound, 7 to 1. 7, Triple. 8, Triple. 9, Compound. 10, Compound, 7 to 1. 11, Triple. 12, Triple. 13, Compound. 14, 15, 16, Quadruple. 17, Quadruple.

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* Promise and Potency of High Pressure Steam; R.H.T.-Trans. A.S.M.E.; No. DCCXVIII., Dec., 1896; Vol. XVIII., 1896. Pages 160-218. Also, Thurston's Manual of the Steam Engine, Vol. I., 1900.

† The Steam Turbine. R.H.T.-Trans. A.S.M.E., Dec., 1900.

‡ The Steam-Engine at the Close of the XIXth Century, R. H. T.; Trans. A. S. M. E., No. 832; Dec. 1899; Vol. XXI., pp. 181-241. Also: Thurston's Manual of the Steam-Engine, Volume I., Chap. IX., 1900.

* The Steam Engine at the End of the Nineteenth Century; R.H.T.-Trans. A.S.M.E., No. 832, Dec., 1899; Vol. XXI., pp. 181-241. Manual of the Steam Engine, Vol. I., Chap. IX., 1900.

Here the coordinates are heat, consumptions per unit of power and of time as ordinates, and the ratios of expansion at which such economies are measured as abscissas, the latter thus constituting the measure employed as a criterion for this case. The lowest line is the ideal curve of variation of efficiency with varying ratio of expansion for an assumed case taken as typical, as, for example, at 100 lbs. initial gauge pressure. The gain in economy is progressive and without limit until, outside the figure, the expansion line intersects the back pressure line. The second curve, directly above, marked friction, shows the modification of efficiency due the increasing proportion of waste by friction, which efficiency has a limit at the point, also outside the diagram, at which the expansion line intersects the line of which the ordinate is the sum of back pressure and the friction resistance, both measured in pounds per square inch of piston area.

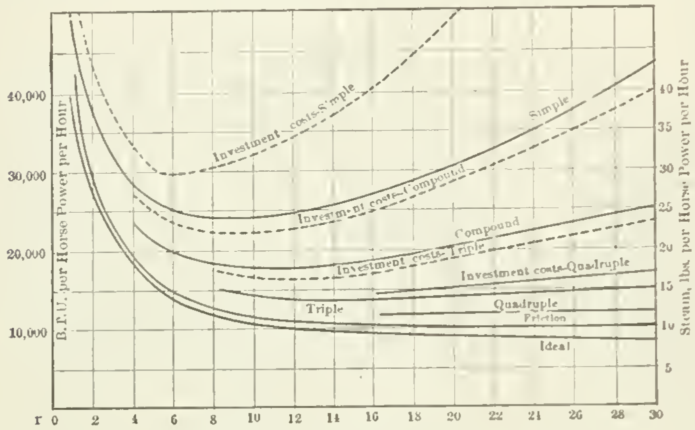

FIG. 4.—COMPARATIVE EFFICIENCY OF ENGINES.

The curve marked simple is that of the varying efficiency of the single-cylinder engine in the actual case, in which the wastes due internal cylinder condensation are added to the friction loss and the ordinates are thus measured of the cost in heat and steam per horsepower per hour for the case taken, which costs find a limit with progressing expansion, at the point at which further expansion would increase wastes by friction and condensation faster than gains by further expansion of the steam behind the piston. In this case this point was found at about eight expansions. On the curve for the compound engine, in which the internal wastes are assumed to be reduced to one-half those of the simple engine, a similar limit is discovered at between 10 and 12, while a limit for the triple-expansion engine appears at a ratio of expansion not far from 16 or 18, and for the quadruple at about 20.

When we add the investment costs and various incidental expenses, reduced to equivalent measures of heat and steam, the above ratios of expansion become restricted, as seen, in this instance, to 5 or 6 for the simple, to 8 to 10 for the compound, to about 12 for the triple and to about 16 for the quadruple machine. Every engine thus has one best ratio of expansion and corresponding suitable "rated power,"which figures must be identified for that engine under the particular financial conditions of its proposed use if the engineer is to make his task a properly fruitful one, and if his client is to profit in maximum degree by his work and by his investment in a power plant. It should be further noted that this problem involves an earlier and equally essential investigation to determine the best proportions of the boiler which supplies the steam.*

Summarizing what has been here collated regarding the progress of the last decades of the nineteenth century and the position of the great motor at the commencement of the twentieth century, it is seen:

1. That steam pressures have risen until double those usual two decades ago, and meantime the water-tube boilers, of which the writer said a generation ago:† "Their use will become general to the exclusion of the older and more dangerous forms of boiler," have come in to meet the demand for safe, compact and economical steam supply in large quantity and under peculiar conditions. About 180 lbs. is now standard, 200 in sight. The limitation at the boiler is disappearing.

2. The ratio of expansion adopted in the engine has risen in magnitude with increasing pressures and has now come to be intelligently limited at that value at which variation either way would reduce dividends on the capital employed in conjunction with the steam plant, averaging a figure giving a terminal pressure of 10 or 20, with or without condensation.

3. The speeds of piston and of rotation have been slowly increasing in compliance with the demands for greater efficiency, thermal and mechanical, and for reduced volume, weight and cost, which elements of design were first completely defined by Charles T. Porter forty years ago. Standard speeds rise to nearly 1000 ft. and to 125 revolutions and upward in large powers.

4. The demand for steam power in electric light and power plants has led to the permanent and general employment in small sizes of the engine advocated by Porter, as a class, with, however, a shaft, governor controlling its positive-motion valve-gear, a compact and strong construction with high speed of piston and of rotation and exceedingly fine regulation. For large powers the engine has come to be very generally a vertical direct connected machine, with Corliss or Greene or equivalent steam distribution and regulated by a loaded governor and operated at a speed of piston exceeding 600 feet a minute and at somewhere about 100 revolutions a minute. The stroke is usually shorter in proportion to diameter of cylinder than formerly.

Finally: The steam turbine seems to have passed its experimental stage and to have found permanent place in the work of power production. The gas engine is coming forward as a rival of the steam engine.

5. The scientific principles of the thermal, dynamic and thermodynamic action of the engine, which control its energy transmission and transformation, have come to be well understood, not only by the man of science but also by the designing engineer, and science and art, theory and practice now unite intelligently to produce the modern power plant, developing any stated amount of power at the boiler and at the engine with maximum total efficiency. These principles are now taught in every technical school of any pretensions to high standing and are thus learned by the new generation of practitioners in engineering at the very threshold of their offices. Professional education and training now underlie all engineering.

6. The limitations of the pure theory by the actual conditions controlling in practice are now recognized, and for the first time the designing engineers of the country are adapting the engine to the requirement that it shall illustrate a maximum *total* efficiency.

7. The requirements of a sound financial basis of construction have come to be seen clearly, and by some designers definitely incorporated into their constructions. The one obstacle in this direction of improvement is the inclination of designer, constructor and user alike to adopt specifications calling for a maximum "duty" in fuel consumption rather than in consumption of capital and its earnings.

8. All the details and accessories of the steam engine have come to be similarly perfected by the conjoint application of the principles of science, thermal and dynamic as well as thermodynamic, and of finance and practical business, in the endeavor to secure a complete design that shall at once illustrate exact methods of design and proportion, good construction and well-chosen materials and the precise adaptation of the whole and of its every element to the fundamental purpose—the production of a stated amount of power with regularity and certainty and exact adaptation to load and in such manner as will in largest degree promote the production of dividends.

The outlook is exceedingly promising and the twentieth century opens full of interest and full of hope for the world of engineering as well as for all good citizens. While we have made little progress as yet, so far as can be seen, toward that ideal of all engineers familiar with energy transformations and uses, the direct transformation of the potential energy in our coal beds into mechanical power, or toward the storage and utilization of the radiated energy of the sun's rays—both essential to the prolongation of the life of the race in the temperate regions and on the earth—we have certainly reached a point far in advance of the best of a century ago, or even a generation ago. But we have apparently perfected the standard forms of steam engine so far that we cannot expect much or rapid progress later; we have reached a point at which the gas engine is threatening to rival the product of the genius of Newcomen, Watt and Corliss; we have come to a perfection of regulation of the contemporary machine which even permits alternating machinery to be operated in parallel when the specifications demand, as is now the fact, that the variation between the pairs shall not exceed 1-60th the angle between two successive poles and the variation in speed in successive revolutions, invisible to the eye, is less than one revolution per minute; we have brought the steam turbine, apparently ideal in this last respect, to nearly the efficiency of the best of the alternating engines;* we have brought the gas engine to a consumption of fuel approximately a pound, sometimes even less, of good fuel per horse-power-hour; we have, in summary, reached a point at which the engineer has opportunity to once more use his inventive powers in the production of new types of heat engine and in their perfection in the devising of new methods of energy transformation, in the substitution of new heat engines for old and in the supplanting of *all* thermodynamic engines by other forms capable of an ideal efficiency of unity, as in electro dynamic transformations.

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* Manual of the Steam Engine; Vol. I., Chap. IX.

† Report of American Institute Boiler Trials, 1871; Trans. Am. Inst., 1872; Jour. Frank. Inst., 1872.

There was never a time in the history of the world when civilized man had better cause for confidence. Assuming that the craze for extension of territory among nations and the tendency toward demagoguery in self-governing countries shall soon have died out, and that all nations then will be permitted to give their entire energies to their own internal development and improvement, as have our own people during the recent period to which we have given especial attention, the "Trend of Progress"† (Fig. 5) undoubtedly is toward rapid evolution of all desirable advances in the arts, in the condition of the world and in the character and virtues of our people. And in no material department of the world's progress is there a larger opportunity for the live man, with suitable preparation for a professional career, whether in invention, design or construction and exchange, than in the field of electrical engineering practice and in the further perfection of the steam engine and its rivals, of the mechanisms for transformation of energies in the supply of the motive power of the industrial world.

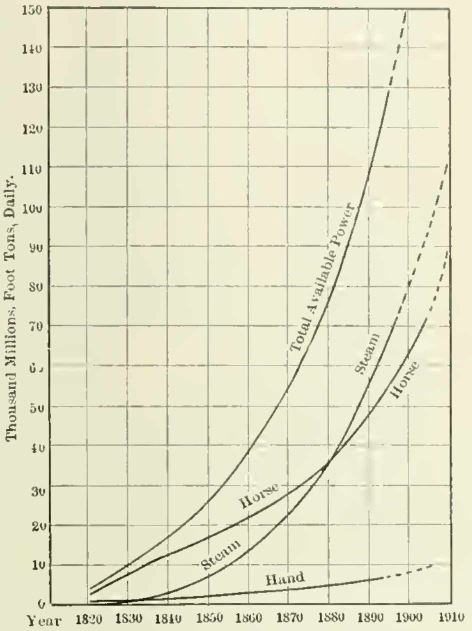

FIG. 5.—AVAILABLE POWER IN THE UNITED STATES.

Centennial Reflections.

The general public have but a limited understanding of the great growth already attained by the industries devoted to the practical application of electricity and the enormous development of which they are capable.—Henry Villard.

All the elements whose aid man calls in will some time become his masters, especially those of most subtle force. Shall he, then, renounce steam, fire and electricity, or shall he learn to deal with them?—Emerson.

If the army of would-be inventors could enter the field with a full knowledge of what science has already done, the conquest of new territory would be still more rapidly accomplished, and not a few of those whose names would be remembered would be found to have come up from the utilitarian ranks.—Prof. W. A. Anthony.

The mechanic well knows that absolute truth is unattainable, but he nevertheless values highly the approximation to truth which allows him approximately to ascertain the result of given simple material combinations.—Fleeming Jenkin.

The great names in connection with our progress in knowledge as to the real nature of electricity, irrespective of a mere study and extension of its known facts, are Franklin, Cavendish, Faraday and Maxwell.—Oliver J. Lodge.

Electricity is subject to laws as definite and invariable as those which govern the mechanical motions of the planetary system.—Joseph Henry.

Electrical Power Transmission.

By Dr. Louis Bell.

The art of electrical power transmission is so recent in its origin that howsoever one looks at it one sees only a fragment of the past and a substantial present, without one certain glimpse of the future. It is as if one were set down in a street of a strange city with a few dingy blocks visible behind him, solid and even beautiful structures around him, and a turn in the street just ahead. What is beyond it can only be told when the corner is rounded—whether stately piles of steadily increasing grandeur or the grim abutments of the city wall. The stream of hurrying citizens moving onward suggests the former—if we only knew how far they were going.

It is less than a decade since electrical power transmission could fairly be called an art by itself, even though the first attempts date back a little further and some of the pioneering work had already been done, and well done. It was really the Frankfort-Lauffen demonstration that more than any other one thing gave the impulse that has carried the work along. It was a daring conception, cleverly and successfully carried out. Two years passed before the first commercial polyphase distribution plant was put into operation in this country, although some isolated plants were started within a shorter period, but, once initiated, the work went on with a rapidity which has been unexampled even in the swiftly written history of electrical progress. The distances covered have grown from a few miles to more than eighty, and the voltages have jumped from a few thousand to the tremendous figure of forty thousand volts. In this connection must not be forgotten the wholesome influence of the early lighting plant at Pomona, which, small though it was, and devoid of any permanent influence in its constructional features, yet rendered important service to the art in that the fearless use of 10,000 volts stiffened the backs of American engineers for the more serious work that was soon to come. Once the fear of high voltage was allayed, the work of development was rendered vastly easier than before, and it became practicable to attempt distances great enough to increase enormously the number of available sources of power. The outcome has been a complete and radical change in the methods and aims of hydraulic development. Up to this period factories had to come to the power; now the power comes to them, so that the conditions of general growth are not cramped by the necessity of utilizing locations undesirable save as regards power supply. It is hard to estimate the economic value of this change, but it is assuredly very great.

At the present time, to speak by the card, it can be considered with entire propriety that with favorable conditions as regards market, power can be electrically transmitted as a commercial proposition for distances of a hundred miles and upwards. In general, such a transmission over 20 or 30 miles can be made to pay in most sections of the country if cheap water power can be secured as the primary source of energy. There is some danger that the possibility of easy power transmission may serve to put a fictitious value on undeveloped powers that may lead to checking temporarily their utilization. Methods of transmission have settled for the most part into a few well-defined channels, and the engineering features of the work are little to be feared.

The generators, always polyphase, may be of any of the species of that genus, but the line is practically always three-phase. For moderate distances of transmission high voltage generators have come into very extensive use for sound reasons of economy, but whenever it is desirable to use 15,000 volts or more upon the line, recourse is usually taken to raising transformers. The frequency, after much violent and acrimonious debate, has usually settled down to 60 ~ for ordinary transmission work, with a tendency to lower alternations for very long distances and for special motor work. The line voltage is busily chasing a limiting value, with some good chances for catching it, although the hunt is by no means over. Line insulation, once feared, has not proved a serious matter, in view of the constant improvements in material; and the dubious question of climatic conditions as bearing upon the maintenance of line insulation has found a favorable answer. Line pressures of 10,000 to 15,000 volts are carried in the severest climates to be found in the United States with such complete freedom from any difficulties chargeable to weather that it is safe to say that these voltages will be much exceeded in the future. Inductance and capacity effects, once dreaded, have been shown to be more controllable and far less generally serious than had been supposed. So much for a brief outline of the present condition of things without going in detail into methods or the characteristics of existing commercial plants.

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* The Steam Turbine.—R. H. T., Trans. A. S. M. E., 1900.

† The Trend of National Progress.—R. H. T., N. A. Rev., 1895.

Perhaps the most striking thing about it all is the remarkable fact that the whole development has been by swift and steady progress without failures or retrogression. It rarely happens that such rapid advance is not accompanied by serious and costly blunders, but throughout the growth of modern power transmission there has been wonderful exemption from such evil chances.

And now for the future—what may it reasonably be expected to bring forth, and in what wonder-working may it have a part? At present, power transmission is showing a tendency to settle into well-defined lines of engineering. The apparatus is every year bigger and better, and the voltage of transmission is steadily rising toward the limit at which the dialectric strength of air seems to fail. What is there beyond? Are we to grow along these lines, or are new methods to be disclosed? For one, I see no reason to expect any very radical changes for some time to come. The oft-repeated prophecy that the power transmission line of the future will be underground, rendered perfect by some strange and occult method of insulation, I see no reason whatever for regarding as anything but a dream. There is not one thing in the present state of the art to hint at it, and on general principles it is a thing to be dreaded. It is a sufficient task to keep fifty or a hundred miles of line in order even when every inch of it is in easy view, and a tithe of the expense of putting it under ground would clear it of most of the dangers which now beset it. It increases the difficulty of repairs a hundredfold to have the conductors out of sight. The whole matter stands in a position entirely different from that of the distributing circuits, where the wiring may have to be somewhat complicated and is likely to be greatly interfered with in many ways. In some places it may be necessary or desirable to put a transmission line under ground, but until there is a complete revolution in our methods of insulation and a complete upheaval in the cost of material, underground work at modern high voltages should be shunned like a pestilence. Transmission of energy without wires in any considerable quantities seems equally to belong in the category of the commercially improbable. As a mere engineering feat one might accomplish something along this line, but any scheme that utilizes earth or air as part of its transmitting system is certain to involve not only enormous and probably insurmountable difficulties in the way of directive action, but commercial and legal difficulties that are practically even more formidable. Even so simple and feasible an operation as working a simple alternating circuit at 100,000 volts or so over one wire and the earth would start a current of litigation truly wonderful to contemplate.

On the other hand, there are likely to be enormous advances in power transmission over paths which are already laid down on the map. It seems quite possible that the present limit of voltage may be greatly exceeded by the very simple process of separating the wires, even if they have to be put on separate pole lines. It is safe to say that without any revolution in general methods the cost of the conductor can be so far decreased that it will have little importance as a limiting factor in commercial work. It must be remembered that most transmission is from natural sources of energy and that these are so distributed that it does not take any great increase in the radii of action already established to bring such sources into competition with each other instead of into competition with fuel. Competition in electrically transmitted power is not unknown even now, and until the general demand for power is far greater than now such competition will have to be reckoned with. The effect of improvements will be to utilize the water powers of the country to the fullest extent of the demand for power, and this can be done without any immense influx of new methods in the art. It is my judgment, too, that there will be very great advances made in the direction of power transmitted directly from coal mines. At present the sole example of such practice on a considerable scale is that for the mines of the Witswaterrand. But that is only the begnning. One can, without a great stretch of the imagination, picture a mine of low grade coal as the coal bunker of a future power house, with the fuel taken direct from the breakers to the furnaces by mechanical stokers, with 10,000 or 20,000-hp steam turbines directly coupled to the generators, delivering power at a cost so low as to compete on favorable terms with all but the cheapest water powers.

If one traces the cost of a ton of coal back to the mine, it is astonishing to see how little of the current price is chargeable to the fuel itself and how much is taken up by transportation and by the profits of combinations and middlemen of various degrees who exist only by the strange, long-suffering sluggishness of the public that is their prey. Some day the worm will turn and there will be an era of startling developments. At present the price of fuel is moving steadily upward, and while the world's stock is yet far from being depleted, it is certain that the tendency is such as to make methods of conservation of vast industrial importance. And we must not forget that our water powers also are threatened. If the policy, reckless and destructive, of the past half century is carried on much longer, the availability of our water powers will be greatly lessened. All this points to the growth of power transmission from coal mines as a most important matter, tending to lessen the depletion of the coal supply and to supplement the failing water powers.

It is safe to say that such transmission will greatly modify existing conditions in cities. There is even now no logical reason why a pound of coal should ever be burned in a city unless for heating purposes. So far as power is concerned, transmission on a large scale from water power or coal mines can solve the whole problem of industrial power, and gas for heating can be piped to do the rest. One huge coking plant providing fuel gas and utilizing the coke *in situ* for the development of electric power would work a transformation in New York, Philadelphia or Chicago that the mind can hardly grasp as yet. Production of all the material for heating, power and light on such a colossal scale would greatly economize the consumption of fuel for the required work. And all this is no dream, calling out of the unknown strange new forces and occult methods that are without the scope of the imagination, but it is a realizable commercial condition, demanding only such daring skill and sound judgment as have already brought our country to industrial primacy.

There are many things for which one might wish in the development of electrical power transmission—electricity direct from coal, a storage battery cheap enough and durable enough to allow its use in a very extended field, an insulating substance with the mechanical properties of a metal, but whether we get these or not, there is work enough to be done. The demand for power upon a huge scale depends on the civic and industrial conditions that may exist in the future, and what these may be no one can tell. It is conceivable that before the dawning century shall end the world's aims and work may be materially changed, or even that the march of modern discovery and invention may be temporarily stayed. Of this much, however, we are certain, that the present generation has before it work enough to last for several decades without calling upon any strange genii. Our children and our children's children will perhaps look back upon our achievements with good-natured amusement, but the last quarter of a century has wrought well the foundations on which they may build beyond our dreams.

Chemistry and Electricity.

The most remarkable advances which have been made lately are due to cheap electric current, says Prof. W. Ramsay, of argon and helium fame, in the New York *Sun*. The electrolysis of alumina, dissolved in fused cryolite to obtain aluminum, an operation carried out at Schaffhausen on the Rhine and at the Falls of Foyers in Scotland, the electro deposition of pure copper for electric wires and cables, electro silvering, gilding and nickeling, all these are instances where decomposition of a compound by the electric current has led to important industrial results. At present soda and chlorine are being manufactured by the electrolysis of salt solution contained in rocking trays, one of the electrodes being mercury, by the Castner-Kellner process. This manufacture is being carried on at Niagara, as well as in England. But electricity as a heating agent finds ever-extending application. Henri Moissan (professor at Paris) led the way by utilizing the enormous heat of the arc in his electric furnace, thereby, among other interesting reactions, manufacturing diamonds, small, it is true, though none the less real. The use of electricity as a heating agent has received new applications. Phosphorus is now made by distilling a mixture of phosphates of lime and alumina with coke; a new polishing agent has been found in "carborundum," a compound of carbon and silicon produced by heating in an electrical furnace a mixture of sand and coke, and cyanide of potassium, almost indispensable for the extraction of gold from ores poor in gold, is now manufactured by heating a mixture of carbon and carbonate of barium in an electric furnace in a current of carbon monoxide. These

Telephony.

By Kempster B. Miller.

FROM what was considered an interesting toy at the Centennial in 1876, the telephone has grown to be one of the most indispensable factors of our modern civilization. The development was slow at first, the great invention being for the most part unappreciated by the public. Once started, however, it surpassed, year by year, the hopes of those most interested in its welfare. Exchanges equipped for an ultimate capacity of hundreds quickly reached that limit and were built and rebuilt for as many thousands. It was frequently impossible for the manufacturers to complete an equipment and ship it before something so much better had been designed as to render it out of date.

The carbon microphone transmitter, the flexible cord switchboard, the multiple switchboard, the adoption of metallic circuits, the central battery system and lamp line signals, in the order mentioned, form perhaps the most prominent landmarks in the history of the development.

The transformation of the toy into the instrument of universal utility has been achieved through the work of such men as Hughes, Edison, Kellogg, Scribner, Lockwood, Carty, Dunbar, Dean, Hayes, Stone, Sabin, Hibbard, White, and McBerty—all Americans.

At the present time more energy is being spent in improving the facilities for adequately handling the inter-connection of the ever-increasing number of subscribers than in improving the actual efficiency of transmission, although the latter problem is not being neglected.

The present tendency is toward the use of larger exchanges and the placing of jacks on closer centres than has heretofore been thought desirable. The old idea of 6000 lines being the maximum number desirable or practicable in a multiple switchboard is being rapidly wiped out, and several boards have already been constructed very much larger than this.

That central battery systems have come to stay no well-informed person can doubt. Their inherent advantages, such as automatic signaling, the simplification of subscribers' apparatus and the ease and cheapness of maintenance have caused them to work a perfect revolution in commercial telephony within the last few years.

The incandescent lamp for both line and supervisory signals seems to be gradually gaining ground over all forms of mechanical signals, the reason being that the lamp is at once effective, essentially self-restoring, cheap, and in itself the heir to but one form of trouble—burn-outs. To be sure, the use of a lamp carries with it the necessity, or at least the strong desirability for a relay, but a relay is a more reliable piece of apparatus than a drop, is more readily accessible on account of not being placed on the front of the switchboard, and the combination of lamp and relay is hardly more expensive than a properly constructed self-restoring drop. The two-lamp system of supervisory signals is now the most modern practice in exchange working, as it keeps the operator constantly informed of the condition of two connected lines, and therefore does away almost entirely with the necessity of her listening in. This system alone has effected a possible increase of about one-third of the number of subscribers handled by any one operator, with a corresponding reduction of operating expenses.

There is a growing tendency toward more substantial equipment and construction, toward the employment of a higher grade of men in both the technical and business departments, and what is of even more importance, toward giving the public the service and the treatment that it demands and should have.

The greatest factor to-day in the general betterment of telephone service and its more universal extension, is the independent movement, which by its fierce and growing competition has forced its rival to more progressive methods and has developed new methods of its own.

It is difficult to see very far into the new century, but we can form some ideas from present tendencies, and, not having lost faith in the progressiveness of our age, predict events which by their desirability now seem sure of accomplishment in the future.

The present rapid increase of the population of the business centres, the rapidly increasing popularity of telephone service, and the reduction in rates for service, will render the building of exchanges very much larger than any in existence at present. A single exchange having 100,000 lines will be built as soon as there is an actual demand for it. This figure perhaps sounds preposterous to many who are acquainted with the difficulties that have been encountered in building switchboards of scarcely more than one-twentieth this capacity, but the idea is perfectly practicable and a switchboard for such an exchange could be built to-day were there a necessity for it. That the demand for such an exchange will exist cannot be doubted. The telephone will be considered more and more in the light of a necessity rather than a luxury in the home as well as in the business offices. Why should not telephone service become as common as the use of gas, electric light and water?

In systems which, on account of the geographical distribution of the subscribers, require several different central offices with a large percentage of trunked connections, I think the tendency will be to do away entirely with the multiple jacks in front of the answering or "A" operators and to extend the multiple jacks only on the sections used for incoming trunking. Such a course will probably prove economical where the conditions are such that as great a number as 75 per cent of all calls need to be trunked. The adoption of such a course would mean that all calls would have to be trunked instead of 75 per cent of them or over, but the uniformity of service, the great saving in multiple jacks and cables and therefore of initial cost and expense of maintenance, would probably outweigh the advantages arising from the ability to make 25 per cent or fewer of the calls without trunking.

With the increasing size of exchanges and the ever-increasing demand for the subway space made by all branches of municipal service, there will be a need for cables of larger conductor capacity for a given size. There is already a tendency toward the reduction of the size of the wires in underground and aerial cables. Instead of conductors corresponding in size to No. 19 or No. 20 B. & S. gauge, as now almost universally adopted, I think the future standard for crowded districts will be nearer to No. 24 B. & S. gauge, with a steel strand running through the centre of the cable, if necessary for strength. To partially make up for the smaller size and greater resistance of the wires in the cables, an increase of the voltage used in the common battery systems will probably take place, and instead of the present standard, which is from 20 to 24 volts (10 storage cells), it will probably be double this or more. This change would perhaps mean the necessity of better insulation and better methods of protecting apparatus than those now in vogue.

The use of automatic coin-collecting pay stations will probably greatly increase in the near future, and those devices in which the coin is necessarily deposited before a call can be registered at the central office, but which allow the return of the coin to the user in the case of an uncompleted connection, will supersede those in which the coin is not deposited until the connection is completed. One reason for this is the delay frequently caused by the user in finding a coin of the proper denomination after the operator has made the connection. The charge for such connections will be 5 cents or lower, and will probably keep pace with street car fare.

The automatic switchboard, that is, the switchboard in which no operators are required, will probably have some field of usefulness (which it has not, up to the present date,) but only for very small private exchanges. If there were any necessity or real desirability for the automatic in large exchanges, the probabilities are that mechanical genius would eventually triumph over their at present seemingly unsurmountable practical obstacles. The present consensus of opinion seems to be that the automatic exchange is impracticable, and even if practicable would not be desirable. For this reason, if for no other, its future does not present a promising aspect.

No practical results have recently been recorded arising from any of the various schemes for radically increasing the transmission efficiency over very long distances. The telephone repeater seems to have met with no practical success, and the various proposed systems of associating impedance coils with the line circuit for improvement in the talking circuit itself are yet, so far as the public is aware, in an experimental stage. Notwithstanding this, and not pretending to know how, I believe that long before the new century is ended it will be possible to talk from San Francisco to London, or, in fact, to almost any other portion of the globe. To believe otherwise is to acknowledge defeat at the very outset and to lose faith in the progress of science and invention.

Electric Lighting.

By Prof. Dugald C. Jackson.

Our grandfathers retired by the light of a tallow dip; our fathers, in their youth, were taught the beauties of lard oil as an illuminant; but the advantages of refined petroleum and illuminating gas drove from the field the older means of illumination. These in turn within the past two decades have been outmatched in public favor by the electric light, until the lighting of streets and public places is almost universally performed by the electric arc while the more modest incandescent lamp shines in stores and dwellings.

The popularity of the electric light must be ascribed to its convenience, its comparative safety, its freedom from heat and harmful fumes and the brilliancy of the arc, which gives the latter form of the electric light special advantages for certain situations. An electric lamp consumes less energy than an ordinary open gas lamp in the production of a unit illumination, but the operation of the electric lamp is little cheaper than that of the gas lamp, and its wastefulness, though less than gas, is still enormously great. The frightful waste of natural resources by civilized peoples in the latter part of the century just closed is illustrated by the losses involved in the production of electric light. A net ton of good bituminous coal may be assumed to hold an amount of available energy which is represented by 25,000,000 heat units. Not less than 22,500,000 of these heat units are lost in the successive processes of converting the available energy of the coal into the heat energy of steam in a boiler, into mechanical energy by means of a steam engine, and finally into electrical energy by means of a dynamo. Of this great loss, an overwhelming proportion is due to the steam engine. A small proportion of the remaining energy, which is now equivalent to 2,500,000 heat units, is lost in the transmission to the lamps, so that perhaps less than 10 per cent of the original total energy is delivered to the lamps. Here is a shining mote in the eye of the designer of the steam engine and boiler.

The waste of 90 per cent of our fuel which is caused by the extravagant process of generating electrical energy through the intervention of the steam engine and boiler, is sufficient to plunge all coal users who are acquainted with the limits of the world's coal supply into pessimism. But this is not the worst of the story! The electric lamp itself is the greatest spendthrift, as it converts into light only about 5 per cent of the energy delivered to it. Of the original 25,000,000 heat units in the ton of coal only about one-half of 1 per cent—or 125,000 heat units—are converted into light, and the great balance of 24,875,000 heat units which is equal to 99½ per cent of the energy in the ton of coal goes entirely to waste.

When gas and kerosene are burnt in our ordinary lamps, less waste is produced between the natural product and the lamps than in the electric system, but so much greater wastes exist in the open flames that the electric light is more efficient when considered as a whole. The coal gas which may be made from a net ton of good coal contains perhaps 7,000,000 heat units. The proportion of this energy which is converted into light at an ordinary burner is not more than 4-10ths of 1 per cent, or the equivalent of 28,000 heat units. This is less than one-fourth as much light from a ton of coal as may be gained through the electric light, but coke, tar and other by products are produced during the making of gas, and the difference is therefore not as great as might otherwise appear. The difference may be greatly reduced or even wiped out by the use of incandescent mantel burners with the gas.

The story of the electric lighting industry—big as it is and of incalculable value to the people—is, therefore, one of woeful wastes that are little if any less serious than those of competing methods of illumination and that cry out for correction. The Nernst lamp, if perfected, should result in a small saving—enough, if the lamp fulfills the expectations of its promoters, to increase the total efficiency by over one-third of its value, thus perhaps raising it to 7-10ths of 1 per cent. This, however, is but a drop in the total, and a revolution of the methods used at each extremity of the circuit must come with the march of progress during the twentieth century to avoid the ultimate exhaustion of the world's supply of natural fuel.

An industry that has grown like electric lighting from almost nothing to such magnificent proportions during the last fifth of the nineteenth century may during the first quarter of the twentieth be revolutionized and increased to still undreamt proportions. The primary generation of electricity for electric lighting through chemical action, and the artificial production of firefly light are day dreams of scientists. The equivalents of both are needed to give us an economical and a satisfactory artificial light. We are now in a period of the use of harsh lights—lights that are unbearable to the eye—and of extravagant lights. The demand of the hour is for diffused and uniform illumination by burners which convert the energy supplied to them into light with little loss. This demand may be filled when the equivalents of the day dreams are found. The firefly makes his light by the slow oxidation of fats; and what nature can do, man will repeat.

Electro-chemistry.

By Carl Hering.

In most cases the safest way to prophesy or to predict a growth or development, is to do it mathematically; that is, to plot the known results of the past and present, then draw a line, usually a curved one, through these points, and then prolong that curve, following as nearly as one can the same rate of change of curvature as that of the known part of the curve. Or in other words, find the law of development up to the present time and assume that this same law will continue in the future.

To apply such a method to electro-chemistry, however, would lead to absurd results, as the growth has been so rapid in recent years that such a curve, when prolonged, would soon become perpendicular to the base line instead of tending to become parallel with it, long before the line representing the end of the twentieth century is reached. Such a result indicates that there must be a point of inflection or change of direction of curvature at some time in the future. Or in other words, the development of electro-chemistry is so rapid at present that it cannot continue to grow at that rate for the next century, and the probabilties are that the present rate of development will continue, probably even at a faster rate than at present, but that in the course of time limits will be reached beyond which progress will be slower and in some cases practically impossible. But before such limits are reached it is probable that very important progress will be made and that electro-chemistry will become, if it is not so already, that branch of both the science of electricity and of chemistry, in which the greatest progress will be made and which offers the most promising field for research and invention. It is already the best field for graduates of good colleges to enter, provided they have a taste for that class of work and are willing to work hard and patiently, as there is much that is still obscure and not clearly described in text books.

Products, which not many years ago were rare specimens preserved in form of small fragments in sealed vials, and kept only in laboratories and museums, as rare curiosities, are now made electro-chemically by the ton. Others, which were not even known before, like carborundum, are now also made by the ton. A long series of new compounds, chiefly the carbides, have been discovered and studied electrically. Materials like graphite and the diamond, formerly found only in nature, are now made artificially, the former by the ton in the largest electrical furnaces in the world. Real diamonds are made, though at present only in microscopic specimens of no intrinsic value. Real rubies are made and small natural ones can be melted into large ones. Unfortunately diamonds do not seem to fuse, otherwise the same process might be applied to making large diamonds.

These few illustrations are enough to show what entirely new directions of development have already been opened up, and they are mentioned here to show how impossible it would be to prophesy what products or operations, heretofore unknown, might be discovered in the future. Could anyone have predicted such an entirely new discovery as the property of the Roentgen rays to enable one to see his own bones while in the body? No attempt will, therefore, be made here to predict what entirely new discoveries may be made in electro-chemistry during the next century, as such a prophecy would be idle and without foundation. This feature in a prophecy may be passed over by saying that the probabilities are that the large and increasing amount of research in this field will lead to some discoveries of heretofore unknown things, but what they are, or are likely to be, no one can predict. It will be more interesting and useful to confine ourselves here to the sphere of legitimate prophesying, and to endeavor to show what the probable developments will be of that which is already known, or of that which, with our present knowledge, seems likely to be known. Also to endeavor to show what the limits are in some directions, beyond which no further progress is possible in those directions.

One of the directions in which improvement should and will be made—and the sooner it is done the better—is in properly formulating what is known, and in explaining, on the basis of well-founded theories, the correct principles of this science; also in the adoption of uniform and correct terms, expressions and definitions. At present there still exists, to some extent, a state of chaos; many things are not yet clearly understood and others that are, are very unintelligently explained; tables of important constants are wanting or are very inaccessible or unintelligible. The same words and expressions are used differently. Mere hypotheses are advanced as theories, notwithstanding that they are still hotly discussed by eminent authorities. Chemists, as a rule, know too little about electricity, thermochemistry and molecular physics, while electrical engineers generally know nothing of chemistry and thermo-chemistry, and too little of molecular physics. An electro-chemist should be versed in all of these. Much time and money is lost in experiments and researches which a proper knowledge of these branches of science would have shown in advance to be fruitless. On the other hand, one who correctly understands all the principles involved, will often be led directly into the proper direction of research, and will not waste his time trying to get something that is impossible. One of the first requirements for the proper development of electro-chemistry is, therefore, that it be studied and practiced as a science.

Let us now review rapidly what is being accomplished in practice in the various branches of electro-chemistry and endeavor to find the direction in which progress is and is not likely to be made.

Electroplating is already a well-developed branch in which no remarkable developments are to be expected. The amounts of metal deposited are so nearly equal to the theoretical, according to Faraday's law, that the limit in this direction has been reached. But improvements in the details of processes are likely to be made, such for instance as getting better deposits and at greater current densities. Graham has shown, for instance, that with copper sulphate the current density may be enormously increased, even up to 3000 amperes per square meter, by extremely rapid circulation and yet the deposits will be excellent. The underlying principle of this is that the molecular layer of the electrolyte next to the cathode is being exhausted by the current of that which is being deposited, and unless it is as rapidly replaced by fresh solution, it will really be some other electrolyte which is being acted upon at the surface of the cathode, and hence the deposite will be affected. A more general recognition of this important principle in the future, not only in the deposition of metals but also in accumulators and batteries, will be likely to lead to important progress.

The great value of zinc plating on iron, for protection from rust, will be recognized more and more after satisfactory processes have been devised for obtaining good deposits of zinc, which is not easy. A good beginning is already being made, chiefly in England. There are a few other metals which, like zinc, are electro-positive to iron in nearly all ordinary solutions, and therefore protect the iron from rusting by a true electro-chemical action which tends to develop hydrogen at the exposed surfaces of iron; possibly processes may be found of plating with some of these instead of zinc.

Plating with aluminium would seem to have no great value as a process of plating, but this would mean that metallic aluminium was being obtained from an aqueous solution of its salts, and might be of great value as a method of producing the metal. While this seems to be a very difficult thing to do, it would be rash to predict that it never will be done. Processes for plating other metals onto aluminium, are greatly needed and will probably be found. Although numerous methods have been suggested, none seem to have come into use to any extent. The difficulty seems to lie in that transparent, glass-coating of the oxide which immediately forms on the surface and interferes with obtaining an adhesive coating.

Electrotypes for printing, made of iron instead of copper, are likely to come into more extended use, on account of the extreme hardness of electrolytic iron, which increases the lasting qualities and improves the definition. The difficulty lies in electroplating with iron to the required thickness. Copper plates are now plated with a thin coating of iron for very fine charts, bank notes, and work of that kind in which extremely sharp definition is desired.

The refining of metals, and their reduction from the ores electrolytically, is a rapidly growing field of very great industrial importance, and is likely to increase in importance as new processes are devised. Already a large part of the copper is refined in this way, not only to obtain a purer metal, but to separate out the other valuable metals like gold and silver, which are often associated with it in the ores. Electrolytic copper is not necessarily quite pure, as some other metals are also apt to deposit with it. Copper thus refined is already being deposited directly in the form of strong, tough tubes and sheets which can be used or worked directly without remelting, and in the future there is little doubt that not only copper but other metals also will be extracted from their ores, refined, and deposited in a form in which they can be used directly, by a single electrolytic operation without the use of any heat.

Although the limits to the amounts of metal obtained per ampere-hour, according to Faraday's law, are already very nearly reached, in many aqueous processes at least, there still is a possibility with some metals, of obtaining a much larger amount per ampere-hour, than is usual, by using salts in which the valency of that metal is lower. For instance, the possible amount of copper obtainable per coulomb from cuprous salts is just twice that from the more usual cupric salts, which, if the voltage is the same, would reduce the power required per ton of copper to one half, and might also decrease the size of the whole plant in the same proportion.

The artificially-maintained high price of copper will induce large consumers to extract their copper themselves from the ores, which might pay in the future even with poor ores. Already mines of poorer ores, which had been abandoned, are being worked by electrolytic processes.

It is likely that zinc will in future be refined and extracted electrically from its ores, although at present the outlook does not seem to be very encouraging. The demand for a pure zinc is not so great as for some other metals; this, however, may be due to some extent to a lack of appreciation of the qualities of pure zinc. It is probable also that zinc will in future be extracted from ores which exist in large quantities, but are not worked now because it does not pay to do so by the old processes.

The reduction or extraction of other metals by electric means is likely to come into use more and more, as fast as processes are invented for doing so. In many cases it will not be difficult to devise better processes than the present which are almost universally thermic, as the efficiency of most processes involving heat is generally very low, at least in air combustion furnaces as distinguished from those in which the heat is generated electrically. Moreover there are other indirect advantages to be taken into consideration, which may outweigh the power efficiency to such an extent that the latter may even be poorer and yet the process, as a whole, be cheaper. It may not be rash to predict that even iron may at some future time be extracted electrically; the energy efficiency is not the only consideration, there being others like the purity of the product, the value of the by-products, the use of water power near the mines, which saves the transportation and handling of the coal or the bulky ore, the diminution of the size of the plant, etc., all of which should be taken into account.

Metals, as such, generally have more potential energy than their oxides or salts, and in reducing the latter, energy is not only required to overcome resistances, but some of it, and sometimes very much of it, is absorbed as it were, or stored, in the metal. Most of the energy of primary batteries, for instance, originally came from the coal used in reducing the zinc from its ores, and was stored in the zinc. There is therefore a theoretical limit to the diminution of the electrical power required to reduce a ton of metal from its salts in the ores, below which it will never be possible to go. This, of course, applies only to ores consisting of the salts or oxides of the metal and not to those containing the metals in their native state, as with copper and gold. For zinc, reduced from its oxide, this limit is a little over 2000-hp hours per long ton of metal. The minimum possible cost will therefore always be the cost of that much power.

Gold extraction processes, like the cyanide, will no doubt come into more general use and are already so much superior to the older processes that the tailings of gold mines are now being profitably worked over again by this electrical process. It is even possible that within the next century the electrolytic gold extraction processes may be perfected to such an extent as to make it profitable to work ores which are very poor but exist in very large quantities and are easily handled. The clay around Philadelphia, for instance, contains gold to such an amount that every brick made of it has enough gold in it to make two square inches of gold foil. The seawater is an enormous gold mine, which even a trust could not monopolize. A long ton of sea water, at least near Australia, contains about 0.07 grains of gold, at which rate the oceans, which are estimated to consist of 400,000,000 cubic miles of water, contain about 7,000,000,000 tons of gold, the value of which is about $4,900,000,000,000,000. Vast though this is, it would have to be a very cheap process to pay to get it out, on account of the enormous amount of raw material which would have to be handled. The gold will therefore probably stay there, but if in the course of the century a process should be found to pay, it will most likely be an electrical one. It might become practicable to extract other useful ingredients from the sea water, such as soda, chlorine, bromine, iodine, etc., in which case the gold would come out as a by-product. But the outlook is not promising, except for promoters like the Rev. Mr. Jernegan, who used methods which do not come under the heading of electro-chemistry.

Alkalies and their usual electrolytic mate, chlorine, are now being made in enormous quantities from ordinary salt. Already the electric process is replacing the older chemical ones, there being about 30 plants in operation, all started during the past ten years; it is likely to continue to do so more and more. The chlorine is converted into a bleaching and disinfecting solution or compound. Paper pulp and textile fabrics are now being bleached in large quantities by electrolytic bleach very effectively and with less destruction of the fibres, and the practice is likely to increase.

Often one of the most difficult obstacles to be overcome in the introduction of electric processes, is the mental inertia of those who have for years and sometimes generations, used the old processes, and who are opposed to trying anything new. One of the developments in the new century will be the weeding out of such antiquities by the natural process of competition with their powerful enemy, enterprise.

Chlorate of potash is now produced very largely by electrolysis, the existing plants being already capable of supplying the demand of the whole world.

There are many other directions in which the use of electro-chemical methods may be reasonably expected. Sewage may be disinfected, although at present the prospects are not very bright, on account of the expense. Oxidizing reagents, such as chromic acid, which are largely used in the industries, may be reoxidized very efficiently by electrolysis. Many organic compounds used in the arts and industries, including aromatic compounds, can be produced electrically. The very slow process of tanning hides can be greatly hastened by electric means, although it does not yet seem to have emerged from the experimental stage. The slow ageing process of wines and spirits may be artificially hastened by electric means. Whether such processes are in use, will probably not be known by any but those who make use of them, as imagination and taste are closely associated human qualities. The electrolytic engraving of steel dies, which can now be done much cheaper than by hand, is another illustration of the varied applications of electrolysis which may be expected in the future. The electric production of that useful substance ozone, by spark discharge, or possibly by some better means, is another possibility of the future, although at present the prospects do not seem very encouraging on account of the very poor power efficiency of those processes, and difficulties encountered in the apparatus.

Besides the electrolysis of aqueous solutions discussed above, there is a very promising field which, though not as varied in scope, may yet be of considerable commercial importance; it is the electrolysis of fused materials. On account of the greater difficulties involved, and in most cases the poorer energy efficiency, it will probably be applied only in cases in which aqueous solutions cannot well be used, as for instance, for the production of metallic aluminium, sodium, potassium, magnesium, etc. This is a field, the development of which has only just begun, and it seems fair to predict that in limited directions some important developments may be expected.

Some of the metals and products produced in this way and by the closely allied electric furnace, may be said to be great stores of energy and much better than coal, in that their energy can be more efficiently utilized. Metallic aluminium, for instance, is an excellent and very energetic fuel when burnt with the oxide of some other metals, and can be used very effectively for certain metallurgical operations; it is already used in this way, for instance, for the reduction of metallic chromium and manganese for the iron industry, with a good abrasive material as a by-product. A more extended use of such artificially-produced fuels, of which calcium carbide is another, may be expected, although their application is, of course, limited.

One of the industries which is already flourishing, but in which there is much room for perfection, is the reduction of aluminium from its ores. All of the metal which is now produced, amounting to between 2000 and 3000 tons yearly, is obtained by electrical processes. It is already beginning to replace copper for bare conductors, due to the artificially maintained high price of the latter material. At present it takes one horse-power for almost a whole day to produce a pound of aluminium, while theoretically it requires only about 4½ horse-power hours to reduce a pound from its oxide, and probably nearly the same for other ores of this metal; its theoretical minimum possible price will therefore never be less than the cost of that much power. It may even become possible in future to use some of the ordinary rocks as aluminium ores, most of them consisting chiefly of aluminium silicates, instead of importing special ores. An advantage of this might be the simultaneous production of some by-product, of value.

Sodium peroxide is one of those materials which was formerly scarcely known, and is now made electrically in large quantities. No one can predict what other new materials may be made cheaply in the future, but it is safe to expect that others will be produced, and that new and important industrial applications will be found for them.

Some of the most important progress in the industrial application of electro-chemistry may be expected in the use of the electric furnace, as this is a comparatively new field. The resistance furnace enables a very localized temperature to be produced of almost any degree, limited only by that which the receptacle will stand and that at which the materials vaporize. Probably all materials, even those like porcelain and fire brick, become fairly good conductors at a high heat, so that all materials to be acted upon in such a furnace may be used as the heat-producing resistance itself. The temperature of the arc furnace is practically limited to that of the vaporization of carbon, between 3000 and 4000 degs. C, which is high enough for most purposes; the atmosphere in it is not only strongly reducing on account of the carbon vapor, but even tends to form carbides with most metals. Electrolytic action on the fused materials, when not simple elements, is likely to occur in both, unless the current does not pass through the material itself. Some of these properties will be made good use of while others are objectionable.

The field opened by the electric furnace is such a new and wide one, that it is difficult to prophesy what the developments will be likely to be; but in general it may be said that whenever the above-mentioned qualities are important requirements, and the expense of the power not too great, the electric furnace will replace the others. It is even likely that, notwithstanding the poor efficiency of the steam engine, it may in some cases be cheaper to use electric heat on account of the still poorer efficiency of some gas or coal furnaces. Moreover, the cheapness or efficiency of the power is not always the first consideration, as there are other advantages which will often outweigh the question of the cost of the power. It is probable, therefore, that the electric furnace will find many applications in the future, even though the actual cost of the heat is much greater than with gas furnaces. They will be likely to be used as day loads for lighting stations or night loads for traction power houses. Undoubtedly new and useful compounds will be produced by means of this furnace and operations will become possible, which before were not.

Calcium carbide, which owes its existence to the electric furnace, is now being made in such large quantities that over-production may result. One plant at Niagara Falls is said to turn out the enormous amount of 100 tons per day. A development that is much needed in the carbide industry is to find markets for all that is made. One of the unpleasant prospects is that a cheaper non-electrical process of making it may be discovered. The figures concerning the energy required differ rather widely, but roughly, about 4000-kw hours are required to produce a long ton of the carbide. The theoretical amount seems to be still in doubt. This material is also a storer of energy which is abstracted from the furnace and can be given out again at any desired time. It is likely that other carbides, which may be as useful as this one, will be found in the future.

Many other chemical products, now made by purely chemical or thermic methods, will in future be made by means of the electric furnace. Phosphorus is already made in large quantities. Artificial graphite is now being made at a rate of nearly 200 tons annually in the largest electrical furnaces in the world, 50 ft. long inside, and still larger ones are under construction. It is intended to make it direct from coal and at a price below that of natural graphite, an important intermediate step being the formation of a carbide.

Carborundum, the carbide of silicum, was discovered with the electric furnace, and is now made by the ton in some of the largest furnaces in the world. The annual production is nearly 800 tons.

With the increasing use of the electric furnace, other equally, or possibly even more useful, products are likely to be discovered in the future. The writer recently had occasion to measure the output and efficiency of a very good electric furnace for the production of metallic arsenic from an ore which is generally considered worthless. Moreover, the matte which remains may then be worked for the gold in it, while the original ore was worthless as a gold ore. In general it is probable that with the electric furnace many ores, which formerly were too poor to work, will in future be worked with profit.

One seems justified in predicting an important future for electrochemistry, from the fact that there appears to be no well developed and established electro-chemical process, which has as yet been superseded by a non-electrical one, while the latter has often been superseded by the former. This, however, will probably not always be the case.

In the accumulator field, there seems to be no promising outlook for anything revolutionary. Recently there has been developed a modified form of storage battery which might be said to be a primary battery in which the materials consumed are afterwards regenerated again by an electric process, but not in the battery itself. For some purposes this has advantages over the usual accumulators. This opens up a new field in which improvements may be expected in the future.

For primary batteries, strictly so-called, the outlook does not seem to promise anything more than small improvements.

There are, of course, possibilities of finding within the new century the long-looked for primary battery in which carbon or other cheap natural battery fuel is burned cold, or even hot, giving off its energy as an electric current with a possibility of obtaining from 6 to 10 times as much energy as at present. If a practical form of it is found, the steam engine, and even the gas engine, may have to go, together with the dynamo; but there seem to be no prospects at present of the solution of this very important problem in this way. The difficulty is by no means only at the carbon electrode, but largely also with the other which furnishes the oxygen.

It is probable, however, that the same ends will be accomplished much sooner by an indirect method, in which the consumed materials of a primary battery will be regenerated by means of the energy of coal; the materials consumed in the battery are then only the carrier of the energy of coal to the cell, and can act as such a carrier repeatedly and efficiently. But even by this method this important problem will probably not be solved in the near future. Moreover, it must not be forgotten that a method which operates will not necessarily replace present methods, as mere efficiency is not the only requisite. The apparatus must at the same time compare with the steam or gas engine in first cost, cost of attendance, depreciation, floor space, etc.

Although many inventors have been working at this problem for many years, we seem no nearer the solution now than we were before, and it may be many years before it is solved. The numerous partial solutions which have been offered, sometimes with great eclat, have either been based on fallacies, much to the humiliation of the inventors, or they were impracticable.

There is still another possibility of the future which might be mentioned here, although it belongs more strictly to electro-physics than to electro-chemistry. It would be even more revolutionary in character than any of the others. A careful study of the electric phenomena in vacuum tubes has led certain prominent English physicists to the interesting conclusion that atoms, which heretofore were the smallest particles known, were capable of sub-division. This implies a recomposition of these smaller particles into different atoms, or in popular language, the possibility of the transformation of one metal into another. Coming from such high authorities, the statement that atoms can be decomposed, startling as it is, can be criticized only by their peers. Let us wait developments; the new century will bring them.

Electricity in the Last Century.

In 1820 Oersted discovered the connection between electricity and magnetism, and in 1825 William Sturgeon, to whose name sufficient honor was not paid, described what was literally the foundation of electrical engineering—the electromagnet. This was applied to the purposes of telegraphy—in America by Morse and in England by Wheatstone and Cooke. Finally, Faraday, arguing that, if electricity could produce magnetism, the converse should be true and magnetism should produce electricity, invented the first mechanical method of generating electrical currents by rotating a coil of wire in such a way that it cut the lines of force proceeding from a magnet. The magneto-machine thus made was improved by Wilde, Gramme and others into the dynamo of to-day.—Prof. S. P. Thompson.

Wireless Telegraphy.

By Arthur V. Abbott, C. E.

To the five ages of Hesiod and Ovid, the historian of the future may well add the century just completed as the age of electricity. Never has the world witnessed a transformation so wonderful, so far reaching or so complete as has been effected by the commercial applications of this form of energy, that have originated during the latter half of the nineteenth century. Sixty-five years ago not a dollar was invested in electrical industries, while to-day the enterprises that more or less directly involve its use, count capital by billions.

To the art of electro-plating belongs the honor of being the first development of electricity, for this invention antedated by possibly a half dozen years, that famous experiment of Prof. Morse in the laboratory of the University of New York, that set electrical arachnids spinning metal cobwebs over the globe so industriously that we can now accept Puck's challenge and put a girdle around the world in considerably less than forty minutes. Though electro-metallurgy is of great value to the human race, the electrical transmission of intelligence vitally affects the interest and welfare of a larger number of mankind than any other invention, save that of printing, and as the telegraph is in the foremost van of electrical development, it is not surprising that the closing year of the first century of electricity should witness a discovery that will certainly profoundly affect the present methods of transmitting intelligence, even if the optimistic prophecies regarding Hertzian waves are not fully realized.

Historically, the electrical discoveries which have made the so-called wireless telegraphy possible, commenced with Lord Kelvin's announcement in 1853 of the oscillatory character of a Leyden jar discharge and the formulæ for determining the time and amplitude of the waves when the capacity, inductance and resistance of the circuit are known. Some eleven years later, Maxwell followed with his brilliant mathematical demonstration of the electro-magnetic origin of light. In 1888 the classic experiments of Hertz demonstrated the physical existence of the previously mathematically predicted waves; showed means for producing them, and proved them in all respects, save speed and amplitude, identical with other ether waves. The apparatus possessed by Hertz to determine the presence of such undulations were, however, so crude that he was only able to show their propagation over the short space of a university lecture room, and thus their availability for the transmission of messages did not occur to him.

In 1890 Branly proved that electrical radiation exercised a peculiar influence upon the molecular condition of pulverized bodies, whereby in many cases the conductivity of a powder was much changed, thus discovering a method of detecting electrical oscillations of greater sensitiveness than existed at the time of Hertz. In 1893 Dr. Lodge so aptly named the Branly "Radio-Conductor" "The Coherer" that this cognomen has become of universal application. Other French and Russian scientists repeated the Lodge and Branly experiments, provided the coherer with automatic means of maintaining sensitiveness and suggested the use of a vertical wire or "Feeler" to aid in the collection of sufficient energy to produce coherence. Prior to 1895, however, Hertzian waves were merely laboratory experiments and even Dr. Lodge is quoted as doubtful of any extensive practical application. But now Mr. Marconi appears on the scene, a skilled mechanician, he presents that indispensable quality of good common sense that seems necessary to place the results of the investigator within the grasp of the multitude. Without any new invention, simply by excellent mechanics and careful investigation, feeling the way, step by step, he succeeded in so developing the apparatus of Hertz, Branly and Popoff, as to startle the world by demonstrating the possibility of transmitting space signals over scores of miles. In 1897, with vertical wires 100 ft. high, nine miles were covered, while last year with 140-ft. masts, nearly 100 miles were spanned. In 1898 Mr. Marconi announced the discovery, that the distance over which signals are transmissible varied as the square root of the height of the mast, but his most recent experiments point to even a greater ratio of range.

Other experimenters have achieved similar results. In 1897 Dr. Slaby, using a kite, transmitted signals over thirty-five miles, with a 900-ft. wire. The succeeding year Marconi reported the international yacht races from a steamer following the schooners, sending the signals to a station located at Sandy Hook.

During 1900 considerable progress, both in theory and practice, may be reported. It has been shown that the coherer will operate only when the difference of potential applied to its terminals exceeds a certain amount termed the "critical voltage." To receive messages then, the vertical wire must be looped by a sufficient number of lines of force to produce this critical potential, and in order to maintain the coherer in a sensitive condition and effect decoherence, the potential of the local battery, plus that due to inductance of the local circuit, must not reach the critical voltage. Here, then, lie the limits of the receiver. By using filings of a non-oxidizable metal in a vacuum and the use of a telephone as a receiver, the critical voltage may be reduced to its lowest terms. While Mr. Marconi, by the addition of a peculiarly wound induction coil, or step-up transformer, raises the potential difference delivered to the receiver by the mast to its highest limit and asserts that thereby the transmitting distance of signals may be multiplied sevenfold.

The researches of Prof. Chunder Bose show that there is a much deeper significance in the phenomena of the coherer than can be accounted for by the hypotheses of Dr. Lodge. Prof. Bose shows that nearly all substances are affected by electrical radiation and divides bodies into two classes, those which he terms positive having their resistance decreased when subjected to Hertzian waves, while the remainder are negative substances, increasing in resistance under similar conditions. Very far-reaching is this discovery, for it immediately opens to view the possibility that with a certain mixture of positive and negative substances any degree of sensitiveness can be arranged, and suggests the possibility of making the coherer automatic in action, thus relieving it of one of the most troublesome and annoying features of the present method of decoherence.

But what is the actual status quo of wireless telegraphy as a commercial art, and what are the probabilities for the future? Both in this country and in Europe, Mr. Marconi has demonstrated that readable signals may be sent over a space of nearly a hundred miles. Other experimenters have confirmed these results. The apparatus is easily manipulated, is reliable, does not require extraordinary skill to operate, and is not excessively expensive in cost of construction. As yet the range is limited to 100 miles, nor has more than a third of this distance ever been covered, excepting at sea, for it is curious to note that all attempts on land have so far been failures when pushed over a space exceeding a few miles. The squadrons of the world have proven the possibility of signalling under all conditions of naval manœuvers, and there are several experimental stations at work at sundry points on the English coast with apparent success. But when the records are examined for reports as to commercial business and when one looks for the number of instruments operated for revenue and the returns therefrom, not a single instance is to be found. The African war would seem to have presented a peculiarly attractive opportunity to demonstrate the value of Hertzian telegraphy. Instruments and operators were shipped to the front, but not a message was transmitted, because, forsooth, no masts were included in the outfit, and it was alleged that the African meteorological conditions were so anti-British that when there was wind enough to fly a kite at one station, there was none at the other, some thirty miles away. Meanwhile an old-fashioned rival of wireless telegraphy (the heliograph) flashed its nightly tidings during all the weary months of the siege of Ladysmith. As the transmitting station is the center of a spherical wave, it follows that a receiver located at any point on the successive surfaces as the wave progresses may be affected. This fact has been urged as a serious objection to radiant telegraphy, as secrecy is impossible. For this reason it is doubtless somewhat easier to obtain a knowledge of wireless signals than those transmitted by other methods, but saving the use of a cipher, there is no method of telegraphing or telephoning with which an expert eavesdropper cannot readily become acquainted, and cryptographers are always busy inventing new codes to replace those which their equally ingenious and too curious opponents have deciphered. A much more serious consequence of the spherical wave, is the enormous expenditure of energy in proportion to the effect on the receiver. When it is remembered that the energy at the emitting station must vary as the square of twice the distance between the oscillator and coherer, the glibness with which the ease of signalling from London to New York is discussed, recalls the Solomanic aphorism regarding "He that answereth a matter before he heareth it." Further, as the radiation from any source may impinge upon any receiver located within the sphere of its influence, a hostile transmitter may be easily operated and the injection of a few meaningless symbols throw into hopeless confusion all of the receivers in its neighborhood. In point of speed Hertzian telegraphy again finds itself sadly handicapped. Even in expert hands it is slow in comparison with other methods. The sending key must transmit the heavy currents needed to excite a powerful induction coil; there is also the inertia of the oscillator and sluggishness of the coherer and decohering mechanism, so a dozen or fifteen words per minute becomes phenomenal and on the average rarely more than eight or ten are achieved. Mr. Gradgrind would probably summarize the present condition of wireless telegraphy something as follows: A limit of 100 miles at sea and one-third of that on land. The impossibility of secrecy excepting by code. The impossibility of operating more than one station simultaneously within the limits of a single receiver. The helplessness of the receiver when subjected to hostile radiation. The probable average speed of less than a dozen words per minute, with the expenditure of an enormous amount of energy. To offset, there is only the saving in the cost of line construction between the two stations, which ordinarily would be cheap in comparison with the royalty which the owners of the Marconi patents are rumored to charge.

But what of the future? Wireless telegraphy is only a few years old and in the natural course of evolution may develop as usefully as the telegraph or telephone. As electric waves differ only in speed and amplitude from others, they obey the same laws of reflection and refraction. Therefore it should be possible to concentrate them and produce an electric beam by means of proper mirrors or lenses, in the same manner as a searchlight ray is obtained. It seems possible that the circuits in the receivers and oscillators could be so adjusted that they should only mutually respond to each other like a pair of sympathetic tuning forks. Theoretically all this is within the nature of things and if achieved would go far towards removing the present impracticabilities. Mr. Marconi claims, it is said, to have solved these problems and to have produced a syntonic receiver and transmitter that only respond to the particular waves emitted by the one and that are intended for the other. He also, it is claimed, has produced a projecting apparatus that emits a well-defined electric beam and has replaced the vertical receiving masts by an equally efficient and more compact collecting cylinder. As yet, however, these are nothing but the merest rumors, unless a very indefinite letter from Prof Fleming may be regarded as confirmatory evidence Possibly the first year of the new century will reveal some discovery that may be a panacea for all of the "ills which Hertzian signalling is heir to," but from the cold and calm standpoint of present facts the way appears to be tedious, the road hard and difficult and the goal a long way in the future

The Storage Battery.

By Augustus Treadwell, Jr.

THE early history of the storage battery is coincident with the early history of the voltaic pile. In 1800, the year made memorable by Volta's discovery of the galvanic battery, Nicholson and Carlisle found that a current from Volta's cell could decompose water. In 1801, Gautherot found that if the platinum or silver electrodes of a voltameter were connected together, after having a voltaic current passed through them, that a secondary current of short duration would flow. Erman found that the positive pole of such a cell was the pole which had been connected to the positive pole of the battery. In 1803 Ritter observed with gold wire the same phenomenon as Gautherot, and constructed the first secondary battery by superposing plates of gold, separated by cloth disks, moistened with ammonia.

Volta, Davy, Marianini and others added somewhat to the knowledge on the subject, and in 1837 Schoenbein found that peroxide of lead could be used in secondary batteries. Sir William Grove next came forward with the discovery that metal plates, with a layer of oxide on them, acted better than the plain metallic plates, and Wheatstone and Siemens found still later that peroxide of lead was the best for such purposes.

In 1842 Grove constructed his famous gas battery, in which the e. m. f. came from the oxygen and hydrogen evolved in the electrolysis of water acidulated with sulphuric acid. By means of 50 such cells he obtained an arc light. Michael Faraday, when electrolyzing a solution of lead acetate, found that peroxide was produced at the positive and metallic lead at the negative pole, and in his "Experimental Researches" he comments on the high conductivity of lead peroxide and its power of readily giving up its oxygen. Although he made no apparent use of this discovery, it may be considered as the next important step in the development of the storage battery. According to some authorities, Wheatstone, de la Rue, and Niaudet were well aware that peroxide of lead was a powerful depolarizer, but nobody appears to have made use of this fact until 1860, when M. Gaston Planté constructed his well-known cell with coiled plates. M. Duerlir claims that Sinsteden used the secondary action of lead in sulphuric acid in 1854. Although it is well known that Sinsteden did notice the peroxidation of a lead plate in sulphuric acid, we have no further proof that he put it to any practical use.

Planté's researches extended up to 1879, and practically determined the state of the art. As to the theory at this time, it may be stated that Clerk Maxwell, although the leading electrician of his time, speaks of the storage battery as storing up a quantity of energy in a manner somewhat analogous to the ordinary condenser; hence the use of the word accumulator for storage battery. In 1879 R. L. Metzger, of Germany, did away with the tedious forming process by mechanically applying the active material. This important discovery was not, however, generally known until 1881, when Camille Faure obtained important patents concerning this method of shortening the time of formation. Charles F. Brush, working independently of either Faure or Metzger, arrived at the same result, and the United States Courts have decided, after long litigation, that to him belongs the priority of invention in this country.

It is claimed by R. Jamins, in his book entitled "Recherches sur les Accumulateurs Electriques," that Planté himself was the true discoverer of the mechanical application of the oxides, or, in other words, the real inventor of the pasted plate.

That this view is shared by Jablochkoff is shown by his application for British patent No. 1745, date April 22, 1881, in which he states that M. Planté proposed to apply the active material mechanically to the support plate.

It should be noted, however, that Mr. Bedford Elwell, the translator of Planté's "Recherches sur l'Electricité," makes no mention of any process for mechanically applying oxides to storage battery elements, nor were the alleged troubles referred to in his translation.

The first United States patent ever granted for storage batteries was granted to George C. Percival in 1866, No. 53,668. This battery consists of a wooden box, divided into two parts by a porous partition and filled with a suitable conducting powder, moistened with dilute sulphuric acid; two lead plates placed on opposite sides of the box constitute the terminals.

The work of Fauré practically ends the history of what is termed the lead-lead battery, the battery of to-day, if not of the future. No history of the lead-lead battery is, however, complete without mentioning the work of Marchinay, Maxwell-Lyte, Andreoli, Payen and Herbert Lloyd. To these men is due the credit of conceiving and bringing into practice the use of lead chloride for accumulator elements. This compound has done much to popularize the storage battery and show to electrical engineers the absolute necessity of a battery of accumulators in lighting and power work.

Besides the lead-lead battery, however, are those in which one or both electrodes are of some other metal than lead. This includes the lead-copper, lead-zinc, copper-zinc, and that miscellaneous set which is intended to overcome all the disadvantages of the former types.

The principal advantages of the lead-copper group are their economy in construction and the fact that they retain their charge very satisfactorily. The voltage, however, is low, averaging about 1.25, and the capacity per unit of weight small.

Reynier, Mason, Sutton, and Erving are the principal workers in this field of batteries, the first of this group appearing about 1880. The electrolyte for this type consists usually of copper sulphate, although in some cases ammonia and acid bisulphate of mercury are used.

The lead-zinc battery is economical in construction and is the lightest, theoretically, of all types. The capacity in watt-hours per pound of working substance is more than 50 per cent higher than with the lead-lead group. The e. m. f. is the highest of all the groups, averaging about 2.5 volts.

Wheatstone, in 1843, was the first to advocate the use of zinc instead of spongy lead for the negative electrodes. The problem was, however, apparently dropped until 1882, when Emil Boettcher produced a practical cell. Reynier, Tamine, Epstein and Main and Meserole are the principal workers to date with this type of battery. Alkaline zincate genus—These cells, which have been used mainly for traction purposes, have given very fair results. The voltage is, however, low, averaging about 1.1 volts. They possess the disadvantage common to all batteries that do not use lead for the electrodes, that the metal is eaten away by the chemical and electrolytic action. This, many claim, is counterbalanced by the fact that they are very easily and cheaply constructed.

The principal workers in this field are Lalande, Chaperon, Edison, Thomson and Houston, Desmazure, Commelin, Schoop, and Waddell & Entz. The Waddell-Entz battery has been very extensively used, more than other batteries except the lead-lead type.

Darrieus, Platner, Kalische and Marx are among the historical names of those who branched out from the beaten lines of experiment and produced excellent results with other metals.

Before going further, it might be well to briefly classify the storage batteries which are in the market to-day, with a prominent example of each type.

The first and most prominent type is the lead-lead battery, divided, of course, into the Planté and Faure types, each of these types being again sub-divided according to the improvements in each, as follows:

A.—The Planté: 1. Chemical or electro-chemical. In this type some special forming bath is used. The Willard and Gould batteries are the best examples of this class.

2. Mechanical. Either some special form of casting is used, or the plates are passed through a die which tends to materially increase the surface of the electrode. To this belong the Ohio and American storage batteries.

3. Electrolytic. Finely divided lead is obtained by the electrolysis of a lead salt, or a lead salt is formed into a plate and then reduced to metallic lead. The Chloride plate is the best example of this class.

4. Plates composed of solid active material. Percival's battery and Fitzgerald's lithanode plate belong to this group.

B.—Fauré: I. Reduction of weight. In this the plate is either composed of some alloy of lead, or of some non-conducting material. The Hagen and Hatch batteries belong respectively to the two divisions of this type.

2. The retention of the paste or active material. This is accomplished either by grooves or by perforations of the grid, or the entire plate is enclosed in a perforated conducting or non-conducting material. Of these types the Brush and the Tudor represent the first method, the E. P. S. the second, the Tommassi and Ford-Washburn the third, and the Pumpelly and Hess batteries the fourth.

3. Provision for better contact between the support plate and the active material. This is usually accomplished by rubbing the support plate with carbon, or the addition of carbon to the active material, or the support plate is partially oxidized. Paget and Tudor are best examples of these methods.

4. The prevention of buckling. Reckenzaun and Hering illustrate this the best.

C.—Lead-copper. Sutton.

D.—Lead-zinc. The River and Rail Battery.

E.—Alkaline-zincate. Waddell-Entz.

F.—Miscellaneous. Marx liquid battery.

Storage batteries are without question to-day an important factor in central station work and in regulation at power stations. The high peak which appears in load diagrams, and which represents the period of maximum demand, the small night load, and the great variations and fluctuations of load on power circuits, especially on those circuits which supply trolley lines are among the worst difficulties which confront station managers, and for these and many other purposes storage batteries are rapidly becoming universally recognized as being an almost indispensable auxiliary. In large alternating current stations, such as that of the Brooklyn Edison Illuminating Company, at Bay Ridge, storage batteries are used for the excitation of the fields of the alternating current generators. For central station work storage batteries find their principal uses in carrying the peak of the load, in carrying the entire load at minimum hours, in acting as an equalizer or reservoir and for the equipment of annex stations.

The period of maximum demand varies anywhere from 1 to 5 hours per day, and were it not for the use of accumulators, generators would have to be supplied which would be able during this time to carry the peak and yet which during the remainder of the day would be called upon for only a small fraction of the total load, thus causing a great loss in efficiency.

It seldom occurs in a properly managed station that the period of minimum demand is long enough to allow of the laying off of one shift of men and the drawing of the fires. In most American stations this period seldom amounts to more than four or five hours, so that as in the case of the Boston Edison station it is found more economical to charge the battery during this period than to shut down the engines and generators entirely. It is in the capacity of an equalizer or reservoir that the storage battery finds its greatest use in station work to-day. Manufacturers will to-day guarantee that the efficiency of a battery, when operated in parallel with the generators, will exceed 80 per cent, and will willingly undertake a maintenance contract for a long term of years upon the basis of 5 per cent. The small loss in efficiency due to accumulators is more than made up by the greatly increased efficiency of the steam plant. In Hamburg, moreover, the loss in the batteries is only 1.2 per cent of the average amount of electrical energy generated during the year.

For the equipment of annex stations a large field for the use of batteries is offered, for otherwise an entirely separate station would have to be installed at this point, or the manager would be compelled to run heavy feeders to the centre of distribution. The latter alternative would mean heavy losses in the feeders, and large interest charges for the conductors. By the use of batteries, higher tension currents would probably be employed, which would necessitate a small amount of copper in the conductors.

Perhaps the best example of the value of the accumulator as an equalizer that has come under the notice of this writer occurred during a test of the storage battery plant in the building of the Commercial Cable Company in New York. In this plant the battery is run in parallel with the generators, which supply together the elevator and lighting service. The battery thus assists in taking the load by meeting the sudden demands of the elevator service, and being charged when the load drops off. During this test the battery current jumped from 350 amperes on charge to 550 amperes on discharge, thus giving a variation of 900 amperes in the load, and yet during this the voltmeter on the lighting circuit did not show a variation of half a volt, which, on a 240-volt circuit, as in this case, means a variation of less than one-fourth of 1 per cent.

A large number of experiments have been made looking to the adoption of storage batteries for traction purposes. As yet, however, but little success has attended these efforts, due in the main to the extreme weight of storage batteries, and to the high cost of maintainance. Both of these factors are constantly being reduced and the author looks for a battery in the near future that can be used on cars with success. It should be remembered, however, that the large number of failures that have attended all efforts to operate a successful storage battery street car service is due not so much to defects of the battery as to outside influences which have nothing to do with the battery.

For example, in the case of the most recent failure, that of the Chicago Electric Traction Company, which has within the past three months been changing over to the overhead trolley system, the line was long and the district through which it ran was but sparsely settled. In this way the passenger receipts were small and the company was compelled to operate more than one charging station, thus doubling the fixed and operating expenses, while with the trolley but one power station will be required. When the road was installed it was the expectation of the officers of the company that that section, because of its advantages, would be quickly built up.

In the storage battery road in Paris, on the other hand, the road is a success. In several cities in Germany the combined trolley and storage battery is being used with considerable success, the battery being used in the denser portions of the city, while the trolley is used in the outside districts.

The Metropolitan Traction Company, in New York, has installed storage battery cars on its Thirty-fourth Street line, which are, from all accounts, meeting with considerable success. This line is the more interesting from the fact that the same company is operating compressed air cars on the Twenty-eighth and Twenty-ninth Street line. These two lines are very similar in character and can therefore be easily compared.

The writer has been informed by a number of persons intimately connected with the company that the latter experiment, while successful, does not in that way compare with the storage battery line, the results of which have been most gratifying. In justice to both, however, it should be remembered these two lines have been operating too short a time to enable the company to determine accurately which will be the most successful in the long run.

The most recent use to which storage batteries have been put, and in which the success is most astonishing when the number of traction failures are considered, is that for automobiles. The electric cabs which are now operating have shown the most gratifying results from the start and are everywhere meeting with ever increasing favor.

A number of automobile companies are operating in the large cities of the United States and Europe, and new companies for this purpose are constantly being formed. In fact, it is due to the storage battery that the automobile has met with such favor, and that carriages operated by other means than electricity are constantly being exploited.

In regard to the future of the storage battery, it is probable that for central and power station work the battery will be so constructed as to give heavier discharges for longer periods than at present. Of course, one of the means of accomplishing the result will be by materially increasing the working surface of the plate, although that alone could not accomplish the result. The plate must also be so constructed as to permit heavy discharge rates without driving out the active material. The plates will also be so constructed that the danger of buckling, if not absolutely prevented, will at least be reduced to a minimum. While not of such great necessity in central station work as in other lines, the plates will be so constructed as to permit of much higher charging rates and consequently decreased time of charging.

For automobile and traction purposes, however, the battery will be materially lightened. It is probable that this will be accomplished by using some alloy of lead for the plate instead of the lead-antimony plate now used. This will permit of a much thinner plate being used without impairing its working qualities. As in the case of central station batteries, improvement will also go on along the lines of increased discharge and very greatly increased charging rate. Batteries will also be constructed with much increased capacity, which will enable carriages to have a much larger sphere of usefulness. While many experimenters believe that storage battery plates will be constructed of some other metal than lead, this does not seem probable; at least in the near future, for the reason that metals are dissolved by the electrolyte, while lead, because of its coating of sulphate, is insoluble. In all other cells in which some other metal than lead is used, the changes that occur with each charging are relatively so large that they rapidly deteriorate and require constant attention and repairs. Lead alone of all the metals forms a sulphate that is practically insoluble and unacted upon by dilute sulphuric acid, and it also forms a peroxide having good electrical conductivity, and equally unaffected by the liquid The compounds formed when other metal than lead is used in any practically possible solution now known are all to a large degree soluble.

With the improvement in machinery the cost of manufacture of batteries will be considerably reduced, which will cause accumulators to be used by more of the small country plants where but little capital is invested in the business. It is probable that some of the improvements will take the form of a modified electrolyte which will be of such a nature as to prevent the formation of, or at once break up any deleterious substances which will be formed during charge or discharge.

It is also probable that batteries will be so constructed that the diffusivity of the acid will be greatly inreased.

This would prevent scaling, which occurs when the acid has become weakened or when a cell has been discharged below its minimum useful voltage.

It is very probable that the coming years will witness many of these improvements taking place.

Scientific Truths.

When an experimental fact was obtained by Faraday, it was instantly enlarged by his imagination—John Tyndall.

If we would judge fairly of the merits of a new invention we should not only look upon it by itself, but compare it with all that has gone before and might be superseded by it.—Gisbert Kapp.

Without the use of hypotheses or antecedent probabilities as a general rule, no extended series of investigations can be made as to the approximate cause of casual phenomena. They require to be used, however, with great care, lest they become false guides which lead to error rather than to truth.—Joseph Henry.

What is the truth, is the goal of intellectual mankind in all ages, and its pursuit leads not only to intellectual but also to physical satisfaction.—Prof. Henry A. Rowland.

Study science with earnestness—search into nature—elicit the truth—reason on it, and reject all which will not stand the closest investigation.—Faraday.

The Automobile.

By Harold H. Eames.

THE mechanical and scientific history of the automobile has been so constantly in print for the last four or five years that the public must by this time be thoroughly "saturated" with it. It is no longer a source of wonder or comment to the reading public that many great names connected with the development of prime movers, either academically or practically, have also been connected with the history of the automobile by indirect prophesy, if nothing else. That these great names include those of Roger Bacon, Sir Isaac Newton, Watt and others on a similar plane, is constantly being stated in the current print. The reading public ought to be now thoroughly familiar with the fact that Cugnot had an operative steam wagon about the middle of eighteenth century and to many of those who have little or no practical knowledge of the automobile, the name of W. H. James, Goldsworthy Gurney, Hancock, J. Scott Russell, and Trevithick are familiarly connected with the temporarily successful commercial operation of automobile passenger conveyances in the first half of the nineteenth century.*

The entire absence of such startling discoveries and inventions in advance of contemporary knowledge as have characterized many other arts has largely divested the history of the automobile of its interest to the public at large, and beyond the natural surprise occasioned upon noting the antiquity of the idea the history contains little of interest to any one not actually concerned in its development.

The regular mechanical evolution of the automobile, however, is now of secondary importance to the commercial. The major mechanical problems have either been already solved or the manner of their solution already determined and the result susceptible of accurate prediction. The opportune availability of already complete and experienced manufacturing organizations with not a little previous experience of the new industry made it possible by the expenditure of relatively vast sums of money to crowd into a few months a development which under generally similar mechanical and scientific conditions in the past has required years. As a result, the character of the "standard" or "type" of automobile from which the product of various manufacturers will depart, with relatively slight variations, is already recognizable, and to those well informed on the subject the "freak" is already easily distinguishable from the commercial type. Although the direct availability of the results of the previous developments of other industries has contributed immensely to the rapidity of development of the automobile, the extremely rapid development of the successful commercial type is nevertheless remarkable when compared with the mechanical development of ordnance material, bicycles, sewing machines and steam engines, or even electrical apparatus—although the last named hardly affords a perfectly fair comparison. Perhaps the most remarkable contrast is in the case of ordnance material—in the development of which the expenditure of money has been practically unstinted. It is only necessary to compare the numerous markedly differing varieties of alleged-armor-piercing shell of fifty years ago, for instance, with what is practically the one type of to-day, to realize that the last eighteen or twenty months of automobile development represents almost as great a commercial advance.

In fact, the conditions are such as to make it seem entirely safe to assert that the present progress and probable future is much more likely to be determined by commercial considerations than any probable mechanical advance.

The automobile "industry" of this country may be said to be just crystallizing into a "business." Although the sales of automobiles have not been without profit to those engaged in it, such profit must be greatly diminished when experimental expenses now legitimately appearing as investment are written off, and the commercial work of the American automobile industry up to the present time must be regarded as almost entirely "missionary work" undertaken not only with a view to revealing the character and purpose of the automobile, but also to the tempering of the exaggerated views of the public as to the scope of their application to purposes of business and pleasure. In fact, one of the greatest difficulties encountered heretofore in the sale of automobiles lay in the specifications resulting from exaggerated ideas of prospective customers not only as to what was to be expected of an automobile, but even more as to the character of the services which they themselves desired to have performed. Few of those even using carriages in a business way had given any consideration to the capacity of the horse in terms of miles and it was not uncommon three years, or even a year and a half ago, for an ordinary city or suburban customer who made no excessive demands upon his horse equipment, to declare an automobile "unfit for his purpose unless he could be sure of 50 miles on one charge," at a speed far in excess of any which city and suburban roads and traffic conditions would have permitted him to use. The introduction of the automobile was also impeded by the confusion of mind resulting from the general similarity between the automobile and fine horse carriage, without which it was impossible even to claim the attention of that class among whom purchasers were possible in the earliest stages. The price of the automobile even this class of customer considered excessive, since it was invariably compared with the price of the fine horse-drawn carriage approaching most nearly to it in appearance, without regard to the added value returned for the price of the motive power. On the other hand, those who appeared to appreciate the value of the motive power were as a rule unacquainted with the usual price of fine horse-drawn carriages and made their comparison between the cost of motive power of more or less novel and special character, with the cost of the "standard" street car motive power of the present date.

Still another class, in some way for which I have not heard a satisfactory explanation, placed the automobile industry on the same commercial plane as the bicycle industry, and failing to realize the limitations as well as the possibilities of the automobile, demanded the qualities of a Persian wishing carpet for the price of a tandem bicycle. For these and analogous reasons the automobile maker has been compelled to appeal almost exclusively to that class of purchasers who, however unappreciative they may have been of the value of the mechanical features, were thoroughly familiar with high-class, horse-drawn vehicle equipments of all kinds, and in order to do this he was compelled to still further enhance the cost of the vehicle produced by employing in its upholstery and finish the most expensive material and workmanship, while the same necessity compelled him to somewhat hamper the mechanical simplicity of his designs by a strict adherence to the latest fashions in "carriage lines" and finish.

Once sold, he had a much more substantial but perhaps no more commercially serious difficulty to contend with than those just enumerated, namely, the almost universal ignorance of the practical care, limitations and strength and weakness of the storage battery. This difficulty was still further enhanced by the unchecked eruption of opinions from a large class of engineers familiar with the principles of the storage battery, but wholly ignorant of it "manually," and grossly unconscious of the entirely empirical character of the data which really affects the use and durability of the storage battery in practical service. Almost every purchaser had some engineer acquaintance who was regarded by him as his sole prophet, and, while in many instances the prophet was a thoroughly well-informed engineer, I can hardly think of a case in which, whatever may have been his general knowledge of the subject, he had had any experience in the use and care of storage batteries. The very eminence of many of these engineers made it difficult to offer them instruction and the results were disastrous to the customers' impression of the durability of automobile storage batteries. In the very early stages this difficulty was further accentuated by the analogy which everybody attempted to draw between the requirements and performance of the stationary storage battery and those that were to be expected of the automobile battery. So persistent was the adherence to this analogy that great sacrifices were made in the pound-capacity of vehicle storage batteries in order to provide insurance against difficulties frequently experienced with storage batteries in other service but which experience has shown to be either wholly absent or commercially utterly insignificant in the automobile. The consequent decrease in mileage capacity still further accentuated the commercial difficulties resulting from the disparity between actual practical possibilities and the customer's exaggerated notions of his requirements. Furthermore, something of "a jump in the dark" resulted in the adoption by many automobile makers of types of batteries which, however well suited they may have been for any other purpose, were utterly unfitted for automobile conditions, and still further confusion was added by an attempt to draw conclusions from the performance of storage batteries on tram lines here and in Germany without recognizing the immense difference in conditions imposed by the far greater weight limitations demanded in the design of the automobile. A glance at the various difficulties arising above will indicate, what proved to be the fact, that they acted and reacted in accentuation of each other.

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*Gardiner D. Hiscock's work on automobiles provides perhaps as excellent a brief and comprehensive historical review of the art as is available to the ordinarily busy man, and I am indebted to it for the refreshment of my memory necessary to these remarks.

The mechanical difficulties were relatively trifling. Where the customer's actual ownership of the vehicle or some other equally strong interest resulted in intelligent and proper care, assistance from the factory was seldom called for after the first month of service. The only serious mechanical difficulties occurred to vehicles in the hands of those much-to-be-avoided customers whose interests were in one way or another so allied with those of the automobile seller as to give him recourse to the manufacturer for assistance or to compel the latter from motives of policy to reimburse him for the losses resulting from neglect and a not altogether unnatural ignorance of a new art. Such customers necessarily lacked the incentive to foresee and prevent even those common difficulties which are almost inseparable from the operation of any traction apparatus. When added to this the partially allied customer was, or believed himself to be, an engineer, much unnecessary trouble and expense and retardation of progress of the industry resulted from the frantic attempts on his part to repair the result of continual gross neglect by radical, and above all, "original" changes of design based on preconceived notions rather than upon any experience with or careful study of the automobile, or any knowldege of the general "harmony" of the design and construction of the particular vehicle then under his notice. A careful comparison of notes with a considerable number of what may be called "prominent" automobile builders in this country indicates that these difficulties were practically in direct proportion to the intimacy of the interest between the maker and the customer. Barring those many cases in which the unfortunate investor capitalized originality rather than commercial utility, it is not surprising that the mechanical difficulties should not have been serious; for, most of the problems the results of which combine to make up the mechanical portion of the electric automobile had already been solved; although, in but few instances, except as inherited from the tram car, were any established general laws available. As a consequence and in illustration of this last-named condition it is interesting to note that the designs of early automobiles were much farther away from those of the horse-drawn vehicles than those of to-day. In other words, as in the parallel case of the metallurgist and blacksmith, the laws being established by careful experiment on the part of the automobile engineer, are continually found to be justifying the results of the horse carriage maker's inherited experience of centuries.

In overcoming the above difficulties it was some time before Americans came to realize how little the commercial portion of the American automobile trade was to be judged from or likely to be assisted by a knowledge of the commercial conditions prevailing in France, and some good time was lost and not a few blunders appear to have resulted therefrom. But, singularly enough, perhaps the only commercial feature of the French trade universally applicable to the early stages of the business was wholly and persistently ignored by American beginners, many of whom seemed to think no returns worth while unless expressed in six figures and to whom it seems rarely to have occurred that the great expense necessarily inseparable from the rapid establishment of a wholly new business justified a consideration of the question of "minimizing losses." This feature is the result of French thrift and is exemplified in those successful Paris firms by whom automobile sales, boarding, livery, repair and sundry business are combined. That the American automobile maker should have instinctively turned toward the French for data is natural. Active automobile experimenting can hardly be said to have begun in this country until the spring of '95, but the automobile had been continually gaining ground in Europe since the middle 80's, although not until '93 or '94 did it command public interest to any considerable extent. Unfortunately for the analogy, in France the automobile was essentially a fad and seems still to be so in the main. In this country, from the beginning the possibility of *permanent* success seems to have been regarded as lying in the direction of business vehicles of one kind or another, although the realization of this expectation has been long delayed by the relatively high first cost of business automobiles when compared with horse-drawn vehicles and the relatively high up-keep, almost invariably traceable to the ignorance and neglect of the user and in a less degree to the conditions inseparable from the development stages of design.

Within the last few months, however, the four or five years of untiring missionary and educational work, the splendid organizing work and business capability recently shown by a company conducting a livery service in our largest city, the tremendous strides made in the adaptation of the storage battery to vehicle service, and above all the real practical advantages of the automobile itself, are beginning to reap their reward. The inquiries from customers wishing automobiles for business purposes are no longer adroitly worded inquiries for "something" to do service heretofore most unsatisfactorily performed by the horse or to which the horse is utterly unadapted—nor is the advertising value of the automobile as a novelty apparently any longer the incentive for their employment except on the part of the back-woods customer who is totally unable to buy one, anyway.

Nor does the customer who wishes to purchase an automobile for pleasure purposes any longer investigate it with a view to its substitution for the suburban local railway train or trolley service.

The bona fide inquirer for business wagons has been studying the subject now for over three years to my certain knowledge and is beginning to find that strict ledger comparison of horse and automobile service is beginning to be strongly in favor of the latter, and the purchaser of pleasure carriages has learned how far he usually wishes to go with a horse and how fast he usually goes, and where it is merely a question of transportation, without reference to the horse as a means of sport, he is beginning to be convinced that the automobile affords him every advantage.

Of course, as implied above, the great improvement in the vehicle storage battery and the still greater improvement in the dissemination of the knowledge of the care of it, play a large part in the change of attitude of the buying public The mileage of the average automobile equipped with the most durable American storage battery is to-day fully 50 per cent greater than it could have been with the same general type of storage battery of four years ago. Even with the violent, and, from the French point of view, ruinous methods of vehicle battery charging employed here, this type of battery in delivery wagon service with otherwise proper care can be counted upon for 6000 or 7000 miles of reliable service. In France, with careful all-night methods of charging, 100 discharges of 60 kilometers each are habitually expected from what we Americans regard as the most inferior and flimsy type of pasted battery. Under some further limitations the French automobilist expects and is reliably said to obtain 200 60-kilometer discharges from this same battery. The combination of French methods of charging with the most durable type of storage battery certainly suggests an enticing combination and an expectation partially justified by the remarkable durability records of similar batteries in tramway service. The brief and general figures just given cannot but serve to emphasize the thoroughly conservative nature of the figures given by Mr. Fliess in the excellent articles published in the ELECTRICAL WORLD AND ENGINEER of Oct. 6, 13, 20 and 27, in which the observation of actual practice on a considerable scale justifies me in saying the author still more conservatively underestimates the advantage to be gained by operating a considerable number of similar vehicles at the same time and place as well as the advantage in investment and up-keep resulting from the added ground covered per vehicle in such a station. In short, it is only within the last few months that the public has been educated to a point to consider the automobile in competition with or as a substitute for horse service, and while this is mainly the result of a gradual development in the public mind, it is to a minor degree the result of the improvement in the vehicles themselves, especially the storage battery, and in a somewhat greater degree to improvement in the knowledge of the care thereof. This gradual change to a substantial and practical attitude certainly justifies the declaration that the automobile has come to stay.

The above paper has been substantially confined to a consideration of the past and possible immediate future of the business in automobiles applied to purposes of trade and convenience, because of the writer's conviction, shared in common with many others connected with the trade, that in these directions must we look for the permanent business sufficient to justify any considerable permanent investment. That there will be, and in fact already is, a considerable business in automobiles for purely pleasure and sport, is undoubtedly true, but I believe past industrial history justifies the belief that this portion of the business will be subject to the same vicissitudes that have applied to the history of almost all trades in pleasure and sporting articles and may be expected to be transitory or at least intermittent.

It seems reasonable, however, to expect a somewhat more nearly permanent and substantial trade in that other line of carriages now most prevalent in France which combines with sport and pleasure the convenient accessibility of country clubs and neighboring towns and the gratification of the growing American desire for touring initiated by the bicycle.

That electricity will be conveniently adapted to this subdivision of the trade seems not likely to take place for some time to come. Whether it ever will be must depend largely upon the progress in the development of other forms of motive power in the meantime. Whether, on the other hand, a remarkable advance or discovery in these other forms of motive power will result in serious encroachment upon the field of the electric vehicle, in its application to business and convenience, as discussed in the above paper, depends upon the advance in the storage battery in the meantime, and, above all, upon its reduction in cost. The necessity for great improvement in its durability, while most important, will no doubt be largely mitigated by the improvement in the knowledge of its care.

That at present some other motive power than the storage battery will be found desirable in the heaviest business traffic, seems probable, but for light and moderate weight-carrying service and general convenience the storage battery bids fair to continue to be the most suitable of all.

The limits and somewhat hasty preparation of the above article have compelled me to confine myself to the consideration of those past and present commercial difficulties more or less peculiar to the automobile business, and which, added to a knowledge of the facts and conditions almost invariably inseparable from any new business, will be of assistance in forming a prediction as to the prospects of the immediate future of this particular business.

Neither time nor space permits a discussion of the special application of those early diseases common to almost any industry of this general commercial kind. I have consequently referred only indirectly to the difficulties arising from the adoption of measures for stock market considerations rather than from those of business expediency the application of the sales methods of the wheat pit in place of the principles which should govern the sales of merchandise; the embarkation of capital into the business with little or no consideration of the commercial conditions or any attempt to obtain data thereon; the investment in manufacturing a single variety of vehicle selected upon a pure guess as to what the future demand would be; the wasteful investments which have resulted, on the other hand, in manufacturing the greatest variety as a very proper means of disposing of the entire business at an opportune moment; the errors, both mechanical and commercial, resulting from an attempt to follow the ideas of the dataless and self-announced exemplar of the public demand; the mechanical criticisms of influential people with no better special mental equipment than a large vocabulary of mechanical terms and an unbounded confidence in the accuracy of their inner consciousness.

All these difficulties have been practically common to almost any rapidly developing industry, and a discussion of them has been purposely omitted to give way to the discussion of a few of those diseases which have been most prominent in this particular case.

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The Tercentenary of Electricity.

At the London Institution on Dec. 17, Prof. Silvanus P. Thompson gave a lecture on the "Tercentenary of the Science of Electricity." This tercentenary, he said, was to be dated from 1600, because in that year appeared Gilbert's treatise "De Magnete," in which it was shown that the attraction of the loadstone for iron was not the same as that exerted by amber for small particles of chaff, feathers, etc., and that this property of amber was shared by many other substances. In the century 1601-1700 Guericke constructed the first electrical machine, using a ball of sulphur, but very little more was discovered. In the next ceutnry there was a galaxy of names illustrious as contributors to the progress of the science of electricity. Still the real beginning of its useful applications dated only from the earliest part of the nineteenth century. Volta, in 1800, gave an account of the voltaic cell, and in 1802 Sir Humphry Davy, experimenting at the Royal Institution with a large battery of cells, produced the electric arc for the first time. About 1836 Daniell constructed a cell whose current was constant, though not very strong, and a few years later Grove invented his more powerful zinc-platinum cell, showing in 1841, in the theatre of the London Institution, that a battery of 100 of these cells could yield an electric arc 4 ins. long.

Future Development of Interior Wiring.

By H. Ward Leonard.

THE wiring of interiors of buildings is a subject with which almost every one living in towns and cities is likely to have some contact, and hence it may be interesting at the beginning of a new century to speculate a little upon the probable development interior wiring will see in the future. Since the future can only be judged by the past, and the past of this subject is represented by only about eighteen years, it is perhaps rather rash to attempt to say anything very definite. However, although we have only eighteen years of development to judge by, those years have seen such an enormous amount of interior wiring done in every civilized country and under so many different influences that certain conclusions may perhaps be fairly drawn as to what is likely to be the trend of the future development in this class of work.

There can be no doubt that the most important matter to be kept in mind when considering the subject of interior wiring is the fire risk. This is especially true in this country where wood enters so much more into the construction of ordinary buildings than it does in European countries.

Probably most of the interior wiring at present in use in this country can fairly be said to be a poor fire risk. This is because most of it was done under the mistaken notion that fires from electric wires were generally caused by overheating of the wires, due to their being too small for the current carried by them, or else that the fires were due to short circuit between the wires.

As a matter of fact there have been very few fires which were due to the use of wires of too small size for the current employed. The fires caused by short circuits have also been but a small percentage of the whole.

The high resistance leak between the two wires is the great cause of electric fires.

Such a leakage current, which may be a very small fraction of an ampere, has no appreciable effect in heating the wire and does not cause any fuse to blow. It is most difficult to test for, as it does not necessarily mean a ground connection. Such a high resistance leak may measure several megohms some days and in a few days it may measure only 1000 or 2000 ohms, if there is some atmospheric or other cause of a slight dampness on the materials between the wires. This condition of affairs causes an electrolytic action which in the course of months or years will reduce the size of the wire at the leakage place to such a small diameter that finally the normal current will cause the wire to melt at such a point. Then an arc, of perhaps 4 or 5 amperes, supplied by perhaps 100 volts, develops, and here we have the best possible condition for a fire. After the fire has burned a short time the resistance between the wires of opposite polarity becomes so low that the increased current blows a fuse. The short circuit and the fire ordinarily disguise the original cause of the fire and it is reported as a fire "due to wires becoming crossed" or "overheated by the current."

It will be evident that the small wires of the distributing circuits are the ones most likely to cause fires from such a cause. Very few fires are caused by the feed wires or the mains between the feed wires and the distributing circuits.

To avoid such fire risks, both poles of the circuit should be enclosed in the same metal conduit and that conduit should be thoroughly grounded. Under these conditions the dangerous high resistance leak working for months or years becomes impossible. If a leak occurs, it develops rapidly into a cross, blowing the fuse promptly: and if the metal conduit is grounded throughout its length no difference of potential between different portions of the conduit system due to contact with the wires inside of them can exist except momentarily, since this would be practically a metallic short circuit and would instantly blow a fuse.

Very early in the history of interior wiring the writer advocated strongly the method of wiring described, but the underwriters and fire departments of the early days believed in paper conduits, a large distance between wires of opposite polarity, and only one wire in a conduit; and such a radical departure as putting both poles in plain iron pipe and grounding that pipe was not permitted, but after many years and a few unimportant installations, the writer finally, in 1892, installed the first wiring system of this kind. It consisted of several thousand lights in the Cable Building in New York City. Two first-class rubber-covered wires were used in an ordinary gas pipe; special elbows, tees and similar devices being employed at the joints and bends. This method of wiring has since become very general and to-day the importance of having both poles in the same metal conduit is well appreciated in the principal electrical centres. But within a few miles of New York City, so called electrical experts still continue to install wires on porcelain insulators, separated by a few inches only, and placed between the floors and in the walls of frame buildings. It is to be hoped that the ignorant helper who puts the wires in place will not let the wires touch the wood or plaster or metal work anywhere and that no moisture due to a leaky roof or water pipe will ever cause a high resistance leak. It is also to be hoped that the insulation on the wires will be unaffected by years. But the chances of trouble in the future from such wiring are extremely good and the underwriters are of late quite properly concerned at the growing increase in fires due to electric wires several years after the installation.

Next to safety, as regards fire risk, the most important requirements in considering interior wiring is that the wires can be readily pulled out and renewed in case of any desirability or necessity. This again leads to the use of a substantial, amply large conduit, and there is nothing better than a good-sized iron pipe.

The voltage and character of current may change so that the wires installed in the past may not be the best for the supply system of the future; but if we have good permanent iron-clad holes of ample size ready at all times to receive the new wires desirable, we are safe, and also able to take advantage at slight expense of all probable developments in interior wiring, but it must be understood that unless a conduit is large enough to permit of the wires being pulled in and out after the building is finished and occupied, it is useless as a conduit.

It seems to be safe to predict that metal conduits will be practically universal in the installation of interior wiring in the future where the building is of the usual character in this country. In most European countries the use of plaster, stone and tile for floors and roofs, and generally where we employ wood, makes the risk of fire from electric wires extremely slight in comparison with the risk in this country. I think it can be stated, without fear of contradiction, that the habitual grade of wiring in European countries to-day is worse than we have had in this country for fifteen years. Any kind of wiring is safe as regards fire risk in a building which cannot be burned. This is probably the explanation of the poor grade of wiring so commonly met with in Europe.

In the future development of interior wiring, one of the most important factors will be the very great convenience and economy which can be obtained from a properly designed wiring system, as compared with any conceivable development in the use of gas or other known illuminants.

The average dwelling of to-day is wired so that electric lights are placed and used almost as gas lights are placed and used. There is no greater mistake than this. The electric distribution is flexibility itself when compared with gas distribution and the chief advantages of electric lighting over gas, lie in the possibilities of placing lamps anywhere we want them and controlling them by switches placed just where they will be most convenient to use.

There is still great room for improvement in the careful arrangement of lights and of the switches to control them. Usually the owner of a residence tries to see how few lights he can get along with and contents himself with a very few switches. In doing so he not only loses the chief advantage possessed by electric lighting over other forms, but he also greatly increases the cost of using it, for the easiest and surest way to economize in the use of electric current is to have plenty of switches, so that any desired lamps can be operated, without operating those not wanted, and to have those switches placed so conveniently that it is really no effort to switch off the lamps, as soon as they are not required.

As to safety devices, it has been already pointed out that there is no way at present known of protecting wiring poorly installed. The safety fuse has seen a great development in recent years and is likely to be used indefinitely, as it is a simple and sure means of opening the circuit in case of excessive current. But it is not a convenient device, since the ordinary user of electric lights is obliged to send to the electric supply company to replace a burned-out fuse.

There is a strong demand for a small, cheap, reliable automatic circuit breaker, but thus far the size and cost of such devices have prevented their introduction for the ordinary circuits of interior wiring. What is needed is a small automatic circuit breaker which will be a substitute for both the present switch and the fuse. Such a device has already been produced, but it is impossible to make it compete in first cost with the ordinary switch and fuse, and it will take time to make users pay the additional cost for automatic circuit breakers, just as it took time to make them pay for the present expensive conduit systems.

Fuses will always have a field and in many instances will be installed in addition to such automatic circuit breakers if they should come into general use, but the fuse should be so large that it will not burn out, except upon failure of the automatic switch to act.

In many respects the interior wiring of to-day is very perfect and in most points it has been rapidly evolved to a state of final permanence, which is without parallel, when we compare its development with the development of systems for the distribution of water, gas, steam, etc., in the interior of buildings.

The greatest bar to the general introduction of really first-class interior wiring is the prevailing notion that since "electricity is in its infancy" and since "no one knows what it really is," that therefore no consulting engineer is of any use and that the local bell hanger and "electrician" is just as good to design and install the wiring system as the large, experienced, electrical engineering and contracting concerns.

An interior wiring system designed for the ordinary residence or other building by a small concern having no engineering staff, and especially when it is designed to suit the owners' desire to "make it as cheap as consistent with first-class work" is probably as great a waste of money as can be found in a modern building. For a few months or years the owner rests contented under the mistaken impression that the underwriters' certificate means that he has a thoroughly first-class wiring job, and in some instances he never learns how far this is from the truth. But if he ever has to investigate the matter because of fire, or any modifications, or repairs, he usually finds that he will have to spend several times as much to make his wiring safe and convenient as it would have cost him had he dealt with the most responsible and highest-priced concern in the beginning.

When all interior wiring jobs, no matter how large or how small, are done under the specifications and supervision of competent and experienced electrical engineers, or are done by contracting concerns, having first class, high-salaried electrical engineers on its staff, we shall see a striking development in the interior wiring in general use and we shall also see the last of the electrical fire risk; and repairs due to defects will be as infrequent as in the case of modern gas pipes.

There is every reason to feel confident that the present comparatively low efficiency of the incandescent lamps will yield to the continued pressure of inventive genius, and it seems safe to predict the commercial use of a lamp of 1 watt per candle within our lifetime. There is, however, no reason to expect that improvements in this direction will have any radical influence in changing the methods of interior wiring.

The future development of interior wiring as viewed by the writer may therefore be summarized as follows:

1. All concealed wires will be placed in iron conduits, both poles of the same circuit being in the same conduit.

2. Distributing centres will be located at convenient places, and iron boxes placed there to contain automatic circuit breakers and fuses for connecting the mains with the distributing circuits.

3. The lights will be located in the most advantageous positions to secure specific results in lighting rather than the general illuminating now secured by large groups of lamps. In order to secure the best lighting effects, the lamps themselves will not be visible, except at a distance.

4. The arrangement of circuits and the location of an abundance of switches will be carefully studied so that the greatest convenience and economy will be obtained. The switches will be small automatic circuit breakers placed in iron boxes, flush with the surface of the wall, and frequently the automatic circuit breaker will have in combination with it a small dimmer, so that the candle-power of the lamps can be controlled at will.

Opinions as to Science.

The great majority, even of the students of science, must take their opinions ready-made as to science in general; each knowing, so far as he can be said to know anything at first hand, only that little corner which research has made especially his own.—S. P. LANGLEY.

The Telegraph.

By Patrick B. Delany.

ALTHOUGH the electric telegraph had been hinted at a century or more before, it may be said that Morse, of America, and Steinheil, of Bavaria, began almost simultaneously to make a practical method. Morse in 1837 made his first demonstration at the University of New York over a third of a mile of wire strung around a room, and a year later, with the help of the superior science of Joseph Henry and the mechanical skill of Alfred Vail, ten words per minute were transmitted over ten miles of wire at the same place. Henry, it must be remembered, rang an electric bell through a mile of insulated copper wire, similarly strung, seven years before. Morse began with what might be termed a short line recorder, using combinations of dots requiring a code book for preparing and transcribing messages. Henry had invented the long line instrument, Vail conceived the embossing register and, with or without Morse's help, supplied what is known to-day as the Morse code of dots and dashes.

Upon this foundation the system grew, until six years later, when the first practical telegraph in this country was put in operation between Baltimore and Washington.

The apparatus was crude and clumsy, but all the elements essential to success were there. In fact, about all that has been done to the Morse apparatus since has been by way of refinement and cheapening. The sounder has taken the place of the recording instrument and the trained ear and nimble fingers of the operator have raised the *possible* speed from ten to fifty words per minute, the average being below twenty, however.

After the Morse came the House printing instrument, which, considering the time, was by far the most ingenious combination of electro-magnetic-mechanical effects ever produced, and compared with which the work of others appears very simple.

After this instrument had been perfected and put into successful operation the inventor went back to his farm in Vermont, and after twenty years or more emerged from his seclusion with a wonderful conception which he had thought out in the furrow as he followed his plow, and worked into shape when the candle was low. He brought this machine to Brooklyn seventeen or eighteen years ago and showed it in experimental operation. The patents covering it have been "bunkers" in the game of telegraph invention ever since, affording at the same time a convenient "reference" for the Examiner at Washington for suppression of over enthusiastic inventors in this field. It is easier for the inventor to contrive a new departure than to argue House's "references" with the Examiner, neither of them having any clear understanding of its operation.

House's new machine was designed to operate on a selective plan and drop off printed messages at any station desired at a speed of about sixty words per minute, and to lock stations in and out of the line obediently to the operator's will. He invited his old contemporary, D. H. Craig, to witness the operation of his machine.

Craig saw it, and then took House over to the American Rapid Company's office, in New York, and showed him how messages were being sent between New York and Boston at several hundred words per minute. The old inventor soon after packed up his symposium of intricacies and went back to his farm. He died at Bridgeport five or six years ago, having worked half a life time with marvelous genius, apparently oblivious to the strides of improvement abroad in the land.

Just as House's original printing system went out of use Hughes brought out his printing telegraph, in a measure a modification of House's machine, and this was followed later on by Phelps' combination of the two, but the more simple and comparatively inexpensive Morse system usurped the field in this country.

In Europe, on the Continent especially, the Hughes printer has been extensively used for about thirty years and brought fame, fortune and honors to its inventor, whose most noteworthy achievement besides, was the discovery of the microphone.

In England Cook and Wheatstone were pioneers in practical telegraphs. The A B C dial instrument, the single and double needle, and the fittest survival of the lot, the Wheatstone automatic system, which to-day is carrying all the press matter and a good portion of the regular traffic for the British post office, are good testimony of the genius and industry of these co-workers.

About 1868 J. B. Stearns, of Massachusetts, duplexed the Morse system, making one wire about equal to two in carrying capacity. A year or two later Edison invented the quadruplex, and had this been the only achievement of his fertile brain it should entitle him to everlasting distinction. This quadruplex system is used most extensively in this country and England. According to a statement made several years ago by the late Norvin Green, at the time President of the Western Union Telegraph Company, the artificial or "phantom" circuits, created by the quadruplex, represented in value over ten million dollars to that company alone.

In 1884 the Delany synchronous multiplex system was perfected. It has not been used in this country, but was adopted by the British post office in 1885 and has been extensively used on all the leading routes in that country up to the present time. By it six Morse circuits are obtained over a single wire and all may be worked in one direction, if required, the circuits, unlike the quadruplex, which permits but two transmissions in one direction, being as independent of each other as though six wires were used.

The Morse, Wheatstone, and Hughes may be said to do the world's telegraphy at present. Each has been improved from time to time, both as to speed and distance of working, and the improvement in lines has contributed largely to their increased efficiency as well.

All these systems are based upon electro-magnetic effects. Without the electro-magnet not a single dot could be sent over land or sea nor a single word spoken by telephone. Even the wireless system of Marconi is dependent on Oersted's discovery. It disclosed the foundation for all electrical development, of which the telegraph was the forerunner.

Until Steinheil discovered that the earth would answer for the return half of the circuit he and Morse used two wires—one for sending, the other for receiving messages. Steinheil, in trying to utilize the two rails of a railway, found his transmitter short-circuited, and when one of Morse's wires, between Washington and Baltimore, broke down, he found that work went on just the same.

Up to 1876, when Bell exhibited his telephone at the Centennial Exhibition, no one dreamed that the telegraph would ever have a competitor in the field of electrical communication. Indeed, for several years after the telephone became a far speaker it was snubbed and scorned by the telegraph magnates. It was offered to them, lock-stock-and-barrel, for less than the price of a good race horse, but overconfidence begotten of monopoly, and prejudice allied to short vision, forced it to set up for itself. Its growth is known to everybody.

This invention by Bell and the wireless system of Marconi stand as the two great departures in electrical communication since Miss Ellsworth's message "What God hath wrought." Like Morse, Bell and Marconi have had their forecasters—purveyors to the architects, as it were.

The state of the art of electrical communication to-day may be summed up as follows:

Telephony	60 words per minute
Single Morse Circuits	15 words per minute
Duplex Morse Circuits	30 words per minute
Quadruplex Morse Circuits	50 words per minute
Multiplex (six circuit)	80 words per minute
Wheatstone Automatic	125 words per minute
Wheatstone Automatic Duplex	200 words per minute
Wireless	10 words per minute

These facilities, keeping in mind the restrictive charges, are ample for the amount of traffic offered. Increase of business can only be handled by increase in the number of wires, but this condition and its continuance falls far short of the legitimate demands of the present, and offer no relief for the future.

The present systems will not admit of any material reduction of rates. The average 30-cent 10-word telegram, and the dollar per hundred miles five-minutes talk by telephone, under most careful management and present capitalization, will not yield over 5 or 6 per cent dividends. Thus far the telephone has derived its great profits from local exchanges and rental of long circuits for private use. The private line business of the telegraph companies is to them the most profitable also. Combined, the telegraph and long-distance telephones do only about 5 per cent of the correspondence numerically, and probably not more than 2 per cent in volume, and their total yearly earnings (exclusive of local exchange business) is less than one-half the amount realized by the post office from the sale of stamps for first-class matter.

Letters average about 30 for each inhabitant. Postal cards 7. Telegrams 1½.

Undoubtedly before the new century is ten years old, at least one-half of the correspondence, now carried by train, will be telegraphed, at an average rate for the whole country of 15 cents for 50 words, or five times as many words for one-half the present telegraph toll.

It is practicable to begin this change at once, but not by present methods of operation. It is only possible by the chemical automatic system.

In 1846 Alexander Bain, of Edinburgh, conceived the idea of punching telegraphic characters in a paper tape, and then transmitting them by passing the tape through a machine which automatically made contacts through the holes. The message was received on a paper tape moistened with chemicals. An iron pen connected to the line resting upon the top of the tape passed the arriving signals through the paper to a drum over which it was drawn continuously, the drum being connected to earth, so that the pen, paper and drum formed part of the circuit. The discovery of the electrolytic action involved in this operation is said to have been made by Dr. J. Redmond Cox, of Philadelphia, in 1810, and afterwards amplified by Davy and others. This idea of stencilling messages on tapes laid the foundation for the present Wheatstone automatic system.

Bain's system was defective in all its main features. The perforator was crude, and his transmitter and all those used in subsequent attempts could not be relied upon to make contacts through the holes in the tape. The records on the receiving ribbon for high speeds on short lines, or moderate speeds on long lines were, owing to retardation, run together, so that translation was difficult and liable to error. These drawbacks have all been overcome, one by one, until recent demonstrations by the writer before scientific bodies, over artificial lines and over regular lines in actual practice, have shown that 4000 words per minute can be plainly recorded from New York to Philadelphia, 1000 words per minute New York to Chicago, and 200 words per minute New York to San Francisco direct, without repeaters, over a single wire. As an evidence that the speed of this system is only limited by the line, and is in no way restricted by the apparatus, 8000 words per minute have been plainly recorded over an artificial circuit of 250 ohms, 2 microfarads capacity, with 110 volts. This, with proper computation of letters and signals involved, amounts to over 2500 impulses per second plainly recorded, the sending tape passing through the machine at the rate of 8 ft. per second.

With such a system all the mails between any two points in the country can be telegraphed over one or two wires.

The train time will ere long be eliminated from correspondence and the Post Office will be used for collecting and delivering these "electropost" communications.

Postal telegraphy by the Government may, owing to political prejudices, be delayed, but utilization of the postal facilities locally in co-operation with private enterprise for long-distance transmission, will accomplish about the same results. Nor is any special legislation thought to be necessary to bring this about. The Postmaster General, having authority to contract with railways, steamships, tube companies and others for transportation facilities, surely has the power to contract with a telegraph company to deliver to the Post Office at one point preferred letters or "electropost" communications handed to the company at another point, enveloped, addressed and duly stamped, at a fixed price, and within stipulated limit of time. In this way a letter filed with the company at Chicago would be in the carriers' pouch in New York in less time than it would take to transport it from the Chicago Post Office to the train.

Liberal subsidy for the saving of time in mail carrying has been the policy of the Government from the beginning, as shown by the evolution from postboy and packet boat to the cannon-ball express and oceay greyhounds. An hour's reduction in the time of a thousand-mile run on land or an ocean trip commands the preference of the mails by the company achieving it, and, both locally and lengthwise, no expense is spared to expedite letter conveyance. A 10-cent stamp is used to hurry delivery so as to gain perhaps half an hour; sub-offices convenient for distribution are established without regard to expense, incoming steamers are boarded down the bay by sorters, and an army of mail distributing clerks are constantly on the go all over the country for the purpose of saving a little time.

Private enterprise will soon appreciate that this mine of business, amounting to about $75,000,000 annually, is worth competing for, setting the advantage of practically all time saved against the difference in expense. When the public realizes that the Post Offices throughout the country are but half an hour apart, and that replies to letters may be received in the same day for a charge not much more than the extra delivery stamp each way, it will be more than strange if letter transport by train, for business purposes at least, does not stop altogether.

A few substantially constructed wires over leading routes, taking in all cities of 25,000 inhabitants and over, leaving to the present methods the broker and exchange business, but using the Post Office, its trolleys, tubes, automobiles and bagmen to collect and deliver telegraph letters, will work an amazing change in correspondence in a short time. The Post Office cannot complain so long as it gets its postage at each end and without the expense of intermediate transportation.

This revolution cannot come by any electro-magnetic system. The Morse will continue to hold its place for speculative exchange business and train dispatching, but the great bulk of ordinary business will be carried by the system admitting of increase in volume and decrease in cost. Further improvements in electro-magnetic telegraphy need not be looked for. The limit in multiple and "phantom" circuits over a single wire has been reached. In fact, deterioration may be looked for, owing to the spread of trolley and power currents through the earth. In many notable instances already quadruplex workings have been seriously impaired, it being next to impossible to maintain a balance against a change of potential varying from zero to 60 volts, which is not infrequent between working points. It is useless to talk of increasing speeds by more sensitive apparatus, as has been proposed; the present instruments are much too susceptible to the stray currents which find their way into lines at every ground connection Present indications are that ere long all balanced systems of telegraphy must be provided with metallic circuits or given up.

The chemical automatic system employs no electro-magnets, has ample margin for recording over and above all variations from extraneous causes, and is only limited in speed to the carrying rate of the wire itself.

The telephone is surely destined for the greatest domesticity, locally. It will be "a household word," but for long distance it must always be an emergency means, on account of the cost Sixty words per minute (a fair average) or 30 words for each wire, will not admit of much cheapening. The time is coming, however, when the telephone and the machine telegraph will be associated in a way that will appeal to every telephone subscriber extensively engaged in business. Leading concerns will have a machine telegraph set, which will enable them to shoot into a correspondent's office, similarly equipped, 1000 words or more in a minute, to be transcribed at leisure by the typewriter, the message or letters having been prepared by the sender's typewriter, so that any business concern or newspaper may have private electrical mail facilities as many times a day as they wish to call up, and have ample opportunity for conversation within the telephone time limit as well.

These advances in cheap and general telegraphy, together with the spread of the uses of the wireless system in its legitimate field, where wires are impracticable, will all come about while the century is still young. The evidences being already here, prophecy has no place.

What the centenarian of a hundred years hence may see, a prophet should leave to his son to prophesy In the way of telegraphy, doubtless the ships amain will hold converse with each other, and correct their chronometers with the last observation a hundred miles away. They will be in constant communication with the shore through the air or by wires on the bed of the ocean, but as the trip from the Hook to the Lizard will be done in a day, and probably without touching the water, only the over-anxious will want a dispatch. Communication with Mars has already been pre-empted, and *seeing* by electricity may be no longer visionary. Our five senses may, forsooth, all be "wired" wirelessly.

Military Engines of the Future.

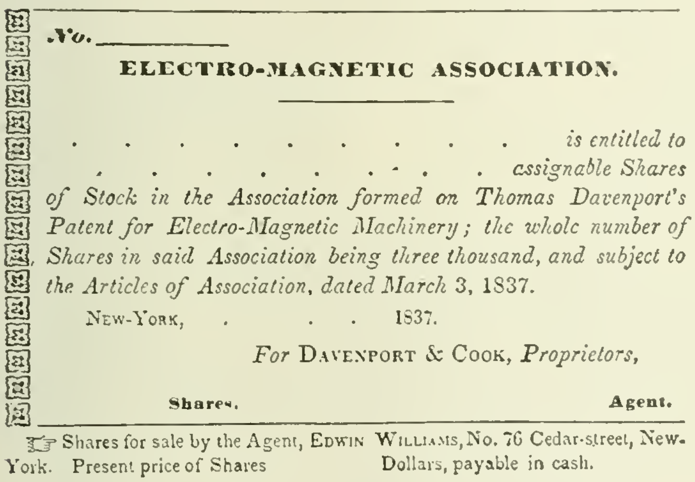
General A. W. Greely, U. S. A., in the New York *World*, says, in regard to military engines of the future: "Scientific forecasts for a century must be regarded as merely vague suggestions, especially in an age of such tremendous advances as have characterized the nineteenth century. War in the twentieth century must, to a greater extent than ever before, make tributary the sciences of commerce and industry. The evolution of offensive military methods must invariably be in the direction of improved mechanism which will be automatically operated. Improved means of operation, communication and transportation will surely follow, as indispensable to efficiency."

One Hundred Years of Electrical Industry and Finance.

By T. C. Martin.

WHILE it is true that the old century started its career with the noble gift from Volta of his battery, it cannot be asserted with any propriety that electrical industry then began. Doubtless, as in the time of Franklin or of Gilbert, somebody was paid for the manufacture of the philosophical apparatus used for experimentation; but only the lightning rod appears to have existed a hundred years ago as an article of commerce. The writer has seen professional bills for electro-medical treatment presented and paid while yet the nineteenth century was young, but he hesitates to regard that as being strictly industrial. It might be included under the head of finance. There are, however, no statistics available as to the annual production then of frictional machines and Leyden jars.

In the early thirties came the first indications of electrical development in this country, in the attempts to float Thomas Davenport's motor inventions and the assistance rendered to Morse by the Vails, the acquisition of an interest in the telegraph by Mr. F. O. J. Smith, and finally the period of industrial and financial exploitation through the formation of the Magnetic Telegraph Company in 1846, with a capital of $60,000, of which half went to the patentees, while for $15,000 cash the stock subscribers received the other $30,000. Even those who would deny to Morse the individual invention of the telegraph must admit some right on his part to the proud title of Father of Electrical Industry in America, and of an investment now representing over $3,000,000,000 in capital obligations. If these figures are doubled for all the rest of the world—a total to be taken with "E. & O. E." attached—the arts of electricity in seventy years have added $6,000,000,000 to human wealth. For the United States of America the half can be very easily established.



No. ______

ELECTRO-MAGNETIC ASSOCIATION.

. . . . *is entitled to*
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of Stock in the Association formed on Thomas Davenport's Patent for Electro-Magnetic Machinery; the whole number of Shares in said Association being three thousand, and subject to the Articles of Association, dated March 3, 1837.

New-York, . . . 1837.

For Davenport & Cook, *Proprietors,*

Shares. **Agent.**

☞ Shares for sale by the Agent, Edwin Williams, No. 76 Cedar-street, New-York. Present price of Shares Dollars, payable in cash.

EARLIEST KNOWN AMERICAN ELECTRICAL STOCK CERTIFICATE.

Telegraphy in this country has run up to a value of over $250,000,000, of which the Western Union and Postal Telegraph systems may be taken at not less than $150,000,000, the dividends on which have gone on steadily many years, the profits of the Western Union having grown from $2,227,965 in 1866 to three times as much thirty years later. Every railroad system has its telegraphs, on which immense sums have been spent. The New York Central lays out $300,000 a year on its telegraphs. There are in addition all the "district messenger" companies, all the police and telegraph systems, and some 800 cities with fire telegraphs. This does not include burglar alarms, thermostatic protection, etc., all of which are essentially telegraphic. Nor need the estimate include any large allowance for ocean cables, now rapidly approaching 200,000 miles, in which there is considerable American investment. In short, with the Western Union system alone standing for about $115,000,000, it will be seen that $250,000,000 for the total is rather low. It may be doubted whether the increase for land lines in the new century will be great, for the growth of the telegraph has been visibly checked by its offshoot, the telephone. But if the habit be formed of sending letters by telegraph, the figures will soon take a gigantic stride forward.

The value of the telephone business of the country, starting from Bell and Gray in 1877, may be put at around $400,000,000. The Bell system alone in 1898 stood for $160,000,000, and should to-day represent $200,000,000, with 2500 exchanges and offices, and 1,700,000,000 connections a year. The recent growth of the "independent" service has been enormous, and a complete list of its exchanges shows some 5000 names, with subscription lists as large in total as the Bell. Their capital investment and its return cannot yet be equal, but there must be at least 1,500,000 telephone subscribers, all told. If the average subscription throughout the country be put at $40 a year, the earnings are $45,000,000, and if the operating expenses are 50 per cent, the net is around $20,000,000, or 5 per cent on $400,000,000, as estimated. There would go into this amount a large expenditure for many years past on "interior" telephone systems, and by steam railroads, street railway, and other companies and persons, to which may now be added numerous hotels and apartment houses. As to the future for the telephone, it seems illimitable. There are some 15,000,000 families in this country. If business telephones be excluded, not half a million of the families have the benefit of the invention, but nearly all want it. A few people will be kept busy this century supplying them.

Electric lighting has been a favorite field for investment for twenty-five years, and the work of such men as Brush, Edison, Weston and Elihu Thomson now rounds up in this country a capitalization of at least $1,200,000,000 for central station companies, isolated plants, municipal plants and ship lighting, etc. There are between 2500 and 3000 companies, with obligations of about $750,000,000, of which a good half is bonded, and nearly the whole of which is in an excellent earning shape, its securities being strongly held. Isolated plants are believed to cover about half of the incandescent lighting done. It would appear that there are over 500,000 arc lamps doing duty, and the number of incandescent lamps connected is between 20,000,000 and 30,000,000, the latter number representing the annual American production, giving the lamp an average life of 600 hours, or two hours daily use, roughly, for a year. At only 1 cent one hour per day, 15,000,000 lamps are earning not less than $45,000,000 per year for the central stations; the arcs are earning $25,000,000, and the motors now connected probably more than $10,000,000. At between 50 and 60 per cent net, this would leave, say, $30,000,000 for charges and dividends, or not less than 4 per cent on the $750,000,000. In fact, central station earnings have been estimated at over $50,000,000 for the incandescents alone, but, as will be noted, a total much lower than that has been assumed. The figures for isolated and municipal plants might be put on an equivalent basis. There is no good reason to question the total for the lighting art at well over $1,000,000,000, and somewhere around $1,200,000,000.

The street railway industry nearly doubles that sum, big as it may appear, and is much more susceptible of verification as there are no isolated plants, no municipal roads, and only some 900 distinct properties. These may all be treated as electrical, for at this moment what remains of the horse and cable systems has begun the process of conversion. These roads, created by the genius of Sprague, Van Depoele, Henry and others, represent at the present time a capitalization of over $1,800,000,000, which, increasing of late at a rate of over $150,000,000 per year, will cross the two billion mark early this year, if, indeed, it has not already done so. Seriously inflated and overcapitalized as many of these roads have been, they yet have conferred such solid benefits on the community that the values are generally sound and sure of appreciation. In 1897 these roads were earning $150,000,000 gross, and in 1898 only 220 of them showed not less than $130,000,000, gaining very materially on this figure in the next year. Estimating that the gross earnings bear the proportion of about 10 per cent to the gross capitalization, therefore, the earnings would be $180,000,000 last year. Allowing, next, 60 per cent for all operation expenses, there was a net of $72,000,000, or exactly 4 per cent return over the whole vast sum. No inclusion is made in this total of such costly work as that done by the Baltimore & Ohio Railroad, or of the large investment in mine electric railways.

Already the three billion point in the calculation has been reached and surpassed, but there are additional items to be considered. Allusion has been made to mining work, quite a class by itself, and millions have been spent on transmission lines in connection with it. Those most familiar with the field estimate a valuation of $100,000,000, based on the few plants within their immediate knowledge. Then comes an analogous class of work in power plants for factories, mills, printing offices, etc., and inclusive of such enterprises as those at

Niagara, where $10,000,000 is a moderate allowance for the power features alone. Power plants blend frequently into those for lighting, but a safe figure for them separately is another $100,000,000 to $150,000,000. Yet a third kindred group of industries is furnished by those for electrolytic deposition. The latest returns show that in copper treatment alone some 200,000 tons of electrolytic are now produced annually in the United States of America, with 170,000 ounces of gold and 21,000,000 ounces of silver as by products. With deposition work again may be noted nearly 500 electroplating establishments with a capital investment of $50,000,000. It would be hard to-day to find a home in America that has not some electroplated articles in it.

Thus far nothing has been said of the electrical manufacturing companies in all the different fields. The General Electric and Westinghouse alone stand for $50,000,000, but they cannot be bought for that figure; and there are forty other concerns of the same class, many of them large, making light and power apparatus, to say nothing of the lamps and fittings. In the telegraph and telephone branches a list of 100 producers can be run up, some of them quite extensive, and to them can be added a score of makers of wire and cable, nearly all with large plants. The futile efforts that have been made to bunch such plants in different lines have proven that a sum of $150,000,000 for the electrical manufacturing industries of America would be unduly moderate, especially if they were taken in at their own valuation. To all these must be added the new group of automobile producers and local companies, with an investment of at least $10,000,000, and a capital on paper many times that amount. The storage battery industry, too, has come to pay dividends on $15,000,000; and the latest development, telpherage, bids fair to roll up millions almost as promptly as any of its predecessors have done.

There are various distributive agencies quite aside from the telegraph, telephone and lighting companies, and quite apart from the traction properties. From 100 to 125 concerns are entitled to the name of wholesalers, or jobbers, and when the retail point is reached, the numbers increase most rapidly. In the aggregate the hundreds of electrical contractors, bell hangers, hardware stores, bicycle shops, etc., dispose of immense quantities of small apparatus. A hotel of any pretensions has its annunciators, telesemes, pan-signals; and hundreds of thousands of homes have their bells, push-buttons, and batteries. Annual renewals, repairs and extensions are considerable. There is, moreover, a very large annual business in the repairs of electric light and power apparatus, and it seems difficult to get any of it finally into the scrap heap. There is quite another class of utilization of electrical apparatus in universities, schools, hospitals, electro-therapeutic work, etc. The list again is well nigh endless of concerns making instruments, batteries, special appliances, and nearly every one of them would scorn to be capitalized at the amount of the first telegraph company.

One is often asked how many people are employed in the electrical industries of the country, but it is a matter difficult to determine. There are over 100,000 in telegraphy in its various branches. The Bell telephone exchanges have to-day over 26,000 employees. Electric lighting, with its large power plants, linemen, wiremen, executives, etc., probably gives employment to 150,000 people. The electric railways, with their service all around the clock, need a numerous force, possibly 150,000. The electrical factories, all told, must have 100,000 hands; three companies alone have 25,000; while scores and scores range from 100 up to 500. A lumping together of all the miscellaneous forces would bring the total above 600,000. It is usually said that over 500,000 souls derive a living directly in the United States from electricity, and that number is certainly below the mark rather than above it.

The above data are available to all and can be tested and checked by any one who deems it worth while. If the estimates are lopped on one side, they expand on another, and it is submitted that there is no escape from the conclusion that upon any fair and reasonable basis of calculation the American people have invested during the past one hundred years enough money to create electrical industries whose values approximate three billions of dollars. The summation of the above is as follows: Telegraphy, $250,000,000; telephony, $300,000,000; electric lighting, $1,200,000,000; electric railways, $1,800,000,000; electric mining, power transmission, deposition and plating, $250,000,000; electric manufacturing, $150,000,000; automobiles and storage battery, $25,000,000—grand total, $3,975,000,000. In other words, four billions is not out of the way, and at the worst must be taken as a plausible and flattering guess—forty million dollars for every year of the century.

Welcoming the Stranger.

An elaborate reception to the new century was given by the City of Greater New York at the City Hall, when a chorus of 1000 singers and a large band competed with 100,000 fishhorns and were extinguished. It was not so easy, however, to obscure the effect of the beautiful illuminations, all of which were electrical. The handsome old building was festooned in strings and designs of colored lamps—red, white and blue—of which 3690 of 10 candle-power were used. A sign reading "Welcome Twentieth Century, 1900-1901," containing 560 lights, was placed over the main balcony. The entire installation was done within 48 hours after the order was received, by the Norden Electric Works, under the supervision of Mr. Mortimer Norden. Just before midnight the lights were cut off, leaving the building in darkness, and then as the century border line was crossed they were all flashed in again, the same effect being repeated by the lights on the *World* dome. For about an hour the City Hall remained the center of a wonderful picture, as colored fires were burning in every direction, throwing it into high relief.

A New Century Call-Up from Mars.

It will be remembered that Mr. Nikola Tesla has for some time past insisted on the possibility of exchanging signals with Mars, as determined by the results of his interesting experiments on wireless transmission. The New York *Sun* publishes on Jan. 3 a column interview with him on the subject and in it asserts that he has recently seen some curious effects on his apparatus. We quote as follows: "When the National Red Cross, which was arranging for the end try, asked Mr. Tesla to indicate what, in his opinion, would be one of the century meetings of its various branches throughout the coun-transmission. The New York *Sun* publishes this week a column in- of the great achievements of the coming century, he gave just a hint of one of the wonders he discovered in Colorado. In a more elaborate way Mr. Tesla dwelt on his work to a *Sun* man. He regards his latest results as far and away the most important he has ever attained. Briefly, Tesla has been able to note a novel manifestation of energy, which he knows is not of solar or terrestrial origin, and, being neither, he concludes that it must emanate from one of the planets. While he was conducting his investigations in his Colorado laboratory one day the instrument he was using to observe the electrical condition of the earth was affected in an unaccountable manner. It recorded three distinct, though very faint movements, one after the other. These movements were observed not once, but many times, the number of impulses varying, and Mr. Tesla now firmly believes that, with improved apparatus, it will be quite possible for the people of the earth to communicate with the inhabitants of other planets."

CURRENT NEWS AND NOTES.

NIAGARA POWER IN TORONTO.—A party of Toronto (Ont.) capitalists recently consulted with Mr. William B. Rankine, of Niagara Falls, N. Y., regarding the transmission of electrical power to the City of Toronto. While the details have not yet been made public, it is said that arrangements are being made to transmit the power from the American side to Toronto at an early date. The development of power on the Canadian side was also discussed.

TESLAIC TELEGRAPHY.—A special dispatch from Washington, of Dec. 29, says: "Nikola Tesla has been asked by Rear Admiral R. B. Bradford, Chief of the Bureau of Equipment, to submit for trial a wireless telegraphy system perfected by him. Mr. Tesla says that his system is equal to, and perhaps superior to that of Marconi, and has offered to install it on naval vessels. Admiral Bradford in his last annual report recommended that negotiations be entered into with Marconi to secure his system for American vessels of war, if a reasonable rate could be agreed on."

UNDERGROUND RAILWAY VIBRATION.—A cable dispatch from London, of Dec. 29, says: "The promoters of the underground electric transit tube projects are still sorely troubled by the vibration difficulty. Householders in Bayswater, where the twopenny tube runs eighty feet below the surface, have had photographs taken in their drawing-rooms while trains were passing, producing an effect as though the walls were trembling. The tube engineers are conferring to find means of correcting the vibration, as failure to do so may prove fatal to all the other tube projects now hatching."

LETTERS TO THE EDITORS.

Variable Ratio of Rotary Converters.

To the Editors of Electrical World and Engineer:

Sirs:—In your Digest of Dec. 8, 1900, a leading place is given to the description of a method for "Varying the Secondary Voltage of a Converter," which is attributed to the General Electric Company, of Berlin. The arrangement shown and described appears to be identical with that introduced by the writer some five and a half years ago, and which forms the subject of English Letters Patent No. 11,153, 1895. Claim 2 of this patent is as follows:

"A rectifying motor generator transformer with main and auxiliary armature cores and magnetic field arranged and wound to afford means for varying the transforming ratio by manual or equivalent regulation, all substantially as and for the purposes hereinbefore described."

Fig. 5 of the same shows a construction precisely the same as that illustrated by you. W. L. Spence.

Glasgow, Scotland.

The Rectifier System in England.

To the Editors of Electrical World and Engineer:

Sirs:—We have read with great interest the article by Mr. F. H. Minshall on "Street Lighting by Electric Lamps" in your issue of Dec. 1, and, while congratulating him on the able manner in which he has treated his subject, we should like in justice to ourselves, to point out one instance where his figures are not quite up to date. As we are the sole makers of the Ferranti patent rectifier, three of which we have supplied to Croydon, we beg to draw attention to the fact that the efficiencies quoted are very much below what can now be attained. The Croydon rectifiers, though at the time the best our experience could devise, were built about five years ago, and owing to this and the fact that their output is only 30 lights, *i. e.*, 18 kilowatts, it is quite probable their full load efficiency is only 85 per cent. However, during the last three or four years, great progress has been made, and on a test made in last May on our latest design of rectifier, the output being 50 lights, i. e., 30 kilowatts, the following good results were obtained:

Full load, 91.3 per cent efficiency; one-half load, 84.2 per cent.

An advance has therefore been made of 6.3 per cent on the full load efficiency. This increase of efficiency reduces the cost of a 550-watt rectifier current open arc $5 per year, making the total cost $102.03 per year. This brings the cost below either of the 650-watt alternating current enclosed arcs mentioned, and there is no question that the 550-watt rectified arc of 11.8 amperes gives by far a better light than a 650-watt alternating enclosed arc.

Another point we would wish to draw attention to is that the synchronous motor has been partially redesigned, and the running improved to such an extent that its liability to run out of synchronism is of rare occurrence, and we are assured by two electric light stations where our new pattern rectifiers have been in use continuously for nearly two years that a run out has never occurred.

We have written this explanation as it may be inferred that Mr. Minshall's results are the latest obtainable from the rectifier system, and it is possible some engineers may in consequence be prejudiced against it. S. Z. de Ferranti, Ltd.

Hollinwood, England.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Large Alternators.—Heyland.—The first parts of an illustrated article giving "Some notes on the design of large alternators" of the fly-wheel type, with special reference to two 1000-hp alternators exhibited at the Paris Exposition by the Electricité et Hydraulique, Ltd., of Charleroi. He thinks that no machines of their type have hitherto been built having such small pressure drop. The good results obtained with these two machines are due first to various electrical details, but principally to the high magnetic saturation in the poles, combined with a very small increase of magnetic leakage from no load to full load. The total weight of one of these machines complete, but without the shaft or bearings, is 42.2 tons, which gives 126 lbs. of total material per kilowatt, of which 7.3 lbs. is copper. The field poles are bolted directly to the rim of the magnet wheel without being let in in any way, as is frequently done in order to decrease the magnetic reluctance between the two surfaces; this construction was unnecessary, as the magnetization of the iron is carried to a very high value, and the paths for the lines of force are very short. The poles themselves are unusually short in order to minimize the magnetic leakage between them; moreover, the leakage path is still further lengthened, owing to the fact that the poles are of comparatively small section, the reduced section being possible on account of the high flux density in the poles and on account of the high permeability of the cast-steel used. The armature windings are in closed slots, the depth of these slots being made small in order to reduce as much as possible the magnetic leakage that occurs in the teeth between them. The closing of the slots, on the other hand, has the effect of causing considerable magnetic leakage of the flux from the poles across the slot bridges, which are about 1-12 in. deep, but this leakage does not alter much with the load. There is at every load a strong leakage across these bridges, to such an extent that at no load (with excited magnets) the bridges are already saturated and therefore the magnetic reluctance is constant. He gives in two diagrams the magnetization curve and the short circuit current curve. He discusses these curves and shows that the smallness of the pressure drop is due in a great measure to the high saturation in the field poles and air gap. While with ordinary machines an increase of the air-gap diminishes the pressure drop, with his type of alternators this effect is inconsiderable. The advantage of a saturated field is thus of even greater value with diminished air-gap length, or, what is the same thing, when a large portion of the excitation is required for the iron circuit alone. This is especially the case with small machines.—Lond. *Elec. Rev.*, Dec. 7, 14. An illustrated description of these alternators also in *Elek. Zeit.*, Dec. 6.

REFERENCES.

Testing of Alternating Current Machinery.—Townsend.—An outline of a series of experiments which make up the alternating current laboratory course prescribed for the fourth-year students in the electrical engineering department of Columbia University. In addition to most of the usual commercial tests, a number of experiments are given which are designed solely to point out and explain the characteristic properties of the apparatus used. The experiments relate to the elementary properties of alternating circuits, alternating

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Journals Abstracted for the Digest.—The following is a list of the more important abbreviations used in the Digest for the titles of the electrical journals referred to. There are many other journals which are abstracted and noticed from time to time, the titles of which are either given in full or are abbreviated in such a way as to be easily recognized:

	Austrian.	
Electro-Techniker.	*Elec. Tech*	Vienna
Elektrotechnischer Neuigkeits-Anzeiger.	*Elek. Neu. Anz*	Vienna
Zeitschrift fuer Elektrotechnik.	*Zeit. fuer Elek*	Vienna
	Belgian.	
Bulletin of the Belgian Society of Electricians.	*Bul. Belg. Soc. Elec*	Liege
	British.	
Abstracts of Papers in Scientific Transactions.	*Abstracts Brit*	London
Electrician.	*Lond. Elec*	London
Electrical Review.	*Lond. Elec. Rev*	London
Electrical Engineer.	*Lond. Elec. Eng*	London
Electricity.	*Lond. El'ty*	London
Electrochemical Review.	*Electrochem. Rev*	Manchester
Lightning.	*Lightning*	London
Philosophical Magazine.	*Phil. Mag*	London
Proceedings of Institution of Civil Engineers.	*Inst. Civ. Eng*	London
Science Abstracts.	*Science Abstracts*	London

current generators, alternators in parallel, transformers, curve tracing, resonant rise of potential, polyphase circuits and transformations, test of a three-phase induction motor, converters.—*Sch. Mines Quart.*, Nov.

Motor Generators and Synchronous Converters.—PERKINS.—A continuation of his illustrated serial. He discusses the use of motor generators for series arc lighting circuits in streets, the most practical form and that most extensively used being to drive an arc lighting machine at each end of an alternating current motor shaft. He then discusses the use of rotaries for electrolytic work, in combination with step-down transformers of a variable ratio of transformation; he describes the installation of several electrolytic plants at Niagara Falls.—*West. Elec.*, Dec. 22.

LIGHTS AND LIGHTING.

Direct Current Arc.—DUDDELL.—The first part of a paper read before the Brit. Inst. Elec. Eng. on "Rapid variations in the current through the direct current arc" (not arc lamp, as that involves the mechanism). He gives an account of what occurs when the current is periodically varied more or less rapidly over a range which is very small compared with the mean value of the direct current. He distinguishes between the two cases whether the variation of the current is due to changes taking place in the circuit, such as variations in e. m. f. or resistance, or due to effects in the arc itself, such as hissing, humming. In considering the first case, he discusses the effects produced by variations of the current on the potential difference, on the light emitted, on the craters and on the vapor column; he shows that the direct current arc may be used as a telephone receiver and even as transmitter, as it is affected by such small changes of outside conditions as sound waves produce. He then discusses the variations of the current due to humming and hissing. In the humming arc the frequencies of the rotation of the arc and of the variations in the p. d. current, and light emitted in a given direction, are identical with the pitch of the note given out. When the current through the humming arc is increased until the arc hisses, the variations in p. d. current and light change in a very striking manner from regular periodic variations to very irregular variations, which, however, can be separated into a large comparatively slow variation and a rapid superimposed one; the rapid variations of p. d. and current correspond with the variations of the light emitted by the positive crater, and the large slow variations with the rotation of the arc as a whole. In many cases the maximum light and minimum p. d. occur practically at the same instant, while the maximum current occurs later than the light maximum. This is the opposite to what occurs when the current through the arc is varied by any change in the circuit, for in the latter case the maximum current occurs before the light maximum. He then discusses sounds emitted by very short and very long arcs; also intermittent arcs.—Lond. *Elec.*, Dec. 14.

Train Lighting.—CLARK.—An illustrated description of a system devised by him for electric passenger coach lighting. It belongs to those systems in which the current is produced by an axle-driven dynamo and a storage battery. The dynamo has two windings on the armature, one for the storage battery and the other for the lamp direct. To keep the voltage constant under variation of speed, a voltage regulator is used, in which a rheostat is actuated by a centrifugal governor. A special electromagnetic switching device is in use for making the necessary connections between lamps, battery and dynamo; also a special device for reversing the shunt field winding of the dynamo when the direction of the motion of the car is reversed. These devices are fully described and illustrated.—*West Elec.*, Dec. 22.

Arc Lighting in Chicago.—An illustrated article on the new municipal arc lighting plant in Chicago. It contains four Brush 160-light arc machines, each giving 9.6 amperes at 8000 volts and running at 500 revolutions; there are five Gen. El. arc machines of the double circuit type, each giving 6.6 amperes at 11,000 volts, the speed being 500. The present equipment provides for 1200 lights, 831 lamps being now used. Seven series circuits are supplied from the station.—*West. Elec.*, Dec. 22.

POWER.

Electric Power in the Comstock Mines.—Two papers on the Comstock mines, which are extremely rich in gold and silver ores, but had to be abandoned in spite of strenuous efforts twenty years ago, as the pumping of the water could not be accomplished successfully. The first paper, by Eckart, gives a description of the historical pumping plants, erected at the Comstock mines up to 1884 and 1886. The second paper, by Low, deals with the Truckee-Comstock power transmission, by which it is hoped the resurrection of the Comstock mines will be accomplished. The contract of the mining companies with the electric transmission company requires the latter to maintain a 2240-volt three-phase service for 1500 horse-power, which shall be measured in the sub-station at Virginia City. The water power plant and the transmission lines are described; the current is transmitted at 22,000 volts. At the mines, electric hoists will be installed, using the balanced tail-rope system, driven by direct-geared 200-hp induction motors. Current for the underground stations is carried down the vertical shaft of the Consolidated California and Virginia to the 1750-ft. level by means of a three-conductor, lead-encased cable, protected by a steel wire armor. A 100-ton mill with two sets of grinders and three sets of concentrators is equipped with six induction motors. Ore from the Gould & Curry mine is brought to the mill by a small direct current haulage equipment, to which current is furnished by a 220-volt direct current generator belt driven from an induction motor.—*Jour. of Elec.*, Nov.

Power from Blast Furnace Gases.—A brief illustrated article on a new installation at the Sheepbridge Iron Works of Chesterfield. Gas given off from the blast furnaces is treated in a Thwaite-Gardner installation and supplied to a 100-hp gas engine driving a dynamo, which gives current for lighting and power purposes. The success of the installation was dependent upon its being capable of running continuously. This has been so successfully done that the system is now being extended.—Lond. *Elec. Rev.*, Dec. 14.

TRACTION.

Electric Traction on Main Lines.—The long abstract of the discussion which followed Langdon's recent paper is concluded. There is also an editorial in this paper. Langdon compared actual steam railroading costs with estimated electrical railroading costs on a certain line; for the electric traction he had assumed conditions which are only theoretical; he ignored the additional energy and cost evolved in acceleration and hill climbing, and assumed a perfectly level track, without any intermediate stops or starts; it is said that a proper consideration of actual working conditions would considerably increase Langdon's estimate of capital outlay and working cost. The greater part of the discussion was devoted simply to the question of replacing the steam locomotive by the electric locomotive, heavy trains being drawn by a separate locomotive at comparatively lengthy intervals of time. This is called a narrow view of the question and attention is called to the declaration of F. J. Sprague that the claims of electric traction involve far more than the mere supersession of the steam locomotive, and that the fact that electricity permits of a faster and more frequent service, may in the end prove even a greater inducement to its adoption by the railway companies than the bare question of relative cost. Electricity cannot only supply cheaper traction than steam; it can accomplish things that steam cannot by any means be made to do. "Electric traction will not be merely a superior thing; it will be the only thing possible. But much must happen before that time arrives."—Lond. *Elec.*, Dec. 14.

Battery Traction.—A note on the experience had in Ghent, Belgium. About a year ago the tramway company decided to adopt electric traction, disposed of its horses and introduced accumulator cars, for, as the town is composed of 26 islands, with 140 bridges, the difficulty of an overhead system was very great and an underground one was practically out of the question. The experiment was undertaken by

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CANADIAN.

Canadian Electrical News.	*Can. Elec. News*	Toronto

FRENCH.

Bulletin de la Société Internationale des Electriciens.	*Bul. Soc. Int. des Elec*	Paris
Cosmos.	*Cosmos*	Paris
L'Industrie Electrique.	*L'Ind. Elec*	Paris
L'Eclairage Electrique.	*L'Eclairage Elec*	Paris
L'Electricien.	*L'Elec.*	Paris
L'Energie Electrique.	*L'Energie Elec*	Paris
La Nature.	*La Nature*	Paris
Le Mois Scientifique et Industriel.	*Le Mois Sc. Ind*	Paris
L'Industrie Electro-Chimique.	*L'Ind. Electro-Chimique*	Paris
Revue Generale des Sciences.	*Rev. Gen. des Sc*	Paris

GERMAN.

Centralblatt fuer Accumulatoren und Elementenkunde.	*Centralblatt f Accum*	Halle
Elektrotechnische Zeitschrift.	*Elek. Zeit*	Berlin
Elektrotechnischer Anzeiger.	*Elek. Anz*	Berlin
Elektrochemische Zeitschrift.	*Electrochem. Zeit*	Halle
Physikalische Zeitschrift.	*Phys. Zeit*	Leipzig
Elektrotechnische Rundschau.	*Elek. Rund*	Frankfurt
Zeitschrift fuer Beleuchtungswesen.	*Zeit. f. Beleucht*	Berlin
Zeitschrift fuer Elektrochemie.	*Zeit. f. Elektrochemie*	Halle

JAPANESE.

The Electrical Friend.	*Elec. Friend*	Tokyo

two companies, one undertaking the exploitation of the line and the other the station for charging the accumulators. The trial is said to have been a failure, but it is not stated in this note why. Despite the enormous difficulties in the way, the company now proposes to construct an overhead system save over the bridges where this is impossible, and where the accumulators will be retained.—Lond. *Elec. Rev.*, Dec. 14.

ELECTRO-PHYSICS AND MAGNETISM.

Cosmic Electric Phenomena.—G. T. FITZGERALD and O. LODGE.—Two communications. FitzGerald refers to Lodge's recent letter. He points out that there are many things which seem to show that comets' tails, auroræ, the solar corona, and cathode rays, are closely allied phenomena. Regarding Cremieu's experiments made to show that there is no magnetic field due to a moving electric charge, he suggests a possible but highly hypothetical way of reconciling these experiments with a great deal of our existing observations and theories. He further remarks that until Cremieu's experiments have been repeated by others, and until no doubt can be thrown on their methods or calculations, he would advise at least a suspension of judgment before we seek for new foundations for our electromagnetism. In the other communication Lodge says that the conditions of a vacuum tube seem to correspond closely with the conditions which must obtain in inter-planetary space; if the sun or other body is negatively electrified, cathode rays can hardly help streaming from it through the great dark space; when they impinge on an atmosphere they should give rise to ordinary vacuum tube appearances, etc. In the question of the disturbances of magnetic observatories by tramways, he says that so far as waste tram-electricity disturbs observatories, he is with the observatories. He says that it would be madness to discontinue or spoil the record of a long series of continuous observations except in case of dire necessity, and that the destruction or removal of Kew would be a national misfortune.—Lond. *Elec.*, Dec. 14.

E. M. F. Due to the Motion of a Liquid.—ZAKRZEWSKI.—An illustrated description of the following experiment: Two basins, containing water, are in communication with another by a capillary glass tube, the inner surface of which is silver plated. There is a platinum electrode in each basin near the end of the capillary tube. By increasing the atmospheric pressure over the liquid in one basin, the water is pressed through the capillary tube; an e. m. f. is then observed between the two platinum electrodes. The sign of the e. m. f. depends upon the direction in which the water flows. The e. m. f. is proportional to the difference of the pressure at both ends of the capillary tube; it also depends upon the distance of the electrodes from the ends of the capillary tube.—*Bull. de l'Ac. des Sc. de Cracocie*, June; *Phys. Zeit.*, Dec. 8.

Permeability of Iron Under the Influence of the Oscillating Discharge from a Condenser.—MARCHANT.—A paper in which he gives photographs of sparks taken with the aid of a revolving mirror, from a coil of 5 millihenry self-induction and a Leyden jar of 0.06 microfarad, the difference of potential before discharge being 13.5 volts. The effect of the soft iron core upon the nature of the spark is well shown. The first half oscillation with the core in the coil is seen to be nearly twice as long as without it, and a series of oscillations follow it, gradually increasing in length.—*Nature*, Aug. 30; abstracted in *Science Abstracts*, Nov.

REFERENCES.

Electric Oscillations.—FLEMING.—An abstract of the third of his series of Cantor lectures on this subject. He gave a summary of Maxwell's theory and discussed some of its consequences as to the identity of the ratio between the absolute unity of the electrostatic and electromagnetic system, with the velocity of light; also the relation between dielectric constant and refractive index. He also discussed various other theories, especially that of Larmor.—Lond. *Elec. Eng.*, *Elec.*, Dec. 14.

Roentgen Rays for Physicians.—ROLLINS.—The first part of an illustrated description of several instruments and apparatus for the production of Roentgen rays for the use of physicians in this country.—*Elec. Rev.*, Dec. 19.

Magnetization of Electro-Deposits.—MAURAIN.—An account of experiments made to compare the magnetization of a deposit of electrolytic iron produced from ammonium oxalate of iron in a magnetic field, with the magnetization of the same deposit exposed to the magnetic field after deposition. The results are shown in curves.—*Comptes Rendus*, Nov. 26; abstracted in Lond. *Elec.*, Dec. 14.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Bleaching.—OETTEL.—An illustrated article on the Haas and Oettel system of electric bleaching. As electrolyte, a sodium chloride solution of 4 to 6 degs. Baume is used; for the single negative end electrode, a lead plate; all other electrodes are of specially-prepared carbon; each of the many intermediate electrodes dividing the tank into numerous cells, acts as anode on one side and cathode on the other, in the two adjoining compartments respectively. A good circulation of the electrolyte is produced by making it flow from the first compartment over the first intermediate electrode into the next compartment, from there below the second intermediate electrode to the third compartment, and so on; from the last compartment it runs off as bleaching solution into a basin. Such an apparatus in 10 hours gives 3000 liter of lye with 3 grams of bleaching chlorine per liter therefore a total of 9 kilograms of chlorine, with 45 to 50 amperes at 110 volts; hence for the given chlorine concentration 7.5 to 8.3-hp hours are consumed per kilogram of bleaching chlorine. Recently it has become necessary to get strong bleaching lyes, containing 5 to 10 grams of bleaching chlorine per liter. It is impossible to accomplish this by running the lye at a lower speed through the apparatus, as the temperature rises too much. Kellner uses a more concentrated solution and runs the solution into a basin, where it is cooled down, and by means of a pump it is forced back into the apparatus; this process is repeated, until the bleaching solution has the required concentration Haas and Oettel use an interesting device by which during the electrolysis the solution is in perpetual automatic circulation between the electrolytic bath and the cooling basin; they utilize for that purpose the hydrogen developed by electrolysis. The electrolyzer is placed into the cooling basin; in general the electrolyzer is arranged as described above, but its compartments are separated from one another; each compartment is in communication with the external cooling basin by a hole in the bottom and by an overflow gutter at the upper rim. As long as there is no electrolysis there is hydrostatic equilibrium between the solutions in the electrolyzer and the cooling basin; when, however, electrolysis is started, the solution in the electrolyzer contains hydrogen bubbles and has therefore a lower specific gravity than the solution outside; there is no longer a hydrostatic equilibrium, but the liquid tends to rise in the compartments of the electrolyzer and flows over through the gutters. He gives a result of a test made with an electrolyzer of 28 compartments, with 60 amperes at 115 volts. 840 liter of sodium chloride of 15 degs. Baume being used; after the first hour the solution contained 2.55 grams of bleaching chlorine per liter and 4.48-hp-hours are consumed per kilogram of chlorine; after the tenth hour the solution contained 14.31 grams of bleaching chlorine per liter and 8.11-hp-hours are then consumed per kilogram of chlorine. He shows that it is economical to use solutions of higher concentration. He compares his system with that of Kellner, in order to show that the latter is less economical.—*Zeit. fuer Elektrochemie*, Nov. 22.

Testing Storage Batteries.—A note stating that Gorski, while testing the "monobloc" storage battery with an auxiliary electrode of cadmium, has proven that the total e. m. f. of a storage battery does not enable one to draw a conclusion concerning the condition of charge of the single electrodes. In one case a storage battery, being discharged, showed 1.9 volts at the terminals, while the e. m. f. between cadmium and the positive polelectrode was 2.2 volts, that between cadmium and the negative polelectrode 0.3 volts, showing that the latter was nearly exhausted. In another case, when a battery was charged at 2.4 volts, the e. m. f. between cadmium and the positive

	SWISS.	
Journal Telegraphique.	*Jour. Telegraphique*	Berne
Revue de L'Électricité.	*Rev. de L'Elec.*	Berne
Schweizerische Blaetter fuer Elektrotechnik.	*Schweiz. Blaetter fuer Elek.*	Berne
	AMERICAN.	
American Electrician.	*Amer. Elec.*	New York
American Journal of Science.	*Am. Jour. of Sc.*	New Haven, Conn.
Appleton's Popular Science Monthly.	*Appleton's Pop. Sc. Mo.*	New York
American Machinist.	*Amer. Mach.*	New York
Bulletin of the University of Wissin.	*Bul. Univ. Wisc.*	Madison
Cassier's Magazine.	*Cassier's Mag.*	New York
Electrical Review.	*Elec. Rev.*	New York
Electricity.	*El'ty*	New York
Engineering Magazine.	*Eng. Mag.*	New York
Engineering News.	*Eng. News.*	New York
Engineering and Mining Journal.	*Eng. and Min. Jour.*	New York
India Rubber World.	*Ind. Rub. World*	New York
Journal of Electricity, Power and Gas.	*Jour. of El'ty*	San Francisco
Journal of the Franklin Institute.	*Jour. Frank. Inst.*	Philadelphia
Journal of the Telegraph.	*Jour. Teleg.*	New York
Journal of the Association of Engineering Societies.	*Jour. Assn. Eng. Soc.*	Chicago
Journal of the Western Society of Engineers.	*Jour. West. Soc. Eng.*	Pittsburg

polelectrode was 2.45 volts, while that between cadmium and the negative polelectrode was 0.05 volts, showing that the latter was still at the start of the charge.—*Centralblatt. fuer accum. und Elem. kunde,* Dec. 1.

Calcium Carbide.—J. B. C. Kershaw.—The conclusion of his article. He describes briefly the three most efficient forms of carbide furnace: The furnace of the Deutsche Gold and Silver Scheide Anstalt, the Willson furnace used at Foyers, and the Gin and Leleux furnace used at Meran. He concludes that the highest yields have been obtained in furnaces working on the intermittent system, with movable box hearths, in which the carbide produced is allowed to cool. Where the cost of power is important, the intermittent system of furnace is to be preferred. Where power is cheap and manual labor costly, it may be better to adopt a continuous type of furnace, from which the carbide is tapped at intervals. With both types there appear to be possibilities of improvement in regard to the utilization of the carbon monoxide gas, which ought not to be allowed to burn away without any utilization of its heating power. Another direction in which greater efficiency and economy may be expected is in connection with the preparation of the raw materials; the idea that it is essential to have these finely ground and thoroughly mixed is now proved to be incorrect.—Lond. *Elec.*, Dec. 14.

Siemens & Halske Gold Process.—J. B. C. Kershaw.—A paper in which he says that the Siemens & Halske process for recovering the gold from the liquors obtained by the treatment of the crushed ore, or the tailings, with dilute potassium cyanide solution, is rapidly making headway, and its application to the solutions, resulting from a still more modern process for successfully leaching slimes with cyanide, is calculated to further extend the field of usefulness. The process has come to stay in South Afrca. It depends upon the deposition of the gold from very weak cyanide solutions by means of an electric current of feeble intensity. Iron is used for the anode, and thin sheets of lead as cathodes. The difficulty of extreme dilution was overcome by causing the electrolyte to pass between several hundred pairs of electrodes before issuing finally from the last of the depositing vats. No attempt is made to remove the whole of the gold from the cyanide solution, the continual return of the effluent to the leaching vats rendering a complete exhaustion of gold unnecessary. Some information is given about the actual South African plant and on the cost of operation. The process is, however, not yet perfect.—*Jour. of Elec.*, December.

Commercial Electrolysis of Water.—Buffa.—An article, giving information on the electrolysis of water, which is in commercial use in several cities. The apparatus are voltameters with iron electrodes; the bath is alkaline. The voltameter is placed in an iron basin containing the electrolyte and has the form of an iron box without a bottom; it is placed upon wooden strips on the bottom of the basin. Vertical diaphragms divide the voltameter into a number of partitions, open at the bottom, into which the anodes and cathodes are placed alternatively; those of each polarity are connected together like the teeth of a comb. Each of these partitions has a hole at the top and through these holes the oxygen and hydrogen pass to the gas basins. In the plant at Rome the electrolyte is a 14 per cent concentration of a sodium solution, or a 16.8 per cent concentration of a potassium solution. The temperature must not fall below 10 deg. C. The current density must not surpass 2 ampere per square decimeter. Some information is given on details of the plant in Rome. Several applications of hydrogen and oxygen, for different purposes, are briefly discussed.—*Bull. de l'Ass. des Ing. Elec., Inst. Elec. Montefiore;* abstracted in *L'Ind. Elec.*, Nov. 25.

Electrolytic Reduction of Difficultly Reducible Substances in Sulphuric Acid Solution.—Tafel.—An account of a special study of the behavior of caffeine "with a view to elaborating a method which would allow of the systematic regulation of the experimental conditions and afford a general method for the preparation of compounds by electrolytic reduction. The reduction of caffeine in sulphuric acid solution is only possible when the cathode consists of a material (lead or mercury) showing a high cathode potential. The disturbances often observed in reductions are found to be due to the contamination of the cathode by traces of foreign metals, and are best avoided by coating the surface of the electrode with lead sponge, electrolytically deposited. The reduction is hastened by a rise of temperature, but only to a slight extent. The current yield, within certain limits, is nearly proportional to the current. For equal concentrations of caffeine and equal currents per litre of liquid at the cathode ("current concentration") the current density has relatively little influence on the course of the reaction, the reduction increasing slightly as the current density diminishes. In apparatus of similar construction, but different size, the reaction follows the same lines, provided the initial concentration of the substance, the current concentration, and the relation between the surface of the cathode and the volume of the cathode liquid are the same in each case."—*Zeit. Phys. Chem.*, July 17; abstracted in *Science Abstracts*, November.

Gas Batteries.—Haber.—He argues that the oxidation potential of hydrogen peroxide, together with its reduction potential, represents the oxygen potential; this implies that for fixed values of the hydrogen concentration and the oxygen concentration there is only one stable value for the hydrogen peroxide. That value obtains at the oxygen electrode, and remains constant as long as that electrode operates in a reversible manner. But the concentration of the hydrogen peroxide does not affect the dynamics of processes in which the maximum work is yielded, and which can be reduced to the work of a battery of the form: metal, metallic ions, hydroxyl ions, oxygen electrode. When the processes are rapid, however, certain metastable conditions may occur, and it is to such conditions that he attributes the phenomena observed at a platinized platinum electrode dipping into hydrogen peroxide solution, as well as the catalysis of hydrogen peroxide by finely divided platinum.—*Phys. Zeit.*, Dec. 1; abstracted in Lond. *Elec.*, Dec. 14.

Electro-chemical Industry in France.—Guillet.—A review of the progress of the chemical industry in France. Regarding electrochemistry, the following information is given: Caustic soda is produced by two companies, using the Greishem and the Outhenin Chalandre process, respectively, 2500 tons being produced yearly by the former process. Alkalies and bleaching powders are produced in an 8000-hp plant in Savoy. Another company produces potassium permanganate, ammonium persulphate, chlorates, and perchlorates, the second of these is obtained by electrolysis of ammonium sulphate, it is used in bleaching operations and in photography. The total French output of chlorate is estimated to be 3850 tons, of which total 3000 tons are produced by electrolysis. Perchlorate of ammonium is a new chemical, used in preparing mining explosives. The manufacture of phosphorus in the electric furnace is about to be introduced into France. Calcium carbide is made in eight factories, with an aggregate capacity of 14,400 horse-power.—*Genie Civil*, June 30, July 7, 14, 21, 28, Aug. 4; abstracted in *Science Abstracts*, Nov.

Electro-chemistry in 1899.—The first part of an article on progress of electro-chemistry in 1899. Brief descriptions are given of new inventions or improvements, mainly taken from patent specifications; sometimes critical remarks are added. Among others the following inventions are noticed: The Kossuth process of producing bromine by electrolysis of the waste lyes, obtained in the manufacture of chloride of potassium; the use by Moissan of copper, instead of platinum, in the electrolytic production of fluorine from hydrofluoric acid or fluorine salts by means of a U-tube; a new method, devised by Billandot & Company, for condensing the phosphorous vapors developed in the electric production of phosphorus; the Acheson process for making graphite in the electric furnace; Mach's alloy of aluminium and magnesium, which is easily worked with the file and similar tools; a Cowper-Coles method for producing vanadium by electrolysis from aqueous solutions.—*Elek. Anz.*, Dec. 9.

Units. Measurements and Instruments.

Magnetized Chronometer.—Cornu.—An account of experiments with a chronometer, which by accident had been brought near a large

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Progressive Age.	*Prog. Age*	New York
Proceedings of the Engineers' Club of Philadelphia.	*Proc. Eng. Club Phila.*	Philadelphia
Proceedings of Engineers' Society of Western Pennsylvania.	*Proc. Eng. Soc. Pa*	Pittsburg
Power.	*Power*	New York
Rose Technic.	*Rose Tech*	Terre Haute
Street Railway Journal.	*St. R'y Jour*	New York
Street Railway Review.	*St. R'y Rev*	Chicago
Scientific American.	*Sc. Amer*	New York
Scientific American Supplement.	*Sc. Amer. Sup*	New York
Science.	*Science*	New York
Transactions of the American Institute of Electrical Engineers.	*Trans. Am. Inst. Elec. Eng.*	New York
The Automobile.	*The Automobile*	New York
The Physical Review.	*Phys. Rev*	New York
Transactions of the American Society of Mechanical Engineers.	*Trans. Am. Soc. Mech. Eng.*	New York
Technology Quarterly.	*Tech. Quart*	Boston
Terrestrial Magnetism and Atmospheric Electricity.	*Terr. Magnetism*	Baltimore
Telephone Magazine.	*Tel. Mag*	Chicago
The Engineer.	*The Eng*	Cleveland
The Polytechnic.	*Polytechnic*	Troy
The School of Mines Quarterly.	*Sch. Mines Quart*	New York
The Sibley Journal.	*Sibley Jour*	Ithaca
Western Electrician.	*West. Elec*	Chicago
Yale Scientific Monthly.	*Yale Sc. Mo*	New Haven

dynamo. It was considerably influenced by the earth's magnetic force, there being a definite acceleration or retardation for each azimuth; the equations expressing this effect are similar to those representing the action of gravitation upon an imperfectly balanced wheel. The practical importance of these researches lies in their bearing upon ships' chronometers. The magnetism of their balance-wheels should be carefully determined, as well as the corrections necessary for various magnetic azimuths.—*Comptes Rendus,* Nov. 26; abstracted in Lond. *Elec.,* Dec. 14.

Frequency Meter.—A brief illustrated description of a frequency meter of Hartmann & Braun, which was exhibited at Paris, for measuring the frequency of any periodic current, either ordinary alternating current, or pulsating direct current, or the current from an induction coil. The instrument is independent of the wave form. It has the form of a voltmeter or ammeter, with a scale for frequencies between 80 and 115; there are 36 steel springs, tuned in the intervals of the whole numbers between 80 and 115. A broad needle can be turned around the scale by means of a button; on the axis of this needle there is an alternating current magnet system. The needle is turned around until it is opposite to the correct steel spring which then begins to give a loud tune.—*Elek. Anz.,* Dec. 9.

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Measuring Instruments.—Aliamet.—The conclusion of his very long, illustrated paper on electric measuring instruments at the Paris Exposition. He concludes the description of voltmeters; discusses the measurement of resistance, resistance boxes, potentiometers, direct reading ohmmeters; deals brifly with condensers and inductances; describes wattmeters; several special instruments to be used with alternating currents, as phase meters, frequency meters, instruments for plotting the wave form; instruments for the study of the magnetic properties of iron, as permea meters and hysteresis meters; thermoelectric pyrometers for measuring temperatures.—*Bull. Soc. Int. des Elec.,* Sept.-Oct.

Localizing Faults.—An illustrated description of several methods of localizing faults in electric lines and cables, especially in difficult cases.—*Elek. Anz.,* Dec. 6.

Magnetometer Constant.—Chistoni.—He determines the constant of a unifilar magnetometer by placing a deflecting magnet at each of two distances from the needle. He gives two formulas, the first being rigorously correct, the second simpler, but only approximate.—*Acad. Sci. Torino,* atti 35, 8a, 1900; abstracted in *Science Abstracts,* Nov.

Firing Mines.—An illustrated article on "Laying out mine fields in the Royal Navy," more especially on the use of the "depression range-finder."—Lond. *Elec. Rev.,* Dec. 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Recorder Working on Composite Landline and Cable Circuits.—Davidson.—A brief description of the application of Harwood's duplex arrangement of circuits composed of cables and landline, as shown in the adjoining diagram. In view of the extending use of the siphon recorder for landline work, cases may happen, where it would be useful. *B* and *C* are the terminal stations of the landline. "The signals from station *D*, received at *C* in the usual way, are transmitted direct to station *A*. Signals from *A* are similarly transmitted by *B* to station *D*. The landline recorders at *B* and *C* are permanently in circuit in order to give a record of what is passing through and also to show the state of the balance. If *B's* recorder is practically unaffected when *B* is sending to *D*, while the signals from *C* to *A* are of legible size, the same state of things will obtain at *A's* recorder and duplex working will be possible. The arrangement can be divided up for sectional working by introducing earths at *B* and *C* on the apex to apex lead. The principal source of disturbance is, of course, the variation of the insulation of the landline, but the recorders at *A* and *D* are so far away electrically that the landline balance must be out very considerably before the incoming signals are affected." The system has been worked successfully over a tropical landline subject to heavy varying leakage.—Lond. *Elec.,* Dec. 14.

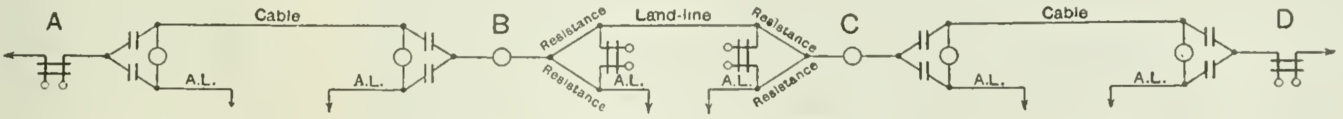
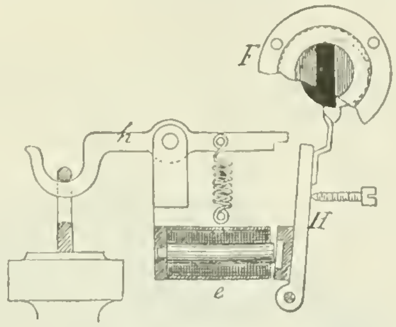


Diagram of Composite Land and Cable Circuits.

West System of Party Lines.—Ruhmer.—In Berlin, in any house which has a telephone connected to the public telephone system, five other parties are also allowed to have telephones connected to the same line; while for the connection of the main telephone $45 per year is charged, for each of the other telephones the charge is only $3.75. The connections are sometimes made by the janitor as an intermediate operator; but there was a lack of punctuality and he could listen to all calls. The West system, however, fulfills the following conditions: Each telephone can call up the exchange without intermediate operator; at each telephone a signal always shows whether the line is busy or not; as long as one party is talking, it is impossible for any other party to use the telephone and to interfere; the exchange can call up any party without troubling the other parties. When a party takes the telephone from the hook, he is connected automatically with the exchange and the five other telephones of the same line are automatically arrested, which is accomplished by "arresting electromagnets" *e*, placed at each telephone, and shown in the adjoining figure; when *e* is excited, the lever *H* is attracted and the hook *h* is arrested; at the same time a signal becomes visible at *F*, showing that the line is busy. In order to enable the exchange to call up any party without troubling the other parties and to prevent any other party from trying to use the telephone at that time, an automatic switch is used, which can be placed at any point in the house and is connected with the telephones by local lines; its operation is described and illustrated, but is too complicated to be given here.—*Phys. Zeit.,* Dec. 8.



PARTY TELEPHONE LINE SYSTEM.

REFERENCES.

Railway Signals.—Abstracts of three papers, read before the Brit. Inst. Civ. Eng.: Szlumper, on "The Signalling on the Waterloo and City Railway;" also a "Note on Signalling Outlying Siding Connections;" Cottrell, on "Signalling on the Liverpool Overhead Railway."—Lond. *Elec.,* Dec. 14.

Type Printing Telegraph.—Conradt.—A communication supplementing his article on an improvement of the efficiency of the Hughes apparatus by modifying the arrangement of the keys (Digest, Oct. 13).—*Elek. Zeit.,* Dec. 6.

Statistical.—The first part of a statistical article on telegraphy and telephony in France; also large statistical tables on telegraphy in 1899 in different countries all over the world (the United States not being included).—*Jour. Teleg.,* Nov. 25.

MISCELLANEOUS.

REFERENCES.

Obituary.—An account of the life and work of the well-known metallurgist, C. Hoepfner, who died recently in Denver, Col. A number of his electro-metallurgical processes have been described in the Digest.—*Eng. & Min. Jour.,* Dec. 22.

Medical Electricity.—A paper, by Yvon, giving an account of experiments which show that the static electricity, in the form of "static baths," produces no physiological effects. Another paper, by Leduc, describing an oscillating rheostat for producing current waves. —*Archives d'El. Medicale,* June, July; abstracted in *Science Abstracts,* Nov.

New Books.

BOOKS RECEIVED.

The Lead Storage Battery. Its History, Theory, Construction and Use. By Desmond C. Fitzgerald. London: Biggs & Company. 383 pages, illustrated.

The Theory of Commutation. By C. C. Hawkins. London: George Tucker. 81 Pages, 24 illustrations. Price, 2 shillings, sixpence.

The "C & C Series-Parallel" System of Motor Control.

By Geo. Fowler.

The application of direct geared motors to large newspaper printing presses offers one of the most interesting problems met with in electrical engineering work. The requirements are certainly most severe, and yet the system herein described performs its work with the ease and satisfaction which is generally credited to the simplest application of the direct current electric motor.

The plant in question is the first of its kind installed, and the writer believes that a description of it at this time will prove interesting because it contains a great many new and unique features.

With an increase in circulation it became necessary for the *Evening Telegraph* to add to the capacity of its press room. When the question of motive power presented itself, inquiry was made into the different systems, and it was finally decided to use direct connected motors and a system of electrical control.

The press equipment consists of six quadruple web perfecting presses, of which four have been installed, built by R. Hoe & Company, of New York. Each press has a capacity of 48,000 eight-page papers per hour when driven at its maximum speed. They represent the latest and most improved form of printing machine placed on the American or foreign markets.

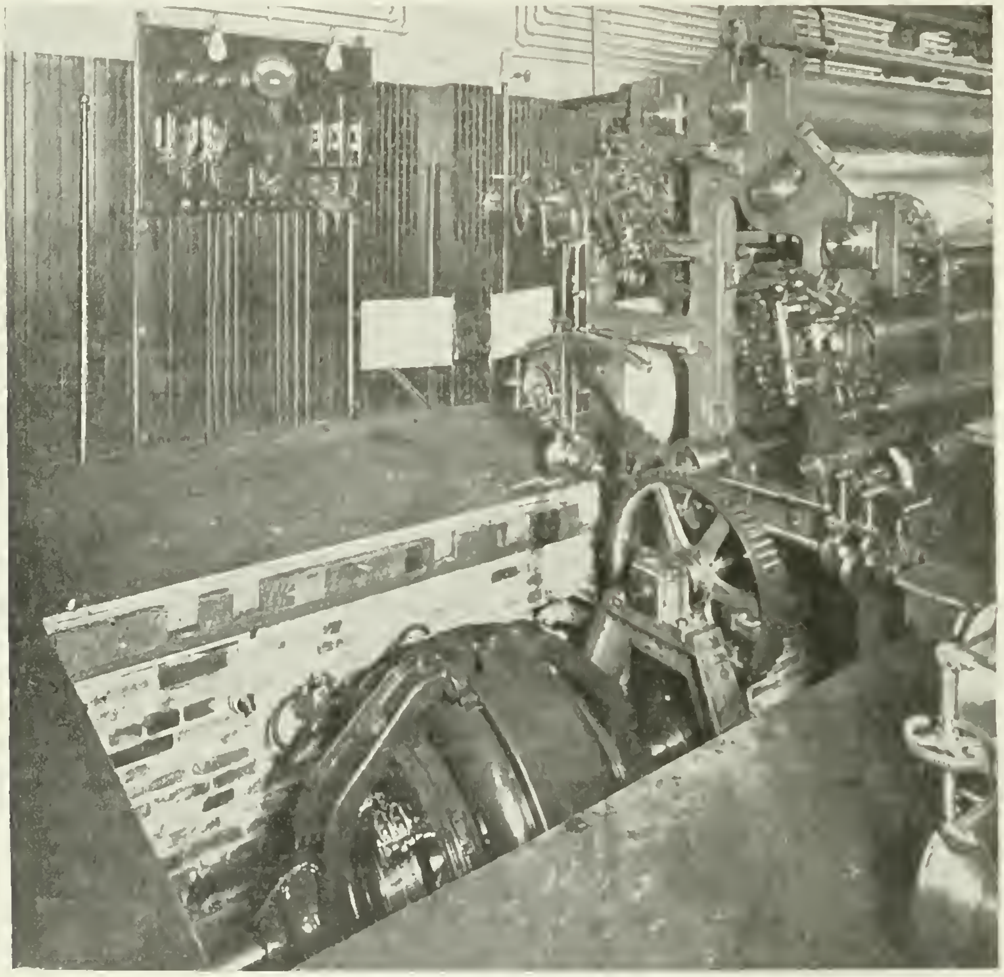


FIG. 1.—SERIES-PARALLEL SYSTEM OF CONTROL.

The system used to control and operate these presses is that recently designed, patented and built by the C & C Electric Company, of New York, and known as the "series-parallel" method of control. Each press is operated by a 50-hp 250-volt 6-pole double commutator compound-wound motor directly geared to the main driving shaft of the press, the maximum motor speed being 400 r. p. m. (See Fig. 2.) In construction the motor consists of a single field frame of soft cast steel with inwardly propecting poles, the armature being of the slotted type and having two independent sets of windings. Each winding is thoroughly insulated from the other and connected to its own commutator. The gearing ratio is to 2 to 1, therefore the press shaft and also the impression cylinders run at 200 r. p. m.

In addition to the motor there is a controller located beneath the press room floor, the controlling arm of which is connected to a lever working through a notched quadrant bolted to a convenient part of the press.

Two automatic switches (see Fig. 4) are also located beneath the floor and fastened to the wall of the pit. An independent switchboard with ammeter, main switch, circuit breakers, etc., completes the equipment.

Practically two distinct speeds are required of the motor. First a very slow speed, not exceeding 20 r. p. m. (10 r. p. m. of the impression cylinders) to "make ready," lead in the sheet, etc., and the normal running speed, which, as before stated, is 400 revolutions of the motor. Of course all speeds up to and in between these two required speeds must be obtained by gradual increase and without spasmodic jumps. It is very common with pressmen, unless there is occasion for a "rush edition," to run the presses a little below the maximum, and in a great many cases this speed does not exceed 190 r. p. m. (380 r. p. m. of the motor). Another operation which the motor is called upon to perform is "inching." This is a partial movement of the press cylinders to get them in a certain desired position, sometimes to place thereon the "forms" containing the printed matter, and for various other reasons. To do this the motor must start and move only a part of a revolution, or at most one or two, and stop again. The starting and stopping must be accomplished without the slightest jar or jump in the speed. Should this occur it is quite likely the sheet would be broken and a great deal of valuable time lost.

This system performs each and every operation to entire satisfaction, and solely through the use of a small controlling lever. The slow speeds, "inching," etc., are obtained with the two armature windings in series with each other, and in series with the series field and also some resistance. The high speeds are obtained with the armature winding in parallel, the series coils on the fields being short circuited and without external resistance, and the highest speeds with slightly weakened shunt field. External armature resistance is used only for intermittent graduations of the speed and for starting.

The controller referred to above (see Fig. 5) consists of numerous contacts mounted on a marbleized slate slab and connected at suitable points to the armature resistance; also contact rings for conveying the current to the shunt fields and a few smaller contacts to operate the automatic switches.

These switches are described below. The controller arm carries the brush which gives the speed changes by varying the resistance, and it also carries a brass shoe which short circuits the contacts connected to the automatic switches, operating them at the proper time. Two other shoes are used, one to complete the armature circuit and the other the field.

The automatic switches were specially designed for this service. Each switch consists of two solenoids wound with fine wire, ironclad in construction, mounted on one side of a slate. The leads from these solenoids are connected to the automatic switch contacts on the controller and are operated by taking a small amount of current directly from the 250-volt circuit. The solenoids work a couple of plungers which are keyed to a shaft extending to the other side of the slate and carrying two blades that work in and out of eight switch jaws. A reference to Fig. 4 will give a more accurate idea of the construction. The switch jaws are connected to the main lines of the two armature windings and controller. There are two switches, one called the "off and on," the other the "series-parallel." The "off and on" switch operates first to one side, then to the other, each time the press is started and stopped; that is, it opens and closes the main circuit of the motor. The "series-parallel" switch operates only when the windings are changed from series to parallel, or vice versa; or, in other words, when the controller arm is moved to run the motor at high speed, this switch opens the armature circuit and closes it again on the opposite side with the windings in parallel.

The function of these switches is to prevent arcing at the controller contacts by making and breaking the circuit at the switches instead of the controller, and also at the time of changing the windings from series to parallel. It can readily be seen that by this means of throwing the brunt of the work on the switches the life of the controller contacts is very materially increased. In fact, there is not the least sign of arcing on the controller. The switches are instantaneous, it taking only a fraction of a second for them to throw from one side to the other, and without arcing.

Let us now trace the path the current takes when the motor is running. The main switch on the switchboard is closed first; this gives the full strength shunt field of the motor.

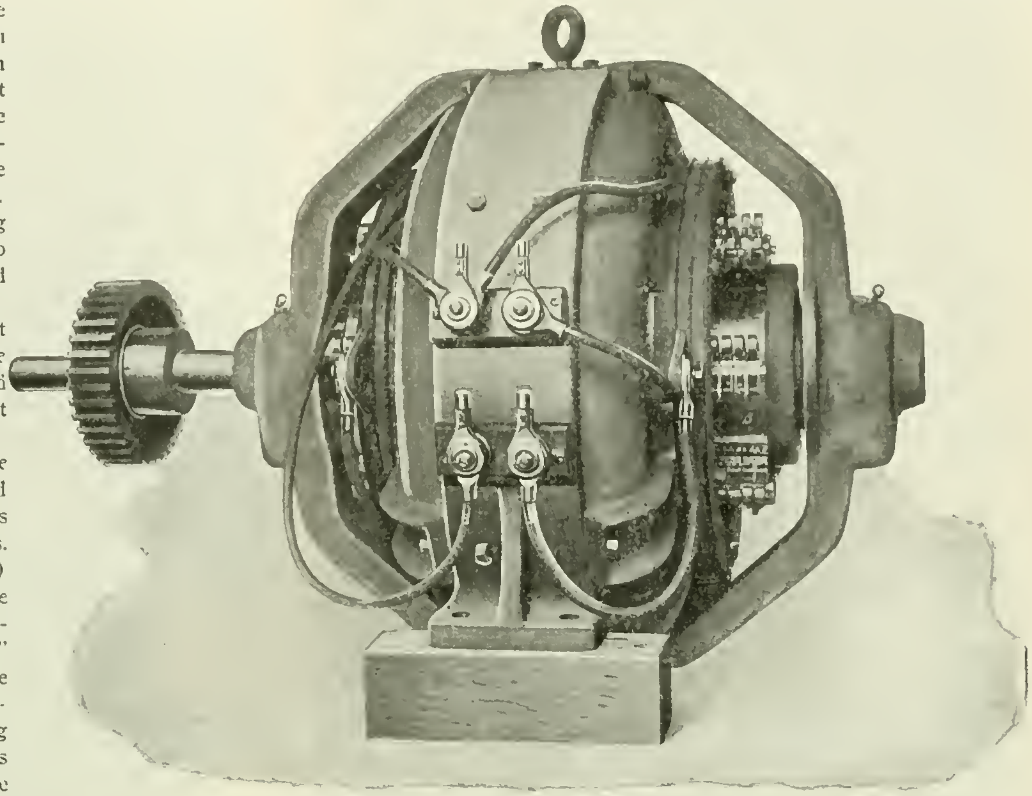


FIG. 2.—50-HP DOUBLE COMMUTATOR MOTOR.

FIG. 3.—CONTROLLING LEVER.

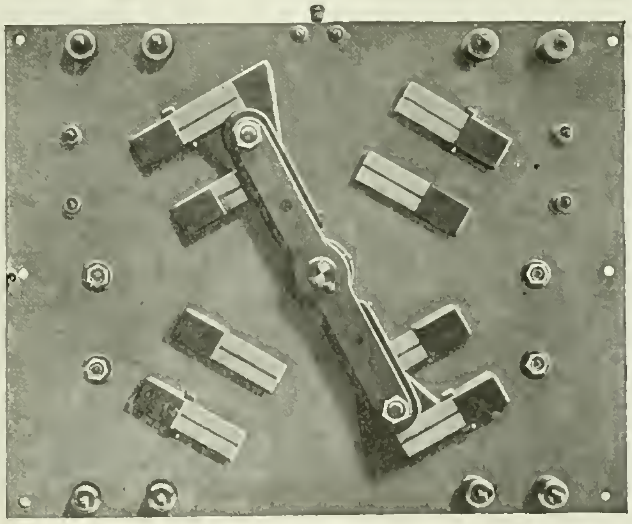


FIG. 4.—AUTOMATIC SWITCH.

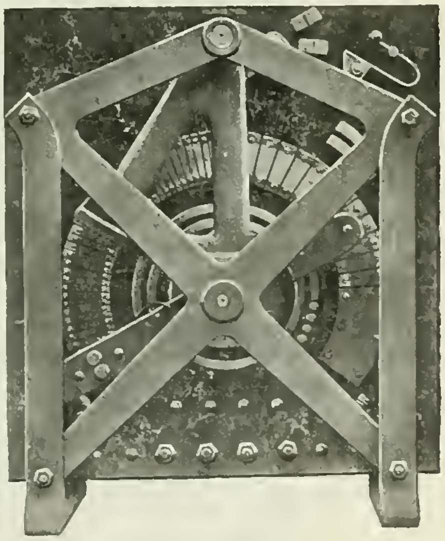


FIG. 5.—SERIES-PARALLEL CONTROLLER.

This switch is left in circuit from the beginning of run until completed, and when closed the current is conveyed as far as the automatic switch terminals. The first move of the lever (see Fig. 3) by the pressman short circuits two of the switch contacts on the controller, throwing the "off and on" switch to the "on" side, and no matter in what position the "series-parallel" switch may be, it is immediately thrown to the side connecting the armatures in series. The circuit is now closed and the current enters at one terminal of the "off and on" switch, thence to the controller through some starting resistance, through the series winding on the fields, through the "series-parallel" switch, through the two windings of the armature in series, and back into the line. This gives the slow speed necessary for "leading in the sheet," etc. The next few moves of the lever gradually cut out the armature resistance. When this is all out one-half of the series windings on the field are short circuited, and with the next movement of the lever the other half of the series are short circuited. This is accomplished by means of a small switch attached to the controller face and operated by a stud on the controller arm. The motor is now running as a plain shunt machine, with the armature windings in series, and without external resistance. This gives an intermediate speed, about 175 r. p. m. of the motor. Now the next move of the lever short circuits the two automatic switch contacts which are connected to one of the coils on the "series-parallel" switch and throws this switch to the parallel side, first opening the circuit where the windings were in series, and closing on the opposite side with them in parallel. The throwing of the switch can never be noticed on the press, for it is done so quickly and the speed kept the same (175 r. p. m.) as it was just before the switch was thrown over by the introduction of certain resistance at that instant. The next few moves of the lever gradually cut out this armature resistance until it is all eliminated and the motor is then running as a plain shunt machine with each armature winding directly connected across the current supply. At this point the speed is about 350 r. p. m. The final movements of the lever interpose some resistance in the shunt field, which increases the motor speed in gradual steps to 400 r. p. m. The devices furnished for stopping the press quickly are known as "floor stops," or emergency switches. In construction these are something like a floor push-button, only much larger and heavier. Four of these are placed in the floor, located at convenient intervals, and should it be desired to stop the press the placing of the foot on one of these stops immediately shuts off the current and stops the motor quickly. This push is so arranged that when the plunger is depressed it short circuits the two contacts that are connected to one coil of the "off and on" switch, which throws this switch to the "off" side, thereby opening the main circuit. The press cannot be again started until the lever is moved back to the starting position where the armature windings are again thrown into series and the series winding inserted with the proper starting resistance. It is an impossibility to start the motor improperly with the connections and devices in improper combination or to damage the electrical equipment or press as all combinations of connections are automatically made by the solenoid switches and controller.

This system of course contains some particular advantages, and among them may be mentioned the following:

First. By the use of the two separate windings on the armature which are used in series and in parallel, the starting torque with them in series is extremely great, but the current required to develop this torque is surprisingly small. From actual tests it has been shown that about one-third the current required to run the press at its highest speed is sufficient to start. A motor with only one winding and commutator with ordinary rheostatic control would be unsuitable for this class of work for the reason that to develop the necessary starting torque the current required would be far in excess of that necessary to run at normal speed.

Second. The flexibility of the controlling device is at once apparent, as all speed changes and different combinations are obtained through the movement of but one lever by the pressman, and for this reason accidents are less likely to occur. The automatic switches also serve as a safeguard, for, as described above, when the switch is thrown off by the "floor push" it is impossible to start again until the lever is brought to the starting position.

One of the main difficulties heretofore encountered by manufacturers in applying shunt or compound wound motors governed by the "series-parallel" method to stationary work where speed was an important consideration was the question of changing the armature windings from series to parallel without too much increase in speed and arcing at controller contacts when this was done. To a certain extent the arcing was overcome by using magnetic blow-outs, but the writer believes that this is the first entirely successful installation of double commutator motors. With this system no blowing device is necessary to overcome arcing, the instantaneous action of the switches preventing this.

The current for running these equipments is taken from the mains of the Edison Company, which are connected to one set of bus-bars on a special switchboard located at one end of the press room. This switchboard is equipped with two independent sets of bus-bars and a double pole throw switch for each press motor. To guard against possible break downs, and as time is such an important factor in a newspaper office, the other set of bus bars is connected to a pair of mains running to the switchboard in the engine room. Here they are properly connected to two 125-volt generators wired on the three-wire system to get the 250 volts. All connections are made to a marble switchboard containing instruments and switches of the latest type.

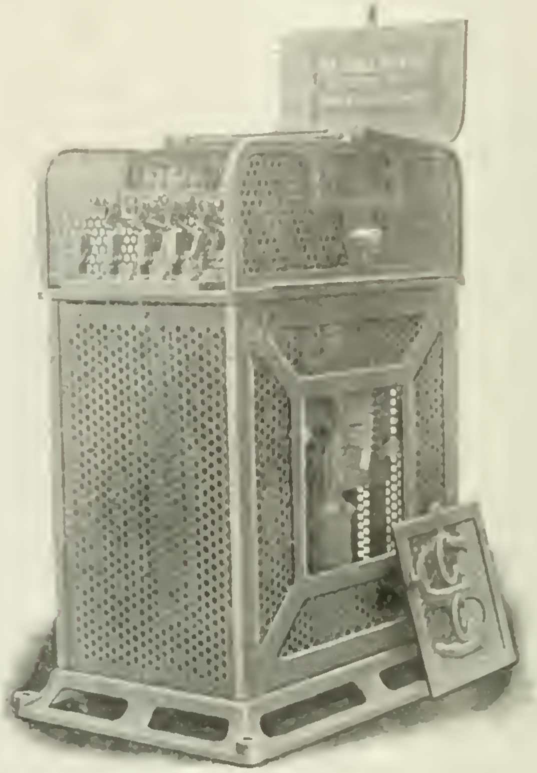
It seems to the writer that there is an extremely promising field for the further introduction of this system, and it is not limited to printing press work alone. In fact, to drive any piece of machinery where wide variations of speed are required, the double commutator method is one of the most advantageous and economical.

The *Evening Telegraph* plant has now been in constant operation, day and night, for nearly a year, and has demonstrated beyond a doubt the success of this system. Mr. William Meyers is in charge as chief engineer, assisted by Mr. Jacob Barger, while Mr. Harry Chappel is in charge of the press room, all of whom are well posted upon, and, I believe, strong advocates of the system.

It might be here stated that notwithstanding the fact that the equipments installed by the C & C Electric Company for the *Telegraph* were the first they installed, they have worked admirably from the first, and but very few minor adjustments and changes were necessary to bring the system to the point of perfection it has now reached. I understand that the company has already furnished and is now building quite a number of other similar equipments.

Automatic Elevator Motor Controller.

The illustration herewith shows the automatic elevator controller manufactured by the Three Rivers Electric Company, Three Rivers, Mich. This controller is designed for single belt-reversing freight and passenger elevator motors and consists of a reversing switch, rheostat and automatic cutout or current diverter combined in one piece of mechanism. No magnets whatever are used. The starting and stopping of the motor is done by a cable operated from the platform which transmits a positive movement that closes the switch to start the motor and automatically cuts out the rheostat. The reversing or controlling switch is placed on top of the controller and consists of two series of quick-throw switches of four blades each, mounted on a slate base with the operating shaft between them. On the end of each switch blade is a carbon brake tip for taking the spark on opening the circuit and protect the copper contacts from burning. The current diverter or cut-out for regulating the flow of current through the armature when starting is placed on the side of the controller and has twenty-one contact blocks. These contact blocks are mounted on a slate base, with a corresponding number of binding blocks on the back for making connection to the rheostat. Pivoted to the iron frame on which the diverter is supported, and provided with slide pieces for making contact with it, is a swinging arm with strap connection to a cam wheel on the operating shaft of the reversing switch and a dash-pot below with suitable connection to the plunger to regulate the speed of starting.



AUTOMATIC ELEVATOR CONTROLLER.

The rheostat is of the company's standard open coil type made up of iron wire mounted on iron frames with plenty of ventilation on all sides. Ample capacity is provided for all current-carrying parts, and nothing combustible is used about it.

The Development of Centrifugal Pumping Machinery.

Electrical engineers who have not paid attention to the subject are surprised when they learn the extent to which centrifugal pumping machinery has been developed and introduced of recent years. Yet this work has been done largely with the aid of the electric motor and there seems to be no limit to the opportunities thus offered wherever current is obtainable. A concern which has been conspicuous in this field of work, the Lawrence Machine Company, of Lawrence, Mass., has already a list of such installations growing with great rapidity and presenting many interesting and remarkable features of design, utility and economy.

An interesting outfit is one that it is now building at its shops, consisting of a 30-in. centrifugal pump of its improved double-suction type, which has a capacity of 5000 tons of sea water per hour against a head of 25 ft. 9 ins. This 30-in. pump will be directly connected to an electric motor of 275 horse-power, direct current 220 volts. The outfit was sold through Mr. E. M. Sutliff, resident engineer of the Flint, Eddy &-American Trading Company, for the Kawasaki dry dock of Kobe, Japan, and is the first plant of the kind ever installed in the far East. The guarantees on this outfit are of the most rigid character, and the contract was awarded to this country despite the fact that there were several European bidders, although only one other concern ventured to bid on an electrically driven apparatus.

The centrifugal pump has many advantages for moderate lifts, say up to 90 ft., and, again, can be erected with the greatest ease.

It works with a smooth, rotary motion, without valves, eccentrics, etc., and it is stated to be a recognized fact that it will discharge a quantity of water greater in proportion to the power expended than any other pump. It is very economical in use, simple in operation and of very great durability. It discharges a continuous and steady stream without air chambers. Its cost, measured by the quantity of water discharged, is greatly below that of other types, it is said. It is hardly affected by sand, mud or other foreign matter in the water. It will admit, in the larger sizes, the passage of solid bodies 6 ins. in diameter, and the smaller sizes in proportion, without injury. It will pump hot or cold liquids equally well. Moreover, it requires but a very light and inexpensive foundation, having no vibration or oscillation in its working.

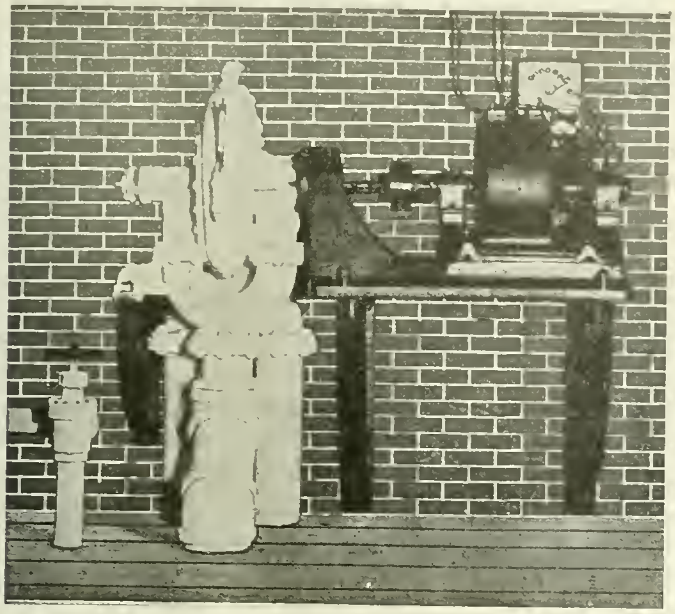


FIG. 1.—CENTRIFUGAL PUMP.

A notable feature of the Lawrence improved double-suction pump is the branching of the suction pipe so that the fluid being pumped enters the disk chamber at each side, at and directly opposite the centre of the revolving disk, forming a balanced suction, and entirely dispensing with the end thrust on shafts, largely reducing the wear and loss by friction that would be likely otherwise to occur. The concern is particularly proud of its ability to turn out high-grade electrically driven pumping machinery, and its trade literature embraces many illustrations of the smaller types. These pumps are used for all purposes, such as water supply work, irrigation and drainage of land, emptying cofferdams and dry docks, and in all places where a large body of water is to be elevated to a moderate height quickly and cheaply and efficiently.

A very interesting outfit is that which is now being installed for the Edison Electric Illuminating Company, Brooklyn, consisting of four solid bronze pumps arranged for direct connection to electric motors. Each pump will be driven by a 20-hp motor and will be capable of delivering 3500 gallons of water per minute when running at 600 r. p. m. These pumps have a guaranteed efficiency of between 50 and 60 per cent, and a more practical pumping outfit could not be imagined. This local lighting company now has in operation seven Lawrence improved double-suction pumps, each electrically driven.

For the circulation of brine in connection with ice-making machinery, a special pump, built for this purpose, is coming into greater prominence daily, and it has now equipped a half dozen prominent plants with pumps of this description, all electrically driven. Fig. 1 shows a plant of this description installed for the Brooklyn Hygienic Ice Company. The pump mechanism is seen coated with ice.

Another very interesting installation is shown in Fig. 2, that of two pumps, each with a capacity of 3000 gallons per minute, elevated 40 ft. high, direct connected to General Electric motors for the Cataract Construction Company of Niagara Falls, N. Y.

For house service work, such as draining cellars, working in connection with lump pits, etc., a class of electrically driven centrifugal pumps are specially made. They occupy but very little space, are low in first cost, very cheaply operated, are automatic in their action, require little or no attention and can be operated by any one. In New York City alone there are dozens of these outfits, and it is said that the first complaint is still to be received. At the Passaic Print Works, Passaic, N. J., there are in operation six 8-in. pumps, directly connected with Westinghouse electric motors. These pumps are operating in connection with the filtration plant installed by the New York Continental Jewell Filtration Company and are of entirely special design, the method being that of utilizing high speed motors, back-geared to slow-speed pumps, rendered practically noiseless by the use of rawhide pinions. This greatly reduces the first cost of the motors. We are indebted to Mr. H. E. Maxfield, the manager of the New York office of the Lawrence Company, for the privilege of inspecting a variety and data of plans for electrical work with centrifugal pumps of a most interesting and striking character, going far beyond any of that which has been referred to in the brief notes above.

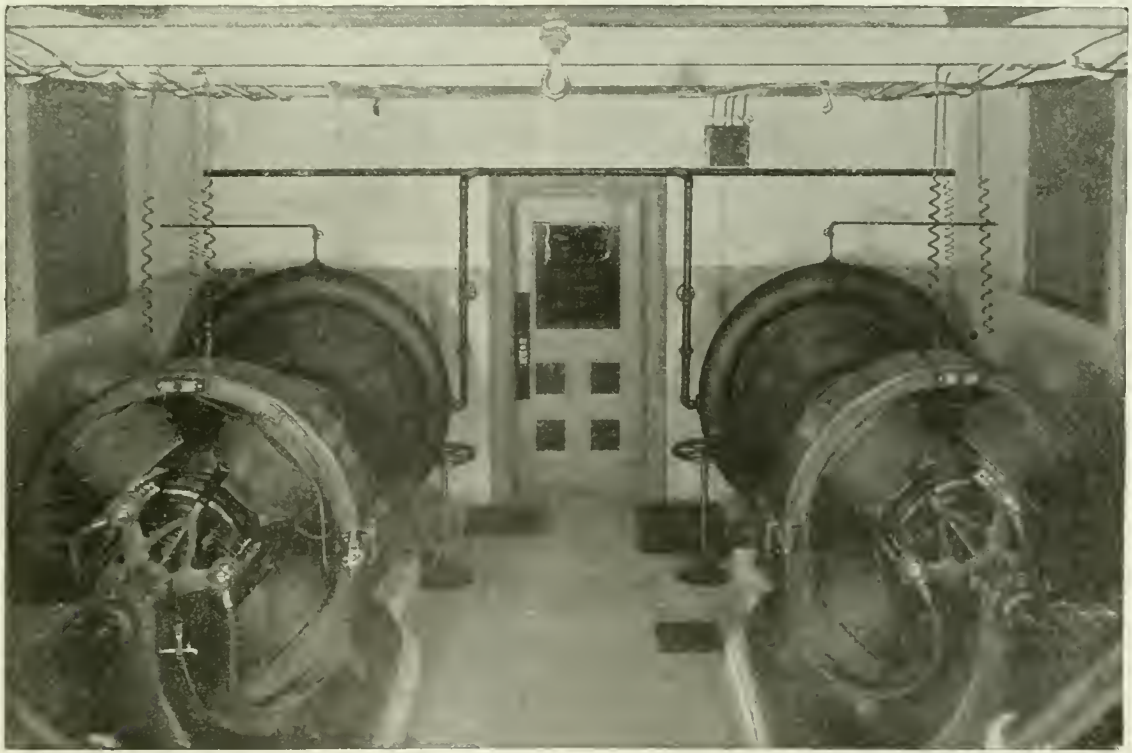


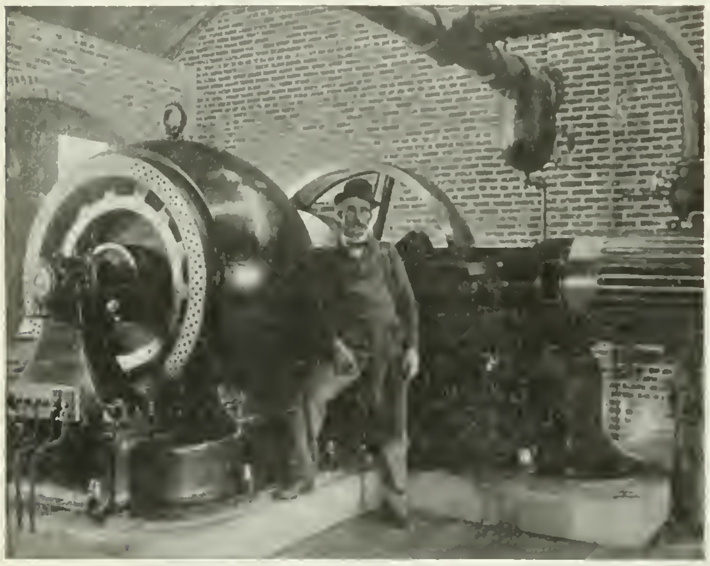
Fig. 2.—Centrifugal Pump at Niagara Falls.

Electric Light Plant at Urbana, Ill.

The plant of the Urbana Electric Light, Heat & Power Company, Urbana, Ill., attracts no little attention on account of its electrical equipment and the application of the same. The present capacity of this plant is 215 kilowatts, of which 180 kilowatts is alternating and 35 kilowatts direct-current. There is, however, boiler capacity for some 300 kilowatts, and the addition of one 120-kw alternator is contemplated in the near future.

Alternators and switchboard were furnished by the Warren Electric Manufacturing Company of Sandusky, Ohio, the alternators being of the well-known Warren inductor type, and of 120-kw and 60-kw capacity, 60 cycle, direct-connected to 16x16 ins. and 13x12 ins. Ideal engines respectively, running at a speed of 257 r. p. m. One of the interesting features of the alternators, besides being direct connected, is the voltage at which they are run, both being designed for two voltages, viz., 220 and 2200 volts, the type and construction of the Warren alternator making such an arrangement possible; the capacity at each voltage is one-half of the full capacity of the alternators.

The idea of installing two voltage alternators was created by the situation of the plant, it being near the center of distribution of the commercial incandescent light service. Running this on a 220-volt, three-wire system it was possible at a very small investment in line copper to dispense with the use of transformers, and still be enabled to get high voltage distribution of arcs and distant incandescent light and power. The 220-volt system supplies four circuits of Manhattan enclosed series arcs for street lighting, as well as circuits for long-distant distribution of power and light. The 60-kw alternator takes care of the day load, and part of the evening load up to about 6 o'clock P. M., when the 120-kw alternator is synchronized and thrown in parallel with the 60-kw machine, and the load of the latter transferred over to the large machine. Later, during the night, the load is transferred back to the small alternator in a similar manner. There being two machines of two voltages of distinctly separate service, the parallel running and transferring of the load is accomplished by synchronizing each voltage separately. Accordingly, at times the 220 volt sides of the two alternators might be working in parallel, while the 2200 volt sides may be either idle or working on entirely different circuits and loads, or vice versa. This flexibility of control is very handy as well as very useful in the proper operation of the plant, from both a practical and a commercial point of view.



URBANA, ILL., ELECTRIC LIGHT PLANT.

The 35-kw direct-current generator (a Triumph 500-volt machine) is driven off the flywheel of the smaller engine and is used for power service of such a nature that alternating curent would be less feasible. Some data on the Warren alternators might be of interest. The weight of the 120-kw alternator is, complete with rotor and shaft. 19,000 lbs., and the weight of the 60 kilowatt is 13,000 lbs. The outside diameters of the frames are 62 and 59½ ins., respectively, and the widths 32½ and 22½ ins. The rotor weights are 7000 lbs. and 37000 lbs., respectively, and they have a diameter of 42⅜ ins. and are provided with 14 teeth, which at a speed of 257 r. p. m. will give a frequency of 7196 alternations per minute, or about 60 cycles per second. The entire weight of copper on the 120-kw alternator is 835 lbs. and on the 60 kilowatt is 610 lbs. The exciters are compound wound, four-pole dynamos, each of ample capacity to take care of both alternators in case of emergency.

The switchboard, also furnished by the Warren Electric Manufacturing Company, is quite elaborate, consisting of four marble slabs, 66x44 ins. wide. Each of the two alternator boards is provided with one set of instruments for each voltage, as well as lightning arresters, main switches, fuse blocks, and exciter rheostats. One of the marble slabs is entirely used for distributing purposes, and besides the circuit switches is provided with synchronizers and equalizing switches. The fourth slab is used partly for the 500-volt direct-current service, but is also provided with ammeters for each individual arc circuit, as well as a recording voltmeter and a recording steam gauge.

This plant is modern in every detail, being supplied with the latest and most efficient apparatus securable, and neither money nor labor has been spared to make it, from the outset, one of the most profitable.

◆

Electrical Development In and Around Pittsburg in 1900.

The electrical operations in that large industrial district, of which Pittsburg is the center, have been unusually active during the last year. The Westinghouse Electric & Manufacturing Company, of course, owing to its position in the electrical manufacturing interests, takes the lead. The company has made many very extensive additions to its immense factory at East Pittsburg. The old machine shop building was enlarged by the erection of extensions at each end, which makes the total length of this structure a quarter of a mile. Similar additions were made to the warehouse and the other buildings, while the company also completed its office building, which is seven stories high. The number of employees has been greatly increased and the company has now 6500 operatives on its pay rolls.

The Standard Underground Cable Company, another Pittsburg concern, during the year completed two new factories, one at Perth Amboy, N. J., and another at Oakland, Cal., in addition to the plant of the company in Pittsburg. By the addition of these facilities, the Standard people have become enabled to add considerably to their output of cable and underground wire and the number of their employees has been doubled during the year.

The Allegheny County Light Company, which practically controls the electric lighting systems in operation in Pittsburg and Allegheny, changed ownership during the year. While it was formerly one of the companies belonging to the Westinghouse interests, it is now an auxiliary concern of the Philadelphia company, which was purchased from Mr. Westinghouse by a syndicate of local capitalists. The Allegheny County Light Company has increased its capacity to a large extent, owing to the natural growth of the territory. Several large light generators, as well as power generators, were added to the main power house and others were also added to the sub-stations at Glenwood and in the East End. The company now operates about 75,000 incandescent lights and 2500 arc lights, while it also furnishes upwards of 1000 ehp for the operation of elevators and small manufacturing plants.

A similar operation took place with all the electric railways around Pittsburg, for which the negotiations are, however, still pending. It is now an assured fact that the Union Traction Company of Pittsburg will include all of the local street railways, except the Birmingham Traction Company, and this new organization will form one of the largest street railway corporations in the country, operating close upon 1500 cars and about 750 miles of track. The final formalities are now being completed, and when the deal is concluded there will no doubt be a number of changes in the operation, in the rolling stock equipment, as well as in the power houses, now operated severally. The companies taken into this combination are the Consolidated Traction Company, the Monongahela Traction Company, the United Traction Company, the West End Traction Company and the Suburban Traction Company, with their numerous allied lines and branches.

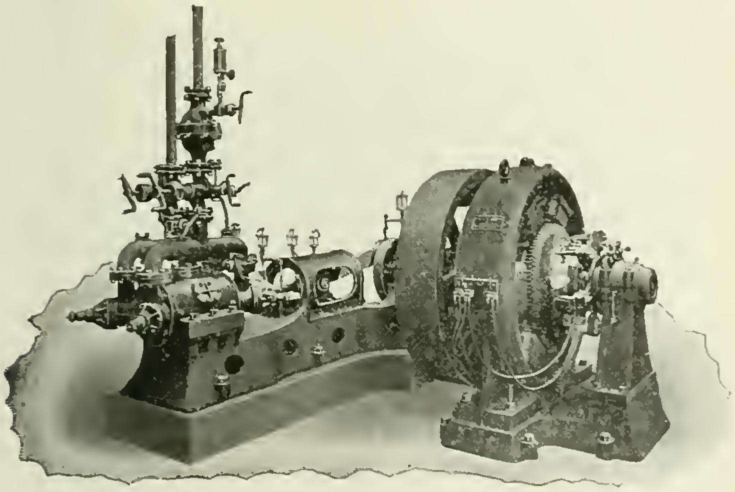
The practice of transmitting power electrically and utilizing it in the operation of machinery has grown in favor among the larger industrial establishments of the district. The Westinghouse companies and the Carnegie works, where the practice was first adopted, are constantly adding to their power equipment. The Carnegie Company uses several thousand horse-power in its Homestead plant alone to operate cranes, mills and rolls. The National Tube Works at McKeesport, the Pennsylvania Tube Works, the H. K. Porter Locomotive Works, the Westinghouse Air Brake Works, the Westinghouse Machine Works, the Pittsburg Plate Glass Works, and the American Plate Glass Works are all large users of electric power, and they operate their own plants for generating electricity.

The automobile has also made its advent in this city during the last year. One company operates 10 and lets them out to private parties, while the department stores and some of the newspapers operate their own.

The year 1900 has witnessed the establishment of a new telephone company in the cities of Pittsburg and Allegheny, which has now some 2500 subscribers on its exchange list. This is the Pittsburg & Allegheny Telephone Company.

Triumph Direct-Connected Ice Machine.

The accompanying cut illustrates a Triumph motor direct-connected to an ice machine manufactured and installed by the Triumph Electric Company in the new office building of the Union Trust Building, Cincinnati, Ohio. The motor is of 25 horse-power and runs at 75 r. p. m. To secure this slow speed, the frame of a 60-kw direct-current generator was used in its construction. All resistance is cut out of the armature and fields, by using the field resistance in the shunt circuit. The motor is compound-wound so as to avoid taking excessive current while the compressor is passing the compression points at each end, the ice machine being double-acting. The machine is furnishing 350 gallons of filtered ice water at 38 degs. F. per hour. There are also two triplex pumps driven by slow speed-belted motors of 600 r. p. m. These pumps will be used, one for circulating the brine, the other for pumping the ice water throughout the seventeen stories of the building.


DIRECT-CONNECTED ICE MACHINE.

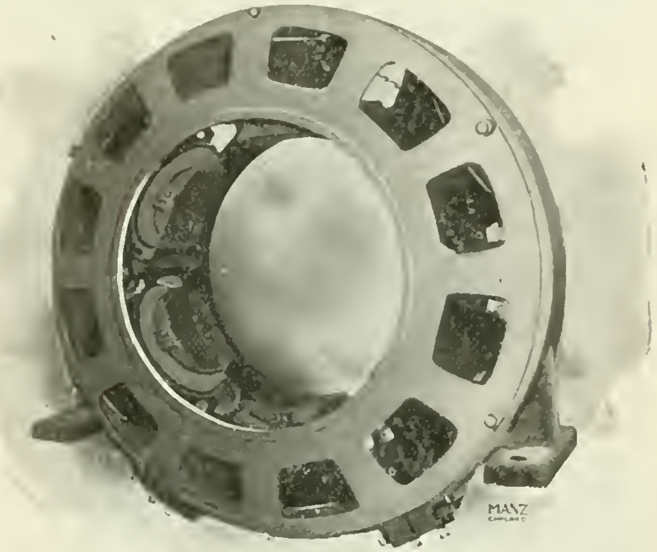
The main feature of this entire system is that any section can be cut out and repaired without shutting down the machine or stopping the work.

Improved Iron-clad Dynamos.

Electrical apparatus has reached a high stage of perfection, admitting of improvements chiefly in the details of its construction, and particularly in mechanical features. The demand of the consumer is for not only the most efficient electrical machine, but one whose operation is the most simple and which will withstand the most severe range and which shall be protected from external injury in every way possible.

Were it not for the great bulk and the necessarily greater expense entailed in the adoption of an entirely iron-clad line of dynamos, in large sizes, that design of machine might recommend itself even more strongly than it does to the general trade conditions. The two conditions noted, however, render such a wholesale adoption impracticable, and as a compromise, the semi-enclosed machine is to-day advocated by many as the best protected and the most economical machine for ordinary usages.

The accompanying illustration shows the design of the magnet frame of the semi-enclosed direct-connected line of machinery which has thus been recently placed on the market by the Commercial Electric Company of Indianapolis, Ind., and is made in all standard sizes from 25-kw to 150-kw capacity. These machines are designed to operate at low temperatures, and special attention has been given to securing high efficiencies at light as well as full loads. The details of the armature are in keeping with the demands of advanced engineering practices. Descriptive matter and illustrations will be furnished on application to the manufacturers.



MAGNET FRAME OF DYNAMO.

Insulators for High Potential Transmission.

At a time when the development of power transmission is being carried on so rapidly, it is interesting to note the gradual evolution of the high potential insulator. In this article are illustrated two sizes of the "Victor" type of insulators manufactured by Fred M. Locke, of Victor, N. Y., who has done much to make possible the transmission of electrical energy at extremely high voltages. One cut represents a No. 304 "Victor" insulator, adapted to 40,000 volts, and another is a No. 316 "Victor" insulator for 60,000 volts. The same type includes insulation for any voltage down to 7000 volts. These insulators are made in brown or white, and every insulator is tested to twice its normal line capacity before leaving the factory, which insures perfect insulators for erection and minimizes the possibility of breakdown after the line is placed in operation.

The No. 316 has been adopted by the Standard Electric Company of California and by the Bay Counties Power Company to carry 60,000 volts line pressure, the total length of line aggregating 400 miles. In connection with the transmission of the Bay Counties Power Company, a nice problem has been presented in carrying the high voltage cable across the Strait of Carquinez, a distance of about 4700 ft. To meet the excessive strain of the cable, which is 19-strand steel, ⅞-in. diameter at this point, and to give the necessary insulating qualities,

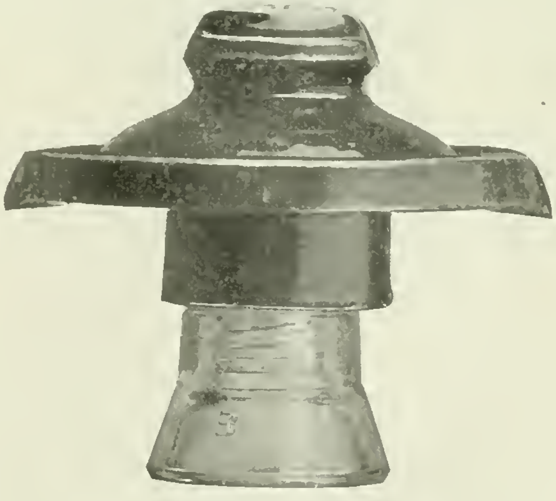


FIG. 1.—INSULATOR FOR 40,000 VOLTS.

there have been designed by Mr. Locke immense porcelain supporting and strain insulators. The supporting insulators are, in turn, supported by structural steel towers on both sides of the strait. An illustration of this supporting insulator is also shown here. This is 11 ins. high, 18 ins. in diameter and weighs 45 lbs. The strain insulator is 11½ ins. in diameter and weighs 32 lbs., surrounding the cable for a distance of 24 ins., and will be required to withstand a strain of 12 tons. There are to be four cables placed "staggering" so that they cannot approach one another within 25 ft. This span, which is the longest on any power transmission line in the world, is truly a remarkable piece of engineering, taking into consideration its great length, the weight of the cable and the high voltage, and is characteristic of the heroic means employed in developing power resources to-day in America.

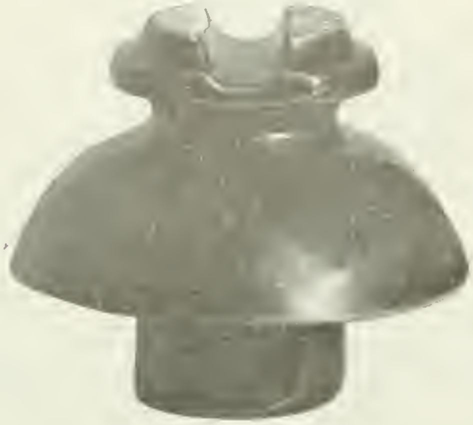


FIG. 2.—INSULATOR FOR 60,000 VOLTS.

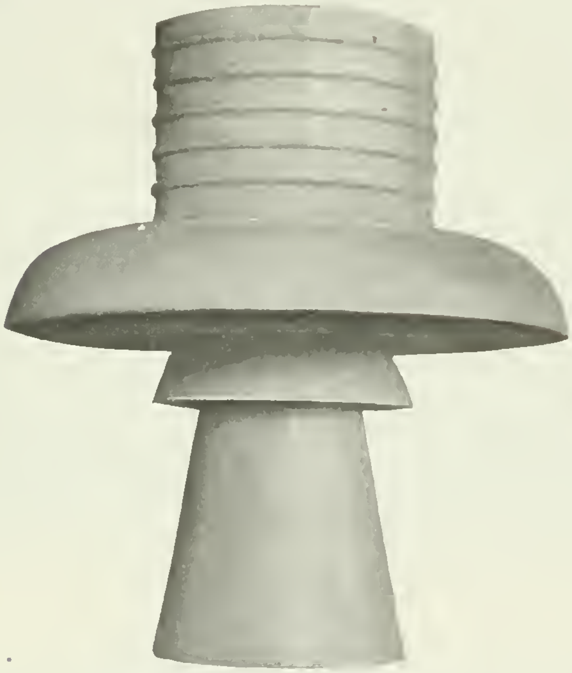


FIG. 3.—SUPPORTING INSULATOR.

Production of Copper Coated Carbons.

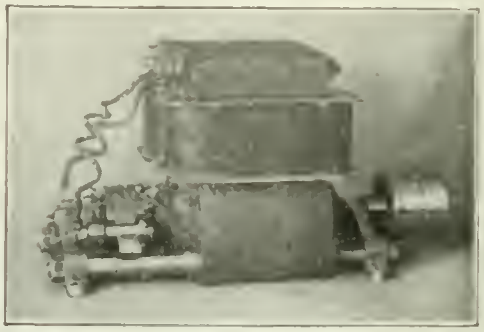
The new machine for automatically and continuously plating carbons, having a capacity of 120,000 carbons per day, installed last fall by the United States Carbon Company, of Cleveland, Ohio, in order to meet the constantly growing demand by this new company for copper-coated carbons, is one of the most ingenious pieces of mechanism employed in the electrical industry. The principle of the machine is simplicity itself. The carbons to be plated are deposited in large quantities in a hopper from which they are taken by a revolving drum and automatically fed to 3000 individual holders, carried on a continuous chain belt. The holders, in circuit with the electrical current, carry the carbons for a distance of 175 ft, through 14 plating tanks, being taken from one tank to the next over large idler wheels.

After passing through the plating tanks, the carbons pass through three tanks containing hot water, for boiling out the copper salts and fixing the color of the copper coating. The endless belt carrying the carbons then returns over the head, through the drying chambers, and after registering on the counter the carbons are automatically discharged from the holders on to a conveyor which carries them for a distance of 50 ft. to the packing room, located in one of the large buildings recently added.

Among the electrically operated, labor-saving devices, such as acid pumps, syphons, etc., used in connection with the machine, is a small double trolley motor car, for lifting and moving any one of the large plating tanks when it is necessary to clean it. This car is notable for the extreme compactness and simplicity of its design, using but one 10-hp ironclad motor for propulsion forward or back, lifting and lowering the tanks and the various operations required.

Franklin Dynamo or Motor.

The little machine illustrated herewith is designed for amateur construction. The Franklin Model Shop, Parsell & Weed, 129 West Thirty-first Street, New York, supplies all of the parts ready for winding and assembling by the amateur. The machine may be used either as a dynamo or a motor. When run as a dynamo, it will supply sufficient current for four 6-cp lamps, and as a motor it will be found useful for driving a sewing machine, a dental engine or a watchmaker's lathe, the pressure required to give the best results being 10 volts. Five cells of storage battery is recommended as being the most suitable source of power. The field magnets are arranged with alternate long and short yoke pieces, the two halves of the field being held together by a key pin passing through the long pieces of the yoke. The armature punchings of sheet iron contain eight slots for coils. The bearings and journals are carefully designed to give the most serviceable results, and either a flat or a round belt may be used on the pulley. The machine is designed for practical use, and affords amateurs an opportunity to become familiar with the construction and winding of such apparatus. It may also be had of the makers already assembled and ready for use.



SMALL DYNAMO OR MOTOR.

The Utilization of Exhaust Steam.

The subject of utilization of exhaust steam appeals especially to electric companies, who either regard their exhaust steam as a wasted by-product, or one from which they get but small compensation by the use of condensers. It is a well-known fact that nearly ten times as many heat units in the form of steam must be generated as can be converted into mechanical energy through the medium of the steam engine. We find flowing from the exhaust pipes of the engines nearly 90 per cent of the steam after doing its power work, which, after heating feed water, is available for heating buildings. The Holly system takes this valuable product and turns it to practical account. It is the impression of some that exhaust steam is saturated with moisture and that it does not contain an equal number of heat units, as compared with live steam. This is a fallacy. Steam at equal pressures has equal temperatures. It is asserted from actual practice that the exhaust steam from each 100 horse-power of engines operated is sufficient to heat from 1,000,000 to 1,300,000 cubic feet of space in average buildings in zero weather, and that a fair commercial rate to charge for such heating depends upon the price of fuel in competition, varying from $2.50 to $5.50 per 1000 cubic feet of space per heating season. It will thus be seen that this valuable product can, when distributed to heat buildings, produce a revenue of from $2500 to $6000 per annum per 100 horse-power.

The American District Steam Company, whose main office and works are at Lockport, N. Y., are the originators and patentees of the Holly system of underground distribution of steam, and have built about 200 of these plants in different cities of this country. During the past year they have constructed some 20 new plants, besides making extensive additions to plants previously installed. Among the cities in which electric companies are operating the Holly system of exhaust steam heating are the following: Erie, Wilkinsburg, Washington, Johnstown, York, Towanda, Pa; Pawtucket, R. I.; Newburg, Hornellsville, Fredonia, N. Y.; Cumberland, Md.; Atlanta, Ga.; Seattle, Wash.; St. Joseph, Mo.; Danville, Champaign, Springfield, Ills.; Grand Rapids, Mich.; Youngstown, Ohio; Crookston, Minn.; Grand Forks, N. D., and many others.

Owing to the rapid increase in their business in the past year they have been compelled to double the capacity of their works to take care of orders. Electric companies operating the Holly system of exhaust steam heating report that they are paying all their expenses and interest on the investment for steam mains from the receipts from the sale of their steam, so they practically get their current free of cost. The company invite correspondence, and will gladly send their printed matter to any company or individual making inquiry.

Automobile Running Gears.

In the manufacture of automobiles the running gear comes next in importance to the motive power and its mechanism. The two gears illustrated herewith are made by H. F. Borbein & Company, 1113 Cass Avenue, St. Louis, Mo., with that point in view.

The gear shown in Fig. 1 has a 1¼-in. oil bearing front axle, pivoted steering device, connecting rods and steering lever with hickory axle bed; also hickory reaches, well ironed and braced, extending from front to rear axle. The rear axle is 1⅜ in. in diameter. The wheels are Sarven patent wood wheels with 1¼ in. solid rubber tires. The tires are set in steel channels bolted to the rims. The front axle is pivoted so that the inside wheel will turn on a smaller circle than the outer wheel when going around corners, thus enabling the wheels to run freely without causing side creeping, and the undue wearing out of the rubber tires. The rear axle is provided with a differential gear which also allows the inside wheel to turn independently of the outer wheel when going around corners.

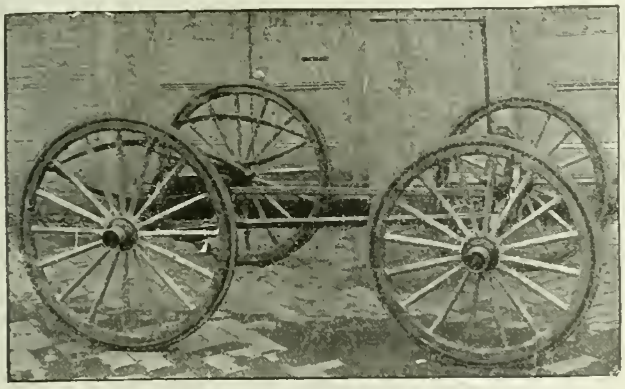


FIG. 1.—RUNNING GEAR COMPLETE.

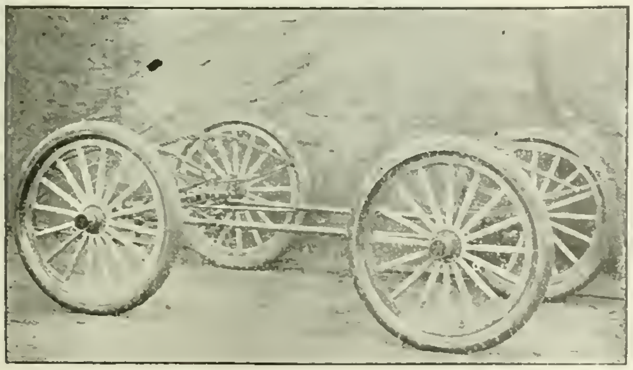
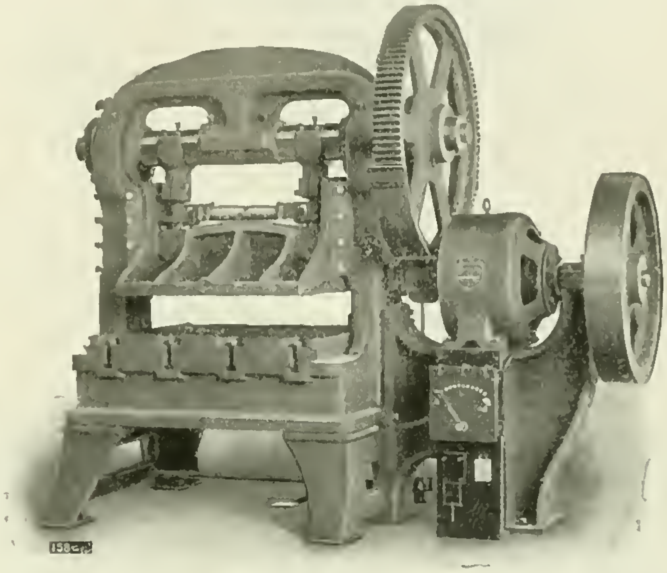


FIG. 2.—RUNNING GEAR.

Fig. 2 shows a gear equipped with 1¼ in. roller-bearing front axle, and tubular reaches. The rear axle is 1½ in. in diameter. This gear is also equipped with Sarven wooden wheels and with 3 in. pneumatic tires, which are set on steel rims shrunk and keyed to the wooden wheels. This running gear has pivoted reach ends and will adapt itself to all kinds of rough and uneven roads. The regular gauge is 4 ft. 8 in., but the firm makes gears of any gauge desired. The distance between the front and rear axle is 5 ft., but this also may be made any length to suit individual requirements.

Electrically Driven Blanking Press.

The machine illustrated herewith is a Toledo punch directly driven by a Bullock motor. The motor occupies no more space than the driving pulley of a belted-driven machine, is series wound and operates at 240 r. p. m., at which speed it developes 4 horse-power. The main switch, fuse box and rheostat are mounted upon a board fastened to the motor support, as shown in the illustration.



BLANKING PRESS.

This machine commends itself for its compactness and power and may be set upon a shop floor in any position without reference to line shafting. This feature makes it possible to effect great economy in floor space. This machine is one of the products of the Bullock Electric Manufacturing Company, Cincinnati, Ohio.

Telephone Exchange Apparatus at Pittsburg, Kan.

An interesting development of the telephone exchange switchboard is shown herewith. The board was built for the Pittsburg Telephone Company, Pittsburg, Kan. One section of the board is seen having a capacity of 300 instruments or subscribers, and arranged with positions for three operators. By adding other sections of the same size, the capacity may be increased to 600, 900, 1200 or any multiple of 300, up to an ultimate capacity of 3000 instruments. Boards of even larger capacity are made by the same company, but they vary somewhat from this, which is a metallic board and full multiple. It is simple, rapid and positive in operation, readily accessible in every part for connections, changes or repairs, and in every respect a most durable board. A full multiple board is so arranged that the operator can connect directly any instrument in her section with any other instrument, either in her own or any other section, thus giving her command over the whole switchboard. A great saving of time is thus effected.

For convenience, the board is divided into five panels and the plugs are placed on two different planes. It is provided with series jacks, and the subscribers' drops are restored by the operator. There are 18 pairs of cords and plugs for each operator, and the clearing-out drops are automatically restored. The lines coming from the cross connecting board pass through jacks in the first multiple, then continue to the next corresponding multiple. From the multiple jacks the wires go to the soldering tags on the intermediate field on the back of the board. This makes it possible to distribute the labor between the operators, which is done by removing busy subscribers from one operator and placing them with another who has more time. From these tags the wires are connected with the home jacks, which are placed on a sloping plane just above the table leaf, and from there they go to the subscribers' drops.

When the subscriber calls the exchange the drop falls and the operator places the answering plug, which is placed on the table leaf, in the home jack, and at the same time pulls the lever of the table key toward the edge of the table to the speaking position. After ascertaining the desired number, the operator takes the ringing plug, which is on the sloping plane between the subscribers' jacks and the clearing out drops, and touches the jack in the multiple which corresponds with the desired line. If it is busy, there is a click heard in the operators' telephone, but if it is disengaged there is no sound, and in that case the plug is placed in the jack and the second subscriber is called by pushing the lever of the table key toward the board to the ringing position. The table key returns automatically to its ordinary position, and the two subscribers are connected with each other.

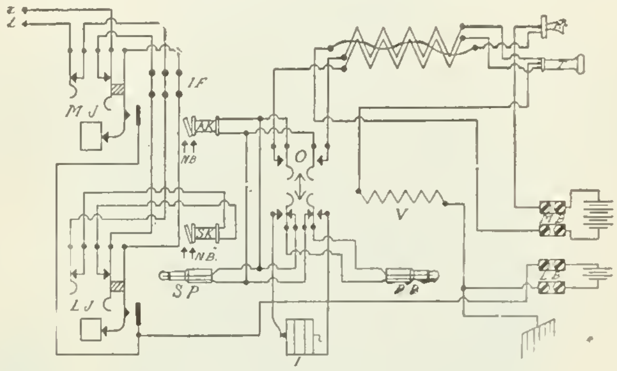


FIG. I.—DIAGRAM OF CONNECTIONS.

L., Line.
M. J., Multiple Jack.
L. J., Home Jack.
S. K., Subscriber's Drop.
A. K., Clearing-out Drop.
I. F., Intermediate Field.
S. P., Speaking Plug.
R. P., Ringing Plug.
I., Generator.
M., Microphone.
O., Table Key.
N. B., Night Bell.
V., Busy-test Coil.
L. B., Test Battery.
M. B., Microphone Battery.
T., Telephone.

When the conversation is finished, a ring-off signal is given and the clearing out drops fall and the plugs are removed by the operator. Each operator has a counter which automatically counts the calls issuing from the exchange. Six marked keys in pairs are fitted in front of each section. They are used for speaking and ringing to each of the two connected subscribers, separately.

If the operator desires to listen in or to speak to both the subscribers, the table key is pushed into its speaking position; but if connection with only one of them is desired, the keys are used. The call is generally given by the table key, but it can also be given by means of the other key. Both the subscribers' and the clearing out drops are provided with night contact, so that the night bell is rung when they are dropped. The diagram of circuits shows a portion of the connections in this multiple board.

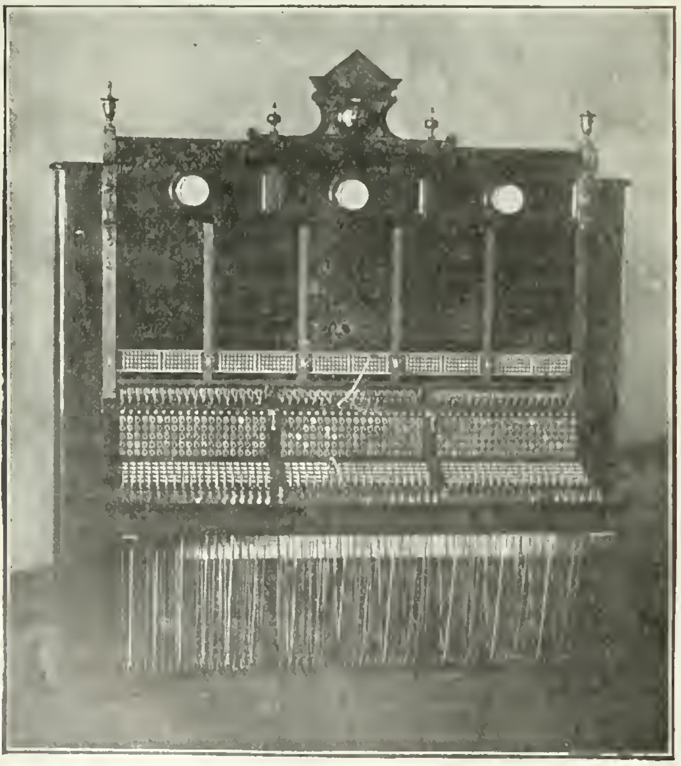


FIG. 2.—SECTION OF SWITCHBOARD.

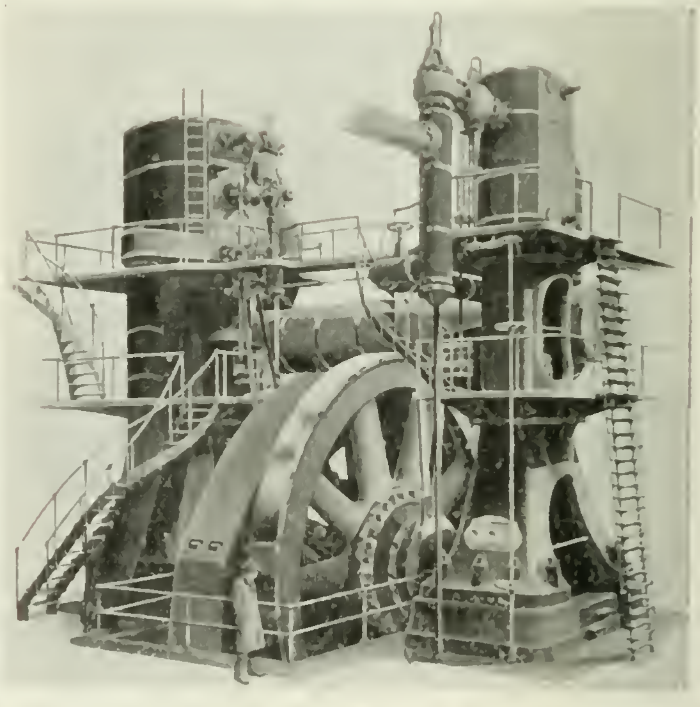
The board was built by L. M. Ericsson, Stockholm, Sweden, and sold by the Ericsson Telephone Company, 296 Broadway, New York City. Sales of boards of the same make have been effected to the Guthrie (O. T.) Telephone Company, Hedrick (Ia.) Telephone Company, Crow Telephone Company, Frank Pierce, Ia., Putnam County Telephone Company, Columbus Grove, Ia.; Montclair & Bloomfield Telephone Company, Montclair, N. J. An opportunity is thus afforded, moreover, in different parts of the country to inspect the apparatus in position. The Ericsson Company is introducing some new features in instruments also, to which it invites attention.

Engines for the Kings County Plant, Brooklyn, N. Y.

Two engines of 5000 horse-power each have just been finished by the Westinghouse Machine Company for the Kings County Electric Light & Power Company, of Brooklyn, N. Y.

One of these units is shown herewith. They are of the Westinghouse-Corliss type, vertical cross-compound condensing, and stand over 35 ft. above the floor. They are to be installed in the Bay Ridge station on New York Harbor.

Each engine comprises two vertical cylinders, erected side by side on massive frames, bolted to ponderous bed-plates. There is room left between the two cylinders for the Westinghouse alternating generator. The revolving part of the generator is mounted directly upon the steel shaft of the engine, and is firmly bolted to a very heavy fly-wheel, which has in the rim alone 100 tons of metal. It is 28 ft. in diameter, and the shaft which carries it is 39 ins. in diameter. It is not feasible to build so large a flywheel in one piece, and it is accordingly built in segments, keyed to each other and all bolted to the hub.



5000-HP VERTICAL CROSS-COMPOUND ENGINE.

In addition to the great mass of the engine which is visible above the floor, a considerable depth below the floor is necessary to allow space for the fly-wheel and the lower frames of the great generator. Then, under all, when the machines are permanently installed, will be foundations of concrete. The over-all length of each of these engines is approximately 40 ft.

The engines are cross compounded with intermediate reheating receivers. The high and low pressure cylinders are of 46 ins. and 86 ins. diameter, respectively, and both are equipped with a new form of Corliss valve gear. The stroke is 60 ins. and the speed is 75 r. p. m. Steam is supplied at a pressure of 180 lbs., and the normal horse-power of the engines is from 4500 to 5000. In emergencies, however, each engine may be forced up to 7000 horse-power. The bearing shells and caps are water-jacketed, as are also the cross-head slides. The generators of the Westinghouse engine type have an output of 2850 kilowatts each, giving a three-phase current of 250 amperes in each phase, at 6600 volts, with 3000 alternations per minute. They have separately excited fields and will operate in multiple with other Westinghouse units.

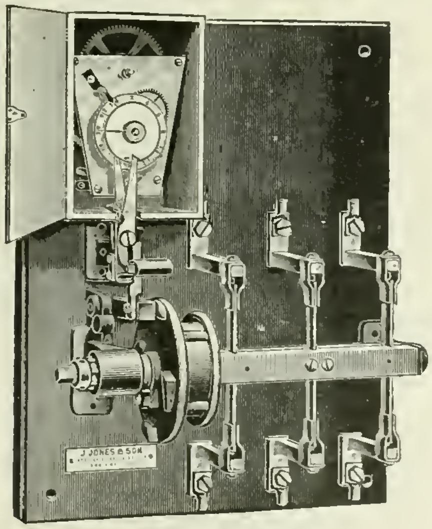
Building engines of such size calls for unusual shop and foundry facilities, and even their shipment is by no means an insignificant problem. Thus, for instance, the two bed-plates of one of these engines weigh over 43 tons each, and as they are cast complete in one piece they are very difficult to handle. For transporting these castings to Brooklyn the Pennsylvania Railroad has constructed special steel cars. The fly-wheel is, as we have said, built up in segments, and each of these segments is a car-load.

Time Switches.

Switches operated by clocks to open or close the circuits, or both, have been worked on for years with results familiar to our readers. The illustration below shows a device which J. Jones & Son, of New York City, have just brought out. It is purely mechanical, the current going through the switch only, and it is made both to throw on and to turn off the current at any designated time once in 24 hours. The movement is 8-day and the winding of it once a week is all that is necessary. It is made up to operate on as high as 200 amperes on either direct or alternating circuits.

Photometer Screens.

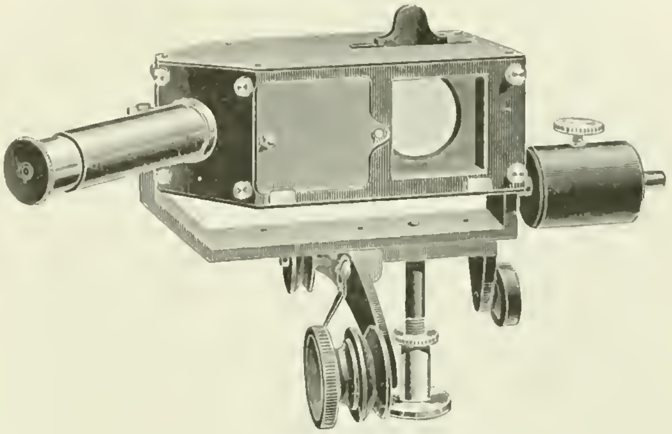
Among the many forms of photometer screens devised for comparing the intensity of sources of light, the Lummer Brodhun pattern is very generally in favor. It has a number of advantages, chief of which perhaps is the fact that the illumination produced by both lamps is viewed with one eye, the optical arrangement being such that the illuminated surfaces overlap, thus rendering the balance for equality very easy to make. This form of box, when properly constructed, enables the errors due to the absorption of the mirrors and inequality of plaster of paris screen to be eliminated if a sufficient number of readings are taken. In view of the fact that in the measurement of the candle-power of incandescent lamps by modern methods great speed is required, and one balance must represent the mean, within a small percentage, of a large number of readings, a new method was devised by Queen & Company, Inc., for adjusting these boxes. Such improvements have been made recently in the box illustrated herewith that the balance secured without the reversal of either the box or the screen may be taken as being correct to even a greater accuracy than 1-10 per cent of the average of 15 or 25 readings taken with the box set in all the various positions. The box illustrated herewith is guaranteed to reverse within 2 mm on a 2500 mm bar.



TIME SWITCH.

It is believed due to a considerable extent to the fact that both the prisms and mirrors used in this box are ground in the lens shop of Queen & Company, Inc., that such accurate reversal is made possible, as the best facilities are thus had for accurate work. Inasmuch as it is important in such boxes to keep the interior parts clean and free from dust, the sides are fastened with milled head screws so that no tool is required to open it for cleaning purposes.

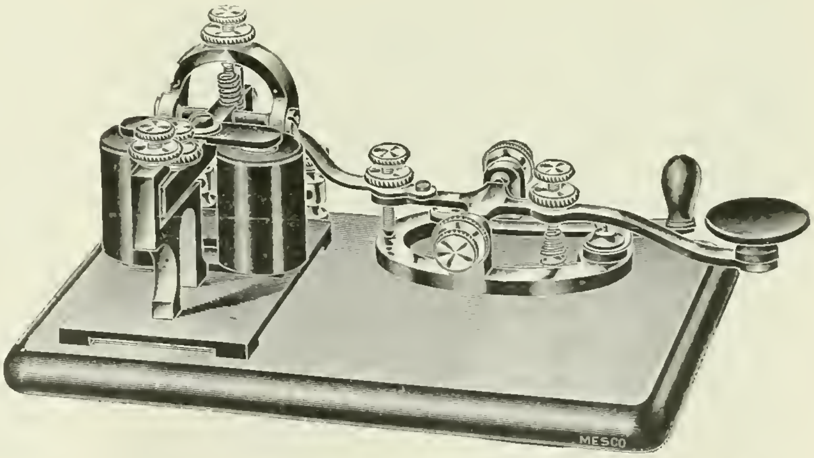
The illustration shows the box mounted on a truck for the ordinary photometer track. This truck is so arranged that it will take the regular Bunsen sight boxes, which answer well enough for some classes of work. The wheels are grooved so that it will easily roll on any track up to 5-16 of an inch thick. There is also a convenient device for clamping the carriage at any desired position along the photometer bar.



PHOTOMETER SCREEN.

Combination Electrical and Mechanical Telegraph Instrument.

A novelty in telegraph instruments has just been brought out by the Manhattan Electrical Supply Company, New York. A standard 4-ohm sounder and a standard key, with an extension piece at the back of the lever, are mounted on one base. The sounder and the key are so placed that the sounder-lever and the key-lever lie in a position at right angles with each other. The extension piece of the key-lever projects back to the line of the sounder-lever and is bent upward sufficiently to bring its end into close proximity with the back end of the sounder-lever. A small hole is drilled vertically through the latter, near the end, into which a brass pin is loosely fitted. This pin is held at any height by means of a tightening screw. When it is allowed to drop down by gravity its lower end rests upon the key-lever extension and when fastened in this position it is evident that the operation of the key-lever will operate the sounder lever mechanically. By raising the pin so as to clear the key-lever extension, and fastening it in place, the instrument may be operated by battery current in the usual way, all of the proper electrical connections being provided for the purpose. Thus, it will be seen, the instrument is both mechanical and electrical in its operation. The former feature will render the instrument of particular value for teaching and practice, and, worked electrically, it may be used on short telegraph lines. With properly wound magnets it could, of course, be used on longer lines, and yet it would be as available for mechanical operation.



COMBINATION TELEGRAPH INSTRUMENT.

In all respects the instruments are of the highest standard in material and finish and the two-fold usefulness of the outfit will no doubt be much appreciated.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money was abundant last week at 3@6 per cent, 5@5½ per cent being the ruling quotations. The rates for time money are 4@4½ per cent for 30 to 60 days, and 4@5 per cent for longer periods. Commercial paper is quiet, prime double names being quoted at 4½@5 per cent. Several factors contributed toward creating a bullish stock market, among the principal of which were the influx of investment buying and more liberal public participation. Transactions on the Stock Exchange were on an enormous scale, and almost all classes of stocks showed advances on the week's business, some high-priced dividend payers being strong and high. Low-priced stocks were active and higher. In the electrics and tractions higher prices are the rule. General Electric went as high as 200 during the week, closing at 193, ex-dividend. Brooklyn Rapid Transit closed with a net gain of 2¼ points, the sales for the week aggregating 224,290 shares. Metropolitan Street Railway closed at 171, ex dividend, a net loss of 1½ points. Western Union fluctuated between 82½ and 85⅛, closing at 85, a net gain of ½. In the market for outside securities there was little activity, although some substantial changes were recorded. The large transactions on the Stock Exchange seemed to draw business away from "curb" trading. The market, on the whole, was erratic, the irregularity being most apparent in several active issues. Among the advances were Electric Vehicle, common, 2½; do, preferred, 10; among the losses were Electric Boat, common, 1½; do, preferred, 1. Following are the closing stock quotations in the four cities named:

NEW YORK.

	Dec. 22.	Dec. 29.		Dec. 22.	Dec. 29.
Gen. Electric	196	193	Elec. Veh.	16	19
Bklyn. Rap. Tran.	83¾	86	Elec. Veh., pfd.	35	45
Met. St. Ry.	174½	171	Gen. Car.	3¾	4¼
Am. Tel. & C.	—	—	Ill. Elec. Veh. Tran.	1	1
West. Un. Tel.	83½	84	N.Y. Elec. Veh. Tran.	6½	6½
Am. Dist. Tel.	—	36½	N.E. Elec. Veh. Tran.	3	3¼
Com. Cable	—	—	Tel. & Tel. Co. of Am.	2¼	2¼
Elec. Boat	29	27	Hud. Riv. Tel.	115	116
Elec. Boat. pfd.	49	48	N. Y. & N. J. Tel.	168	173

BOSTON.

	Dec. 22.	Dec. 29.		Dec. 22.	Dec. 29.
New Eng. Tel.	—	—	Erie Tel.	100	100
Mex. Tel.	2¾	2¼	Gen. Elec., pfd.	—	155
Westing. Elec.	55¾	56*	Am. Tel. & Tel.	155	155
Westing. Elec. pfd.	—	—	Ed. Elec. Lt.	—	—

PHILADELPHIA.

	Dec. 22.	Dec. 29.		Dec. 22.	Dec. 29.
Elec. Stor. Bat.	—	88	Phil. Elec.	4¼	5⅛
Elec. Stor. Bat., pfd.	90	90	Pa. Elec. Veh.	3	2
Elec. Co. of Am.	9	9¾	Pa. Elec. Veh., pfd.	1	1
Gen. Elec. Auto.	—	—	Am. Rys.	33⅝	33

CHICAGO.

	Dec. 22.	Dec. 29.		Dec. 22.	Dec. 29.
Chicago Edison	145	145	Chicago Telep. Co.	240	235
Chic. City Ry.	253	253	Union Traction	11¼	11¼
Nat'l Carbon	16¼	16	Union Traction, pfd.	44½	45¼
Nat'l Carbon, pfd.	84½	83½	Northwest Elev. Com.	29	28½

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*Asked.

LONDON FINANCIAL SMASH.—There has been a mining smash in London, which may have some effect on one of the underground railway schemes, Mr. W. Wright being a central figure in the troubles. Whitaker Wright is about 55 years of age and has been operating in London for about 10 years. He formed the London & Globe Finance Corporation, which bought West Australian mines of marvelous richness but of doubtful enduring capacity. Among them were the Lake Views, which returned half a million dollars a month and whose £5 shares advanced to £28. Wright then broadened out in the banking world and undertook the financing of the Baker Street Underground Railway in London to the tune of $20,000,000; in fact, he subscribed for the entire issue of bonds to the amount of £4,000,000 sterling. The railway is in process of construction, but the bonds, it is believed, have never been floated outside of Whitaker Wright's banking resources. His third great venture was the British-American Corporation, where $7,500,000 was subscribed and the market value was swollen to $25,000,000.

NEW ENGLAND ELECTRIC VEHICLE COMPANY.—George von L. Meyer has retired from the presidency of the New England Electric Vehicle Transportation Company to fill his post as Ambassador to Italy. Francis R. Hart, vice-president of the Old Colony Trust Company, has been elected president. There has been a readjustment of the executive department of the company, by which some of the executive duties of the president will be performed by a vice-president. John Balch, of Boston, has been elected a vice-president for these duties. He will also assume the executive duties of the treasurer, T. K. Cummins, Jr., who has recently been appointed secretary of the Bay State Trust Company. Mr. Cummins has been elected a director of the Transportation Company and it is understood that he will retain the treasurership for the time being. William A. Burroughs has been elected secretary in place of Mr. Cummins, resigned. Charles L. Edgar, president of the Edison Electric Illuminating Company, remains a vice-president, and Knight Neftel chief engineer and general manager.

BOSTON LIGHTING CONSOLIDATION.—It is announced from Boston that the efforts which have been making for four years now to unite the Edison and the Boston Electric Light Company are about to succeed, if, indeed, they have not succeeded already. A meeting of the stockholders of each corporation will be held within a fortnight. Each company pays 8 per cent dividends and earns a great deal more. The new plan is to eliminate competition and to enable the stockholders to receive the largest surplus earnings. Both the present companies, according to the plan, are to be leased to a new company, which will agree to pay 10 per cent on each stock, giving to them an almost immediate market value of $240 or $250 a share, against $215, the value lately. The stock of the new company is to be offered to the stockholders of the two present companies, pro rata, and it is expected that the surplus earnings and increased business will pay large dividends upon this new issue.

DIVIDENDS.—The Binghamton (N. Y.) General Electric Company has declared a regular semi-annual dividend of 2 per cent, payable Jan. 10. The New London (Conn.) Street Railway has declared a semi-annual dividend of 2 per cent, payable Jan. 1. The Consolidated Traction Company of New Jersey has declared the regular semi-annual dividend of 1 per cent, payable at that rate until 1902, out of $150,000 received from the North Jersey Street Railway Company for the operation of the Consolidated Traction lines in Jersey City and Newark. The United Power & Transportation Company has declared a semi-annual dividend of $1 per share, payable Jan. 21. The directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent, and an extra dividend of 1 per cent.

MASSACHUSETTS ELECTRIC COMPANIES.—At a meeting of stockholders of the Massachusetts Electric Companies it was voted to issue at once $2,700,000 4½ per cent coupon notes for the purpose of purchasing stock in the sub-companies, recently authorized by the Railroad Commissioners, and retiring floating debt. The indenture also provides for an additional issue of notes to the amount of $800,000 to purchase, in the future, stock of sub-companies that may be issued for improvements under the plan of consolidating the properties.

INCREASE OF METROPOLITAN CAPITAL.—A certificate of the increase of the capital stock of the Metropolitan Street Railway Company from $45,000,000 to $52,000,000 was filed at Albany on Dec. 21 with the Secretary of State. The certificate says that the debts and liabilities of the company amount to $32,750,000.

Commercial Intelligence.

THE WEEK IN TRADE.—In the retail trade last week there was unprecedented activity, due largely to the holiday season. In the wholesale trade business was of reasonably small proportions, but reports from leading lines, such as iron and steel, lumber, glass, etc., were encouraging. All sections of the country report excellent business. New business in iron and steel was well sustained and quite good during the week. Free sales of finished products and of hardware are reported from Chicago, at which point 15,000 tons of rails were taken. In the metal market weakness and inactivity prevailed, there being but two business days during the week in this market. Copper quotations are unchanged, lake being 17c and electrolytic and casting 16⅝c. According to *Bradstreet's*, the number of failures last week was 213, against 262 the week previous and 220 the same week last year. The same authority states that railroad earnings continue very good, the gain of 7 per cent in gross for the second week being followed by a gain of 9 per cent for the third week of December.

THE GENERAL ELECTRIC COMPANY reports that the business done during the year 1900 shows a large increase over that done in 1899, notwithstanding the fact that the latter year's business was the best in its history. We gave some data recently as to this business. By means of enlarged facilities in its workshops this company has been enabled to make deliveries keep pace with increased orders. The number of new projects requiring large quantities of electrical apparatus and supplies has been noteworthy during the year, and final deliveries have been made on several large outstanding orders. The prices of the raw materials chiefly used in the electrical work remained at the high record made during the year 1899 until November last. Since then actual advances have been demanded on these prices, which, if continued, must ultimately lead to increased prices for finished electrical products. During the year noted improvements have been made in the equipment of central station lighting apparatus, the older and more inefficient types of generators and devices having been discarded and replaced by larger units of higher efficiency and of a more substantial character. In electrical railway work there has been a decided tendency to use equipments of four motors instead of two, thus giving greater power, higher speed and generally more satisfactory service. The increasing demand for railway equipments for suburban and interurban work shows clearly the tendency on the part of all railway companies to extend their lines. So rapid have been the strides in the successful transmission of power by electricity over considerable distances that the limiting factor is no longer the length of the transmission line, but is now merely a question of the market price at which the power can be sold. Power at a loss of only 8 per cent on the line is to-day being transmitted 80 miles in California. The electrical transmission of power from coal mines—using slack for fuel—is now beginning to attract the attention of capitalists, and at the close of the year 1900 there are several plants of this character in different sections of the country which have proved to be great commercial successes.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material and kindred lines from the port of New York for the week ended Dec. 26: Amsterdam—7 packages electrical material, $274. Athens—4 packages electrical material $10. Antwerp—181 packages electrical material, $9,759. Argentine Republic—191 cases electrical material, $5,249; 20 cases electrical machinery, $1,667. Bremen—1 case electrical machinery, $200; 4 packages electrical material, $69. Bilbao—23 cases electrical material, $717. Brazil—363 packages electrical material, $14,194; 10 packages electric railway material, $1,102. Birkenhead—2 cases electrical machinery, $462. British Possessions in Africa—4 cases electrical machinery, $862; 103 cases electrical material, $8,159. British Guiana—35 cases electrical material, $1270. British West Indies—89 cases electrical material, $2,852; 2 cases electrical machinery, $58. Chili—1 case electrical material, $14. Central America—130 packages electrical material, $1,666; 2 cases electrical machinery, $255. Cuba—79 packages electrical material, $2,548; 4 cases electrical machinery, $760. Ecuador—33 packages electrical material, $796. Glasgow—102 cable reels, $42,667; 6 cases electrical material, $164; 122 packages electrical machinery, $34,236. Havre—78 cases electrical material, $9,374; 3 cases electrical machinery, $2,500. Hayti—3 packages electrical material, $61. Hamburg—105 cases electrical material, $11,993. Liverpool—41 packages electrical machinery, $5,339; 67 packages electrical material, $4,792. London—31 packages electrical machinery, $4,442; 237 packages electrical material, $17,415. Mexico—4 cases electrical material, $355. Newfoundland—15 cases electrical material, $443. Nova Scotia—11 cases electrical material, $124. Newcastle—39 cases electrical material, $4,400; 6 cases electrical machinery, $1,000. Portuguese Possessions in Africa—31 packages electrical material, $2,185. Porto Rico—14 packages electrical material, $942. Peru—79 packages electrical material, $3,375. Southampton—51 cases electrical material, $3,153. St. Petersburg—12 cases electrical material, $355. United States of Colombia—4 cases electrical material, $200. Vienna—9 packages electrical material, $154. Venezuela—15 packages electrical material, $259. Wallsend—30 packages electrical machinery, $6,392.

THE GROWTH OF EXPORT TRADE.—The United States seems likely to stand at the head of the world's list of exporting nations in the year 1900. During the past five years, only the United Kingdom and the United States could be considered as competitors for the distinction of being the world's greatest exporter of articles of home production. In 1894 the United Kingdom led the United States by nearly $250,000,000, and in 1897 the United States had so rapidly gained that she was but $60,000,000 behind. In 1898 the United States took first place, our exports in that year exceeding those of the United Kingdom by nearly $100,000,000. In 1899 the United Kingdom again stood at the head of the list, her exports exceeding those of the United States by nearly $35,000,000. In the eleven months of 1900 whose figures have been received by the Treasury Bureau of Statistics, the domestic exports of the United States exceed those of the United Kingdom by $5,473,670, and should this rate of gain be maintained in December the United States will in the year 1900 show a larger exportation of domestic products than any other nation in the world. Even this distinction, however, of heading the world's list of exporting nations but partially tells the story of our export trade as measured by that of other nations. Comparing the growth of exports during the last quarter of the century with those of the other great nations of the world, we are able to better measure the wonderful progress shown. France shows no increase in her exports of domestic merchandise in the closing quarter of the century; Germany shows during the same period an increase of about 50 per cent, and the United Kingdom shows from 1875 to 1900 an increase of nearly 40 per cent, while the United States shows during that time an increase of practically 200 per cent.

WESTERN TELEPHONE CONSTRUCTION COMPANY.—During the past eight months this company has, under its new organization and management, done a most successful business. The cities to be equipped by the "Western" are Pottsville and Williamsport, Pa.; Corsicana, Tex.; Greensboro, N. C., and Binghamton, N. Y. In addition to the contracts named it has also recently shipped a 200-line "Western Express" switchboard to J. P. Helfenstein, Ashland, Pa., and has booked orders for 100-line "Western Express" switchboards for the Columbia Telephone Company, Columbia, Pa.; Mutual Telephone Company, Greenfield, Ohio (for Leesburg, Ohio); J. B. Rhodes, Zanesville, Ohio; Lancaster Telephone Company, Lancaster, Ky., and smaller orders for other points. Large orders for telephones have been recently filled for Leesburg and Eaton, Ohio; also an additional order for telephones from the Chicago & Alton Railroad for their lines between Chicago and Bloomington. Orders for the new "Western Express" No. 3 bridging telephones are very satisfactory. The strength and size of generators and the good ringing qualities of these instruments have caused their adoption by many farmers' lines and long distance companies.

NORCROSS BROTHERS, of Worcester, Mass., who have the contract for constructing the magnificent new plant of the Natural Food Company at Niagara Falls, have commenced work on their contract with great vigor. Many men and teams are at work, and, as fast as they can be utilized, the working force is being added to at every point in expectation that the factory and institute may be completed in time for opening with the Pan-American Exposition, May 1 Electric power will be used in every possible way in order that the plant may be perfect in its workings and cleanliness. President H. D. Perky has taken possession of the home of Mr. W. B. Rankine, which he purchased, and he is now a resident and citizen of Niagara Falls. Naturally, Niagara Falls people feel much elated over William B. Rankine's success in capturing this fine new industry for that city. The structural material has already begun to arrive at the Falls in large quantities.

TELPHERAGE.—With the opening of the new century, telpherage comes forward as a new art, and is at once finding its place and function for light transportation, particularly in regions where it is not desirable to lay trolley tracks or where there may not be traffic enough to warrant the installation of an expensive rail system. The capacity of the telpher to handle large quantities of material in the aggregate is nothing short of remarkable. The Consolidated Telphage Company, of this city, whose organization is due to Mr. H. McL. Harding, is now executing some interesting contracts and is receiving inquiries and requests for bids from all parts of the world. A large number of agencies have been applied for and appointed, and there hardly seems to be a country or an industry that does not need this latest of the electrical arts on a large scale.

NEW CORLISS ENGINE WORKS.—A stock company has been formed at Milwaukee whose object is the construction and the operation of a new plant for the manufacture of Corliss steam engines. The name of the concern will be the Brown-Corliss Engine Company, and the management will consist of the following: T. W. Phillips, of Providence, R. I., president; W. F. Brown, of Milwaukee, superintendent; Chas. Rhode, of Milwaukee, treasurer. C. M. Paine is handling the financial end of the deal. The capital stock of the corporation is to be $1,000,000 and will consist of 5000 shares of preferred and 5000 shares of common stock. The plans and articles of incorporation are drawn up and will be placed before the public in a short time. The factory will be located at Milwaukee.

MANHATTAN ELECTRICAL SUPPLY COMPANY.—As already noted in this department, the Manhattan Electrical Supply Company, of New York City, in pursuance of its aggressive forward policy, is branching out in various directions. Its latest departure, which is of interest to the supply trade and to electrical people in general, is the securing of the whole store and basement at 186-188 Fifth Avenue, Chicago. It will take a little time to fit up and stock this well-known piece of property, and then the company will open there for that part of its growing Western trade early in the new year.

ELWELL-PARKER ELECTRIC COMPANY.—We understand from President F. C. Phillips that the Elwell-Parker Electric Company of Cleveland, Ohio, whose works were destroyed by fire recently, together with those of the Brown Hoisting Machinery Company, have been fortunate enough to secure temporary premises that are considerably larger than the old ones. They will be in full swing with their new facilities and ready to take and fill new contracts by Jan. 1. Fortunately, also, insurance is going to about cover all the actual property loss.

MR. W. R. MASON, who of late has been representing in St. Louis the Siemens & Halske Company of America, will act, after Jan. 1, as district manager for the Northern Electrical Manufacturing Company, Madison, Wis., and the Stanley Electric Manufacturing Company, Pittsfield, Mass. His office will be at 110 Laclede Building, in that city.

W. J. MURDOCK & CO., of Boston, Mass., the manufacturers of the new "Solid" telephone receiver, are removing their factory and office to Chelsea, a suburb of Boston. The new plant, which is on Carter Street near Edward Avenue, will increase its capacity very largely.

Special Correspondence.

ENGLISH NOTES.

London Office Electrical World and Engineer,
Dec. 20, 1900.

MR. SLATER LEWIS has retired from the position of engineer and general manager to P. R. Jackson & Co., of Manchester, England, and has accepted a seat on the board of the Brush Electrical Engineering Company, Ltd.

UNDERGROUND ROADS.—The rapid development of underground railway schemes and work in London is said to be having an effect in Paris. It is now stated that the municipality have under consideration another underground railway from Montmartre to Montparnasse. It would cross beneath the Seine through two tunnels, join three important railway stations—St. Lazare, Orleans and Montparnasse—and form the connecting link between the metropolitan and the circular underground lines building. The proposed railway would be a great boon to Parisians.

NERNST ELECTRIC LIGHT.—The report of the directors of the English Nernst Electric Light Company, from Feb. 23, 1899, to Sept. 30 last, states that the expenditure on capital account during this period is shown to have been £9,696, while the disbursements on other accounts amount to £6,757. The directors, after deducting from the latter amount £846, received on account of interest and transfer fees, have placed the balance of £5,911 to a development suspense account, to be dealt with in future years. Apart from the purchase consideration for the patent rights, the only prominent item of expenditure on capital account is £5,000 contributed toward the purchase for this company of Professor Nernst's British royalties, the balance of the consideration having been provided by the vendors. As the owners of the British rights have not commenced business in England, this investment is still unproductive. Since the formation of the company the directors have been engaged in further developing the Nernst lamp, so as to render it more capable of being manufactured and sold in quantities on a profitable commercial scale, and with a uniform degree of quality and efficiency for the various sizes; they have also taken out subsidiary patents, which, it is hoped, will prove of considerable value. The fire which occurred on the company's premises in May unfortunately destroyed the patterns, instruments and apparatus collected during the previous twelve months, and, notwithstanding the most strenuous efforts of the staff, progress was practically arrested for more than three months. While every discovery involving radical changes from existing methods must necessarily take time before the result can safely be placed on the market, the directors have found that the practical difficulties to be overcome in the wholesale reproduction of the Nernst lamp to the best advantage have been greater than they anticipated. The variations which occurred in endeavoring to repeat on a more extensive scale results already obtained have involved lengthy experiments and chemical research in directions where no precedent was available. It is now, however, confidently hoped that the main causes of such variations have been traced to their origin, and means devised for their elimination. It should be considered that, although all the licensees possessing rights for other parts of the world commenced work many months before the formation of this company, and had, in most cases, the advantage of an organization already equipped, this company has, in the opinion of the directors, made at least as rapid progress in the practical development of the lamp as other concessionaires. According to the balance-sheet, the development suspense account amounts to £6,757, less interest, etc., £846. The annual meeting was a stormy affair, when charges were made against the managing director, and adjournment was taken for a month.

General News.

THE TELEPHONE.

CANAL WINCHESTER, OHIO.—The Columbus Citizens Telephone Company is preparing to establish a branch exchange at this place.

ELMORE, OHIO.—The Home Telephone Company recently organized by local people is installing its exchange. A large number of subscribers have been obtained.

YOUNGSTOWN, OHIO.—Harry Koplin, formerly of the Youngstown Telephone Company, has been appointed superintendent of the Columbiana County Telephone Company.

TOLEDO, OHIO.—It is reported that a company with $1,000,000 capital stock will be incorporated for the purpose of establishing an independent telephone system in this city.

MONROVIA, CALIF.—The Monrovia Telephone Company is operating a system connecting villages in the orange-growing districts. The Monrovia exchange has 82 subscribers and a switchboard capacity of 100 drops.

CALEDONIA, OHIO.—John Pommert has commenced work on a local exchange, and thus far has secured 50 subscribers. Next spring he expects to connect with Marits, Adelaide, New Winchester, Kirkpatrick and other surrounding towns.

YOUNGSTOWN, OHIO.—The Central Union Telephone Company is preparting plans for a large six-story office building, part of which will be utilized for its offices and local exchange. New switchboards will be installed, and the facilities will be greatly increased.

CLEVELAND, OHIO.—The Cleveland Telephone Company is having trouble with its toll stations throughout the city through slugs and counterfeits. The number of boxes being broken into indicates that there is an organized gang at work. One night recently forty boxes were reported broken into and their contents abstracted.

SPRINGFIELD, OHIO.—J. J. Dunn, of Columbus, and D. F. Snyder, of this city, are promoting a company which will be incorporated with $150,000 capital stock, to build an independent telephone system in this place. A franchise will be applied for in the near future, and it is believed it will be secured without difficulty.

CADIZ, OHIO.—The Harrison County Telephone Company has been incorporated by A. J. Vernier, C. D. Duvenal, J. M. Schreiber, W. W. Wright, W. W. Potts and R. Cunningham. Capital stock, $25,000. The company will build a local exchange with toll lines in Carroll, Belmont, Guernesey, Jefferson and Tuscaraws counties.

NEW HAVEN, CONN.—The Automatic Telephone Company, of Waterbury, Conn., organized some two years ago, under the Joint-Stock Law of the State, has filed application to the State Legislature for a special charter. It ceased any further steps toward doing business when last year, Judge Thayer in the Superior Court found against the public necessity and convenience of a similar company seeking to do business in New London.

CLEVELAND, OHIO.—The Stark County Telephone Company, which is composed of local people, and which is building exchanges at Canton, Alliance and other places, has organized as follows: Joseph Beichele, president; J. B. Hoge, vice-president; Ferdinand Herbruck, treasurer, and James E. Flohr, secretary. Directors: Ferdinand Herbruck, Augustus Dannemiller, T. H. Phillips, Joseph Beichele, John C. Welty, H. D. Critchfield, J. B. Hoge, Harry A. Cavanah and R. S. Shields.

CONNECTICUT.—The Southern New England Telephone Company has announced an important reduction in the private and business rates of all Connecticut towns where there are less than 160 subscribers. The rates for house party service is reduced 25 per cent., and for business offices 33⅓ per cent. The towns affected are Brandford, Danielson, Guilford, Litchfield, Manchester, Milford, Naugatuck, New Milford, Ridgefield, Rockeville, Southington, Saybrook, Simmsbury, Wallingford and Winsted, and their connecting towns.

SALEM, OHIO.—The Independent Telephone Association, of Columbiana County, was organized here a few days ago for the purpose of making a closer alliance among the independent companies in this vicinity. Lewis H. Walker, of the Eastern Ohio Telephone Company, was elected president, and W. F. Crossley, of the Columbiana County Telephone Company, secretary. Representatives of the Bayard, Winona and Damascus companies, with the above mentioned, were chosen as an executive board. It is believed the new association will tend to improve the service of all the companies interested.

INDIANAPOLIS, IND.—Hugh J. McGown, of this city, who is a director in the American Telephone, Telegraph & Cable Company, says that the company is responsible for the consolidation of telephone interests recently made in the South. He says the company is progressing with its plan of extending the use of telephones to the rural districts. The extension work will be pushed more rapidly when the company brings about closer relations between existing telephone companies now controlling certain large districts in the Eastern, Central and Central West States.

ELECTRIC LIGHT AND POWER.

NEW ORLEANS, LA.—The Merchants' Electric Light & Power Company has sold out to the Merchants' Electric Company.

SANFORD, N. C.—There is an opening here for an electric light plant. Mr. W. A. Wynne, of Raleigh, N. C., may be addressed on the subject.

NICHOLASVILLE, KY.—The Mayor has appointed a committee to investigate the advisability of establishing a municipal electric light plant here.

CLEVELAND, OHIO.—The village of East Cleveland has practically decided to erect a municipal lighting plant. A council committee is having plans and estimates prepared.

BLOOMINGTON, IND.—Indianapolis capitalists represented by Councilman S. V. Perroll is proposing to purchase the Bloomington Electric Light plant, and have secured an option.

SAN FRANCISCO, CALIF.—The Union Iron Works are building an extension to their electric power house, in which additional boilers, generating sets and an air compressor will be installed.

PARRY SOUND, ONT.—A by-law to raise $30,000 to purchase the electric-light plant of the town of Parry Sound, Ont., will be submitted to a vote of the ratepayers of the town in January next.

HOOD RIVER, OREGON, will soon have electric lights. A local company has commenced the construction of a water power electric power system to be supplied from Hood River near the town.

INDIANAPOLIS, IND.—The county power, heat and light plant has been accepted by the County Commissioners from the contractors, Joseph McWilliams & Co., of Louisville. Its cost was $150,000.

MONTPELIER, IND.—The City Council has voted to purchase the local plant of the Montpelier Electric Light Company of the Kerlin Bros., of Toledo, O., owners thereof. The contract price is $38,000.

SLOCAN, B. C.—A company has been formed here for the purpose of securing a water power from Goat Creek, near this place, and to develop electric power. The estimated cost of the works is placed at $40,000.

WASHINGTON, D. C.—The U. S. Signal Corps at its post at Fort Myer, Va., is installing an electric generating plant for charging the storage batteries of the automobiles at that post, and also for purposes of instruction.

MT. GILEAD, O.—The Mt. Gilead Water & Electric Light, Heat & Power Company has been incorporated with a capital stock of $60,000. Mr. J. C. Fish, of Shelby, O., is manager. The company's plant has not yet been installed.

HAMILTON, OHIO.—The capacity of the electric light plant here is inadequate to meet the demand for light. It has been estimated that an additional plant will cost about $50,000, which will require the issue of bonds by vote of the people.

TERRA ALTA, W. VA.—The Terra Alta Light, Heat & Power Company has been incorporated with a capital stock of $10,000. Mr. J. F. Gienger is manager. The company is in the market for equipment. Its power house has not yet been built.

YOUNGSTOWN, OHIO.—The Youngstown Consolidated Gas & Electric Light Company has submitted a proposition to the city to furnish 300 arc lamps, or as many more as are needed, at the rate of $64 per year; contract to remain in effect for nine years. The proposition will be accepted.

ST. LOUIS, MO.—The bill for the erection of a municipal lighting plant at the city waterworks has passed the Council. It authorizes work to commence on installing the new electric plant at once, and it is expected it will be in operation by September 1, 1901. The annual saving to the city is estimated at $10,000.

SIDNEY, B. C.—A company composed of American capitalists has been organized by J. Keith Fisher, of the British Columbia Portland Cement Company, the object being to establish extensive cement works near Sidney, on Vancouver Island, B. C. It is intended to operate the works by electric power.

SAN BERNARDINO, CALIF.—The San Bernardino Gas & Electric Company was recently incorporated with San Bernardino, Cal., as the place of business. Directors: Charles R. Lloyd, of San Francisco; W. S. Hooper, W. F. Gordon, J. W. Curtis, San Bernardino; E. D. Roberts, Colton. Capital stock, $200,000; subscribed, $500.

KINGSTON, ONT.—The corporation of the city of Kingston has served notice on the Kingston Light, Heat & Power Company of the city's intention to proceed, under the terms of an agreement existing between the city and the company, to arbitrate and fix a price for the purchase of the gas and electric light plants from the company. The value of the plants aggregate $300,000.

DENVER, COLO.—Suit has been brought in the District Court against the Lacombe Electric Company, attacking the validity of the ordinance by virtue of which the company is now installing its system for the purpose of supplying electric light to the city. The suit was brought on the grounds of publication only, it being alleged that the bill granting the franchise was not published in a daily paper as required by law.

CINCINNATI, OHIO.—Attorney Charles H. Shaw, representing the New York syndicate, which purchased the Suburban Electric Company's plant in Covington, says the question of confirmation of sale is up to the courts and that Jan. 10 has been set for a hearing. Attorney Shaw believes the sale will be confirmed, as the charge that the sale was not held on the day indicated in the order was due merely to oversight and was not premeditated.

NEW ULM, MINN.—The city council has under consideration the advisability of installing an electric light plant for the city, and steps are being taken looking toward favorable action in the near future. The committee on lights will receive plans, specifications and estimates of the cost for a plant of 100 street arc lights of 2000 candle-power, with all necessary machinery. For further information application can be made to Louis Schilling, city clerk of the City of New Ulm, Minn.

BROCKVILLE, ONT.—Some time ago the city of Brockville purchased the plant of the Brockville Gas & Electric Light Company for $85,000, on a valuation by a Toronto civil engineer. The Brockville light commissioners, however, recently engaged a New York expert named Mr. Blossom, to make an inspection of the plant. Mr. Blossom's report has come to hand, and it practically condemns the whole plant which is not only stated to be out of date, but also in a very bad condition. The value of what material might be utilized would be about $30,000, but the wiring, etc., is of little account. To repair the systems, as they now stand, would cost about $63,000. Mr. Blossom favors concentration of the two plants and building an entirely now system at an estimated cost of $125,000.

MINNEAPOLIS, MINN.—The International Electric Company, whose big plant in the Lumber Exchange and Edison Building was installed at a cost of $150,000, has been sold to Eastern parties, who have already taken charge of the property. The transfer was effected through the Old Colony Trust Company, of Boston, acting as agent for Eastern capitalists, who have been negotiating with the local stockholders for weeks. The International Electric Company was organized in 1894 with H. C. Akeley as president. Its plant and main offices are located in the Lumber Exchange and Edison Buildings. The company's lighting operations have been principally confined to the downtown district, and cover the territory from the river to Thirteenth Street and between Fourth Avenue South and Third Avenue North. This territory comprises what is known as the underground district. The company is at present supplying about 10,000 lights, and has been running to the limit of its capacity for some time.

THE ELECTRIC RAILWAY.

OKLAHOMA CITY, OKLA.—A franchise has been granted to a company of Chicago capitalists to construct and operate a street railway here.

FORT WORTH, TEXAS.—Bids will probably be opened and the contract let Jan. for the construction of the inter-urban electric road to Cornear, Fort Worth and Dallas.

CHARLOTTE, N. C.—It is stated that Dr. Pratt, of Chapel Hill, N. C., who is interested in the proposed electric railway to Durham, N. C., has raised about $200,000 toward the enterprise and that he is now working for an additional $100,000.

ST. LOUIS, MO.—The new position of second vice-president of the Transit Company has been filled by the appointment of A. B. Dupont, general manager of the Citizens' Street Railway Company, of Detroit, Mich. Mr. Dupont will take up his new duties Jan. 1.

GALVESTON, TEX.—The charter of the Galveston City Railway Company has been filed at Austin, Tex. Its capital stock is $800,000. The incorporators are R. B. Baer of Houston, Walter G. Oakman, George H. Turnbull and Edward Cornell of New York City.

ST. LOUIS, MO.—The St. Louis, Clayton & Western Railway Company, which was granted a franchise for an electric road in the county two years ago, has made application for further time in which to accept the provisions of the county court, and was given until Feb. 1, 1901.

TIFFIN, OHIO.—President Sneath, of the Fiffin, Fremont & Fostoria Electric Railway Company, has presented each of the 23 employes of the road with a paid-up accident policy, good for $7.50 per week in event of injury, and $1,500 in case of death. The working day has been reduced to 10 hours.

PITTSBURG, PA.—The Pittsburg newspapers have started a movement for the establishment of a street railway men's relief fund by inviting the public to give the conductor on Monday, Dec. 24, some trifling sum, in addition to the regular fare of a nickel, and the sum thus realized is to form the nucleus for that fund.

KANSAS CITY, MO.—Articles of incorporation have been issued to the Kansas City & St. Joseph Railroad Company, capital $1,500,000, to operate an electric line between the two cities. The incorporators are Senator Perry A. Gibson and John Doll, Erie, Pa.; R. P. McGeehan, Homer Reed and C. E. Gibson, of Kansas City.

SCRANTON, PA.—The strike of the employees of the Scranton Street Railway Company, which began about ten days ago, was settled on Dec. 30, by a compromise between the strikers and the company. Several acts of violence took place during the strike, during which property of the company was damaged. The men get a ten-hour day at $1.85 per day.

AUSTIN, TEX.—The Sherman & Denison Electric Railway Company, which proposes to construct and operate an electric railway between Denison and Sherman, Texas, recently made application to the Railroad Commission of Texas for authority to issue $300,000 of first mortgage bonds, the proceeds of the same to be used in the construction of the road. The authority was granted.

JUAREZ, MEX.—The municipal authorities of this city are anxious to secure an electric street car service. They have offered the company operating the mule street car line exemption from all municipal taxation for a period of five years, and also to refund to the company over $15,000 of taxes that have already been paid if it will equip the cars with electric power. The proposition is being considered by the company and will probably be accepted.

GREENFIELD, IND.—The Indiana Railroad Company has been incorporated with a capital of $100,000 to build two inter-urban electric roads. One will be from this city to Knightstown, a distance of 14 miles, and the other from this city to Pendleton, a distance of 16 miles. The directors of the new company are all Greenfield men, namely: F. G. Banker, M. C. Binford, C. M. Kirkpatrick, E. J. Binford, W. C. Dudding, L. E. McDonald and W. R. McCowan.

PITTSBURG, PA.—The formation of the Union Traction Company, which means the consolidation of all the street car companies in this city, is now about completed. For a long time the matter has been hanging fire on account of litigation, but all legal entanglements were discontinued last Monday, when the different suits were compromised. This consolidation will take in the Consolidated Traction Company, the United Traction Company, the West End Traction Company, the Suburban Traction Company and the Monongahela Traction Company.

BLACK RIVER, N. Y.—The consolidation of the Black River Traction Company with the Dexter & Brownville Street Railway Company has just been certified to the Secretary of State of New York. Their capital stock is $65,000 and $40,000 respectively. The name of the new corporation resulting from the consolidation is the Black River Traction Company. The capital stock is $105,000, divided into 1050 shares of $100 each. The directors are Julius A. Lebknecher, George Krementz, Chandler W. Ricker of Newark, N. J., and Hiram F. Inglehart, George H. Walker, Thomas Burns, N. P. Wardwell, Chester C. Inglehart and S. R. Smith of Watertown.

THE MINNEAPOLIS STREET RAILWAY lines were tied up in rather a remarkable way recently. The dam which furnishes power to the street cars lies a short distance below the dam used by the flour mills. In consequence of the shutting of the mills the water was held back and the street railway water wheels soon exhausted the supply of water in the fore bay. The railway company, realizing that it would take some time for the water to rise sufficiently to turn the water wheels, ordered its local steam power houses started. However, it takes considerable time to get the steam power under way, and by the time that everything was in readiness the water had risen and was rushing over the dam at its usual rate.

CONNECTICUT.—As a result of projected trolley parallels between Waterbury and Middletown, New Haven will change the Waterbury, Meriden & Middletown road, about 26 miles long, between Waterbury and Middletown, to an electric line. It is understood that the opposition of the New York, New Haven & Hartford Railroad to the acquisition by the United Gas Improvement Company of trolley lines in Connecticut will only temporarily set back the plans of the latter company. The New Haven Company attempted to prevent the United Gas Improvement Company from securing control of a trolley line between Bridgeport and New Haven and won in the courts. Meantime, however, an entrance into New Haven was secured by way of Derby, so that connection by trolley between New York and New Haven is complete.

NIAGARA FALLS, N. Y.—At a meeting of the boards of directors of the Niagara Gorge Railroad and the Niagara Falls Street Railway, held in Buffalo, General Francis V. Green, of New York, tendered his resignation as president of the companies represented, and Captain Joseph T. Jones, of Buffalo, was elected to succeed him. It is understood that Captain Jones will give considerable attention to the roads of which he is the head, and it is understood that the line of the Niagara Falls Railway Company will be constructed under his management. This new line will give the Niagara Gorge Railroad direct connection with Prospect Park by way of Main, Falls and Riverway streets. At present the Niagara Gorge road uses the tracks of the Niagara Falls & Suspension Bridge Street Railway Company from Second street to the monument at the foot of Falls street. It is evident from the influence and energy of Captain Jones that the travel over the Niagara Gorge Railroad during the Pan-American year, and all future time, is to be well looked after.

THE AUTOMOBILE.

INDIANAPOLIS, IND.—An effort is being made to organize an automobile club in this city.

THE AUTOMOBILE CITY.—The Junior Munsey for January contains an article on Washington, as the automobile city. It shows eleven illustrations of vehicles, of which nine are Columbias.

AUTOMOBILES IN WASHINGTON.—Bills are before Congress for the appropriation of money for the purchase of electric vehicles for delivering books from the Congressional Library to senators and members of congress at their homes, and also for electric vehicles for police ambulances and patrol wagons.

ELIZABETHPORT, N. J.—The Riker Motor Vehicle Works at Elizabethport was partly destroyed by fire on Dec. 29. The fire started in the boiler room, and spread through the west wing, including the machine shop, engine room and trimming department. Several unfinished automobiles were burned and a large lot of material.

AN AUTOMOBILE STAGE LINE will be operated between Columbus, Ind., and Bloomington, via Nashville. Two three-seated machines are being built on a guarantee that they will make the trip between the two places in four hours, a distance of 40 miles over the most hilly region of the State. Each machine will carry six passengers and baggage. The fare will be 3 cents a mile.

AUTOMOBILE CLUB OF AMERICA.—The committee on new quarters of the Automobile Club, composed of Albert R. Shattuck and Albert C. Bostwick, has about concluded arrangements for leasing rooms on Fifth Avenue, near the Plaza. A large automobile company will open storage and warerooms at the corner of Fifty-eighth Street and Lexington Avenue, where club members and visitors may store their machines. The club's idea is to have an attendant during the active season on the sidewalk to watch vehicles until men from the storage place can be sent to take them to the warerooms. The automobile company will send the carriages back at the call of the members. This does away with the necessity of the club's doing its own storing, cleaning and repairing, to do all of which successfully would require a building, paraphernalia, force of mechanics and superintendent that in nine times out of time would financially swamp any concern except one maintaining itself on strictly business principles—a thing that clubs rarely do.

NEW INDUSTRIAL COMPANIES.

THE CLARKE ELECTRO COMPANY has been incorporated in Delaware. It will make and deal in medical electrical appliances.

THE JOHN S. BUSHNELL COMPANY, of New York City, has been incorporated to manufacture electrical and steam appliances; capital, $25,000. Directors: A. C. Lippincott, of Newark, N. J., and J. H. Spencer and H. A. Hartt, of New York City.

THE ELECTRO-PNEUMATIC COMPANY, capital $1,000,000, has filed a petition of incorporation in Hartford, Conn. It is planned to build a pneumatic tube service between Boston and New York by which a package can be sent between these two cities in 27 minutes. The incorporators are Charles P. Phillips, Warren K. Dowe, James L. Wolcott, Charles B. Johnson, William C. Case and Percy S. Bryant, all of New York, except the last two.

THE CALAVERAS DITCH COMPANY, capital $2,000,000, has been incorporated in New Jersey to supply water for agricultural, mining and manufacturing purposes, and to construct reservoirs, dams, canals and pipe lines, and restoring and conveying the same. Of the capital stock $300,000 is to be preferred with 7 per cent. cumulative dividends. The incorporators: Alvah Beech Thompson, August Roesler and William Stone Hubbell, Jr., all of Jersey City.

TO BUY AND SELL STREET CAR TICKETS.—Articles of incorporation were filed by the American Co-operative Ticket Company, of Newark, N. J., the object being to purchase and sell street-car tickets, merchandise, real estate mortgages, hold and improve, lease and convey lands and real estate and personal property; also to deal in merchandise in the State of New Jersey and any other State or Territory of the United States. The capital stock authorized is $100,000. The incorporators are Franz J. Beyer, John S. Johnson and Charles G. Beyer, all of Newark.

LEGAL.

ELECTROLYSIS BY RAILWAY RETURN CURRENTS.—Judge Carter, of the Indianapolis Superior Court, has made a ruling holding the complaint sufficient in the case of the Manufacturers Gas Company vs. The Indianapolis Street Railway Company, for $50,000 damages for injuries to the gas company's pipes through electrolysis. The ruling is one of the first in the country on the question of whether or not damages will lie from injuries attributed to electrolysis. A judgment will next likely be given for the extent of the damages proven, and an appeal will likely be taken to the Supreme Court.

PERSONAL.

MR. W. J. HAMMER, who went over to Europe early in the summer to attend the joint Institute meetings and the International Electrical Congress, returned just in time for Christmas, having made a very thorough tour of the Continent, England, etc.

DR. T. C. MENDENHALL, president of Worcester Polytechnic Institute for seven years, has resigned, to take effect July 1, 1901, and his resignation has been accepted by the trustees. Poor health is given as the cause of his decision. Dr. Mendenhall, before going to Worcester, was superintendent of the United States Coast and Geodetic Survey at Washington.

MR. C. W. PRICE, the veteran telegrapher and electrician, who has of late been actively connected with the Montauk Multiphase cable, is once more among his friends after a very severe bout of illness, which threatened serious results at one time, but which seems to have left him better than ever. He has been using some of this enforced leisure to work out a new plan of electrical work, to which attention will shortly be called.

MR. GEORGE O. PROCTOR, of the Anchor Electric Company, Boston, has just received a very handsome compliment on retiring from office as Mayor of Somerville, Mass., after two years' incumbency. To him and his successor a banquet was given at Young's Hotel, Boston, on Dec. 28. The references to his administration were most flattering, and Mayor Proctor, in his acknowledgment, was able to point out the various ways in which he had conducted the affairs of the city on business principles with success and efficiency.

MR. CHARLES H. SCHUM, who has been with Messrs. F. A. La Roche & Co., of New York, for the past four years, has resigned his position as electrical engineer to accept one with the Bergmann Electromotoren und Dynamo Werke, of Berlin, Germany. Mr. Schum is a graduate of Sibley College, Cornell University, class of 1895, and has had an extensive experience in switchboard and dynamo practice. Mr. Schum will sail from New York for Germany on Jan. 3.

OSTERBERG & SUTTON.—The well-known consulting engineering firm of Osterberg & Sutton, 11 Broadway, New York, dissolved on Jan. 1 The two members of the firm will continue their engineering practice separately at the same address. Mr. Max Osterberg, E. E., A. M., will continue to devote himself to consulting engineering and expert work. Mr. Frank Sutton, E. E., will continue work along the same lines, and is prepared to draw up specifications for heating and ventilating plants and sprinkler and fire protection systems.

Trade Notes.

THE WESTERN ELECTRIC COMPANY, Chicago, is prepared to furnish arc-light carbons for direct and alternating current lamps. It would like to receive specifications.

THE AMERICAN ELECTRICAL WORKS have issued as the illustration of their calendar for 1901 a picture of Michael Faraday together with a commendation of Faraday's work by Tyndall.

THE HAINES & NOYES COMPANY, of Chicago, Ill., has just closed a contract for equipping with telephones the traffic and advertising department of the Chicago & Great Western Railroad, Chicago.

FOOTE, PIERSON & CO., 82 and 84 Fulton street, New York City, have issued to their friends a neat little vest pocket book with calendar, and containing a large amount of useful information. It is bound in a prety celluloid cover.

THE AJAX IRON & WIRE COMPANY, of Brooklyn Borough, New York, has been incorporated with a capital stock of $5,000. The directors are Lina Beecher and M. L. Smith, of Brooklyn, and Banyon Moore, of New York City.

TEXAS ARM & PIN COMPANY, of Beaumont, Tex., has distributed among its friends and patrons as a New Year memento a very tasteful and substantial leather pocketbook, which all who receive will be very glad to carry around with them.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has issued a 96-page catalogue (No. 57) for the sawmills, lumber and woodworking industries. A copy of the catalogue, which is profusely illustrated, will be mailed to any one interested in the subjects.

THE MAXWELL M. MAYER ELECTRIC COMPANY, 2369 Second avenue, New York, has issued Bulletin No. 9, dated January, 1901, in which are described the direct-current dynamos and motors built by this concern. These machines have been on the market for six years.

AMERICAN ELECTRIC TELEPHONE COMPANY, 38 to 50 West Jackson Boulevard, Chicago, has issued to its friends and patrons a very neat little model telephone receiver, of the butter stamp pattern. It is about an inch in length and makes a neat watch charm.

CHARLES J. BOGUE, 209 Centre street, New York, reports sales as being very good at present, and the demand for his automatic focusing lamps exceedingly large. A special feature of these lamps is that a saving of over 40 per cent in current is effected by using two lamps in series.

ELECTRICAL CONDUCTORS.—The American Steel & Wire Company has issued a "pony" catalogue and price list of electrical conductors of all sizes and for all uses. It will be followed later by a more elaborate production. Copies of the booklet may be obtained by addressing the company at any of its sales offices.

AMERICAN BRIDGE COMPANY publish some interesting views of the famous Atbara bridge in Egypt, built at their Pencoyd Works in record time. One point in connection with that "rush job" was the fact that electric motors are freely used at Pencoyd, contributing greatly to speed in production of finished product.

THE ST. LOUIS AUTOMOBILE & SUPPLY COMPANY, St. Louis, Mo., is sending out a batch of circulars of interest to automobilists. This company carries a full line of automobile supplies, and complete vehicles of the gasoline type. It also makes electric vehicles, and has some second-hand machines on hand, which are stated to be in perfect condition.

ENGINEERING FIRM.—Messrs. N. S. Amstutz and H. C. Osborn announce that they are associated under the name of Amstutz-Osborn Company, and will carry on business as designers, supervisors and contractors of special mechanical and electrical devices. The company will also solicit United States and foreign patents. Its headquarters are in the Caxton Building, Cleveland.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., states that the year 1900 was the most successful it ever had, and that 1901 has every promise of being better. The company states that its exhibit at the Paris Exposition and the fact that it secured the only gold medal awarded in its line of goods, have resulted in a splendid increase in its foreign trade all over the world.

AUTOMOBILE BATTERY.—Messrs. Sipe & Sigler, Cleveland, Ohio, manufacturers of the Willard storage battery, are preparing to bring out a new battery for automobile work. It shows a slight change in construction over the present battery, and it is claimed that the liability to short circuit is lessened, that the life of the battery is increased, and that a more uniform voltage is obtained.

MR. W. F. WENDT, president of the Buffalo Forge Company, Buffalo, N. Y., has called a meeting of its various representatives to be held in Buffalo the first week in January to discuss business prospects for the coming year. This enterprising company offers several prizes for the best suggestions at this meeting by the representatives as to how best to increase business and promote the interests of the company.

THE ELECTROLYSIS PROOF CONDUIT MANUFACTURING COMPANY, Chicago, whose factory was destroyed by fire recently, resumed its work on Jan. 4 in larger quarters with a capacity three times what it possessed before. Its present contracts cover about 600,000 feet of conduit, and notwithstanding the loss by fire the company has declared its first quarter's dividend of 2½ per cent. on a capitalization of $150,000.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has just furnished dynamos to the city of Dayton, Ohio. A shipment of generators and dynamos has just been made to the State Normal School at Peru, Neb.; another to the Silvertown Mining Company at Silvertown, Col. The company is also wiring two boats for the Convoy Towboat Company. The Triumph Company has secured the contract for the machinery to be installed in the municipal plant at Versailles, Ohio.

THE NEW YORK SAFETY STEAM POWER COMPANY, 113 Liberty street, New York, in a recent catalogue, describes the features of the Worthington boiler. The advantages possessed by this boiler are accessibility to its parts, and consequent ease of repair; absence of brick work, and straight tubes without screwed joints, gaskets or leaks. Every one interested in steam boilers will no doubt find much of interest in the construction of this one. A copy of the catalogue can he had by asking for it.

MECHANICAL STOKERS.—A very artistically gotten-up catalogue, with many excellent illustrations, has been issued by the Westinghouse Machine Company, in which is given some valuable information about mechanical stokers. The new Roney mechanical stoker is manufactured by this company, and is the subject of the catalogue. Its operation and application to boilers of all types are clearly illustrated. The advantages of the use of this type of stoker are pointed out, and a list is given of the concerns using it.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, has placed in New York a very complete stock of its indicating instruments. A portion of this stock will be on exhibition at the company's office, No. 15 Cortlandt street, the balance being held in the storeroom, boxed and packed ready for delivery. The rapid increase in its business from New York City has rendered it advisable to carry such a stock, in order that the company may meet demands for prompt deliveries in cases of emergency.

THE BUCKEYE ELECTRIC REPAIR WORKS, Columbus, Ohio, are experiencing remarkable business. They have had to extend their plant and are running over-time. These are the only electric repair works in Columbus. They are owned and operated by Messrs. E. F. Coldren and A. F. Beck, under whose able management the most careful work is done in the way of building and repairing all classes of electric power generators and motors, refilling commutators, etc. The company is also in a position to estimate upon and install complete isolated plants.

POWER PRESSES.—Messrs. G. A. Crosby & Co., 2836 Archer avenue, Chicago, Ill., own and operate the plant of the E. S. Stiles Press Company, formerly of Watertown, N. Y. Messrs. Crosby & Co. have issued a four-page sheet, enclosed in a large mailing envelope, describing and illustrating their new plant, which is operated entirely by electric power. The generators, switchboards, motors, etc., were built and installed by the Northern Electrical Manufacturing Company, Madison, Wis. The Crosby Company manufactures foot and power presses, shears, etc.

THE STEPHENSON MANUFACTURING COMPANY, Albany, N. Y., is sending testing samples of its bar belt dressing by mail, free of charge, to all who are interested in maintaining full speed with the least trouble, and with the least expense. In the use of this dressing a clean power station is guaranteed by the makers, as it is applied to the belt by friction and consequently stays where it is put—on the belt. No spattering of floor, side walls or ceiling. Duplicate orders from those who have used nothing else for ten years speak well for its belt-preserving qualities.

STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., are pushing their S. K. C. hot wire ammeters and voltmeters, to which attention was recently directed by an article in these pages. They recommend particularly their hot wire portable ammeter, which is mounted in a well-finished, polished oak case, provided with lock and key. It is very light. Portable ammeters of 200 amp. or less, provided with only one range, have the shunt in the instrument case. Those for more than one range have the necessary shunts mounted in a polished oak box with connection leads.

HUBBARD, HALL & CO.—One of the noteworthy successes of the past year in the electrical supply business has been made by the firm of Hubbard, Hall & Co., of Cincinnati. They entered the field in November of 1899, and in six months were compelled by growing business to move into larger quarters at their present location, 213 West Fourth street. They have a new and large stock of all the standard and up-to-date supplies, and are ready to fill all orders right out of stock and make prompt shipments. They not only deal in electrical goods, but carry a line of mechanical supplies for factories, mills, etc.

COLUMBIA UNIVERSITY, New York, has recently announced that students desiring it can now take a course in motor vehicle construction. In adding such a course the faculty say that the motor vehicle has now become such a factor in commercial and private use that it is deemed as essential that a mechanical engineer should now be as well posted in motor vehicle construction as in marine, stationary or locomotive engineering. Sometime ago the International Correspondence Schools, Scranton, Pa., announced a course in gas, gasoline and oil engines in which special attention is given to the application of these engines to motor vehicles.

GENERAL ELECTRIC LITERATURE.—From the press of the General Electric Company has been turned out an artistic pamphlet of 42 pages, entitled "Type H Transformers in Use." The experience of central station managers using these transformers is given in fac simile reproductions of the original letters, and all speak well of the apparatus. The company has also issued Bulletin No. 4238, relating to railway motor controllers. The various types of controllers are illustrated, and their principal features pointed out. Price lists of "Red Core" and "White Core" wires and cables and a leaflet on an improved arc for series incandescent street lamps have also been issued.

MESSRS. CHARLES H. BESLY & CO., 10 North Canal street, Chicago, Ill., are receiving many inquiries for their catalogue, together with requests for estimates on tools and material. Many letters are being received from foreign countries, asking for circular matter and full particulars regarding their specialties and recent shipments of same have been made to Buenos Ayres, Montivideo, Brazil and England. They report that they are very busy at their factory, and by the addition of new and special machinery, they have increased their output five fold. Their new 300-page illustrated catalogue is now ready for distribution, and will be mailed to any address free upon application.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., was recently in receipt of a letter from the Enterprise Foundry Company, of Sackville, N. B., which contained this interesting evidence of the endurance of one of their blowers: "We have had one of your No. 6 noiseless blowers in use for 28 years with entire satisfaction, but the blast wheel is now apparently worn out, and the left side piece is broken. If we had this left side piece and the blast wheel as shown in your circular it would make the blower all right. Can you furnish this for the No. 6 blower which you were selling in 1872? This blower is driven by two belts, but we fear we have been driving it at too high a speed."

NEW AGENCY.—The American Electric Fuse Company, Chicago, announces that it has secured the general Western agency of the McIntire Company, of Newark, N. J. It will also handle American and improved American connectors, as well as a full line of fuses, fuse blocks, lightning arresters, paper insulators, magnet wire and other electrical specialties. The company will mail a catalogue, or send samples free to any one desiring them. It also announces that it has been appointed general agent for the sale of A. B. C. battery compound, which is a substitute for sal ammoniac. Many important advantages are claimed for this compound. Those interested in battery work will do well to investigate its merits.

CALENDARS.—The Rollins Engine Company, Nashua, N. H., has issued an art calendar containing a reproduction of Detti's painting, "A Minister of the Old School." The coloring is well done, and the calendar presents a tasteful appearance. The Emerson Electric Manufacturing Company has issued a desk pad calendar for daily memoranda. The space for notes is entirely ample, and is, in fact, a little larger than is usually given to such calendars. Throughout the calendar is advertising of the Emerson specialties, and on the back of the pad is a complete calendar for 1902. The Direct United States Cable Company has issued a neat 1901 calendar showing the sprite electricity joining the hands of Columbia and Britannia.

A NOVEL SUBWAY STATION.—Underneath the Germania Theatre property, purchased by John Wanamaker, the New York Rapid Transit Commission had designed to place a station of the rapid transit subway; and the acquisition of the property by Mr. Wanamaker will not cause any change in the Commission's plan. It will be necessary for the city to condemn only the basement of the property; all above that may remain Mr. Wanamaker's. Hence, if Mr. Wanamaker should extend his store over his recent acquisitions of property on Fourth avenue, Eighth and Ninth streets, as his intention apparently is, he would have one of the most important stations of the trunk line portion of the subway directly in his own basement. Mr. Wanamaker is credited with contemplating a larger project than the extension of his store to cover the Fourth avenue end of the block bounded by that avenue, Eighth and Ninth streets, and Broadway. It is understood, upon good authority, that he is negotiating for the purchase of that entire block, with a view to erecting upon it a store building to eclipse all rival structures of the kind.

THE VIADUCT MANUFACTURING COMPANY and its predecessors have been advertisers in THE ELECTRICAL WORLD AND ENGINEER and its predecessors since the *Operator* was first issued 27 years ago, which is substantial evidence of the WORLD'S value as an advertising medium, and it also shows the long-continued work of the Viaduct Company. Another good word for the stability of this company is that it still has several employees in the service who began with Mr. Augustus G. Davis, the president, in January, 1871. Mr. Davis has been identified with the company as its head since that date. During this time it has continuously made district messenger boxes and supplies. When the telephone was invented, the company contracted with the American Bell Telephone Company to manufacture for it during a period of five years, since which time it has been actively engaged in manufacturing telephone instruments, as well as district telegraph messenger boxes and supplies. Its immense factory is located at Relay Station, B. & O. R. R., which is run by water power from the Patapsco River, where the great viaduct, from which the company derives its name, crosses the river. This viaduct was built in 1834, and was first of its kind constructed for railroad purposes in the United States. This company has a long line of specialties of modern styles, many of which are familiar through their illustration in these columns.

THE VICTOR ELECTRIC COMPANY (incorporated), 418 Dearborn street, Chicago, Ill., carries over from the old century to the new a large and varied business, together with a large stock of practical experience that promises to forward the concern to greater successes than it has ever before enjoyed. The chief business of this company is the manufacture of dynamos and motors of capacities under 1 h.p., rotary transformers, electric air compressors, electric lathes and other small direct-connected apparatus. These limits include a great variety of apparatus and instruments that is best shown by the voluminous trade literature of the company. Among its specialties are high-grade dental and surgical instruments, including, besides the motors, batteries, rheostats, induction coils, electric dental engines, shunt boxes, and the great variety of devices that go toward making dental and surgical outfits complete. The electric motor is a very compact machine, iron-clad and entirely protected against injury from outside causes. In the ¼-hp. size the starting and regulating rheostat may be located on top of the motor, if so desired. The direct-current rotary transformer has, in the largest size made by this company, a capacity of 60 amperes at 6 volts, the transformation being from 4 amperes at 110-volts pressure. The machines can, however, be wound for 220 volts if desired. They also are entirely iron clad. All those operating gas and gasoline engines will be interested to know that the Victor Company manufactures an efficient igniter. All the switching is done automatically, and the cost and care of batteries are reduced to a minimum by the use of this machine.

Record of Electrical Patents.

663,951. SYSTEM OF MOTOR CONTROL; Abert H. Armstrong, of Schenectady, N. Y. App. filed Oct. 6, 1900. A multiple control system for induction motor railway car equipments. A master controller controls a plurality of small induction motors on each car, the latter in turn actuating contact devices.

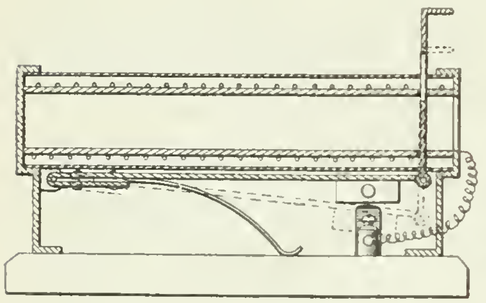
663,981. ELECTRIC LIGHTING APPLIANCE; Arthur Peters, of Manitou, Col. App. filed Nov. 11, 1899. A magnetic cut-out which is tripped when an excess of current passes through a relay electromagnet.

664,369. TELEGRAPHY; W. E. Athearn, New York, N. Y. App. filed April 5, 1900. Static discharges from condensers instead of induction impulses from induction coils, are employed to produce a more perfect method of dual transmission than has heretofore been attained.

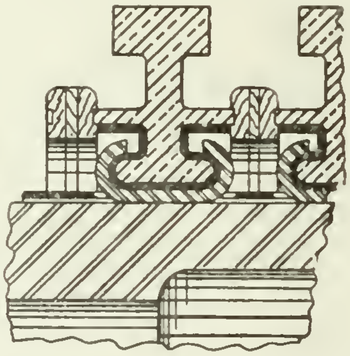
664,371. ELECTRIC HEATER AND CIRCUIT CONTROLLER THEREFOR; J. I. Ayer, Malden, Mass. App. filed May 20, 1899. A circuit closer is attached to the oven in such a way that the act of placing anything in the oven necessarily closes the circuit.

664,396. DYNAMO ELECTRIC MACHINE; I. Fisher, Boston, Mass. App. filed April 3, 1899. The commutator has a segment for each armature coil, the alternate segments being connected with each other and adjacent segments being connected respectively with the opposite ends of the series winding on the armature poles.

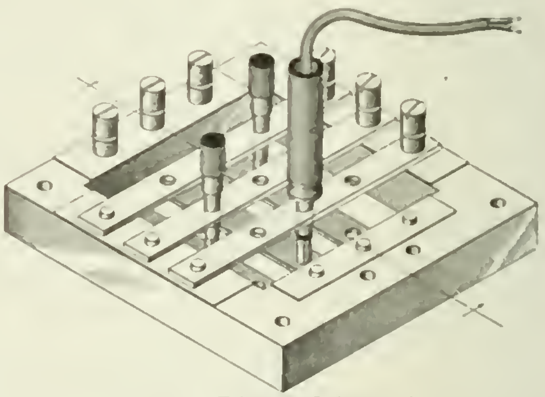
664,430. TELAUTOGRAPH OR FAC SIMILE TELEGRAPH; A. Pollak, Budapesth, Austria-Hungary. App. filed Dec. 21, 1899. Comprises improved means for moving the ray of light along the receiving chamber, said means being an improvement upon the device for a similar purpose described in a previous application.



664,371.—Electric Heater and Circuit Controller Therefor.



664,503.—Collector Ring.



664,557.—Telegraph Switchboard.

664,432. INSULATOR; E. Renault, Waldo, Fla. App. filed May 8, 1900. A porcelain insulator made in two parts of peculiar shape and threaded together to clamp the wire between them.

664,442. COIL FOR ELECTROMAGNETS; S. D. Sprong, Long Branch, N. J. App. filed Nov. 29, 1899. To facilitate repairs the coil is wound in sections separated by rings of insulating material, so that any section can be removed and replaced without difficulty.

664,459. OVERHEAD ELECTRIC TROLLEY; J. H. Brown and W. H. Tobin, Jr., Pittsfield, Mass. App. filed July 10, 1900. One side of the harp is pivoted to the other side and held in operative position by a latch, so that it may be easily opened to remove the wheel.

664,470. CONSTRUCTION FOR THIRD-RAIL ELECTRIC RAILWAYS; W. Courtenay, New York, N. Y. App. filed Sept. 29, 1900. An insulator block upon which the third rail rests, having overhanging sides and means for attaching brackets to hold the rail.

664,503. COLLECTOR RING; H. G. Reist, Schenectady, N. Y. App. filed March 29, 1900. A current collector comprising a split collar or hub adapted to be mounted on a shaft, and a split contact ring provided with feet supported by said hub, but separated therefrom by insulated metallic clamps.

664,511. ELECTRIC CUT OUT; J. H. Trumbull and H. Trumbull, Hartford, Conn. App. filed April 17, 1899. Details.

664,550. ELECTROLYTIC TREATMENT OF IRON FOR PRESERVATION THEREOF; H. L. Hollis, Chicago, Ill. App. filed Feb. 20, 1899. The iron object is first made the cathode in a caustic soda solution to clean its surface, and is then made the anode in the same solution to oxidize its surface.

664,554. REGULATING SOCKET FOR MULTIFILAMENT INCANDESCENT ELECTRIC LAMPS; C. A. Hussey, New York, N. Y. App. filed Aug. 29, 1900. Details of a socket switch for throwing the several filaments into and out of circuit.

664,557. TELEGRAPH SWITCHBOARD; F. W. Jones, New York, N. Y. App. filed July 16, 1900. Two series of conducting strips are attached to the opposite sides of an insulating frame; one series contains large holes and the other small holes. A tapered plug having an insulated conducting end and a conducting sleeve will pass into said holes and fit, the one in the small hole and the other in the large hole.

664,594. MEANS FOR TRANSMITTING MOTION TO DISTANT POINTS; D. P. Thomson, Lynn, Mass. App. filed Sept. 29, 1900. By this invention it is possible to secure the simultaneous movement of any number of controller cylinders upon each movement of a master controller, and the stopping of the controller at the desired point without opening the controlled circuit between the actuating motor and the master controller.

664,649. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; C. W. Kragh, Madison, Wis. App. filed Sept. 11, 1899. A spring is secured at its free end to the brush for conducting purposes, while another spring furnishes the necessary force to hold the brush against the commutator.

664,650. ELECTROMAGNETIC ORE SEPARATOR; E. Kreuser, Mechernich, Germany. App. filed Sept. 3, 1898. The separator consists of two rotary cylindrical magnets placed side by side so that a field of force will be established between the adjacent heads of each magnet.

664,667. ELECTRIC PUSH BUTTON; T. A. Nathans, New York, N. Y. App. filed June 1, 1900. The device is so constructed that the circuit will be closed when the button is pushed or when an attempt is made to remove the cover plate.

664,679. ACCUMULATOR; L. Renaud, Paris, France. App. filed May 24, 1900. Details.

664,681. ELECTRIC CALL BOX; E. A. Salisbury, Chicago, Ill. App. filed July 24, 1900. Details.

664,691. TELEPHONE EXCHANGE SYSTEM; C. Timberlake, Indianapolis, Ind. App. filed Oct. 23, 1899. The system comprises suitable calling lines, a series of connecting circuits and a switching relay in each connecting circuit so that if the circuit is in use the relay connects a calling line with the switching relay of next connecting circuit in the series.

664,713. ELECTRIC ARC LAMP; R. E. Ball, New York, N. Y. App. filed Sept. 21, 1899. This is a double lamp in which the current is shifted from one set of carbons to the other by means of levers, one having greater leverage than the other, and an arrangement for transferring to the lever having the greater leverage, when the first carbon has been consumed, part of the weight sustained normally by the lever having the lesser leverage.

664,733. METHOD OF CONVERTING THE ENERGY OF ALTERNATING CURRENTS INTO EFFECTIVE MECHANICAL ENERGY; Rudolf Eickemeyer, of Yonkers, N. Y. App. filed Nov. 21, 1893. A single-phase alternating current commutator motor, with two magnetic circuits. The commutator has alternate dead bars and an auxiliary coil in proximity to the armature which opposes its self-inductive effect, the armature current flowing in this coil. The form of the field is such as to oppose a high magnetic resistance to the fluxes in the local magnetic circuits surrounding the armature conductors.

664,757. TELEPHONE SERVICE APPARATUS; U. S. Jackson, Ossipee, N. H. App. filed June 15, 1900. Details.

664,761. PRINTING TELEGRAPH; E. Kinsman, Malaga, N. J. App. filed Dec. 21, 1899. A type plate having four motions is shifted by suitable shift keys and the desired type then selected by the regular type keys, which are by this arrangement fewer in number.

664,802. FIRE ALARM TELEGRAPH; L. G. Woolley, Kenton, Ohio. App. filed July 30, 1900. A motor and magneto electric generator are arranged to send an impulse over the circuits at intervals to indicate the condition of the lines.

664,807. ELECTRIC ADVERTISING DEVICE; P. Dawson, Detroit, Mich. App. filed May 24, 1899. Details.

664,819. ELECTRIC SAFETY APPLIANCE FOR RAILROADS; E. L. Orcutt, Somerville, Mass. App. filed Jan. 3, 1898. Details.

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TRAIN TELEPHONY AND TELEGRAPHY.

A good deal of talk has been heard lately as to the general adoption of the telephone in place of the telegraph on steam railroads. Without doubt, the telephone is finding a place in railway work, and theoretically it has several recommendations. The difficulties and objections are often overlooked, however, and we give in this issue an expert's discussion of these practical points. It will be seen that the limitations are quite serious. But within them we look for a rapid extension of use, and shall be prepared to find the telephone widely adopted as an important auxiliary, even if it should not usurp all the time-honored functions of the telegraph.

STREET DESTRUCTION!

For some time past New York has been torn up, and her streets bid fair to remain in a state of disruption for many months to come. It has seemed as though, in this respect, New York would be hard to beat, but the reports now coming from London show that the state of affairs there is worse, being intensified by all the conditions of fog, gloom, dirt and slush that are the natural concomitants of the English winter. But our English friends, in their usual solid manner, are looking into the question to see whether for its main thoroughfares London cannot have a subway system for wires and cables, pipes, etc., so that the surface of the street would never have to be disturbed. The figures quoted in an item in this issue prove that not only have the electrical companies, gas companies, etc., torn up the streets with amazing and exasperating frequency, but that they have spent millions of pounds in doing so. The same is true of New York, where the automobile is being subjected to the rudest tests, owing to the manner in which so many of the asphalted streets are ripped to pieces. This form of waste and this absence of good engineering, is one of the evils to which the new century can well address itself. There can be no good roads until they are permanently laid.

THE BENEFITS OF ELECTRICITY.

The readiness of many people to deny that electricity has conferred any benefits on mankind is quite striking. It is particularly noticeable at such a period as this when humanity makes up its accounts and strikes a centennial balance sheet. Some persons insist that certain items are on the wrong side of the ledger; others, that the items have a wrong value attached to them. Thus Emile Zola has celebrated the end of the century by inquiring despairingly what the telegraph, telephone and electric light have done to fill the stomachs of mankind; the inference being, of course, that they have done nothing, regardless of the point whether that is their mission or not. We had been under the impression that the telegraph and telephone had done much to equalize and distribute the supply of food all over the world, but Zola has probably had his thoughts so intent on other questions connected with fecundity that he overlooked the fact that telegraphy is to-day one of the greatest known safeguards against famine.

And now comes Richard Le Galliene, so well known for his economical writings on the golden-haired girl. He gets this off: "We all know that the idea in the minds of the dreamers of machinery was the lightening of human labor, just as a man buys a motor car to save him walking. That expectation, however, we all know too well has not been fulfilled. A few favored ones are carried in the motor car, but for the most part the motor car is carried on the shoulders of a straining, sweating humanity." He goes on to develop this naturally into the remark that machinery has not been a liberator but "the most terrible engine of enslavement the world has seen," the reason being that "a few rich men have bought up all the machines." Such cases as this seem hopeless. One may permit a poet to exercise the license of his imagination, but when he froths like this, one can only regret that the man was not born in antecedent ages when all were free and did not have a single improvement to worry them, not even clothes.

The Manhattan Railway.

In this issue is concluded a description of the general details of the electrical equipment of the Manhattan Elevated Railway of New York City, now being installed. Even those who follow currently the development of electric traction cannot but be impressed with the magnitude of the system now being put down for the elevated roads. Indeed, fifteen years ago one would have been considered daft had he predicted the installation of an electric traction system by the close of the century calling for generators towering 42 ft. into the air and weighing 445 tons, and supplying a service demanding current for motors aggregating, during the period of heavy load, 70,000 amperes at 625 volts. The immensity of such systems as those of the Metropolitan and Manhattan railways naturally involved many problems, but so comparatively simple is it to pass from small to large types of electrical generating and receiving apparatus that the principal problems have not related to these, but notably to such details as the switching arrangements. As described in outline, it will be seen that the arrangement that will be used on the Manhattan road safeguards in a remarkable degree against interruptions of the service from accidents to any part of the system. To attain this end necessarily involved considerable complication, but this has been happily balanced by an admirable controlling system operated from boards containing in miniature a general scheme of circuits which can be taken in at a glance, and where, for instance, the throwing of a small knife switch on a dummy circuit operates a monster oil switch on a working circuit.

The Evolution of the Electric Railway.

Elsewhere in this issue appears the concluding article of our series "Electricity in Two Centuries," the branch of electrical application treated being the electric railway. The writers of the article come to the subject with minds free of the natural bias of those in close contact with the every-day details of the art, which is apt to prevent them from taking radical views as to the future of the art. Thus unfettered and with ample qualifications to view the subject from the standpoint of broad electrical principles, the speculations contained in the article will bear careful thinking about. They must appear a bit radical at first sight, but the radical to-day is the conservative of to-morrow, so that one can well afford to have patience. Their favorable horoscope for conduit roads will surely not surprise us if it comes to its fullest accomplishment. Steadily decried until engineers were permitted to put the necessary expense into its construction, its record in New York City gives ample promise of a very striking future. Nor is it saying too much to assert that our authors' judgment of the direct-current motor system as applied to trunk lines is thoroughly sound, for in such work polyphase traction is surely at its best with everything in its favor. And the suggestion of varying the periodicity at the station to make up lost time strikes us as being most useful and practical. In point of fact, such a process could be very simply carried out in practice. For on a high-speed trunk line of such length as would be desirable for the great speeds that are surely to come, the whole line would not be operated from a single station, but in sections, perhaps a hundred miles or so in length. This would mean that few trains would be on any one section at the same time. Now, when equipped with induction motors, a locomotive could run fairly well at a considerable range of speeds below synchronism, even if occasional coasting were necessary to do so economically. But they could not run at or above synchronous speed, and so could not make up time. If, through delays, such a step became necessary, it would only be needful to wire the power station to raise the frequency 10 per cent or so, and the train affected could then make haste, while the one or two other trains on the same section could run on slightly increased slip or by occasional coasting during the process.

But to the conclusions we must take exception vigorously in one respect. We have never been able to see what conceivable excuse for material existence is to be assigned to that composite oddity, the Heilmann locomotive. In our early youth some aggressive and doubtless well-minded temperance society scattered broadcast a fearfully and wonderfully colored lithograph entitled "The Black Valley Railroad." We can see it as if it were but yesterday, a long, sinuous line, running from the fair fields of grace in the upper left-hand corner down through Tippletown and Sotville, by Drunkard's Gulch and Devil's Home, to the ulterior suburbs of Sheol in the lower right-hand corner. It had trains as many as the heart of manager could wish, all fitted up with café cars, faro cars and pool-for-drinks cars, and none ever ran back, which must have called for an unconscionable amount of costly rolling stock. And around about the picture ran an alluring fringe of drunkards' stomachs in progressive stages of dilapidation. But its chief glory was in the locomotives—long-wheeled dragons, with firemen amply horned and tailed. And since those days of childhood we have never seen a locomotive so soul satisfying save the Heilmann. A whole power station per train to save the shock of reciprocating parts seems needless at best, and when one considers the necessary loss of energy incurred in so operating, the wonder is not that it has failed of extensive use, but that any human being should ever have thought of such a contraption. And in the present state of affairs, if one really means to try for transcendental speeds, what is the matter with the steam turbine? We are far from crying down our own wares, but an eight-wheeled locomotive with a 400 or 500-hp steam turbine on each axle would make speed at a rate that would make even an electric motor bend to its work to keep within sight. Moreover, there is good reason to think that the turbines would not only beat the present locomotive considerably in point of efficiency, but in the matter of cost of operation would push electrically transmitted power quite as hard as would be comfortable. Engineers who are familiar with the modern developments of steam turbines would do well to sit down and think this matter solemnly over.

But there are many other suggestions in this paper worth thinking about. Although the world's supply of coal is far from being seriously depleted as yet, every decade will see further inroads and the coal supply less convenient in distance and less satisfactory in average quality. It certainly behooves mankind to utilize natural sources of energy so far as may be, and this tendency to help the transmission of power for railway and for other purposes. Coal once burned is lost for all time, but the water that has done its work comes back again in due season for another period of helpfulness. And the world's water powers are hardly touched as yet, so that as time goes on and the coal problem looms up, there is much that can be done to conserve the supply. Electricity direct from coal, if we are lucky enough to get it, will work wonders, for even doubling the efficiency of the transformation of the energy of carbon into work means putting off the evil day for many centuries; and there is still another possibility that must not be forgotten—the direct transformation of solar radiation into electrical energy. The problem has not as yet been touched, but it certainly is as far within the range of possibility as electricity direct from coal, and infinitely more important in its possible results. For the coal supply is not renewed, and sooner or later the time must come when its end will be in sight, but for the other—it could be relied upon until the sun grew cold and the children of men and their need had passed away.

KEW MAGNETIC OBSERVATORY AND THE DEADLY TROLLEY.

We are so accustomed to hear the welkin of the daily press ring with the horrors of the trolley, that we are growing somewhat callous to the outcry of Cassandra. At first no doubt many persons were killed by electric cars, owing to the increase in the speed of traction which electricity provided, and there is no doubt that carelessness on the part of drivers may be the cause of wanton destruction. The diminution in the number of fatal accidents due to being run over by trolley cars is diminished, partly by increased experience and training on the part of motormen, and partly by the education and experience of the people, who, down to the youngest children, have learned the habit of watchfulness for electric cars. The wail this time comes from over the Atlantic, and it is not the citizens, but an observatory that is assailed. The electric railroad takes powerful currents, and when these return via the track, particularly when they partly return via the ground, they exercise a magnetic influence at comparatively long range—a range as long as or longer than that of the most powerful cannon, when delicate magnetic measuring instruments are in question.

The electric traction companies engaged in exploiting the neighborhood of Kew in the outskirts of London are temporarily blocked by the powers in control of the Kew observatory, who fear the disturbing influence of the electric working currents upon the magnetic recording instruments. A continuous record of the local magnetic elements has long been established in this observatory, and an effort is being made to protect the ether in the vicinity of the observatory from violence at the hands of the ruthless motorman. The powers that be, want the traction company to operate the double-trolley system, and when the company demurs, insist upon the maintenance of a difference of potential between the tracks and ground, which is said to be unreasonable and impossible.

It is difficult to judge impartially of events occurring nearly a quarter way round the globe, but the case seems a simple one. If the electric traction companies could at small extra cost completely protect the observatory, it would be reasonable to demand the additional expense. We doubt, however, whether the particular neighborhood of Kew can be magnetically shielded for many decades, in view of the increase of electric systems. If the cost of protecting the observatory were prohibitively great, then Carthage must be destroyed, and the observatory should go. As to where it should go is a question to be answered by those in authority after consulting the map of the British Islands, and the local probability of freedom from electric car systems. There is no doubt whatever as to the value to science of a proper magnetic record, and there is no doubt of the desirability of maintaining that record unbroken. But when the choice comes between providing a community with cheap, rapid transit, and maintaining a temple of science, we think that the question admits of but one answer. After all, it is not so expensive to build a new house in which self-registering magnetometers can be watched and safeguarded in a remote and inaccessible district, far from the madding crowd. We certainly want all the knowledge about the earth's magnetism that we can afford to accumulate, and that people can afford it most which experiences the benefits of cheap and rapid traction.

PERSISTENCE OF VISION.

An interesting research upon the borderland of psychology and of photometry is published in the last number (November-December, 1900) of the *Physical Review.* An acetylene flame burning under uniform pressure sent a beam of light through a spectroscope, and the beam was periodically interrupted by a slit disk, with quadrantal sectors, rotating at a controlled and determined speed. The disk speed at which the interrupted beam appeared continuous to the eye, in any particular part of the spectrum, measured the persistence of the vision of the observer for that color under those conditions. Such a series of observations are necessarily local and specific, since the persistence depends upon the intensity of the light, and the results are, therefore, dependent upon the particular spectrum furnished and its intensity at each point. Within this limitation, however, a number of interesting observations are recorded. The persistence observed varied between one-hundredth of a second in the yellow, and one-thirtieth of a second in the violet.

The persistence was found to be increased throughout the spectrum when the eye was rested in total darkness. If we assume that the mechanism of the eye corresponds to that of the coherer and decoherer, then it is easily understood that the sensibility of the coherer may increase with rest in darkness. Consequently, we might expect the stimulus of vision upon the rested eye to be so much increased that the decoherer's action would be delayed and the persistence of vision thereby increased. The curious effect supervened, however, that when the eye was purposely fatigued by exposure for several minutes to a powerful beam of simple primitive color (red, green or violet) the persistence of vision was increased in that color, although it was not sensibly altered in other parts of the spectrum. At first sight this appears to be in opposition to increase of persistence with rest. One would at first thought assume that if rest increased persistence, fatigue should decrease it. The observations, assumed as correct, can, however, be accounted for by supposing that the fatigue affects the decoherer more than it affects the coherer, and consequently, although the coherer stimulus may be weakened, and a constant decohering action would extinguish it more quickly, yet the decoherer is still more exhausted, and the vision persists longer by reason of delayed decohering. The increase of persistence accompanying fatigue varied from 8 per cent in the red to 27 per cent in the violet, and was, therefore, quite an appreciable quantity. A very interesting observation was also made in one or two cases of color-blind observers, that the persistence of vision was abnormally great in those regions of the spectrum to which their blindness extended, accompanied by a curious sharply-localized increased persistence in another region.

Observations in this field are particularly valuable, owing to the indirect assistance which they offer to the very backward science and art of photometry. The method of observing persistence gives us a quantitative comparison between different eyes under the same conditions of illumination. We have no knowledge as to how closely different observers may agree in their consciousness of vision. The picture which one man sees when looking at a landscape may be appreciably different from the picture which his neighbor sees, even if both are apparently free from color-blindness, and yet we have no apparatus for comparing their sensations. It is quite conceivable that the average eye of the civilized man at this time may differ in its color appreciation from the eye of the average Greek or Roman of 2,000 years ago, in the same manner that the average eye of the present day is appreciably more nearly myopic than the eyes of our distant progenitors. If we could devise a perfectly definite source of light which could be accurately reproduced a hundred or a thousand years hence, we could make a series of observations of vision persistence for a number of representative observers, at this day, which should serve as a reference for comparing the vision of observers in the distant future. Moreover, the systematized study of the persistence of vision might furnish valuable material for assisting in the gauging of health and the diagnosis of disease.

A Report on Submarine Boats.

The United States Naval Board on Construction has filed a report with the Secretary of the Navy, in which it is pointed out that the failure of the General Board of the Navy and the Construction Board to include torpedo boats in their building programmes for this year "may be accepted as conclusive evidence that they did not consider it advisable at this time to increase the number above those now authorized."

The board shows that it regards submarine boats as experimental and asserts that the tests of the Holland at Newport last year "were interesting and answered the purpose for which they were intended, namely, to instruct the crew, but nothing more." As to these experiments with the Holland the board says: "During the manœuvres of the North Atlantic fleet off Newport last summer, the Holland participated, making a surface run of seven miles outside Newport harbor, in charge of her naval crew only, and succeeding in getting within striking distance of the battleship Kearsarge without being discovered, due, no doubt, to her small size. She was ruled out, however, as the Kearsarge had already been put out of action by another ordinary torpedo boat, which also got within striking distance unperceived, and it has been stated that on account of the latter the vigilance of the lookouts on the Kearsarge had been relaxed when the Holland made the attack. Be that as it may, the conditions by no means simulate the actual warfare, and the Holland was not on that occasion used as a submarine boat, nor did she accomplish more than an ordinary torpedo boat. Without desiring to discredit the Holland in any way or to detract from her merits," the report says, "the board is of the opinion that the utility of the boats of this class has not been sufficiently demonstrated to warrant the construction of others than those already authorized—eight in number—which are considered a sufficient number to experiment with."

In conclusion the board had this to say: "Should Congress see fit to authorize any more submarine boats, the board is of the opinion that no special type should be specified, but that the Secretary of the Navy should have discretion to contract for such boats as in his judgment are likely to prove the most efficient and the best suited for naval purposes, thus opening up competition and giving other inventors a chance."

A British Governmental World Telegraph System.

Sir Sanford Fleming has addressed a letter to Hon. William Mulock, the Canadian Postmaster General, at Ottawa, in favor of a State-owned telegraph service to girdle the globe. The letter is said to be the beginning of a movement to nationalize the cable and telegraph service of the British Empire. Sir Sanford claims that it is an opportune moment to consider a question which affects Canada as well as Australia. The arrangement for the establishment of the all-British cable across the Pacific Ocean has been completed. That arrangement implies joint ownership, and, in the opinion of Sir Sanford, is the harbinger of a complete system of State-owned telegraphs, by land and by sea, ramifying throughout the whole British Empire. The existing lines of telegraph between distant portions of the Empire, pass in part through foreign countries, or traverse shallow seas in proximity there to, where at a critical moment they are liable to speedy interruption. The rates, too, are said to be oppressive by reason of the monopoly. The reason the friends of the Pacific cable have never relaxed their efforts is due to the fact that the Canadian route between England and Australia is absolutely the only one by which the globe can be girdled by an all-British chain of telegraphs. With the telegraph system nationalized as suggested, Sir Sanford Fleming asserts that messages will be transmitted to and from the most distant British possessions at one-eighth or one-tenth the rates now levied by the companies.

This proposal to nationalize the telegraph lines throughout the empire, and that as a step to this end Canada should take over the lines of private companies in the dominion, has caused a great deal of discussion there. Prominent business men state that they had had correspondence regarding the suggestion before it was made public. This would seem to indicate that the dominion government has had previous knowledge of Sir Sanford Fleming's letter before its appearance. The difficulty of operating public lines in Canada, touching and merging in the lines of private companies at many points on the United States border, is an objection noted by those who are now discussing the proposition.

In Favor of Pacific Cable.

At the regular monthly meeting of the New York Chamber of Commerce last week, Gustav H. Schwab, for the Committee on Foreign Commerce and the Revenue Laws, introduced a resolution (which was adopted) committing the chamber to favor the establishment of an American Trans-Pacific cable by private enterprise and to approval of "the general principles embodied in the Bill H. R. 2980, introduced in the House of Representatives by Mr. Sherman."

The report of the committee showed four reasons why private control was to be preferred over Government ownership:

(1) The first cost of a Government Trans-Pacific cable would appear to be at least $15,000,000.

(2) The cost of maintenance of a Government cable, it is estimated, would be at least $1,500,000 per annum.

(3) To be commercially profitable and useful, the proposed Trans-Pacific cable should reach Japan and China, but a United States Government cable would, in all likelihood, not receive permission from the Governments of Japan and China to land on their shores, as these Governments would naturally reserve the right to control every new cable landed on their coasts.

(4) The laying, maintaining and operating of ocean cables require a large amount of expert knowledge, based on experience, and in the opinion of your committee, no department of the Government is in a condition to supply these essential requisites.

The Tarrant Explosion.

In his report submitted a few days ago on the fire and explosion last October in the building of Tarrant & Co., in New York City, Fire Marshal Seery recommends that the testimony be sent to the District Attorney, in order that he may aid in determining whether there was any criminal neglect on the part of Tarrant & Co. Prof. C. F. Chandler, in a sub-report, declares that the explosion appears to have been caused by the chlorate of potash in the third and fourth floors of the building He said that such an explosion would cause a fire to burn with greater fierceness, owing to the amount of oxygen liberated. In the report proper it is asserted that the fire, which probably occurred before and started the explosion, might have been caused by the ignition of the tarred paper between the floors and ceilings by a spark from the electric wires, which had frequently been repaired and changed, with notification to the proper authorities, as provided by law. By the fire and explosion 7 lives were lost, 7 buildings destroyed and 35 others damaged, glass broken in 200 and a loss of $1,000,000 entailed. There is absolutely nothing adduced showing an electrical origin. In fact, the fire occurred at midday, when little or no current was on, although gas was burning.

The Cost of Tearing Up Streets.

London has been suffering very seriously from the tearing up of her streets, but the proposal to construct permanent pipe ways has been met with objections as to cost. It would appear, however, that in the long run, the pipe way would be cheaper than the constant disturbance of the streets, leaving out of consideration the loss to business from the interruption of traffic. A well-known contractor has estimated that a huge tunnel could be constructed under the principal streets of the metropolis at a cost of £25 a foot. The subway would be sufficiently large to include every kind of pipe and wire, and allow of a 5-ft. 6-in. man walking upright through it. It is calculated that at present not more than 75 miles of London streets would need to be tunneled, as minor side streets could be left as at present. This would involve an expenditure of £15,000,000, a large sum that would have to be provided by the ratepayers. But it is suggested that in a few years' time the rent from various companies using the tunnel would show a handsome profit. This calculation is based on the fact that during the last five years the principal "road breakers" have spent no less than £10,563,741 4s. 5d. The three chief gas companies, taking no account of seven others that supply the suburban districts, have in the last five years spent upon road breaking £3,747,154 12s. 2d. In the same period thirty local authorities and companies who have the power to pull up roads when anything goes wrong with their electric-light cables have spent on that work £2,554,900. The water companies have given the professional road breaker work to the tune of £2,892,188 in the five years, and the telephone companies have disemboweled the streets at a cost of £1,369,498 12s. 3d. in the same time.

The New Station of the Electric Vehicle Transportation Company—II.

(*Concluded.*)

By R. A. Fliess.

As a cab battery of 44 cells weighs on an average some 1500 lbs. and over, it is evident that some rather elaborate method had to be devised to handle the 960 tons and over of battery which the battery charging room accommodates when full, especially as the speed with which this great weight of battery must be handled is an important factor. To handle the batteries in the charging room a 15-ton electric crane is used. Later a second 15-ton crane will be installed as a reserve, and for use at times of particularly heavy load.

THE CRANE.

It has a 41 ft. 2½-inch span. It was built by the Morgan Engineering Company of Alliance, Ohio. It runs on a track some 300 ft. long, placed 11 ft. 4½ inches above the battery room floor. The rails on which it runs are supported by 20-in. steel girders fastened to the columns which support the ceiling of the battery room. Longitudinal registering racks are bolted to the web of each run-way girder, into which the driving pinions of the crane are geared. By this arrangement of positive drive the crane can never get out of true.

The crane is composed of two 3-ft. single web plate girders, spaced 4 ft. 9 in. between centers of webs, from which are hung ten battery lifting elevators. The hoisting apparatus is operated by chains wound on drums grooved in the form of a double right and left-hand screw, beginning from each end of the cylinder and running towards the center, forming a double winding drum, to which are attached two battery hoisting and lowering chains, and an auxiliary chain used to raise and lower the hoisting frame when the grappling hooks are open, and consequently free from the battery box. The auxiliary chain is connected by means of lugs to the top of the hoisting frame, and is guided centrally by means of an idler located directly under the hoisting drum. The auxiliary chain is wound on the drum in the opposite direction from that of the hoisting chains, so that, when the battery frame is lowered by the hoisting chains until the battery which it is supporting rests on the charging stand, the auxiliary chain is just tight, and takes the weight of the battery off the hoisting and lowering chains. Heavy counterweights connected to the four grappling hook arms by levers cause the grappling hooks to open and thereby release the battery. The frame is then lifted by the auxiliary chain. When it is desired to pick up another battery, with the same hoist, the battery frame is lowered by the auxiliary chain until the weight of the frame is taken by the hoisting chains. Then the grappling hooks close under the battery to be raised.

The crane is operated from a platform hung in the center. On the platform are placed the controllers which operate the crane-driving motors. Ten levers, within easy reach of the operator's hand, are fastened to the ceiling of the platform. Each of these is connected to a controller operating one of the ten hoisting frame motors.

There are many safety interlocking devices employed on the crane which can probably be described better by following the crane through a complete cycle of operations than by any other way. Suppose, for example, the craneman wishes to pick up a battery at the opposite end of the room from which he is. He moves the controller handle that operates the driving motor in the direction which he wishes to go, and the crane is propelled, at a speed of about 300 ft. per minute, by a Westinghouse 25-hp. series motor geared to a long driving shaft, the pinions on each end of which mesh with the longitudinal registering racks spoken of above. There are two 25-hp. driving motors—duplicates in all respects. Only one is used, however, to operate the crane. The second, with its controller, is for use in case of accident to the first.

When the crane has reached a position nearly over the battery to be lifted the craneman pulls the controller handle back to its zero position and applies a mechanical brake, which acts through a foot lever fastened to the platform on a big band brake attached to the driving shaft. When the crane has come to rest, if it is in the desired position, a lever on the back of the platform causes a bolt to shoot forward and catch in a groove cut in a flange fastened to the web of one of the 20-in. girders which support the crane. There are seventy of these grooves, each placed so that when the bolt locks in any one of them the crane is just centered over a row of batteries or a transfer train. The operation which shoots the bolt in place automatically opens the circuit to the driving motors and closes the circuit that operates the hoisting elevators which until then had been inoperative. The hoisting frame is then lowered, picks up the battery and raises it, as already described. Here again a safety device is employed to prevent the operator from starting his crane forward before the battery box has been raised high enough to clear the tops of the boxes on the racks. This device acts by locking the rod which controls the bolt in the groove on the girder until the battery has been raised high enough to clear the others. The rod is then automatically unlocked, and the operator may withdraw the bolt, which action opens the battery hoist circuit, and closes the crane operating motor circuit.

The crane is then moved until it is over the one of the six transfer railways, running across the battery room, on which it is desired to place it. The bolt is shot. The battery is deposited and the hoisting frame is raised, completing the cycle. If at any time the operator should forget to stop a hoisting frame there is an automatic cut-off arranged to be operated by it when it reaches a height slightly above the normal. This opens the circuit to the motor which controls that frame. So, it will be seen, all contingencies that it was thought necessary to look out for have been considered in the design of the crane. Power is supplied to it by a double trolley of No. 0 B. & S. wire strung along the ceiling of the battery room.

This room is ventilated by two 11-ft. fans, built by the B. F. Sturtevant Company of Boston. These fans, it is said, have a capacity sufficient to change the air in the battery room in between 3 and 4 minutes. The fans, a 60-hp. electric motor and other necessary paraphernalia, are installed in a specially constructed room situated on the roof of the building over the eastern end of the battery assembling room. The air is drawn out of the battery room through 10 ducts made of wood ranged at intervals along its north wall. The opening of the ducts is placed only a few feet above the floor, as the heavy acid fumes are thickest there. The room is heated by steam pipes strung near the ceiling, and is lighted by inclosed arc lights.

THE BATTERY TRANSFER TRAINS.

It was remarked above that the crane deposited a battery upon one of the cars of a transfer train—six of which cross the battery room. This part of the equipment, illustrated in section in Fig. 7, was installed by the George T. McLauthlin Company, of Boston, represented in New York by Rumsey W. Scott.

From the sectional view shown a general idea may be obtained as to the operation of the transfer train. As will be noticed, the floor of the battery charging room is a few feet lower than that of the loading room—3 ft. 7 in., to be exact. A reference to Fig. 1 in connection with the section shown in Fig. 7, will show the six tunnels which reach from the battery room to the 49th street wall of the building under the loading room. In each of these tunnels a light railway of 2 ft. 8½-in. gauge is laid. This railway extends across the battery charging room. Each train is composed of five cars; each car can carry two batteries. Each train is operated by a cable fastened to one of the five cars. The cable passes over suitable pulleys placed at different points along the line, and is then carried up to the second floor close to the Forty-ninth Street wall of the vehicle-loading room. Here the cable is connected to an electric hoisting machine of the direct connected worm gear type operated by a special 6-hp C & C compound wound motor. The shunt field of the motor is kept in circuit all the time through two 220-volt lamps in series. This is done to reduce the starting current. It also improves the regulation. The motion of the train is controlled by a hand-reversing starting rheostat, which gives it proper speed regulation. This rheostat is placed within easy reach of the hand of the man who operates the hydraulic rams used for loading the vehicles, as seen in Fig. 8.

The hoisting machine, a view of which is shown in Fig. 9, has an electric brake attached to the driving shaft of the motor. This is always released before the armature circuit is made, and is thrown on when it is broken. The load that each train can carry is 15 tons, and the maximum speed is about 300 ft. per minute. The rheostat is so arranged that it is possible to regulate the position of a transfer train to within less than one-quarter of an inch. This close adjustment is necessary to enable the operator to center a battery over the lifting ram, and under the hoist frames of the crane. As will be seen from Figs. 1 and 7, the location of the loading stands close to the northern side of the loading room permits of each of the ten batteries on a train being brought into such a position that they can be lifted off their car by the lifting ram and a battery placed on each empty space with the minimum movement of the train. Each car is skeleton in make up to permit of the rams passing up through it, and the cable is fastened to one side so as not to interfere with the operation of the lifting ram. There is an end automatic fastened to the cable winding drum so adjusted that it stops the transfer train, should the operator forget to do so, just before it reaches either end of its track. Also interlocking devices are connected to the transfer train and hydraulic ram systems by means of which a transfer train cannot be moved while the lifting ram is above its lowest position.

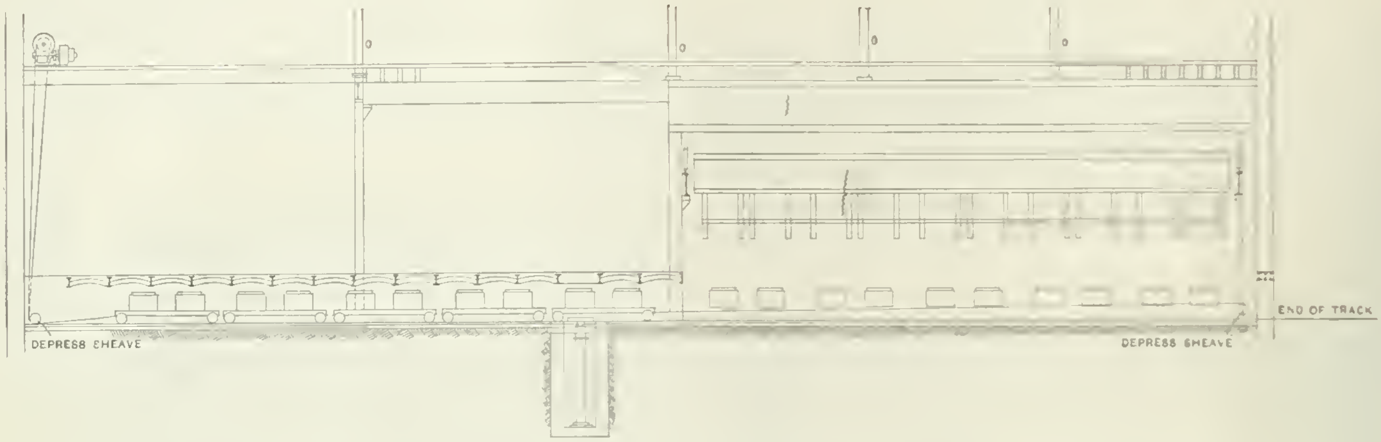


FIG. 7.—SECTION THROUGH BATTERY ROOM AND LOADING ROOM.

THE VEHICLE LOADING ROOM.

The loading room occupies that portion of the station situated directly behind the southern part of the vehicle assembling room, spoken of above, and connects with it by wide doorways. This room also has eight broad doorways which open directly into Forty-ninth Street; the room is 47 ft. wide by 302 ft. long. In it are placed six loading stands, three elevators and several inspection pits, as may be seen from Fig. 1 (last issue). The pits are so arranged that when not in use they are covered with a sectional wooden floor which can be taken up. When a pit is in use a guard rail, hinged in such a way that it can be made to disappear in the pit, is turned up and is held in place by a suitable support.

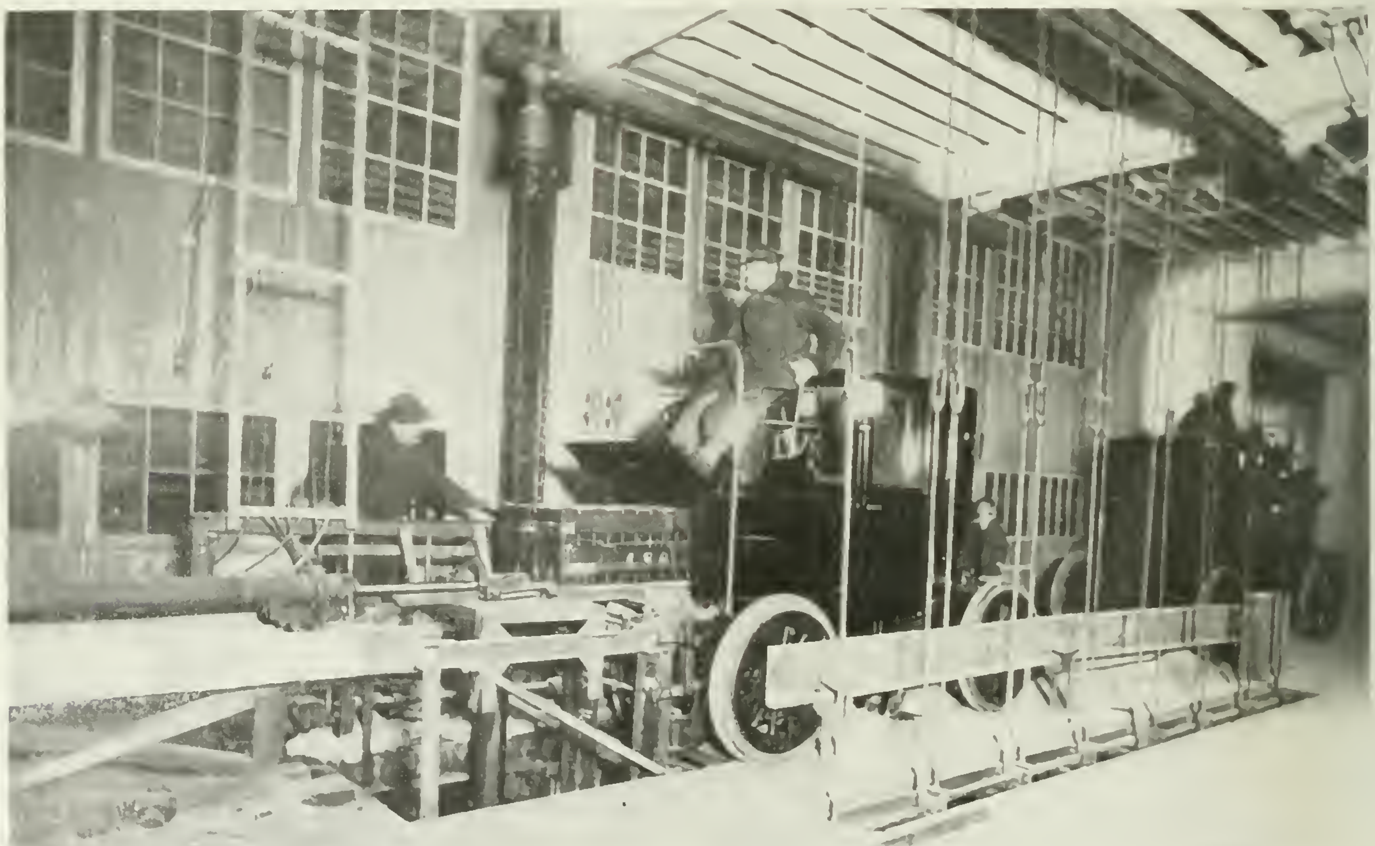


FIG. 8.—LOADING STAND FOR END-LOADING VEHICLES.

The three elevators, also installed by the G. S. McLauthlin Company, are of the platform carriage type and have a capacity of about 4500 lbs. and a speed of about 75 ft. per minute. The hoisting machines for each elevator are placed directly over the hoistway. They are of the direct-current worm-gear type and have extended drum shafts on which drums are placed at each end in order to get a direct lead for the hoisting cables attached to the platforms at their four corners.

A very important part of the equipment of an operating station for electric vehicles is that which is designed to take the discharged batteries out of the vehicles and place freshly charged ones in their place.

THE LOADING STANDS.

There are two cases, each of which must be considered separately when designing loading stands for electric vehicles. First, the case where the vehicle is so constructed that its battery must be run into the battery box compartment on a horizontal plane; second, the case where a vehicle is equipped with an underslung battery. In the loading room there are six loading stands, as was mentioned above. Four designed to load and unload end-loading vehicles, and two to handle under slung batteries.

Fig. 10 shows a general view of one of the latest designs in loading stands intended for use with end-loading vehicles. Fig. 11 shows a section of the centering platform used with this stand. It is, of course, understood that when what is called an end-loading vehicle comes into the station after a run to get a fresh battery, the vehicle must first be centred and then held in a certain definite and fixed position before its battery can be withdrawn by the horizontal hydraulic ram seen in Fig. 8. The centering of vehicles is done automatically at Stands Nos. 1 and 3 (Fig. 10) by a very ingenious device. This consists of a series of seven freely swinging platforms, each supported by four iron rods about 14 ft. long, hung from channels fastened to the I-beams which hold up the second floor of the building. Fig. 11 shows the details of this arrangement quite clearly. The principle upon which it works is very simple. As a vehicle enters the loading stand it is gradually guided to the centre in position for unloading and loading its battery by the contact of its hubs with the converging buffer channels shown in the illustrations. The weight attached to the buffers produces lateral pressure. It also provides flexibility and reduces the jar of impact with the hubs. The weight has two chains fastened to it, each connected to a lever arm which supports the buffers. This provides equal movement of the buffers on the two sides. The operation of the centering device is comparable to the action which centres a ferryboat in its slip. The movable floor taking the place of the mobile water, allowing the side motion of the vehicle without any sliding of its wheels on the floor and the buffer channels taking the place of the flexible guiding walls of the slip.

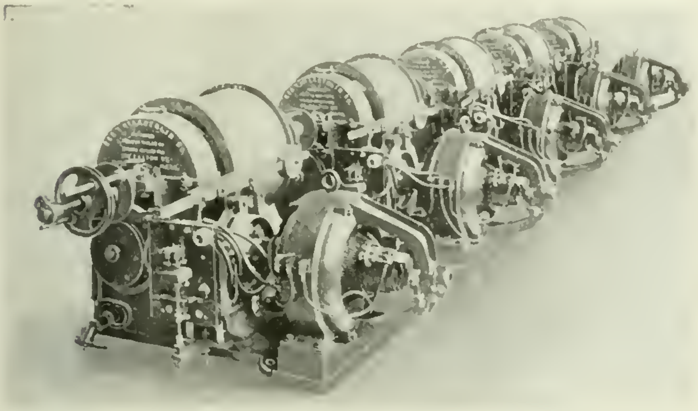


FIG. 9.--TRANSFER TRAIN OPERATING UNITS.

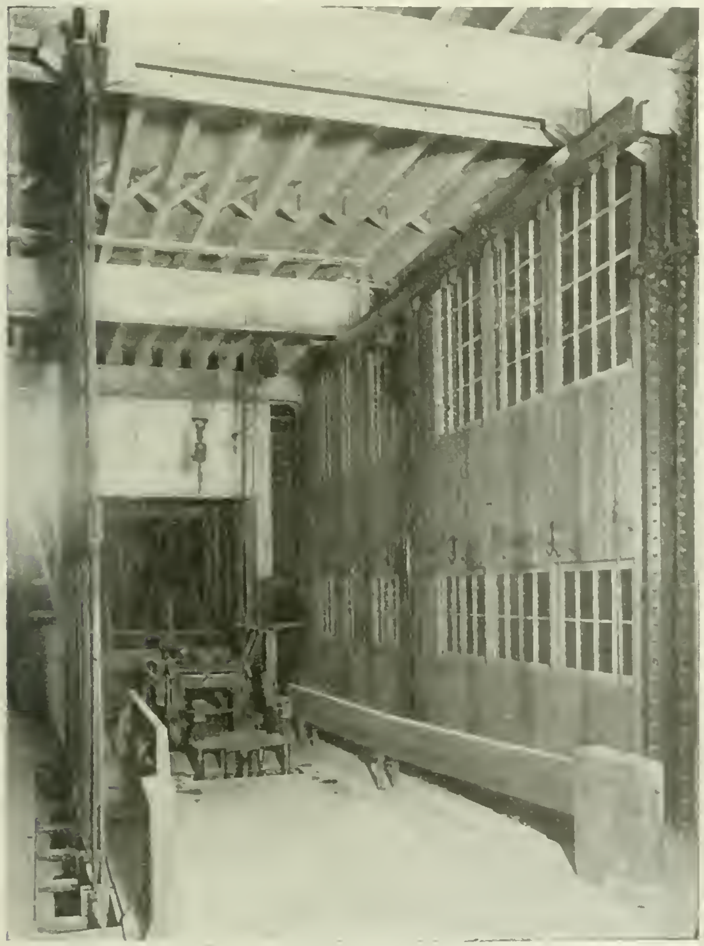


FIG. 10.—FERRY-SLIP LOADING STAND—GENERAL VIEW.

Suppose, for instance, a vehicle enters the stand somewhat off the centre line; then the hubs of its wheels on one side will come in contact with one of the buffer channels. The weight fastened to the lever arm of the buffer channel causes a lateral pressure against the hubs which tends to crowd the vehicle to the opposite side. Since the platform swings freely laterally, they give to the pressure and the vehicle is carried over until its other hubs come in contact with the opposite buffer. Then the pressure due to the weight is equal on both sides, the platform stops swinging and the vehicle is centred. When there is no vehicle in the loading stands the buffer channels are kept a fixed distance apart by stops which act against the lever arms to which the buffers are fastened. Each buffer channel has a possible lateral motion of about 2 ft. Hence a vehicle which has longer axles than normal can be centered by the apparatus. The swinging platforms of the centering device have no appreciable longitudinal motion, as all such motion is prevented by suitable stops.

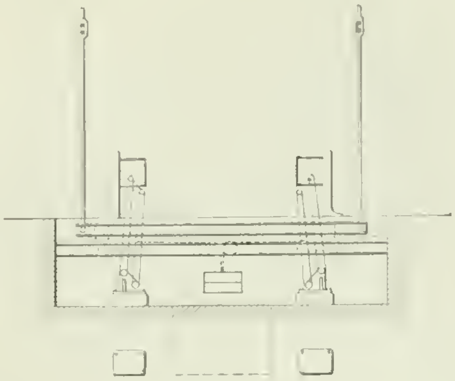


FIG. 11.—FERRY-SLIP CENTERING DEVICE—SECTION.

When the vehicle enters the loading stand it is run as far onto the movable platform as it can go. Fig. 8 shows the position of a vehicle when it has reached this point. It is then in contact with two iron straps fastened to the frame which guides the platform of the lifting ram, and is directly over the two hydraulic lifting rams situated under the platform of the centering device. These rams are shown in Fig. 10. They are operated by means of a single lever controlled by the man in charge of the loading stand. When the vehicle has reached the proper position the pressure is turned on and the rams engage the body of the vehicle at four points where suitable iron straps are provided. The rams lift the body of the vehicle several inches, until all the weight is taken off the springs. This is done to keep the vehicle battery box floor at a fixed level during unloading and loading, which could not be accomplished if the weight of the body of the vehicle were allowed to rest upon its springs. Fig. 12 shows in detail the operation of the horizontal hydraulic loading ram which is also seen in Fig. 8 in actual operation. The door which closes the battery box of the vehicle having been removed, the lever which controls the horizontal loading ram is turned and the ram advances until the hooks fastened at its end latch into iron handles fastened to the end of the battery box. The ram then recedes, pulling the box out of the

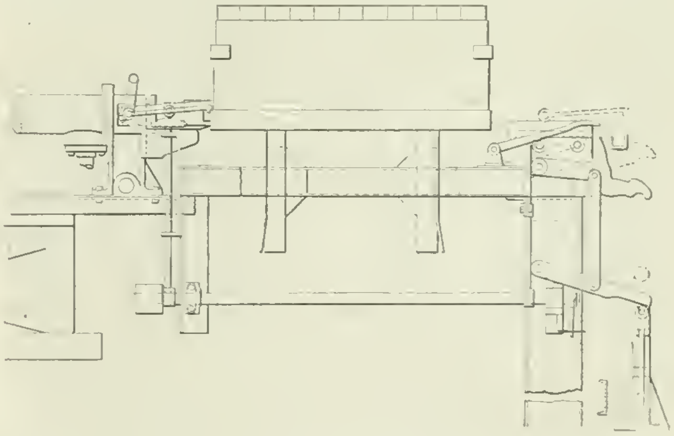


FIG. 12—DETAILS OF HORIZONTAL RAM.

vehicle onto the platform of the lifting ram. The hooks are then disengaged by means of a foot lever, the operation of which is clearly shown in the illustrations. The battery box is lowered on the platform of the lifting ram until it rests upon one of the cars of the transfer train, which is then moved by means of the rheostat, spoken of above and seen in Fig. 8, until a freshly charged battery is brought into position over the lifting ram. This ram raises it to a proper level; the horizontal ram comes forward and pushes it into the vehicle, the door to the vehicle battery compartment is closed and the vehicle body is lowered till it rests on its own springs. When the vehicle-lifting ram has disappeared beneath the platform of the loading stand an incandescent lamp is automatically lighted, indicating to the driver that he can leave the loading stand.

Fig. 13 shows a sectional view of a battery-lifting ram in place in its pit; also the rails on which the transfer train runs. The hydraulic ram's centering platform and other details connected with the new loading stands were installed by the Watson-Stillman Company, of New York City. The battery lifting rams for the end-loading vehicle stands have a 5½-in. diameter plunger, an 8-in. water pipe and a lifting capacity of over 3400 lbs.

The hydraulic pressure required to operate the various rams is obtained by means of an accumulator placed in the battery assembling and repair room. This accumulator has a capacity of about 100 gallons and keeps a constant pressure on the line of 150 lbs. to the square inch. The electric pumps which feed the accumulator are also in the battery assembling and repair room, and are automatic in their action.

Loading stands Nos. 2 and 4 differ slightly from Nos. 1 and 3, just described. These stands are the two formerly used in the Fifty-third street station, where they gave good service for several years, but where, owing to the very cramped quarters of that station, it was never possible to work them to their full capacity. A description of these stands was given in the ELECTRICAL WORLD AND ENGINEER of Sept. 3, 1898. The only addition that has been made to them is a lifting ram, made necessary by the lay-out of the new station. The lifting rams are duplicates of those already described.

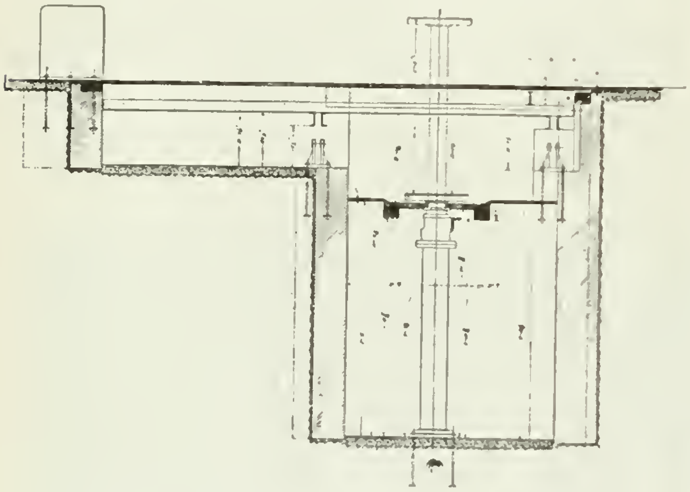


FIG. 13.—SECTION OF LIFTING RAM PIT, WITH RAM IN PLACE.

Loading stands Nos. 5 and 6 were designed for the use of vehicles equipped with underslung batteries. These stands employ the same device for centering the vehicles as is used with loading stands Nos. 1 and 3. The only difference is that made necessary by the fact that the battery has to come up through a suitable opening in the floor of the swinging platform. Of course, in these two stands the horizontal ram and its appurtenances are not used. The only difference between the lifting rams used for underslung and end-loading stands is in their capacity—there being a difference of an inch in diameter of cylinder and water pipe in favor of the underslung battery lifting ram, made necessary by the fact that the underslung batteries are slightly heavier than those used in end-loading vehicles. The loading stands required for underslung batteries are much less complicated than are those designed for the use of end-loading vehicles. When the six loading stands of the new station are working to their full capacity, and when the two cranes are operating in the battery charging room, the station should be able to change batteries in from 175 to 200 vehicles per hour.

In the vehicle-loading room are placed about a dozen ring washing stands for vehicles, by means of one of which two men can wash a vehicle in a very few minutes.

The photographs of the new station which illustrate this article were taken, as can be seen, before the station was entirely completed, and consequently cannot be considered entirely representative of what the finished plant looks like. It is thought, however, that they indicate quite clearly the very elaborate scale on which the new station of the Electric Vehicle Transportation Company is laid out.

The rolling stock equipment of the station consists, at present, of some 300 vehicles, which include hansoms, broughams, delivery wagons, wagonettes, victorias, phætons and surreys. The vehicles of the company have been described so many times recently in the various technical journals that no detailed description of them is necessary here. It was thought, however, that it might not be uninteresting to show the advance that has taken place in the general style, construction and finish of the vehicles of this company in the four years that have elapsed since the first introduction of commercial electrical vehicles for transportation purposes in New York City.

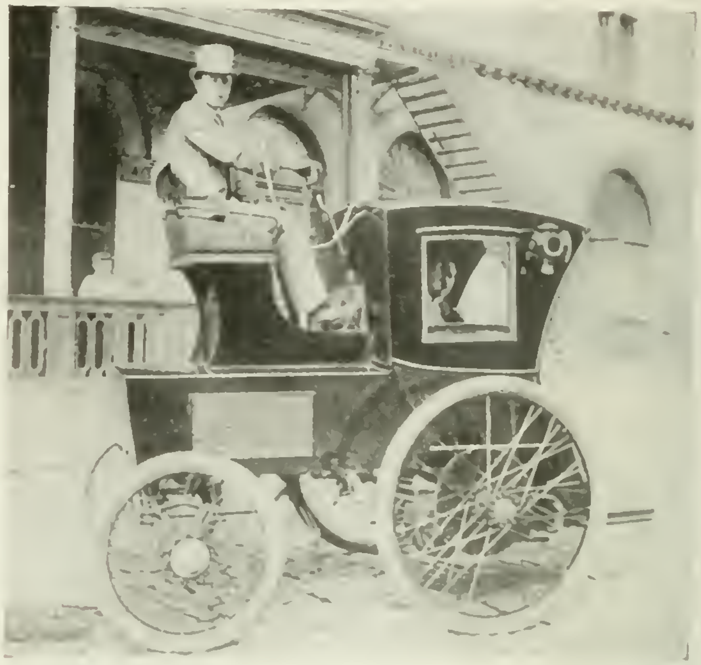


FIG. 14.—A PIONEER HANSOM.

Fig. 14 shows one of the first hansom cabs operated commercially in the city. This was one of the original equipment of the Electric Carriage & Wagon Company, and was placed in service in March, 1897. Fig. 15 shows one of the latest styles of hansom cab used by the Electric Vehicle Transportation Company. The improvements that have been made in elegance of design, finish, etc., are readily ap-

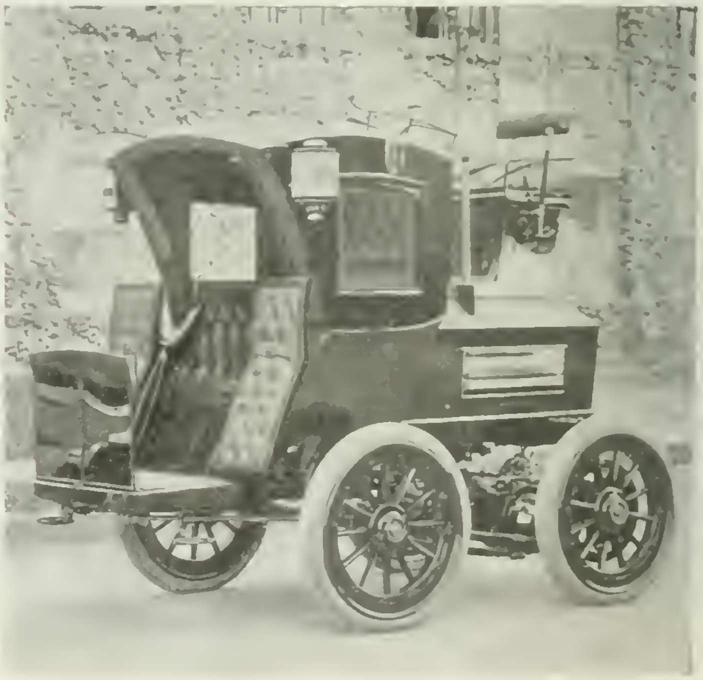


FIG. 15.—ONE OF THE LATEST HANSOM CABS.

parent. Fig. 16 illustrates one of the new 11-passenger wagonettes used for park service, etc. Fig. 17 shows an extension-front brougham. It has a seating capacity for four passengers inside, and room for an attendant with the driver. Fig. 18 shows a straight-front brougham. This can accommodate two passengers inside. The illustrations indicate the extensive field which the company is now covering.

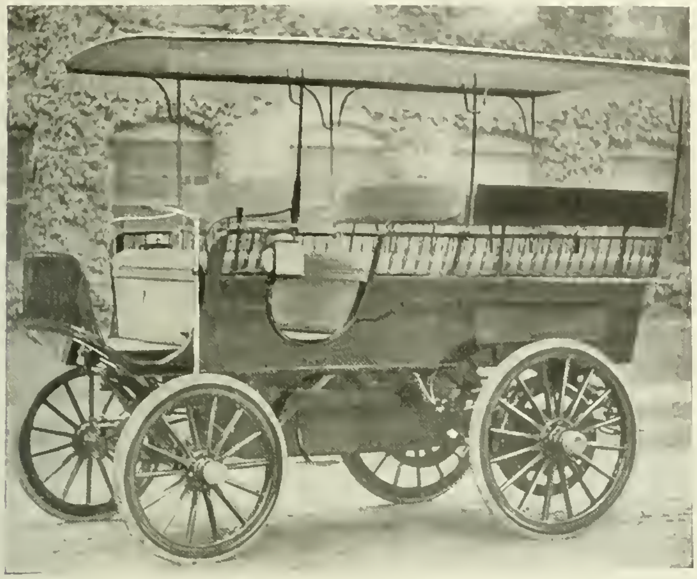


FIG. 16.—ELEVEN-PASSENGER WAGONETTE.

Beside the Forty-ninth Street station the Electric Vehicle Transportation Company has several sub-stations in operation in different parts of the city. These are, of course, small and are only intended to accommodate a few vehicles at a time. They are established for the accommodation of such vehicles as are called upon to travel further from the main station than one charge of their batteries would ordinarily carry them. They are supplied with current from the Edison Illuminating Company's mains and are equipped with charging sets and a few battery racks on which a number of batteries are kept fully charged and ready to put in a vehicle. There are three of these sub-stations in operation at present. One in Vesey Street, one in Eighty-eighth Street, just east of Madison Avenue, and one at 100th Street, on the West Side. These will be enlarged as the necessity arise, or more sub-stations will be established.

Before closing this article the writer wishes to acknowledge his indebtedness and to express his thanks to Mr. G. H. Condict, chief engineer and general manager of the Electric Vehicle Transportation Company, for many courtesies shown by him while the data incorporated in this article were being collected.

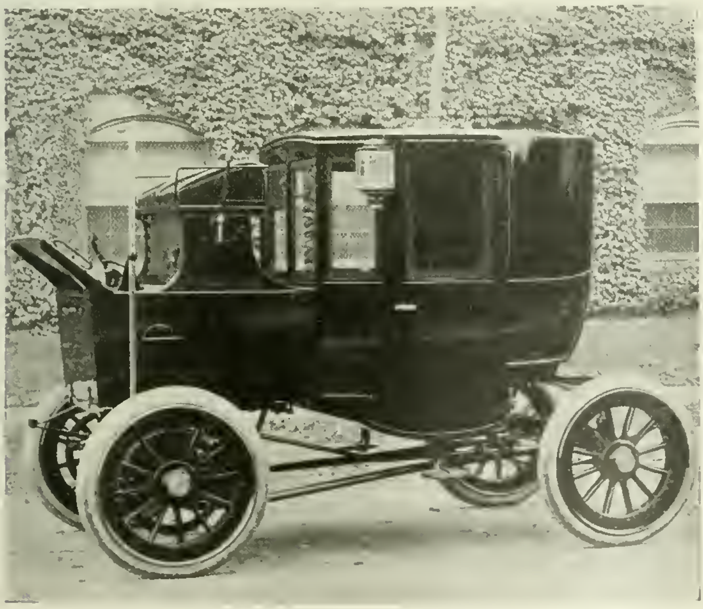


FIG. 17.—EXTENSION-FRONT BROUGHAM.

Doubtless in years to come the new, and, to us, mammoth station of the Electric Vehicle Transportation Company will appear as small and insignificant in comparison with those which the present century seems destined to see rise as does the little pioneer station of four years ago when compared with the Forty-ninth Street station. Yet, to those in whose minds the last years of the nineteenth century are still fresh, it is probable that an electric automobile charging station which has an available floor space that covers the equivalent of nearly three acres of ground can still excite some slight degree of admiration. In fact, it would seem as though this last production of the nineteenth century is worthy to serve as a monument to mark for future generations the beginning of the horseless age.

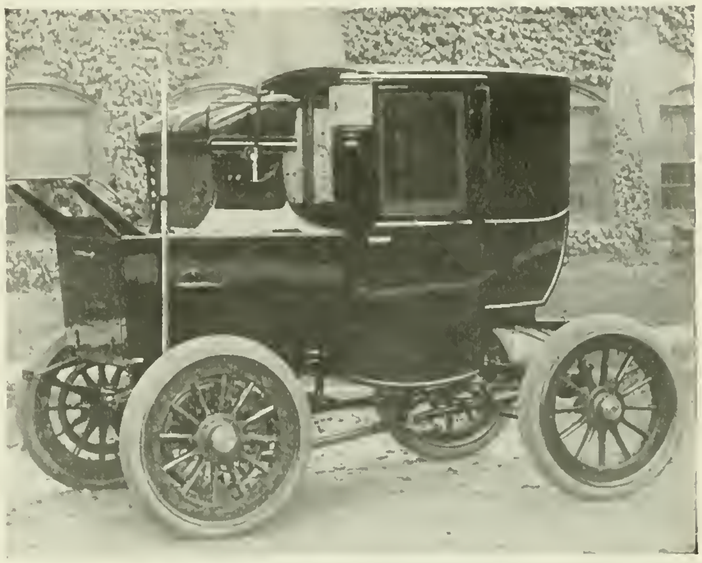


FIG. 18.—STRAIGHT-FRONT BROUGHAM.

Inventions of the Past Century.

Mr. Levin H. Campbell, principal examiner in the United States Patent Office, reviews in the New York *World*, the development of American ingenuity during the past century, as it is recorded in the Patent Office, in the patents applied for and granted.

The primitive methods employed in agriculture and in almost every department of human industry one hundred years ago, he says, have witnessed improvements as great as these. Recall, for instance, the changes in artificial illumination since 1800. When the century opened the best artificial light was that furnished by tallow or wax candles. Then came the kerosene lamp, to be followed by illuminating gas, and this, in turn, to be largely displaced before the end of the century by the electric light.

The most wonderful developments of this remarkable century have been in the departments of transportation, agricultural methods and electricity. Each of these departments overlaps into the other, and each has been dependent on the development of the steam engine for much of the advance that has been made.

A mere enumeration of the leading inventions and discoveries of the century would make a long list. It would include the locomotive and the steamship, the telegraph and the telephone, photography, the invention of the reaper, the thresher and the many other machines and appliances which have revolutionized agriculture.

The records for the Patent Office for the century strikingly illustrate the progress that has been made. No statistics are available showing the exact number of patents granted one hundred years ago, but as the total issues up to 1836 numbered only 9957, it is not probable that more than a few score were issued in 1800. The issues for the year just closing number 24,660, and the total for the century will number, approximately, 673,000.

There is no indication that the inventive genius of mankind has reached its limits. The century now opening will witness advances in every department of science and art. It is difficult to predict along what lines the most remarkable developments will be made.

Just now there is an unusual advance in the development of self-propelling vehicles. This will doubtless be carried still further in the coming century, and it is not unreasonable to predict that the horse will have practically disappeared from the streets of large cities by the first of the next century. It is also not improbable that the problem of navigating the air will have been solved before the lapse of another century.

The Future of the Electric Railway.

By B. A. Behrend and A. G. Wessling.

To peer into the future and to forecast events is one of the services that science has rendered to humanity. That divine faculty of looking before and after marks out man from his lowly brethren of the animal kingdom. As it is fascinating to the philosophic mind to dwell upon the past and to draw from it general rules and lessons, so it is even more tempting to the thinking mind to extend the conclusions, to which a contemplation of the past has led it, to the predetermination of the future, just as the physicist, by producing an observed curve to a realm that he has not heen able to explore, tries to fill out the lack of observation and experience.

The tendency of the human mind to wander back into the past and forth into the future, is deeply ingrained in human nature, and to the materialistic philosopher, it would be an inherent quality of the structure of the cerebrum. But though it is partly the office of science to occupy itself with future events, it is a paramount duty of science not to allow the human mind to run into apocalyptic visions, and to overstep the limits of what John Tyndall so appropriately called the scientific imagination.

The prophet's business is a thankless task. The great English historian and writer, Thomas Carlyle, is an illustration of this fact. Few, if any, of his predictions have come true, and his country, to which he prophesied doom and overhanging fate, has since his death risen to more greatness than ever was its own. The well-worn saying of the prophet who is without honor save in his own country, and in his own house, should make other prophets wary of so unprofitable an occupation. But if the probable development of an art is sketched without the cocksureness of the prophet, if it is considered with full knowledge of its being worth not more than any other apocalyptic vision, the effect, though perhaps not being eminently useful, will certainly not be injurious.

The following is a brief sketch of what may, or may not, be the evolution of the electric railway in the century the threshold of which we have just overstepped.

While the electric motor dates its origin in 1873, it was not until five years later that electricity as a motive power for the propulsion of street cars was adopted in Richmond, Va. One of the first changes brought about by this move was a change in the exterior shape of the motor, which gradually resolved itself into the present universal type of enclosed weatherproof form with not more than one reduction in speed between armature shaft and car axle. At the same time all kinds of systems were tried, every one of which helped either in a negative or a positive way to prove the advantages of our present system. Shunt wound motors soon showed they would not operate satisfactorily, and a system using a constant current was just as little suited to such service. The characteristics of the series wound motor working at a constant potential are such as to make it peculiarly suitable to meet the requirements of railway work. Its variation in speed with load is, as it were, an automatic safety device, which protects it against overloading itself, by reducing the rate at which it works as soon as it is called upon to increase its torque. Of course, higher speeds will be constantly demanded, which will necessitate the use of motors of increased capacity, but it is safe to predict that as long as direct current is used as the motive force the series wound motor will hold its own. Higher voltages will also be used, but the danger to life will not allow present limits to be greatly exceeded when using the present system of overhead transmission. The desirability of using higher voltages, together with the popular demand that all overhead wires be removed, will soon result in the adoption of the underground conduit system, at least so far as the cities are concerned.

As regards interurban traffic, there will be an extension of the present systems, but the present system of direct current transmission will not be used to replace the steam locomotives on our great trunk railroads. If direct current is to be used for this purpose, we may expect to see a modification of the Heilmann locomotive. The advantages possessed by the multi-unit train would lead to the adoption of trains made up of several motor cars, combined with one or more cars equipped with boilers and high-speed engines direct connected to direct current generators for producing the requisite electrical energy. The advantages of such a system would be the saving in weight of the generating car, since it would not then be necessary to carry such enormous weights on a few pairs of driving wheels as is now the case. The propelling force of the train being applied to the axles of the cars would do away with the pounding now caused by the reciprocating parts of the engine being directly connected to the drivers, and would greatly reduce the cost of repairs of the roadbed. Radiation from the present exposed surfaces of boilers and cylinders could be greatly reduced, and would result in a material reduction of the fuel burned. The generating cars could be made uniform in size and design and of capacity sufficient for trains of only the minimum or perhaps the average number of cars. By using two or more generating cars, working in parallel, trains of any desired number of cars could be operated and controlled as easily as at present.

While reviewing the history of street railway development, the storage battery must not be overlooked. The attempts that have been made to introduce it into actual service have clearly proved that there is little to be expected from it as a source of motive power. It has a place in the central station for taking the peak of the load, and future development will not be greatly affected by the storage battery. The only form of battery from which we may hope for great achievements in the future is one that will transform coal directly into electrical energy, in a manner more economically and directly than it can now be done by the use of the steam engine. A car equipped with a battery of such a kind could then be used in place of the generating car above mentioned. If the size and weight of such a battery could be small enough, it might even be feasible to equip individual cars therewith.

Turning from direct currents to alternating currents, there is no doubt that the polyphase induction motor promises to take the place of the direct current motor in all those cases in which overhead wires may be employed. Necessitating, as it does, two overhead wires instead of one, there still remains a great deal to be done in the application of three-phase currents to street railways The alternating current flowing through the rails cannot injure water pipes through electrolytic action, and this may be an offset for the greater drop caused by the inductance of the iron rail. The overhead system, complicated enough for direct currents, becomes fearfully complicated with three-phase currents, and the streets of the cities would be covered by cobwebs of wires. Whether engineering difficulties, or æsthetic circumstances, will be in the way of polyphase electric traction we have no means of determining to-day. There was just as much objection ten years ago to the direct current trolley as there is at present to the two trolleys of the three phase system.

The induction motor is surely at present the ideal motor for electric traction, at least as far as interurban traffic is concerned. It operates at practically constant speed, producing almost any torque it is capable of developing at all. It starts under load and if its winding is properly made, the heaviest starting currents are unlikely to injure it in the least. No precarious collectors, no sparking, no flashing over, and no bucking are to be borne up with in these motors.

The series-parallel control of two induction motors in the same truck permits of a reduction in speed to one-half, and the elaboration and development of this concatenation of induction motors may bring to light new, and, so far, unthought of possibilities for this system. It has already found application to mountain railways, and may be promised a wide field.

While the nearly constant speed of the induction motor would be a decided advantage in interurban railway work, the impossibility of overstepping synchronism is as great a disadvantage for trunk railroads. It often becomes necessary to make up lost time, and this is not possible if the motors are fed from a line the frequency of which cannot be changed. This would logically lead to the use of special generating sets for each train, the frequency of which could be changed within certain limits. The locomotive of the Heilmann type, only equipped with polyphase generators and induction motors, instead of direct current motors, would be the next step that might be taken, and whatever one may say about the combination of a steam engine with generators, and of the latter with motors, and about the irrationality of transforming motive power into electricity and electricity back into motive power, surely the polyphase locomotive of the Heilmann system would present a great advance upon its direct current sister. The starting of such an engine can be done even without using starting resistances, generator and motor being started up together, and the excitation of the generator might be derived from a small storage battery, or from separately driven exciters. With such engines very high speeds may be attained, and very heavy trains may be hauled.

There is no doubt, however, that the very conditions which gave birth to the Heilmann locomotive will lead to an improvement of the steam locomotive as at present in existence. The inertia of the human mind has not yet succeeded in getting away from the general plan Stephenson gave to the locomotive. But there are waiting for application the vertical steam engine of the Schlick system, doing away with the lifting up and pounding down of high-speed locomotives, and the steam turbines of De Laval and of Parsons. A severe struggle for existence is in store for the present locomotive as well as for all new inventions using electricity as driving power for the motors. Natural selection, sitting high above the lists, will judge the contest and award the prize to the strongest and fittest.

The near future will doubtless avail itself of the higher voltages that could easily be turned to account in polyphase traction.

Single-phase induction motors may be improved upon and perhaps the time of their application to railroads is not so distant as many of us suppose. But who can tell what slumbers in the lap of the future?

The preceding are but a few predictions of the developments that may be expected as the logical result of the persistent striving of engineers in this direction. But when such natural growths are aided by such startling discoveries as were recently made public by one who may be ranked as the most fertile and inventive genius in his line, the results obtained will far surpass our expectations. Regarding the transmission of energy, he states: "Thus the discovery of these new properties of the atmosphere not only opened up the possibility of transmitting, without wires, energy in large amounts, but, what was still more significant, it afforded the certitude that energy could be transmitted in this manner economically. In this new system it matters little—in fact, almost nothing—whether the transmission is effected at the distance of a few miles or of a few thousand miles." May we then hope to see every natural source of energy on the globe, including waterfalls, tides, winds and sunshine, transformed into electrical energy, which will then be transmitted to any point where it may be desired to use it? Having an unlimited amount of power available, the speed at which electric cars can then be run, will be limited only by the strength of the materials used in their construction. For the same reason their time of acceleration and of retardation will be reduced to as small a period as the sensibilities of their passengers will permit. This, from our present standpoint, seems to be the limit in the development of electric railroads which we may hope to attain.

But many unphilosophical minds, in dwelling upon future events, believe that the curve of development and improvement is still far from its maximum. Nay, more, they believe that, as they have watched an ascendancy during the past century, the slope of the curve will remain positive and there never will be an end to improvement. As Lord Kelvin once remarked, quoting Immanuel Kant, these people are like Fontenelle's roses, who looked upon their gardener, saying: "Our gardener must be a very old man; in the memory of roses he is the same he has ever been. It is impossible that he can ever change or be other than he is." Evolution does not necessarily mean progress, and as our globe is in a state of cooling, the time must come for the earth when evolution will mean adaptation to a universal winter, and as the great cosmos will finally end in destruction, as each individual passes from childhood to a maximum of development and then into death, as nations rise and fall, so will the industrial development, doubtless at present near its climax, go down as it has risen, only when and how is not revealed to human ken.

Telephone vs. Telegraph on Railroad Lines.

By G. F. Jenks.

There is a story going the rounds of the railroad columns of the newspapers to the effect that one of the large railroads in the far West is about to give up its telegraph system and substitute a telephone system therefor. This is perhaps as likely to occur as that this road is about to use typewriters exclusively and give up entirely the use of pen and ink.

Of course telephones are largely used by our railroads, both in their own work and in communicating with the public. The Philadelphia *Record* has recently printed a careful account of the telephone system of the Pennsylvania Railroad Company, which we may presume is as extensive as any in the country. The *Record's* picture of the central switchboard, located at the Broad Street Station, Philadelphia, shows that four telephone operators are employed at once, more than are needed at the "Central" of many sizeable towns, and the article states that this railroad exchange is connected by lines under the control of the railroad with smaller railroad exchanges at all important points on the lines between New York, Washington and Pittsburg. This is evidently a telephone system of some importance, and yet we understand that the telegraph system of the Pennsylvania Railroad is as extensive as ever, and we cannot learn that any change is contemplated in its methods of dispatching trains or other telegraph work.

We gather from the proceedings of the Association of Railroad Telegraph Superintendents and from various items in the daily press, that the New York, New Haven & Hartford Railroad has a railroad telephone system second only to that of the Pennsylvania. This railroad has a chain of exchanges between New York and Boston linked by wires, some supplied by the telephone companies, and others owned by the railroad. But here again the telephone is used only to supplement the telegraph, and there is no talk of superseding one with the other.

Many other railroads could be named with more or less complete systems of telephones. The New York Central, the Lehigh Valley, the Lackawanna, the Baltimore & Ohio and others use telephones extensively, but upon all of them the telegraph is kept in its usual state of efficiency.

There are various reasons why the telephone should not supersede the telegraph in railroad work. The first reason is its greater cost. Speaking generally, two wires are needed for a telephone circuit, as against one for a telegraph circuit. Of course, there are many isolated cases of satisfactory "grounded" telephone circuits, but they are generally short lines and at a distance from the large towns where electric power plants make the "ground" lively and grounded lines noisy with their escaping electricity.

Whenever considerable distances are to be covered and more than one circuit put upon a line of poles, it is safe to say that two wires must be used. Nor is it enough to provide two wires. If they are to be of any length, they must be of copper, while on most railroads iron is plenty good enough for the telegraph. Now, copper wire of the usual weight costs fully twice as much as the ordinary iron telegraph wire, so that it is fair to say that an efficient telephone circuit will cost the railroad four times as much as a telegraph circuit of the same length. This high cost of long distance telephone lines is a chief deterrent to their general use, by the railroads as by the public, and we should not be surprised if the use of their long-distance telephone wires were strictly limited to important communications even on the railroads controlling through circuits.

A second difficulty, akin to the first, is that a telephone circuit can only be used for one conversation at a time, while a telegraph wire, by the introduction of the various duplex and quadruplex systems, can take two or four messages at once. To be sure, these systems are only adapted to circuits connecting two or three stations, but the longest circuits seldom connect with more.

In railroad work the shorter or "division" circuits usually connect with every station on the division. It is quite usual for "train wires" and division "message wires" to connect with forty or fifty telegraph offices, and here we reach a third case where the telephone is at fault.

Transmitters and receivers might work well enough under such circumstances, but no telephone signalling apparatus is available which will work on a single circuit to fifty stations at once. If such an arrangement were tried it would probably be necessary to retain the old telegraph instruments to signal the various offices.

On the other hand, it is hard to see that the telephone possesses advantages in the handling of the message business now sent by telegraph that would warrant the increased expense involved. There might be emergencies when it would be extremely useful to the railroads to be able to fill the places of some of their telegraphers with "telephonists," but in such circumstances it is probable that temporary telephone circuits could be improvised from telegraph wires as quickly as the "telephonists" could be secured, so that no permanent expense on this account would be justified.

In point of fact, although the telephone is nearly half as old as the telegraph, it shows no signs of absolutely replacing it, either with the railroads or the public. Before the advent of the telephone, a man would divide his correspondence into two parts, one to be done by telegraph and one by letter. Now we make a third division. When we think we need a well-nigh immediate answer, we telephone, risking a waste of time through slow connections or a reply of "busy." If, on the other hand, a reply within a few hours will do, we telegraph, and we prefer to telegraph.

The Exchange of the Atlanta, Ga., Standard Telephone Company.

FIG. 1.—ATLANTA STANDARD TELEPHONE EXCHANGE.

ONE of the most interesting and novel of the recent "independent" telephone exchanges is that equipped for 3,000 subscribers by the Sun Electric Manufacturing Company, of Philadelphia, for the Atlanta (Ga.) Standard Telephone Company. We are indebted to Mr. E. E. Clement for a number of details in regard to the work, the exchange having been installed under what are known as the Clement & Gharky patents by the Atlanta Standard Construction Company.

The exterior of the exchange building is shown in Fig. 1, while Fig. 2 illustrates the operating room. The cables from the distributing board, coming up at the left, are taken from the top of the chute onto brackets supported on vertical hardwood studs secured along the walls, 25 ins. apart. The switchboard is divided into sections of three positions each, and there are struts to each section, a pair of cables being let off from every third strut, beginning with the lowermost pair, and across the top of the board to the connecting terminals. The chute through which the cables pass up to the operating room is provided with doors on each floor, so that it can be opened for its entire length, and the same arrangement is followed with the chute through which the line cables pass up from the vault in the basement to the distributing board, perfect accessibility of every part of the line, either individually or in all its cable, being thus secured. The board is divided into sections of three positions each. Two of these positions are taken by "A" operators, who answer all calls and initiate trunk connections, the third position being taken by a "B" operator, whose sole duty is to complete trunk connections according to instructions received from the "A" operators. This "B" operator does neither ring nor talk to any subscriber except when the line wanted is busy. Her sole work is to insert plugs and the "A" operator does the rest. When the work is very light, all but the "B" operators can be released, in which case these operators take up the work on the adjoining "A" panels · in order that they may do this, switches are provided on the right and left of each "B" panel, as shown, to connect the head circuits together.

In Fig. 3 is a section of three positions in course of erection, with parts removed to exhibit the inside construction. An inclosed gallery passes all around it, perfectly clear of cables or other obstructions. Behind the left-hand transmitter is a continuation of one of the struts, bored to receive the horizontal members of a trunk cable frame. The trunk cables run along the wainscoting of the wall, where they are not only out of the way, but absolutely open and accessible all the time. They cross the floor of the gallery, accessible under short sections of false flooring raised 3 ins. At every third strut along the wall a pair of line cables is led off and taken across the top of the board to the front behind the moulding down through the roof. The braided covering is removed and the wires are formed and laced to come down to the inside ends of the terminals on the top of the vertical strip. The eleventh pair of terminals on each strip and the eleventh opening in each case shown unfitted with a line unit are "extras." These openings are normally plugged. In each section of the switchboard there are 20 vertical line strips, carrying normally 200 line units. The first and tenth, and the eleventh and twentieth strips, however, each carry an extra unit the same as a line unit, wired to the chief operator's desk for one and the trouble operator for the other. The "A" operators call the chief just as they would a subscriber, her desk being fitted with a row of annunciators consisting of plungers which also serve as keys, and which, when depressed, put her telephone set into circuit.

Each line unit is carried on a yoke secured to the back of the strip, the relay being of tubular form, and the lamp fitted in the front end of the tube. This is closed on the outside by a bull's-eye of translucent material (right-hand strip in Fig. 3), the bull's-eye being removed from the other strips in that engraving, leaving the lamps exposed. Below the line strips the trunk panel is fitted with jacks and order keys. The panel in Fig. 3 is bored for the full equipment for 4000 lines, but with jacks for only 1000 installed. These are plain open-circuit jacks, each connected to its individual trunk line leading to some particular "B" section. In actual service it was found that two trunks from each "A" to each "B" operator was sufficient, giving four on each double "A" panel that lead to the same operator. The order keys at the top correspond with the pairs of trunks, the order circuits being separate from the trunks. The trunk and order-circuit cabling is wired on the trunk panel before it leaves the factory, and the connections are at one end, where the cable passes down the leg of the board and thence under the floor to the rack in the rear of the gallery.

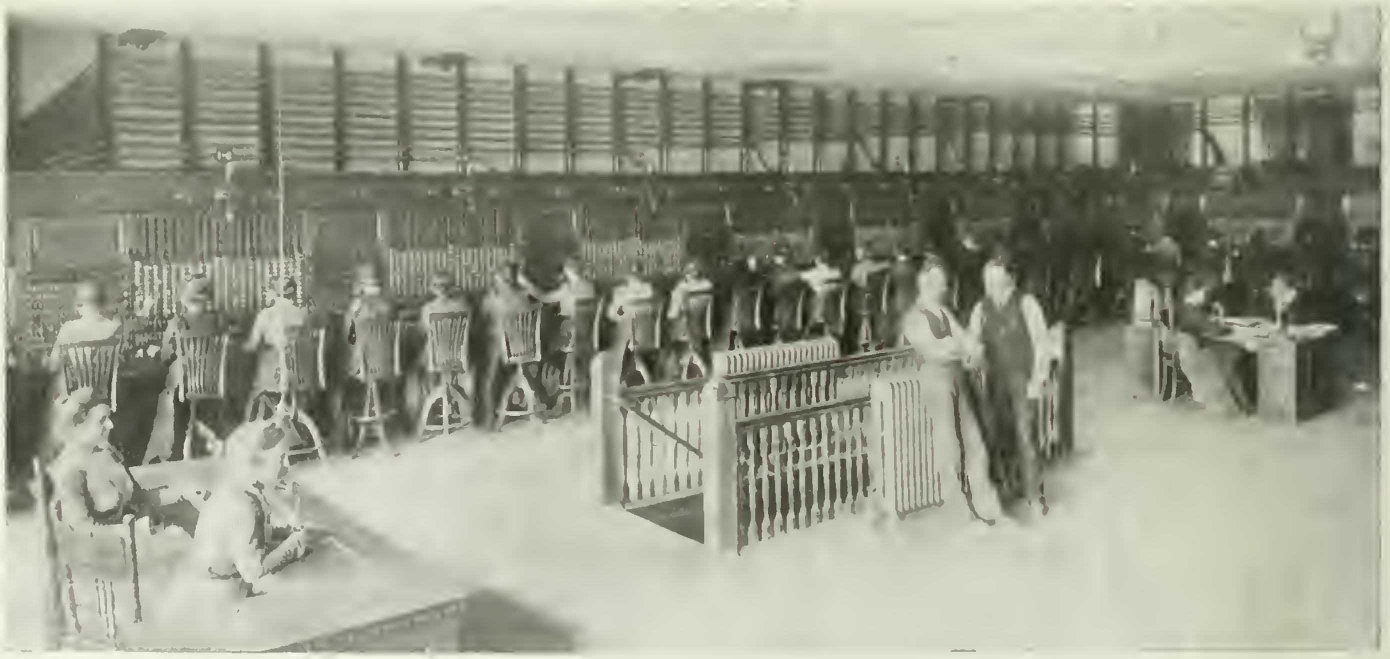


FIG. 2.—MAIN OPERATING ROOM INDEPENDENT TELEPHONE EXCHANGE, ATLANTA, GA.

Below the trunk panel, and extending across each double "A" section is a signal panel, and directly in front of this are the "operators' strips," a series of units composing the horizontal table. Each strip is of five-ply wood veneered on its surface with black fibre, and carrying a pair of plugs and a combination key. The calling plug of each pair has a switch in its seat which, as long as it is not in use, connects the operator's head telephone to the corresponding cord. No listening key is required, therefore, for as soon as the operator has inserted the answering plug in response to a call she is already on the line. The combination key in one position connects the generator to ring, and in the other position it connects the corresponding signal lamp back of the plug to act as a supervisory signal, leaving it connected until the called subscriber answers, when it is automatically thrown off. This key, the plugs, and the plug seat switch, are all wired in grooves in the edges of the strip before leaving the factory.

On the right of Fig. 3 is section B, which consists of a cast-iron panel in two parts, made in "stair-steps," and drilled through with rows of holes for the plug seats and "B" signals. The former are plain plug seats, tubular in form, held in place by a shoulder on one side of the iron and a nut on the other. The latter are plungers which serve both as push buttons and as signals. The row of these in front of any "B" operator represents all the "A" operators in the exchange, and when one comes out it signifies that the corresponding operator has come in on a trunk leading to one of the two plugs below it. This signal is only intended to guide the eye, for it is operated by the "A" operator having pressed her order key on the trunk panel for this particular "B" operator, and as soon as she has done that she has crossed her talking circuit with that of the "B" operator and gives the order orally for the connection; but the visual signal is found to be useful in many ways.

Should several trunk signals come in at the same time, the orders would be confusing to the "B" operator receiving them, but they are made non-interfering by a "lock-out" mechanism which prevents more than one signal coming in at a time. At the same time, if the "B" operator happens to be busy, the signal shows her who called, and she can ask for the order to be repeated by simply depressing the plunger to its fullest extent.

The wiring on the rear of the "B" sections, as well as the management of the cords and weights of the trunk plugs, is simplified by inverting the plugs; this also gives an opportunity to use long cords, which permit the trunk plugs to be used over a large part of either of the two adjoining "A" sections, as indicated in Fig. 4.

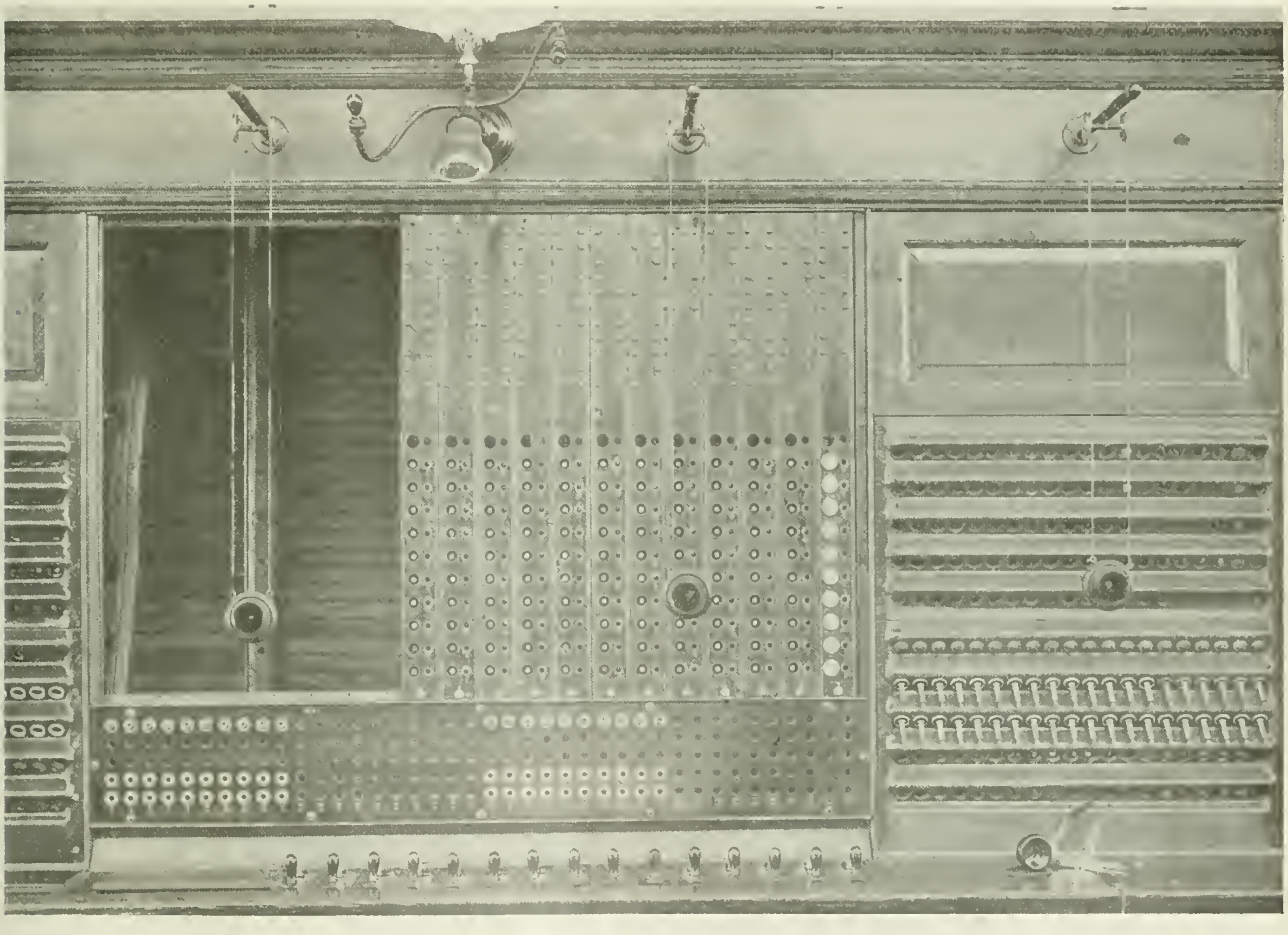


Fig. 3.—Details of Atlanta Exchange Switchboard Construction.

In the operators' suspension sets the transmitters are suspended by bare conductors, which pass over insulated sheaves. This allows the conductors to be reduced so that they are almost imperceptible, and do not obscure the view of the board. The sheaves are carried on a sliding support, locked in position by the weight of the transmitter, the operator being thus able to adjust her transmitter up or down, inward or outward, by merely raising it in her hand. An automatic switch is operated by a stop clamped on the cord so that when the transmitter is pushed all the way up by a retiring operator the battery is cut off. The head telephone is plugged in on a jack underneath the table in the ordinary way.

The board works with a central battery for signalling. Local batteries are used at the subscribers' stations. The subscriber calls by removing his receiver from the hook. This act closes the battery circuit and current flows through one coil of his relay, which closes the lamp circuit. The "A" operator, perceiving the signal, inserts the answering plug of a pair, and being already on the cord, is enabled at once to ask "number." If the number wanted is on her own section she inserts the calling plug in the jack of the line wanted and pushes the knob of her key in one direction at one operation. This connects the lamp signal corresponding to that pair of plugs, and a reverse motion of the key rings up the subscriber. The previous insertion of the answering plug connected the line relay in a bridge circuit, presenting high impedance to talking current but permitting the battery current to pass neutrally and retire the signal. The supervisory signal, however, remains lighted until the called subscriber answers, and it is therefore unnecessary for the operator to listen in. As a matter of fact, she has no means of listening in after the connection is made. When the called subscriber answers, the supervisory signal disappears, and a clear through circuit is established between the subscribers, with no branches or coils, and only one pair of cord contacts, interposed. Either subscriber can control his own lamp signal by moving his switch hook, and when both have hung up their receivers both line lamps are lighted for clearing out. If one lamp only should light, it would either be a sign of trouble or indicate that one subscriber had neglected to hang up his receiver.

When the line wanted is not within reach, the "A" operator inserts the calling plug in the jack of a trunk leading to the desired section, at the same time pressing the corresponding order-key and repeating the number to the "B" operator, and pulling the knob of her combination key as before. The "B" operator takes the proper trunk plug and inserts it in the desired jack. The instant she has done so a circuit is completed for the supervisory signal in front of the "A" operator, who is thereby informed that the connection is complete and proceeds to ring. There need be no delay in the "A" operator's work, because of a slight delay in the completion of the connection; for the lighting of that lamp always means the same thing—that is, she is to ring, and the order cannot be lost, for the "B" signal will bring the "B" operator back on the order circuit if she has missed it. When the subscriber answers, the supervisory lamp goes out, and when the conversation is finished the clearing-out signals are received at both ends as before. In case a line is busy, that is, if the "B" operator finds a plug already in the jack, she speaks directly to the calling subscriber through the trunk wire, informing him that the line is busy, and in hanging up his receiver he gives the clearing-out signal; or should he neglect to do so the "B" operator can directly inform the "A" operator of the fact.

An arrangement of multiple trunks, instead of the simple trunking described, is furnished where trunking between exchanges is to form a considerable percentage of the business. For this purpose a set of busy signals are used in addition to the supervisory signals shown. The desk at the left-hand side of Fig. 2 is a monitor's desk, fitted with listening keys only, so that the monitors can listen to or talk with any operator or the chief. Where conditions permit, this desk is also fitted with a distributing board for all the operators' circuits, and "on and off" keys giving control of the individual operator's battery connections, to insure economy. The chief operator's desk is also fitted with a limited number of special line units, whereby "kickers" among the subscribers can be accommodated by the chief herself.

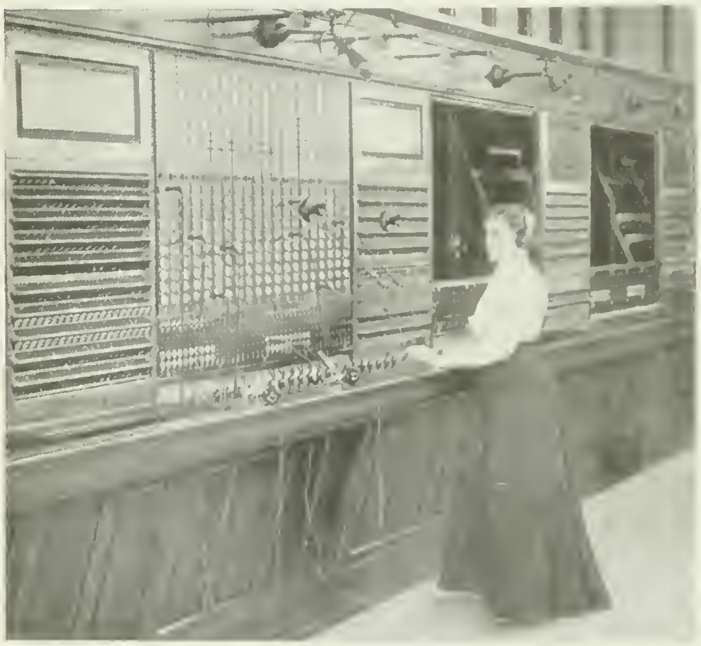


FIG. 4.—PANELS IN OPERATION.

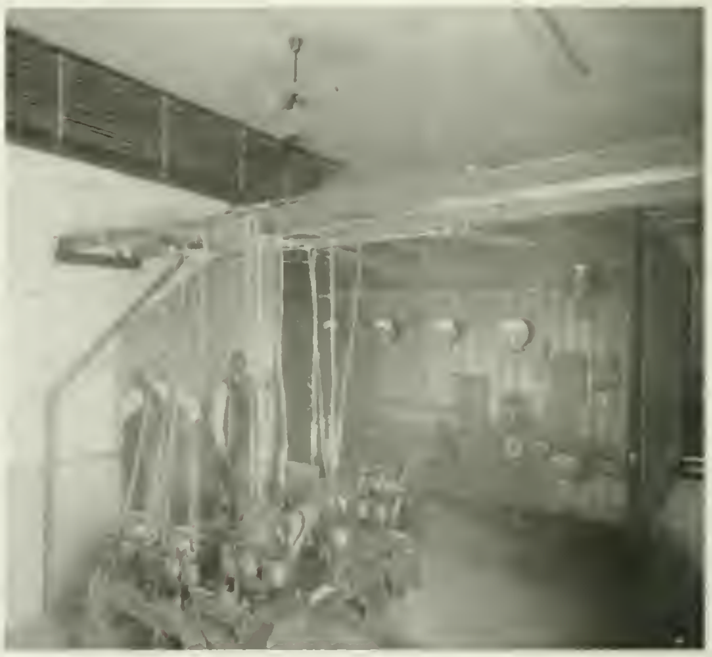


FIG. 5.—POWER ROOM.

The power room, with its switchboard, and one side of the combined cross-connecting and distributing board is seen in Fig. 5. The cables enter at the right-hand side from beneath and pass under a false floor, being brought up in rows along the sides of the distributing-board frame, an iron structure formed of angles and tees forming a cage with cross-bars overhead of iron pipe carrying vertical pins 5 ins. in height arranged in rows; each pin has a sleeve of hard fibre slipped over it to prevent short circuits or crosses in case the insulation on the jumper wires should break. The cage has two partitions inside, and each of these is faced with hardwood panels, as are also the two sides and the back. Each cable is brought up to the foot of the panel and there fitted with a pot head, the wires from which are formed up and led to rows of pairs of brass terminals passing through the panel. On the outside of each panel is a corresponding row of fuse protectors on porcelain bases, to which the cable wires are connected. From each fuse block a continuing pair of wires is threaded back through the panel and up the inside face to the top of the frame, where it is led along between the parallel rows of pins to its appropriate terminals on the rear face of the board. This whole rear face is covered with small brass terminal connectors having binding screws to facilitate the changing of jumpers, the latter being threaded through in each case and being connected on the face of the panel. The switchboard line cables are 52-pair interior cables, and start from the inside of the rear face of the cross-connecting board, thence passing down under the false floor and across to the right-hand side in the picture, where the front of the switchboard cable chute is located, but not shown. Each cable has its terminal wires formed up and threaded through one side of the panels to the connectors. Across the front of the distributing cage, and with about 4 ft. intervening, is the power switchboard. It is shown with temporary wooden panels before the slate panels had been received. The only available source of electrical supply at the time was a 500-volt direct-current circuit. A 5-hp 500-volt Crocker-Wheeler motor has been installed, belted to a counter shaft hung on the under side of a heavy wooden platform which carried all the machines. From this the two charging machines are driven, either being capable of running independently, of course. A reserve motor has been added, pending the completion of 110-volt lighting mains by the local electric light company. In addition to this set of machines a water motor is provided in the basement with a ringing generator connected to it and wired to the power switchboard for use in case of failure of the 500-volt current, the storage cells having capacity to tide over any ordinary interruption. These are chloride batteries of 500 ampere-hours capacity, arranged in duplicate on shelves, protected by a casing with glass doors. Twenty-six cells are employed in each set, the voltage of the signalling current on the lines being about 32, sixteen cells being thus required for this service, and the others furnishing current for the operators' transmitters, local switchboard circuits and the lamp signals.

Most of the subscribers during the past year have been served through underground cables. All of the main cables are 120-pair, lead sheathed and paper insulated, of Roebling make. The conduits are of terra cotta, in four-duct and six-duct units; the main trunk conduits have sufficient capacity for over 4000 lines. The distributing poles are of locust, averaging 50 ft. in height, and provided with square platforms strongly framed with iron, and wooden terminal boxes containing double rows of terminal strips with protective devices. Wherever practicable within the city, conduits were run and the cables taken directly into the basements of buildings to be served, distribution being then effected by means of small terminal boards and interior cables. At the exchange all cables enter through the front foundation walls, passing into a cable vault. Thence a vertical brick shaft passes up to the second floor, into a large room over the main entrance, where the distributing and cross-connecting boards are located. This cable shaft is located about 20 ft. back from the front wall, and between it and the latter is a second vertical shaft which carries the switchboard line cables up to the third floor, where they pass directly to the wall brackets in Fig. 2 over the top of the switchboard.

Elements of Illumination—XVIII.

By Dr. Louis Bell.

It is not desirable or economical to operate an incandescent lamp too long, since not only does it decrease greatly in efficiency, but the actual light is so dimmed that the service becomes poor. If the lighting of a room is planned for the use of 16-cp lamps, and they are used until the candle-power falls to, say, 10, which would be in about 600 hours in an ordinary 3-watt per candle lamp, the resulting illumination would be altogether unsatisfactory. Quite aside from any consideration of efficiency, therefore, it becomes desirable to throw away lamps of which the candle-power has fallen below a certain point.

Much of the skill in modern lamp manufacture is directed to securing the best possible balance between efficiency and useful life, a thing requiring the best efforts of the manufacturer. Fig. 1 shows graphically the relation between life, candle-power and watts per candle derived from tests of high-grade foreign lamps. In comparing these, like the previous data, with American results, it should be borne in mind that these foreign tests are made, not in terms of the English standard candle, but generally in terms of the Hefner Alteneck standard, which is somewhat (approximately 10 per cent) smaller.

These curves show the results from lamps having an initial efficiency of 2.5, 3.0 and 3.5 watts per candle-power and an initial candle-power of 16. They show plainly the effect of increased temperature on the life of the lamp and it is unpleasantly evident that in the neighborhood of 3 watts per candle a point is reached at which a further increase of efficiency produces a disastrous result upon the life. In other words, that efficiency represents a temperature at which the carbon filament rapidly breaks down. And so long as carbon is used as the radiant material there is a strong probability that there can be no very radical improvement in efficiency. Of course, if incandescent lamps were greatly cheapened, it would pay to burn them at a higher efficiency and replace them oftener. It is quite possible that increased experience and persistent efforts at standardization would lead to this result. In manufacture on a large scale the mere manufacture of the lamps can be done very cheaply, probably at a cost not exceeding 7 to 8 cents, but the cost of proper sorting and testing to turn out a uniform high-grade lamp, and the incidental losses from breakage and in lamps of odd and unsalable voltages raises the total cost of production very materially. Much of the reduction in the price of incandescent lamps in the past few years has resulted from better conditions in these latter respects, as well as from the improved methods of manufacture.

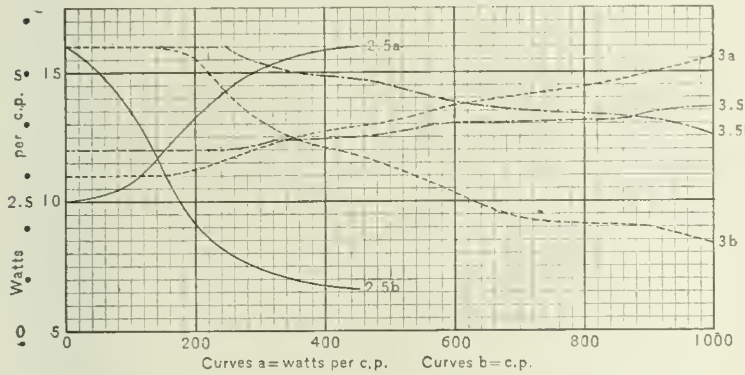


FIG. 1.—CURVES SHOWING LIFE, CANDLE-POWER AND WATTS PER CANDLE.

And it should be pointed out that the difference between good and bad lamps, as practically found upon the market, lies mostly in their different rates of decay of light and efficiency. It is the practice of many of the large lighting companies who renew the lamps for which they furnish current to reject and replace lamps which have fallen to about 80 per cent of their initial power. First-class modern lamps worked in the vicinity of 3 watts per candle-power will hold up for 400 to 450 hours before falling below this limit, and at 3.5 or 3.6 watts per candle-power, will endure nearly double that time. They are often rated in candle-hours of effective life and on the showing just noted the recent high efficiency lamp will give a useful life of 6000 to 7000 candle-hours, with an average efficiency of perhaps 3.25 watts per candle. A medium grade lamp of similar nominal efficiency may not show more than 250 or 300 hours of effective life with a similar consumption of energy—say 4000 to 4500 candle-hours. The economics of the matter appear as follows: The first lamp during its useful life of, say, 6500 hours, will consume 21,125 kilowatt-hours, costing at, say 15 cents per kilowatt-hour, $3.17, and adding the lamp at 18 cents, the total cost is $3.35, or 0.0515 cent per candle-hour, while the poorer lamp at 4000 candle-hours will use $1.95 worth of energy, and at 18 cents for the lamp, would cost 0.0532 cent per candle-hour. To bring the two lamps to equality of total cost, irrespective of the labor of renewals, the poorer one would have to be purchased at 11 cents. In other words, poor lamps generally so increase the cost of renewals that it does not pay to use them at any price at which they can be purchased under ordinary circumstances.

As has already been explained, lamps deteriorate very rapidly if exposed to abnormal voltage, and the higher the temperature at which the lamp is normally worked the more deadly is the effect on increased voltage. It thus happens that if high efficiency lamps are to be used, very good regulation is necessary. Occasional exposure to a 5 per cent increase of voltage may easily halve the useful life of a lamp, while, of course, permanent working at such an increase would play still more havoc with the life, cutting it down to 20 per cent or less of the normal. Good regulation is therefore of very great importance in incandescent lighting, not only to save the lamps and improve the service, but to render feasible the use of high efficiency lamps. On the whole, the best average results seem to be obtained in working lamps at 3 to 3.5 watts per candle. Those of higher efficiency fail so rapidly that it only pays to use them when energy is very expensive and must be economized to the utmost. The 2.5-watt lamp of Fig. 1, for example, has an effective life of not more than 150 hours, at an average efficiency of about 2.75 watts per candle. A 2-watt lamp will fall to 80 per cent of its original power in not far from 30 hours at an average efficiency of about 2.25 watts, while if started as a 1.5-watt lamp, a few hours reduces the lamp to practical uselessness.

There is seldom any occasion to use lamps requiring more than 3.5 watts per candle-power, save in case of very high voltage installations where the saving in cost of distribution may offset the cost of the added energy. The difficulty of making durable 250-volt lamps on account of the extreme thinness of the filament has been already referred to, and it is certainly advisable to use in such installations lamps of 20 candle-power or more whenever possible, thus making it possible to work at better efficiency without increased risk of breakage. Even when power is very cheap there is no object in wasting it, and a little care will generally procure regulation good enough to justify the employment of incandescent lamps of good efficiency. And not only this, but in the commercial use of lamps it is necessary for economy that the product should be uniform. It has already been shown that medium grade lamps are characterized by a shorter useful life than first-class lamps. Unfortunately, there are on the market much worse lamps than those described. It is not difficult to find lamps in quantity that are so poor as to fall to 80 per cent of their initial power in less than 100 hours. A brief computation of the cost of replacement will show that these are dear at any price. Now, if lamps are not carefully sorted, a given lot will contain both good lamps and poor lamps, and will not only show a decreased average value but will contain many individual lamps so bad as to give very poor and uneconomical service. Fig. 2 shows what is sometimes known as a "shotgun diagram," illustrating the variations found in carelessly sorted commercial lamps. In this case the specifications called for 16-cp 3.5-watt per candle-power lamps. The variation allowed was from 14.5 to 17.5 mean horizontal candle-power, and from 53 to 59 total watts, which is a liberal allowance, some companies demanding a decidedly closer adherence to the specified limits.

The area defined by these limits is marked off in the cut forming the central "target." The real measurements of the lamps tested are then plotted on the diagram and the briefest inspection shows the results. In this case only 46 per cent of the lamps hit the specifications. All lamps above the upper slanting line are less than 3.1 watts per candle-power, and hence are likely to give trouble by falling rapidly in brilliancy and breaking early. Lamps below the lower slanting line are over 4 watts per candle-power, hence are undesirably inefficient. Moreover, the initial candle-power of the lot varies from 12.2 candle-power to 20.4 candle-power. Such a lot will necessarily give poorer service and less satisfactory life, and is, as a matter of dollars and cents, worth much less to the user than if the lamps had been properly sorted at the factory. Filaments cannot be made exactly alike, and the manufacturer has to rely upon intelligent sorting to make use of the product. For example, the topmost lamp of Fig. 2 should have been marked for a lower voltage, at which it would have done well. Nearly all the lot would have properly fallen within commercial specifications for 16-cp lamps at some practicable voltage and rating in watts per candle-power. The imperfect sorting has misplaced many of the lamps and depreciated the whole lot.

In commercial practice lamps should be carefully sorted to meet the required specifications, and the persons who buy lamps should insist upon rigid adherence to the specifications and should, in buying large quantities, test them to ensure their correctness. To sum up, it pays to use good lamps of as high efficiency as is compatible with proper life, and to see that one gets them.

The real efficiency of an incandescent lamp, *i. e.*, the proportion of the total energy supplied which appears as visible luminous energy, is very small, ordinarily from 5 to 6 per cent, not over 6.5 per cent even in a 3-watt per candle-power lamp. This means that in working incandescent lamps from steam-driven plants not over 0.5 per cent of the energy of the coal appears as useful light. This is a sad showing, and one which should spur invention. To get better results, it seems necessary to abandon the carbon filament, at least in any form in which we now know it, and either to turn to some other material for the incandescent body, or to abandon the principle of incandescence altogether and pass to some form of lamp in which the luminosity is not due to the high temperature of a solid radiant. The writer is strongly disposed to think that the ultimate solution lies in the latter alternative, although the former offers hope of very considerable and perhaps revolutionary improvements.

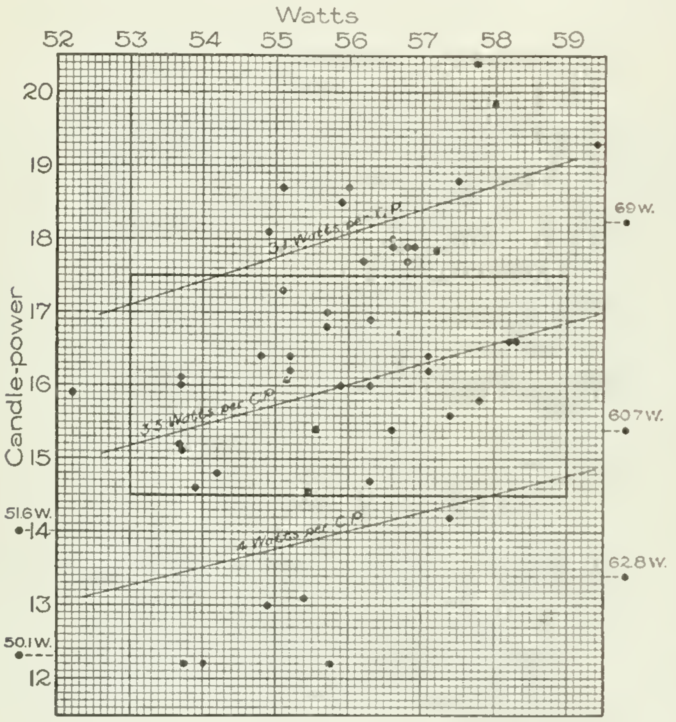


FIG. 2.—"SHOTGUN" DIAGRAM.

Within the past few years a large number of attempts have been made at preparing a filament for incandescent lamps of some material far more refractory than pure carbon, and hence better able to endure the high temperature necessary for securing high efficiency. A glance at the temperature curve of the last paper shows that a rise of 200 degs. C. or so in the working temperature would produce an efficiency of nearly or quite one candle-power per watt.

These attempts have been of several kinds. One method has been to incorporate refractory material with the carbon in manufacturing the filaments, thus both increasing the resistance of the filament and giving it a proportion of heat-resisting substances. Owing, however, to the fact that such filaments still contain a considerable proportion of carbon which is comparatively easily vaporized, there is good reason to doubt the efficacy of the process. The carbon, which is the cement, as it were, once disintegrated, the filament would give way, and experience up to date has tended to throw doubt on the success of any such scheme.

An interesting modification of this method is that proposed by Langhans, who forms filaments of carbide of silicon, *i. e.*, employs carbon in chemical combination instead of merely as a species of cement. This process has not been carried to commercial success, but it certainly looks more hopeful than the process of incorporation on general principles.

Another line of attack on the problem is that of Auer von Welsbach, who proposed a filament of platinum or the allied metals, coated with thoria, the rare earth which is the chief constituent of the Welsbach mantle. This looks mechanically dubious. Still another modification of this idea is the use of a filament mainly of carbon, but with a coherent coating of thoria or the like, a line of investigation which appears worth pursuing. Akin to this is the Nernst lamp, which is at present exciting great interest, although it is not yet in the commercial stage. The basic fact on which Dr. Nernst's work is founded is that many substances, non-conductors at ordinary temperatures, become fairly good conductors when heated. Thus a tiny pencil of lime, magnesia or the rare earths, when once heated, will allow a current to pass at commercial voltages sufficient to maintain it at vivid incandescence. From this fundamental fact Nernst has developed a most interesting and promising glow lamp.

Important Developments in Erie Telephone.

It is stated that the stockholders of the Erie Telegraph & Telephone Company did not subscribe largely for the new issue of stock offered in December for extension work, etc. The company has therefore had to look elsewhere for funds. A special meeting of the Erie Telegraph & Telephone Company was held in New York on Jan. 9 for the purpose of authorizing the directors to mortgage the property to secure the payment of obligations, or of debt contracted in transacting the company's business; to ratify and confirm an agreement with the Postal Cable Company, of Texas, for the joint use of lines, and to authorize the appointment of a finance or executive committee by the directors with such powers as the board may delegate to them, and to authorize amendments to the by-laws that may be suitable for this purpose. President Charles J. Glidden, in a circular letter to stockholders of date Jan. 2, says: "The Erie Telegraph & Telephone Company has expended through its subsidiary companies very large sums during the past year in extensions and improvements of the telephone properties owned by them. These properties are now in excellent condition, and the expenditures will, it is confidently expected, very materially increase the earning capacity of the several companies, and consequently of the Erie Telegraph & Telephone Company. The expenditures could not be made, however, without raising large sums of money, and the Erie Company has been obliged to incur debts amounting to about $6,000,000, including those of the subsidiary companies, which it is now desired to provide for, which debts are represented by notes falling due from time to time during the coming eight months. It is proposed eventually to provide for this indebtedness in permanent form, either by the issue of additional stock or by bonds running for a term of years, or both. At the present time, however, the company has an opportunity to make a very satisfactory agreement with the Old Colony Trust Company and its associates, whereby there will be raised a sufficient sum to pay and take care of the company's notes and to provide not exceeding $1,000,000 for further needed extensions and improvements in the telephone properties during the coming year."

The amount raised is said to be $7,500,000, coming from bankers understood to be identified with American (Bell) Telephone & Telegraph interests. Twenty per cent. of the sum is to be forthcoming Jan. 10. The stock went off to 82, a loss of 15 points, on the announcement, which carries with it an implication that the Telegraph, Telephone & Cable Company of America, representing "independents," and which is said to have bought it in at about 115, had lost its control of Erie.

The Erie Telephone system made a net gain of 2,278 subscribers in December; 35,041 for the year. Total connected, Dec. 31, 141,599; waiting connection, 2,924. As to how and where the Erie Telephone Company could use $6,000,000 in one year, "the question is easily answered," said a prominent telephone man last week. "Over 35,000 new subscribers were added to the Erie system in 1900. This would cost alone about $4,500,000, and the balance could be wisely invested in exchange buildings and long-distance lines. Erie's gross earnings, it is said, increased over $1,000,000 in the ten months ending Oct. 31, and the net exceeds 8 per cent. on the cost of all improvements."

requirements. If the voltage delivered by alternators at the power house is too low, sub-station attendants will attempt to raise it by cutting out the field resistance of the rotary converters, and thereby drawing leading currents from the power house. This will be shown upon the power factor indicators of the alternators, whereupon the operator at the power house will raise his voltage to meet the sub-station's requirements, restoring the power factor to unity. The reverse sequence of operation will occur when the direct-current voltage is too high.

Train Lighting in Germany.

The Electrotechnical Association, under the presidency of Secretary of State Von Podbielski, heard at a recent meeting in Berlin a report of Engineer Doctor Buttner upon the "Electric Lighting of Railway Carriages," followed by a discussion. The reporter naturally referred to the Offenbach railroad disaster and the demand in the daily press that the dangerous oil gas should be replaced by electric light. He said it was remarkable that Germany, otherwise so forward in electricity, had developed next to nothing of this form of lighting. Since the Swiss railway administration began in 1888 on the Simplon Railway with electric lighting, the Swedish, English, French and Danish had followed, so that one encounters in foreign travel much electric lighting of railway carriages. The Paris Exposition had also demonstrated that the electric lighting of railway carriages had made rapid strides in the last decade and had become a formidable competitor of gas lighting. The Prussian railway lines would have perhaps already busied themselves about the installation of electric lighting had not the method of lighting with acetylene gas, or by the system of Julius Pintsch of a mixture of acetylene with oil gas, meantime been adopted.

With electric lighting, about 8000 carriages have been equipped, as against about 75000 carriages and 3000 locomotives with oil gas. Electric lighting is afforded either by means of dynamos, assisted by accumulators, or by these latter alone—and either for the entire train or for each separate carriage. In England, toward the end of the year 1880, it was attempted, without favorable result to utilize the motion of the train to rotate dynamos. In 1886 similar attempts were made on the Frankfurt-Fulda Line, and on the Wurtemburg State Railways. These also failed of adoption. In recent times the following systems were used: 1. The Stone system, extensively used in England, based upon a hanging eccentric dynamo, whose eccentricity is utilized to regulate the pressure. In France the Mediterranean Railway has utilized this system. 2. The Moskowitz system, principally in use in America. 3. A similar system to this called Vicarino. 4. The Dick system, with lighting for each car by means of storage batteries. In Europe this method of lighting is used in the court trains of the Emperors of Russia and of Austria. The court train of the German Emperor uses a mixed system of gas and storage batteries. In Sweden and Denmark the trains are lighted by means of two batteries, one in front and the other at the rear of the train, with couplings between the carriages for conducting the current. Whether this system would be adopted in Germany was doubtful. The Scandinavian system might be strongly opposed by the Imperial railway management because the independence of each carriage is so essential. More advantageous is the installation in each car of one or more batteries, which could be easily handled. Every circuit must possess resistance, resistance regulators and fuses. The charging of the accumulators is easy to arrange. The North-Milan Railway and the Jura Simplon Railway have individual cars with storage batteries—the last named owns 630 cars so equipped. In Austria several railway lines have followed suit, and in Germany nearly all the private lines, as, for example, the Dortmund-Gronau, the East Prussian Southern Railway, etc. The German Post Administration has its carriages all lighted by storage batteries. The postal authorities of Bavaria and Wurtemburg have also adopted this system. Outside of the Continent of Europe electrically lighted railway cars are frequently encountered, recently even in Japan. Dr. Buttner said he might place the number of electrically lighted cars at more than 8000. On account of the ease of turning on and extinguishing the electric light—the former at the instant of need during the trips—it affords a substantial economy, which, for example, in the Dortmund-Gronau line amounts to 50 per cent of the lamp-hours as compared with oil gas, effecting a considerable saving. The objection that storage batteries are too great a weight for the train is erroneous. The speaker had had three years ago the opportunity of proving this to Minister Von Thielen as not tenable, in comparison with the weight of the oil-gas equipment. The cost on the whole, through the economy of lamp attendance should not be considerably increased. The lighting alone costs about 4.3 pfennigs per lamp-hour. The Postal administration reckons the lamp-hour at 3.5 pfennigs. With the cost of installation, amortization, maintenance and current, etc., the cost per lamp-hour should be about 2.55 pfennigs—about the same as the cost per lamp-hour for the oil gas. Certainly the expense is no greater, and this will remove all objections to electric lighting on account of too great cost.

The speaker maintained that the simple accumulator is well suited to German conditions, as shown by the experience of the Postal Department. But while these cars are charged outside, this method is not always suitable for passenger cars, as the batteries require about three hours for charging. A mixed system is recommended, and the charging should be done by changing batteries. Batteries with 20 hours' lighting capacity would be sufficient. The Imperial authorities are using 27 lamp-hour capacity storage batteries. The present stations could be used for electric lighting and the charging of storage batteries. Batteries have also the advantage of being useful for the propulsion of other vehicles. The Prussian Railway Commission has never taken the trouble to arrive at a verdict in regard to electric lighting on the basis of its own experience. At least an experiment upon a small scale could not be cited, such as the equipment of two D-cars on the Berlin-Cologne line with the Stone system. According to the statement of the Prussian Minister, the equipment of the lines with electric lighting would cost 25,000,000 marks. But this amount could be divided among several years, and, contrasted with the extent of the Prussian railway lines, was not great. Above everything, the greatest safety for passengers must form the determining factor. The speaker said he was aware of an official opinion and of the answer published by the Frankfort *Gazette* that the introduction of electric lighting of railway trains would not reduce the dangers of deaths due to fire. At the close of the address he expressed the hope that the Prussian Railway management would make thorough trials with electric lighting and that they would lead to the conviction that 25,000,000 marks would not be too much to expend in order to increase the safety of the traveling public.

Engineer Gerdes spoke in favor of the safety of gas, criticized the methods of electric lighting then in vogue and stated that the question was not yet ready for discussion. This caused Secretary Von Podbielski to remark that the Imperial Postal Service which had, since 1892, used electric lighting, was well pleased with it and had had no disagreeable experiences. Prof. Von Wedding spoke in favor of electric lighting, and especially by storage batteries. He preferred to travel at a speed of 60 to 70 kilometers per hour on top of the battery rather than on gas tanks with a pressure of 6 atmospheres. A speaker who was not wholly a stranger to the Prussian Railway Administration styled gas and mixed gas lighting as harmless. He raised doubts against electric lighting, especially from the technical manager's point of view, and remarked that the cost was too great at present. Mixed gas has three times the illuminating power of oil gas, and can easily, by mixing it with 50 instead of 25 per cent acetylene, have ten times the power. Besides it would not be economical to throw aside the millions invested in excellent mixed gas machines and for 30,000,000 to 40,000,000 more introduce other methods of uncertain value. Herr Von Hefner-Alteneck was of the opinion that German electrical engineering stood on so high a plane that when called upon the engineers surely could produce a good system of lighting. He only regretted that the discussion as to the value of electric lighting on the railways had been connected with the Offenbach disaster, as during thirty years of gas lighting no severe accidents have been reported. But he was confident that if German electrical engineers should have the question presented to them by some large railway management the problem would surely be solved.

The Development of American Railway Bloc Signaling.

Mr. B. B. Adams, one of the editors of the *Railroad Gazette*, has just concluded in that journal a series of articles on railroad signaling apparatus, and gives some statistics and estimates which are of general interest. He says: "If we deduct the 8,423 miles of four roads we have in the United States 17,480 miles of line; 15,161 miles worked by manual block signals, and 2,319 miles worked by automatic block signals. With the 8,423 miles included, we have just about ten times as much manual as automatic. On the basis of miles of track, however, the proportion would be different, as of the mileage with automatic signals five-sixths is double track or four track, while of the lines with manual signals three-fourths is single track. Of the road worked by manual signals about 1,000 miles has the 'controlled manual,' more than a third of this being four-track line."

Referring to the cost of block-signal installations, Mr. Adams says: "The Philadelphia & Reading has spent for enclosed disk signals from $1,500 to $4,000 per mile of road. Cost per mile varies according to length of the block sections and frequency of switches. The larger sum refers to lines with more than two tracks with a distant signal for each home signal, the distant being on the same post with the home signal of the next block section in the rear. Cost of disk signals has been reported in various cases as about $400 per signal. Cost of maintenance of disk signals has been reported at from $67 to $100 per signal per year. For semaphores worked by electric motors, actuated by batteries, a complete equipment for a double-track line, with distant signals, costs from $1,200 to $1,800 per mile.

"Cost of electro-pneumatic signals on a four-track railroad, with block sections averaging three-fourths of a mile long, in a certain case, $5,000 a mile, which, of course, included distant signals. The cost of maintenance of signals of this kind for one year, including oil and attendants for the lamps, material and attendants for batteries, air compressing and repairs to compressing plant, is given for one four-track railroad as $33.93 per signal arm. Cost per mile of road, with blocks of the length just mentioned would, therefore, be $362 a year."

CURRENT NEWS AND NOTES.

MR. HENRY VILLARD has left $50,000 unrestricted to Columbia University, New York City, by his will, just probated; and an equal amount to Harvard.

CHICAGO ELECTRICAL ASSOCIATION.—The officers of the association for 1901 are: R. F. Schuhardt, president; Harold Almert, vice-president; H. G. Dimick, treasurer; W. B. Hale, librarian; G. M. Mayer, auditor; directors: L. G. Bassett, J. R. Cravath and H. P. Clausen. Mr. W. J. Warder, Jr., 242 South Jefferson Street, has been elected secretary.

AN EXHIBITION OF FIRE APPLIANCES.—An international exhibition of appliances for protection and rescue from fire will be held in Berlin, Germany, in June and July, 1901. Mr. Von Podbielski, Postmaster-General of the German Empire, invites a large display of appliances from the United States. Copies of the programme of the exhibition may be obtained by addressing the German embassy, Washington.

NEW YORK ELECTRICAL SOCIETY.—The 211th meeting of the society, through the courtesy of the New York Gas & Electric Light, Heat & Power Company, will be held at the Edison Station, corner of Elm and Duane Streets, on Wednesday, Jan. 16, at 8 p m. Dr. Louis Bell will deliver a lecture on "Electric Illumination at the Beginning of the Twentieth Century." Unusual preparations have been made for this lecture. Ladies will be welcome.

ELECTRIC LIGHT IN YOSEMITE PARK.—The Yosemite Commissioners in their annual report to the Governor of California, asked for an increase of $35,000 in the appropriation for keeping up the park. It is proposed to expend $25,000 for an electric lighting and road-sprinkling system. The electric system will be used to light the hotel and some of the roads. It is also proposed to illuminate Yosemite Falls, 2,600 ft. in height, by the use of 20 arc lights in connection with devices for producing color effects.

A MODERN HOTEL.—Rudolph M. Haan has leased from John Jacob Astor the five lots on the southeast corner of Fifty-fifth Street and Fifth Avenue, New York City, together with a sixteen-story basement and sub-basement fireproof apartment hotel which will be erected there. The lease is for twenty years, with the option of three renewals. It is proposed to introduce a system of electric service elevators, and movable pantries, fitted with electric heating tables. These will be run through every apartment, thereby insuring rapid service and hot food to guests taking their meals in their rooms.

ELECTRICITY AT OXFORD.—Prof. T. S. Townsend, of Trinity College, Dublin and Cambridge University, has been appointed to the newly-established Wykeham professorship at Oxford. Commenting on this appointment, *Science* says that while the abilities of Mr. Townsend are fully recognized, and it is expected that he will place the teaching of electricity on a satisfactory footing at Oxford, yet some dissatisfaction is expressed that an Oxford man should not have been elected. In the present case, however, the complainants can scarcely point to an Oxford electrician suitable for the post.

ELECTRIC RAILWAY MOTOR.—A patent granted Jan. 1 to Edw. J. Priest describes several improvements in the direct-current electric railway motor. With the object to increase the effective length of the armature without increasing the external dimensions of the motor, the shaft is made stationary and fixed in two lugs formed integral with the lower half of the motor case. A sleeve on the shaft carries the armature, there being a bearing in the form of a bushing at each end of the sleeve. Both bearings are thus entirely enclosed by the magnet frame, which enables the length of the armature to be increased by the space that otherwise would be required for an external bearing.

A TROLLEY CAR ORIGINAL.—It is stated from New Haven, Conn., that Benson Bidwell, of Hartford, will bring suit in the near future in many of the United States District Courts of the country against over a hundred electric road corporations for infringements of patents. Mr. Bidwell, some fifteen years ago, evolved a system of applying electricity to trolley car propulsion identical, he asserts, with the systems now used by trolley roads all over the country. For this invention, which he says was patented, he never received any remuneration, though trolley companies throughout the world are using it. He asks damages and royalties for the fifteen years, the whole sum amounting to hundreds of millions of dollars. His suits will also be brought abroad, where his system is used. Meantime the threatened parties are inert and somnolent.

WIRELESS TELEGRAPH APPARATUS.—A patent granted Jan. 1 to Warren S. Johnson and Charles L. Fortier relates to improvements in the construction of wireless telegraphic apparatus, which improvements are claimed to increase the efficiency and render more positive and reliable the operation of such apparatus. The main feature described consists in the use of an air-blast for decohering. To prevent corrosion or injury to the metallic pipe of the coherer, the compressed air, or other gas by which decoherence is effected, passes through a receptacle containing calcic chloride or other material for depriving the air, or other gas, of moisture. In order to protect the receiving coherer from the influence of neighboring sending apparatus, with each depression of the signal key air is admitted to the coherer and the filings are thus agitated and held in a non-conductive condition at the moment when powerful wave impulses are produced by the transmitting instrument. When the sending key is released, electrical connection is established between the aerial conductor and the coherer, thus at each operation momentarily putting the apparatus in condition for the receipt of messages or signals from a distant station.

INDEPENDENT TELEPHONE SERVICE.—General Manager James M. Thomas, of the United States Telephone Company of Cleveland, and president of the Independent Telephone Association of the United States, referring to the possibilities of the formation of a combination of independent telephone companies of the country, stated that so far as he could learn the recent story of a $50,000,000 combination had little foundation. Several of the eastern organizations, which are merely large corporations on paper, have been advocating a combination, he said, but the companies having properties in actual operation are well satisfied and can see nothing to gain in a combination. He stated that the western companies constantly are making alliances for long distance traffic, but the arrangements are not combinations in any sense of the word. For instance, the United States Telephone Company has lately made a traffic arrangement with the Pittsburg & Allegheny Telephone Company of Pittsburg, whereby the companies reached by United States lines will have access to all points in Western Pennsylvania and in the near future will have direct connection to Baltimore and points in Maryland. A similar arrangement has been made with the Interstate Telephone & Telegraph Company, of Philadelphia, whereby points in Western Pennsylvania will be reached. This company will also give direct connection with Jersey City.

THUNDERSTORMS IN HUNGARY.—July is a month of thunderstorms in Hungary. Last July 33 persons and 286 sheep were killed by lightning. No explanation is offered.

"DUPLEX TELEPHONY."—The Chicago Telephone Company a few days ago sent out a circular urging its customers to have their telephone business double-tracked—one instrument for outgoing business and one for incoming. Some smart local reporter who got hold of it thought it was a plan for "duplex" telephony and so heralded it to a startled public. General Manager Hibbard has been kept busy explaining the thing to his telephonic friends in different parts of the country.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.—Following is a partial list of the papers which will be read at the Milwaukee convention of the Northwestern Electrical Association on Jan. 16: "The Rate Question," by Henry L. Doherty; "Synchronous Converters," by Prof. Goldsborough; "The Series Incandescent Lighting System of the Future," by P. D. Waggoner; "Practical Line Construction," by Loren W. Burch; "Education of Central Station Employees," by Prof. D. C. Jackson. Others will be read and discussed. The annual banquet will be held on Thursday night, Jan. 17.

NEW CABLES IN PHILIPPINES.—According to cable dispatches from the Philippines, the United States cable ship Burnside is now proceeding to Damuguete, Island of Negros, to begin the laying of 600 miles of Government cable to connect Negros, Mindanao, and Jolo. Negros and Cebu already have cable connection with Iloilo and Manila. The new line will extend from Damuguete to Oromaueta, Misamis, Iligata and Tagaloan, all on the north coast of Mindanao. A land line will connect Misamis and Tigum and the main portion of the cable will extend from Tigum to Zamboanga and thence to Jolo. At present there is scarcely any telegraphic communication with Southeastern Luzon, owing to the persistent wire cutting. It is proposed eventually to connect that section and the larger islands adjacent by cable with Manila. A detailed map of all this projected work appeared not long since in these pages.

ELECTRICITY AS FOOD.—According to the *Saturday Evening Post,* Dr. W. J. Herdman, of the University of Michigan, has made the discovery that the "galvanic current" promotes the growth of tissue, and has expressed the belief that pigs may be fattened by a diet of electric current. Commenting upon this, our contemporary says: "Nobody can say what may be the final influence of this new discovery upon the packing trade, or whether the "electric bacon" of the future may not command a special price in the market. The imagination extends the application of Dr. Herdman's discovery to almost any lengths. Why may not the day come when every cow in her stall shall have her private wire? And if electricity is good for pigs, it may serve to fatten babies, or even grown persons who are desirous of increasing their avoirdupois, and thus most interesting possibilities for the improvement of the human physique are opened up.'

AUTOMOBILE FOR POSTAL USE.—Although the Post Office Department took pains in its latest advertisement for proposals for carrying the mails through cities, between post offices and railway stations, to incorporate a special invitation to automobile and locomobile companies to compete, not a bid of this sort has come in. The default is explained by the experts on the ground that a large wagon loaded with full mail pouches is a very heavy vehicle, and that the mechanical motor needed to impel one must be proportionately heavy, combining to make a tremendous weight with rather indifferent apparatus to control the momentum it is liable to acquire. "An electric storage battery of the size necessary to move such a mass is said to cost $500, and to have so short a life that it would probably have to be changed three times a year, if not oftener, even in a city where the distance traveled daily is as small as in Washington. This would mean an expenditure with each change of enough money to buy a good pair of draught horses, and no contractor could afford, at the prevailing rates of compensation, to change two horses so often as that. Horses have to be fed and stabled, it is true, and they do sometimes fall ill and require medicine and surgery. But the recharging of batteries, the incidental repairs, and the liability to costly accidents are all to be included in estimating the possible expenses of a motor service."

THE ELECTRIC LIGHT IN SPONGE FISHING.—There are to-day some 310 vessels, with more than 2000 men, employed in this one industry about the coast of Florida. As it takes at least a year for a sponge to grow to a moderate size, and the grounds are fished over several times every twelve months, the large sponges have all been removed from the available portions of the ocean's bed and the large fleet of fishing vessels keep the product limited to sponges of small value. The United States Commission of Fish and Fisheries has recently taken steps toward the regulation of this wholesale destruction of the young sponges on those submarine plateaus which are now accessible. The operation of collecting the sponges is very simple, the fisher spearing with a long pole all those which he can see by the aid of a water glass. The depth of water, therefore, in which they can be obtained is only limited by the distance penetrated by the light. If this distance could be increased, large areas would immediately be opened up where sponges have been growing unmolested for years, and the production would be not only greatly increased in quantity but the quality would probably be as fine as that from any part of the world. Experiments are soon to be made upon a new submarine electric arc lamp to ascertain by practical demonstration the feasibility of reaching these lower strata by its means, and if successful its application to this important industry will undoubtedly follow.

MUNICIPALITIES' LIABILITY.—The Judiciary Committee of the House fixed Jan. 11 for hearing at Washington the representatives of municipalities relative to the bill proposing to give the Federal courts means of enforcing their judgments against municipalities. An important departure from existing law is involved in the proposition, and one affecting all cities and towns which borrow money on bonds or otherwise. The serious increase in municipal obligation is being recognized as a national peril. At present there is no means of enforcing judgments from the Federal courts on these obligations, and many peculiar conditions have arisen through efforts to enforce them. The United States Supreme Court has ruled that mandamus against the local tax officers to compel them to put the obligation on the tax rolls is the only remedy. But in several cases the local officials have avoided the mandamus by resigning. Several exciting incidents have occurred in some of the cases, the local officials taking to the woods to avoid service. The judgment of creditors, representing directly and indirectly many millions of dollars of claims against municipalities have been heard by the Judiciary Committee, and it is now the committee's desire to hear from the municipal debtor class. The plan under consideration is to authorize the United States District Court at the place where a municipality is in default and the local officials fail to act, to appoint a special tax officer to assess the tax. Representative Jenkins, of Wisconsin, chairman of the sub-committee having the matter in charge, says it is the first instance in which the power of the Federal courts is sought to be extended to municipalities. Aside from the many millions involved, Mr. Jenkins says the matter is specially important not only to municipalities in default, but to those desirous of protecting their credit and securing low interest rates.

NEW CENTURY RAILWAY TENDENCIES.—Mr. James J. Hill, president of one of the large American railroad systems, says with regard to future railway tendencies, in the *World's Work* for January: "The forces likely to determine in future the construction of new lines of railway in the United States are the need for better terminal facilities, and the special requirements of particular sections. That the building of great trunk lines has come to an end is shown, I think, by the fact that during the past dozen years there has been a steady decline in railway construction in all parts of the United States. A railway that will not yield a prospective profit to its projectors has no legitimate reason for existence, and, as the existing lines between the West and the East are prepared to transport twice or thrice the tonnage now offering, or likely to offer for many years to come, to attempt to parallel them with new ones would be a financial blunder little better than a crime. The competition of older rivals and the consequent division of business would render the stocks and bonds of the newcomers practically worthless, and investors have learned caution from the disasters of the past. Lines now in operation are pretty sure to seek and secure improved outlets, and there is bound to be a small but steady increase in mileage having for its object the development of some particular interest or section; but more than that should not be looked for in the near future. Indeed, in most of the States of the East and Middle West, the existing mileage supplies all the facilities wanted. In such States no considerable amount of new mileage can be built with the assurance of profit, and this fact will exert a salutary influence in checking doubtful ventures and compelling obedience to the very excellent rule that where a line is capable of handling the transportation of its section, the construction of a second should not be undertaken. Capital seeking investment will be mainly directed in future to the development of urban and interurban electric railroads, a department of transportation which is still in its infancy."

LETTERS TO THE EDITORS.

Determining Rail Joint Resistance.

To the Editors of Electrical World and Engineer:

Sirs: I notice that in an editorial on page 3 of your last issue you refer to a useful apparatus "recently described in a foreign contemporary" for determining the resistance of rail joints in terms of the rail length. You are certainly correct as to the value of this device, but you need not have gone abroad to have learned of its use, as this method was described by me in full in the *Street Railway Journal* for May 5, 1900. The device described in the *Journal* contained an improvement over that mentioned by you in that resistance coils external to the instrument are used to make a differential measurement. In this way an instrument of high sensibility can be used, and the rail contact resistance becomes negligible. By a slight change in the instrument described in the *Journal* it can also be used to determine the current flow in the rail.

NEW YORK CITY. ALBERT B. HERRICK.

Compound Dynamos as Motors.

To the Editors of Electrical World and Engineer:

Sirs:—I am very much interested in Mr. J. T. Freeman's letter, published in your issue of Dec. 22, 1900, regarding "Compound Dynamo as a Motor," to which I will endeavor to answer, as follows:

His machines undoubtedly operate satisfactorily while running as generators, at which time the compound windings of both machines are in multiple with each other. When he releases the friction clutch on the engine, thereby causing the generator to stop generating and run as a motor, driving the arc machine, the current consumed by the motor does not feed through the compound winding of the generator, but feeds the over equalizing bus, and the generator is operating as a shunt machine for the amount of current consumed by the motor. As the compound windings are still in multiple, he gets but one-half of the compounding effect on the generator, as its compound winding is shunted by the compound of the motor.

If there is no load on the generator except the motor, he gets no effect of the compound whatever. Consequently the drop in voltage.

DETROIT, MICH. JAS. W. BISHOP.

Incandescent Lamp Development.

To the Editors of Electrical World and Engineer:

Sirs:—In common doubtless with others I have read with much interest the narrative of Mr. Edwin W. Hammer concerning "Incandescent Lamp Development to the Year 1880," which recently appeared in your columns.

He begins, rightly, as I believe, by giving some consideration to the early incandescent lamp work of J. W. Starr, best known by the British Starr-King patent of the year 1845, but seems to have little more information about Starr than can be gleaned or inferred from that patent.

There is, however, further information at hand, and while some of it may be legendary, there can be no doubt that in a general way Starr's story is told with substantial correctness by articles or communications appearing severally in *Nature*, Sept. 7, 1877, pp. 459-460; the *Telegraphic Journal*, London, Jan. 1, 1879, p. 15, and the *Scientific American*, Jan. 18, 1879, pp. 40-41.

The *Nature* reference is a communication from Mr. Mathieu Williams, who says that he assisted Starr in his experiments on the light; that the results of the said experiments with batteries were such as to convince Mr. Starr that a magneto-electric arrangement should be used as the source of power in electric illumination, and further that Starr died suddenly in Birmingham in 1846, while constructing a magneto machine.

The *Telegraphic Journal* and *Scientific American* articles are more full in their details, especially the latter, and refer to a caveat filed by Starr for his light in the United States, reciting the claim thereof; speaking also of capitalists, including George Peabody, who were ready to assist him; of a kind of electric candelabrum whereon electric lamps were to be mounted of number corresponding to the States of the American Union, as they were at that time, saying that the system was exhibited to Faraday, who pronounced it a perfect success, and that Starr died suddenly during the night following the exhibition, the supposed cause of his death being "excitement and overwork of the brain." THOMAS D. LOCKWOOD.

BOSTON, MASS.

On the Standardizing of Steam Driven Generating Units.

To the Editors of Electrical World and Engineer:

Sirs:—The work now being done by the American Society of Mechanical Engineers and the Engine Builders' Association in the direction of promoting a more thorough co-operation between engine and dynamo builders in standardizing direct connected units should result in practical benefits to both makers and purchasers of such machinery. The subject resolves itself, or may be resolved, into three distinct branches, as follows:

1. Selection of standard units on the basis of capacity and speed.
2. Establishment of rules and standards as to overload capacity, regulation of speed and efficiency.
3. Standardizing such details of construction as affect mutually the two elements of the unit.

In regard to the first question above, it can be said that there is already a fairly well standardized line of direct current units in general use. Of course, in exceptional cases, as, for instance, where a Corliss engine is used for a small capacity unit or a relatively very high speed engine like the Willans is used, these standards cannot apply. Above 50 kilowatts the various makers of direct current dynamos agree very well as to sizes, but in the smaller units we have in common use 20, 25, 30, 40 and 50-kw units and specifications calling for 35 and 45 kilowatts are not uncommon.

I think three sizes should be sufficient to cover this range, and would suggest 20, 30 and 50 kilowatts as the most desirable. In the case of alternating current dynamos it would seem desirable to establish, if possible, two standard frequencies before deciding on sizes of units. This question of sizes is, of course, purely a commercial one, and to secure satisfactory results it will be necessary to get the various manufacturers and consulting engineers to agree upon the standards to be adopted.

The second branch of the subject deals with engineering questions entirely, and the various points should be settled on the basis of the best that can be accomplished without requiring expensive additions, having little or no practical value, to existing machinery, or adjustments too delicate for practical service. In regard to overload specifications, the aim should be to secure a margin of safety sufficient to take care of reasonable momentary overloads without injury to the machinery or interruption of service. Consulting engineers are largely to blame for the extravagant overload requirements so frequently called for, and which often seem to indicate a lack of faith in the builders' ratings. I can find no sound argument for great overload requirements. It is rather like trying to get something out of nothing. A machine that will carry 25 per cent overload continuously is simply underrated; and as for the argument that efficiency should be maximum at average load, it must be remembered that the difference in the efficiency at one-half load and at full load of a dynamo does not exceed 3 per cent; consequently there is very little possible gain in efficiency in providing machines the rating of which approximates the average load. This reasoning, of course, does not apply with equal force to the engine end.

In special cases where heavy loads are more than momentary and the average load is relatively small, it would probably produce more satisfactory results if the conditions were stated in the specifications and the manufacturers permitted to work out the proposition on the basis of meeting the conditions to the best advantage.

The above remarks apply to overload requirements exceeding, say, 50 per cent momentary and 25 per cent for one hour, which I would suggest as a standard. The standard for regulation can be readily determined for direct current dynamos by taking the best practice of to-day. With alternating current generators something more is required, and improved methods may be looked for. The question of efficiency is a serious one, and it is most desirable that some standard be generally adopted.

The separation, with accuracy, of engine and dynamo losses is well nigh impossible. A common method of making efficiency tests of direct connected units is to consider the engine losses the same at all loads. Obviously this method is inaccurate, and as these engine losses are determined from the card taken at no load, the result will throw the additional losses in the engine, when loaded, on the dynamo, making the latter appear lower in efficiency than it really is. It must also be remembered that the dynamo builder of to-day is required to guarantee the highest efficiencies attainable, which efficiencies are determined by extremely accurate electrical methods, while the value of his guarantee depends on the relatively inaccurate results of indicator tests. Whatever standard may be decided upon, it would seem that only an empirical rule can be established, as, for example, the allowance of a fixed percentage to cover the difference between no load and loaded engine losses for each size of unit.

The details of construction, which I have made the third branch of the subject, might perhaps be more properly put first as being of more immediate importance and more easily settled. It would seem only necessary for the engine and dynamo builders to get together to arrange these details in a satisfactory manner. The dimensions of shafts should first be determined by the engine builders, who should obtain the weights of armatures and the magnetic pull due to, say, a displacement of 1-16 in. from centre of field. The diameter of such shafts is chiefly if not entirely determined by the above factors plus weight of fly-wheel and distance between bearings. There should be no difficulty in coming to an agreement on shaft diameters. Standard allowances for forcing fits should also be made, and the decision of this, I think, belongs to the dynamo makers. Regarding mounting armatures on shafts, I advocate doing this in the case of side crank and coupled shafts, at the dynamo works, wherever possible or economical. In the case of centre crank shafts, this work should be done at the place of erection. In the case of double cranks (cross compounds) send the armatures to the engine works and let it be prearranged that the dynamo builder have his man on hand to look out for the handling of the armature. The reason for this suggestion is that few dynamo works are equipped to force on the crank properly after putting the armature in place. With machines under 200 kilowatts it is an easy matter to put in shafts at the place of erection if a suitable tap hole is provided in the shaft, but it is cheaper in most cases to do it at the dynamo works.

In regard to bases, I think that in the smaller units having extended sub-bases, comparatively few patterns would be required if these are made with slides allowing them to be widened and lengthened, and vice versa, to accommodate the differences in dimensions between different makes of the same capacity. It should also be possible by means of loose pieces to adapt the same patterns to vertical or horizontal split dynamos. Possibly some engine builders do not realize that the days of "freak" dynamo design have passed, and the ring with two feet is now universal. One thing, above all, must never be lost sight of in designing bases and foundations for dynamos and outboard pedestals, and that is that on the front of every dynamo, be it of any make, size or kind, there are more or less rocker rings, cables, terminals, brushes, collector rings, etc., and that it is sometimes necessary to get at these things, and therefore the base should be designed to give ample space in front of the magnet frame. It is to be hoped that these matters will receive the careful attention of those interested and that we will, in the near future, have generally accepted standard rules of practice covering each of them.

BROOKLYN, N. Y. F. V. HENSHAW.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Large Alternators.—HEYLAND.—The conclusion of his "Notes on the design of large alternators" (Digest, Jan. 5). In summing up he says that the principle of designing alternators with abnormally high flux densities in the field system possesses two great advantages; it greatly reduces the pressure drop and it enables the rating of a standard carcass to be increased. He thinks that as soon as the advantages of this method of construction become more widely known, the principles will be generally adopted on account of the important bearing they have on the commercial aspect of alternator design.—Lond. *Elec. Rev.*, Dec. 21.

Test of Steam Alternator.—APPLEBEE.—An account of the results of a test of the steam consumption of a 300-kw steam alternator. The mean output of the alternator was 315 kilowatts. The mean horsepower shown by the indicator cards was 499. The combined efficiency of engine and alternator was 84.6 per cent.—Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Dec. 21; *Lightning*, Dec. 20.

REFERENCES.

Theory of Synchronous Motors and Alternators.—SEEFEHLNER.—An illustrated article in which he corrects some minor points in his paper noticed in the Digest Oct. 20 and Dec. 8.—*Zeit. fuer Elek.*, Dec. 16.

Converters.—PERKINS.—The conclusion of his illustrated serial, in which he deals with the use of alternating direct current motor generators and synchronous converters for railways.—*West. Elec.*, Dec. 29.

LIGHTS AND LIGHTING.

Nernst Lamp.—NERNST and WILD.—An account of photometric measurements with electrolytic incandescent bodies, consisting of the oxides of zirconium, thorium, yttrium, etc. The incandescent bodies were all in the form of thin, straight rods. They took the photometric measurements in a direction perpendicular to the axis of the incandescent body, and "to get the average spherical intensity, the numbers are to be multiplied with a constant factor $\frac{\pi}{4}$ " (= 0.785). The incandescent bodies are first heated with a flame; they become conducting at 500 to 700 degs. C. For one incandescent body the conductivity at 600, 800, 1000 and 1100 degs. was 0.0003, 0.0064, 0.036 and 0.099, respectively (in cubic centimeters divided by ohms). He gives the results of tests of four incandescent bodies of different sizes with varying currents. For one rod 17 mm in length and 0.32 mm thickness, the watts per candle were 1.72, 1.05, 0.76, respectively, for 0.15, 0.25, 0.35 amperes. For another rod 30 mm in length and 1.87 mm thickness, the watts per candle were 2.04, 1.02, 0.70, respectively, for 1.2, 2.4 and 3.2 amperes. He gives the results of life tests, from which it appears that "with an average load of 1.35 watts (= 1.73 spherical)" (1.73 is obtained from 1.35 by dividing by 0.785), the life of the thinnest rods is about 180 hours, and that of the thicker about 360 hours or more; at the end of this period the rod is not destroyed, but continues to give light, but with less economy. Nernst lamps consume about half the energy per candle that ordinary incandescent lamps do, but about 20 per cent more than large arc lamps. For comparison with the arc lamp it is to be remembered that Nernst lamps can be made for higher voltages, for instance, for 220 volts; that the Nernst lamp is entirely free from the flickering in the arc lamp; that the electrolytic incandescent bodies have a much longer life than the carbons of the arc, and that if, for instance, instead of one 400-watt arc lamp, two 200-volt Nernst lamps are used, a better distribution of the light is obtained; the pure white color of the light of the Nernst lamp is also to be taken into account.—*Zeit. fuer Elektrochemie*, Dec. 20.

Direct Current Arc.—DUDDELL.—The conclusion of his long, illustrated Brit. Inst. Elec. Eng. paper on "Rapid variations in the current through the direct arc," the first part of which was abstracted in the Digest Jan. 5. Under certain conditions the direct current arc will emit a musical note when shunted by a self-induction in series with a condenser. "When emitting the musical note the direct current arc transforms direct current energy into alternate current energy, the frequency of the latter being determined by the self-induction, capacity and effective resistance of the oscillating circuit." The pitch of the note emitted may be used as a means of comparing self-induction and capacities. If a direct current arc be shunted with a condenser of several microfarads capacity, the arc will generally be extinguished if the electrodes are of metal, and not if they are of cored carbon, the resistance in series with the arc being non-inductive. If the resistance in series with the arc be highly inductive, then when the metal arc is extinguished by shunting it with a condenser, a violent rise in p. d. occurs between the terminals of the arc. The rise in p. d. that occurs when an inductive circuit is broken by means of a switch, the contacts of which are shunted by a condenser, is much higher if their contacts are of metal than if they are of cored carbon, owing to the condenser extinguishing the metal arc formed at the contacts more suddenly than the arc formed when carbon contacts are separated. There are two appendices, one on the resistance of the cores of cored carbons, the second on the conditions which govern the conversion of direct current into alternating current in the musical arc.—Lond. *Elec.*, Dec. 21. The first part of the paper also in Lond. *Elec. Rev.*, *Elec. Eng.*, Dec. 21.

POWER.

Electric Plow.—A brief article on the Borsig electric plow, which is used on German sugar estates. The cost of a complete plant, including engine, electric generating station, line construction, transformers, five electric plows and sundries, is $44,250. The plow works by means of two wire cables which run in a parallel direction over the field, about 3 ft. from each other.—*West. Elec.*, Dec. 29.

REFERENCES.

French Water Power Plant.—BORDEAUX.—An illustrated description of the water power plant of Chevenoz, in Savoy, for supplying current to the cities of Thonon and Evian for lighting. There are three 300-hp alternators, generating three-phase currents at 3300 volts.—*L'Ind. Elec.*, Dec. 10.

French Transmission Plant.—PERKINS.—An illustrated description of the monophase and three-phase plant at Chapareillan-Chamberk. The transmission line has a length of about 7 miles and a voltage of 15,000 is used.—*El'ty*, Jan. 2, 7.

Naval Gun Circuits.—An illustrated article in which attention is called to the advantages of the use of electricity for firing guns in the navy. The arrangements of the circuit for quick-firing guns are described.—Lond. *Elec. Rev.*, Dec. 21.

TRACTION.

Long-Distance Heavy Electric Railways.—R. KENNEDY.—A brief article in which it is said that probably the best system is an alternating current primary supply at 20,000 volts or more, feeding stationary transformers of a ratio of 10 to 1 along the line; a secondary overhead trolley wire at 2000 volts, feeding a locomotive carrying two rotary converters converting the 2000 volts alternating to 400 or 500 volts direct current, this 500 volts direct current to work motors on each locomotive axle by ordinary controllers. Or even 100-volt direct current might be used, and 50 large storage cells carried on each locomotive, capable of moving without the trolley; these cells could be charged from the converter. The converter should be a very high speed synchronous motor connected to a direct current generator. Such a system requires attendance only at the generating and at the consuming end, while "the losses would be a minimum in transmission." A single-phase system seems to be the simplest for the purpose. The battery would save all complications at crossings, junctions, round houses, and so on. The field of the generators and motors on the locomotive would be better excited from the battery; then, by keeping the motor fields constant, and by varying the generator fields by rheostat, perfect regulation can be most economically obtained without any trouble.—Lond. *Elec. Rev.*, Dec. 21.

REFERENCES.

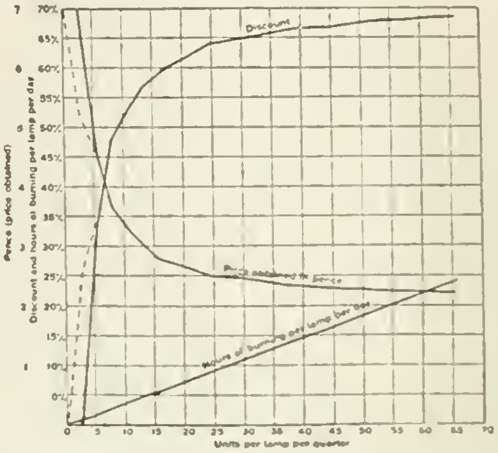
Tramway Equipments.—An illustrated description of tramway motors and controllers of the Brush Elec. Eng'ing Co.—Lond. *Elec. Rev.*, Dec. 21.

Railroad Switches.—SCHNATTER.—An illustrated description in which a rail switch is arrested by the switchman at the point where it is located, but it is released electrically from a distant central station, after the train has passed that point; this is done by an electromagnetic device. The operator in the central station can tell whether the position of the switch is right.—*Zeit. fuer Elek.*, Dec. 9.

Canal Traction.—GERARD.—A well-illustrated article on electric haulage on the Charleroi Canal in Belgium, which was noticed before in the Digest.—*Cassier's Mag.*, Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electrical Energy.—A. W. D.—A method of charging based on a price of 14 cents a unit as a maximum, with rebates for long hour consumers. The total number of lamps of 8 candle-power and 30 watts which a consumer has installed is first ascertained; the consumption of the meter is read off; the reading is divided by the number of lamps and the discount is obtained from the accompanying curve. This method charges a consumer having many lights installed and a low maximum demand, at a higher rate than one with few lights and high maximum demand; to overcome this a supplementary curve is shown dotted, which he thinks fits the case and the increased maximum demand caused by charging on a basis of all the lights installed, is balanced by the rebates as shown dotted. By Wright's method a large consumption for a single night or even a single hour compels the consumer to pay full rates for the whole of the quarter, while by the pesent system this is not the case. At the same time the latter induces consumers to place lamps only where they will be really used and not to have a lot of lamps seldom used. The curve can be made to suit any price per unit desired. The system does away with the demand indicator, makes the system of charging simpler and capable of being easily understood by the average consumer, and relieving him of the bugbear of a demand indicator.—Lond. *Elec. Rev.*, Dec. 14.



CHARGING FOR ELECTRICAL ENERGY.

Development of the Density Factor.—TURNBULL.—A paper read before the Newcastle section of the Brit. Inst. of Elec. Eng. The density factor of a plant may be defined as the number of 8 candle-power connected per $5 worth of mains laid, or, perhaps better, as the number of units sold per year per $5 worth of mains laid; mains in this case should include transformers and similar apparatus. He gives the density factors of six British towns; for the first definition based upon the number of lamps, they varied between 0.64 and 1.21, for the second definition based upon the number of units sold, they vary between 6.5 and 25.4. The cost of transformers is not taken into account in these figures. In a system of rented wiring, he suggests the following points: To charge a fixed quarterly rental for a plain fitting, including lamp and switch complete; to charge at a second and lower rate additional fittings on the same switch; to charge at a third and still lower rate additional lamps on a fitting not having independent switches; the hirer should have the option of "hire-purchasing" the installation at rates based on the rentals, or he should be allowed to purchase them outright at any time for a reasonable sum. Regarding the maximum demand system of charging, he says it has always been the trouble that consumers fear that their accounts will go up suddenly if they happen to put on extra lamps some night; he suggests allowing consumers to have two meters, one for long-hour lights, and the other for the remainder. The units registered by each meter are charged as if for separate consumers, so that practically the full rebate is obtained on the long-hour lights and no rebate on those occasionally used.—Lond. *Elec.*, *Elec. Eng.*, Dec. 21. In an editorial on this paper it is said that what is required is not an increase or decrease in the factor of consumer density, in whatever way this be defined, but a network so designed that while the initial capital expenditure is kept as low as possible, the cost of extensions and amplifications shall not be unduly great. Furthermore, it is not additional consumers that are needed per yard of main or additional lamps, but additional long-burning lamps—in fact, a better load factor.—Lond. *Elec.*, Dec. 21.

Electricity in a Locomotive Shed.—An illustrated description of the electric equipment of the Southeastern & Chatham R'y Co.'s locomotive sheds at Slade's Green. Electric current is used for power purposes and arc lighting, and for a number of 230-volt incandescent lamps. The two 100-kw steam-driven dynamos are connected across the outers of the 460-volt three-wire system, the middle wire being connected between the two sides of a battery, consisting of two sets of Tudor cells with a capacity of 324 ampere-hours at a three-hour discharge rate, and with an emergency output of 200 amperes for half an hour.—Lond. *Elec.*, Dec. 21.

REFERENCES.

Combined Heating and Lighting.—An illustrated description of the Evanston central station, using the Yaryan hot-water system for the supply of heat to a territory of six or eight square miles of area, with a supply of electricity for lighting as a by-product. A three-wire 220-volt system with compensator, and 110-volt lamps is used, the capacity of the electric plant being 225 kilowatts.—*West. Elec.*, Dec. 29.

Power Station Design.—Dawson.—An article on modern electric power stations and some conditions governing their design. The differences between the requirements of a lighting plant and a traction plant are shown and some statistical data are given regarding British plants.—*Cassier's Mag.*, Jan.

Small British Lighting Plant.—An illustrated description of the water power plant of Fladbury, a small village in Worcestershire. There is a turbine driven 10-kw compound dynamo, supplying a two-wire circuit, the pressure being 220 volts.—Lond. *Elec. Rev.*, Dec. 21.

Calculating Storage Batteries for Installations.—Suchy.—An article, illustrated by diagrams, in which he develops formulas for calculating the size of a storage battery, which is required, if the load curve for discharge is given.—*Zeit. fuer Elek.*, Dec. 16.

Wires, Wiring and Conduits.

Electric Fire Risks.—Wynkoop.—He shows the advantages of systematized electrical inspection and advocates the passage of suitable laws providing for the licensing of electrical workers. He shows how fire risks arise from poor joints or the use of too small a size of wire, and that a fuse is no protection against the heat developed at bad joints or at points of local leakage.—*Cassier's Mag.*, Jan.

REFERENCES.

Regulations.—An abstract of the projected law for Switzerland concerning regulations for electric installations.—*Revue de l'Elec.*, Dec. 15.

Concentric Cables.—O'Gorman.—A communication referring to a suggestion of Duddell on a danger with concentric cables and metal break, quick break switches, and its reasons.—Lond. *Elec.*, Dec. 21.

Electro-Physics and Magnetism.

Self-Inductance and Electric Inertia.—Schuster.—Abstracts of two Brit. Phys. Soc'y papers. The first deals with "Electric inertia and the inertia of electric convection." Calculations of self-induction are based on the assumption that the currents which traverse a conductor fill it continuously, the flow being treated as that of an incompressible liquid. If, however, the current consists of positive and negative electrons moving with different velocities, the magnetic field in the neighborhood of an ion is many times greater than that calculated on the supposition of continuous distribution, and hence the total magnetic energy is underestimated. He calculates the additional terms which become necessary for the evaluation of self-induction, and discusses the possible cases in which the corrections may affect experimental results. It is necessary to add a correcting term containing a quantity which may conveniently be called electric inertia. In the second paper he applies this to the theory of terrestrial magnetism. If the earth's magnetism is due to electric currents, he investigates whether the effects of inertia can explain the secular variation of the magnetic elements. He finds that a magnetic precession of the character of the secular variation would be produced, but that the precession would be very much slower than the variations actually observed.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Dec. 21.

Refractive Index and Dielectric Constant.—Fleming.—A communication on Maxwell's law that the square of the optical index of refraction of an insulator should be numerically equal to the dielectric constant. Starting with Larmor's conception of the electron as a strain-centre in the ether, he proceeds to show deductively how it can be that certain dielectrics behave at all temperatures according to Maxwell's law, while certain anomalous dielectrics are brought into agreement with that law only when, by means of a low temperature or by high frequency alternations of electric stress, their molecular and electronic conditions are made conformable to that law. In an editorial note Flemings' deduction is called "An excellent piece of reasoning. We have nowhere seen the electronic theory more lucidly and convincingly applied."—Lond. *Elec.*, Dec. 21.

Electric Oscillations.—Fleming.—An abstract of his fourth concluding lecture on "Electric oscillations." He discussed the properties of electric waves. The term "electric displacement" has not yet been thoroughly defined. He showed Hertz's experimnts, a coherer being used as wave detector. After discussing experiments on reflection and refraction he explained that the reason why wireless telegraphy is much more successful over sea than over land is because the land absorbs the waves, whereas they are reflected from the surface of the water. He remarked that in the new century "electrical engineers will have to become more and more ether engineers."—Lond. *Elec. Eng.*, *Elec.*, Dec. 21; *Lightning*, Dec. 20.

Electron Theory of Metals.—Drude.—A paper in which he seeks to explain the electric current and its effects in the magnetic field by the hypothesis of the movement of electrons or corpuscles between the atoms of the metals of the conductors. He finds sufficient agreement with known facts to make the hypothesis plausible, but he points out that it is highly desirable to collect observations on the four transverse-galvanic and thermo-magnetic effects, together with the thermic, the electric conductivity and the Thomson effect in the same piece of metal, in order to prove his theory.—*Ann. der Physik*, No. 11, noticed in *Am. Jour. of Sc.*, Jan.

Electro-Chemistry and Batteries.

Carbon as Electrodes.—Winteler.—A discussion of the properties which carbon should have when used for electrodes in electrolytic processes. When used as anodes in aqueous chloride solutions it should be as free as possible of carburets of hydrogen and of inorganic impurities, which are acted upon by the electrolyte or by the anode deposits; these requirements are best fulfilled by retort carbon; the gas development should be as much as possible at the surface, and the current density should not be over 2 amperes per square decimeter. Other properties are required in the aluminum and carbide manufacture. For the production of aluminum purified artificial carbon free of silicium compounds is the best. For carbide manufacture artificial carbon should be used, obtained from powdered retort graphite or powdered coke, and need not be purified from organic impurities except those containing phosphorus.—*Zeit. fuer Elektrochemie*, Dec. 6.

REFERENCES.

Electrolytic Production of Caustic Potash and Soda.—Winteler.—An article giving tables of the solubility of an aqueous solution of chloride of potassium in caustic potash at 20 degs. C. of chloride of sodium in caustic soda, of chlorate of soda in chloride of sodium, and of chlorate of potassium in chloride of potassium. These tables are useful in practice.—*Zeit. fuer Elektrochemie*, Dec. 6.

Electro-Chemistry in 1899.—The conclusion of the article, giving brief descriptions, of new processes or improvements, taken from patent specifications. This part deals with compounds of metalloids and metals, also with reductions, oxidations and syntheses in organic chemistry.—*Elek. Anz.*, Dec. 16.

Electrolytic Production of Alkaline Metals.—Fischer.—An illustrated description of improved apparatus for the production of alkaline metals by the electrolysis of melted chlorides.—*Zeit. fuer Elektrochemie*, Dec. 6.

Stirrer.—Neumann.—A brief illustrated description of a stirrer to be used for electrolytic processes requiring energetic stirring during the measurement of the escaping gases. It seems to be more practical than that of Loeb (Digest, Dec. 15).—*Zeit. fuer Elektrochemie*, Dec. 6.

Units, Measurements and Instruments.

Compensation Method for Small E. M. Fs.—Bose.—A description of a simple method to be used with a millivolt and amperemter. The one used in the description has a resistance of 1 ohm and 150 scale divisions; when connected as in Fig. 1 it will serve directly for measuring to 0.150 volt by adjusting the resistances. But the same instrument may be used for very accurate measurements of very small voltages by using the shunts that come with it, having resistances of 1 / 9,

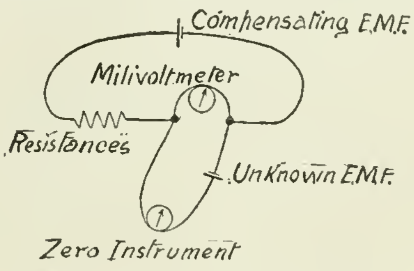


FIG. 1.—COMPENSATION METHOD FOR SMALL E. M. F.'S.

1 / 99, etc.; one of these resistances is then connected in series with the millivoltmeter as shown in Fig. 2 and the reading will then be 9 times, 99 times, etc., that of the unknown e. m. f. No interpolation is required and no standard cell and even the compensating resistances need not be known.—*Phys. Zeit.*, Dec. 8.

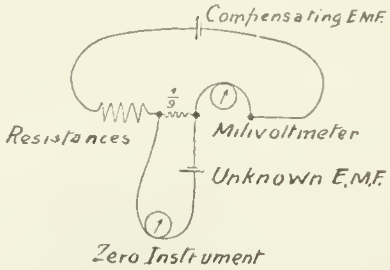


FIG. 2.—COMPENSATION METHOD FOR SMALL E. M. F.'S.

Defense of the Cadmium Cell.—Jaeger.—A reply to the criticisms by Barnes and Cohen, concerning the Weston cadmium cell, noticed before in the Digest. "That the e. m. f. of the cadmium cell shows certain irregularities at zero deg. C. was already found by Wachsmuth and the author in 1896, and at that time they indicated 5 degs. C. and 25 degs. C as the limits within which the new standard cell could safely be used. Similar irregularities are known to occur in the Clark cell, due to the transition point occurring at 39 degs. C., below which the zinc sulphate may assume two different states, the normal curve being broken with respect to the portion above 39 C. Such a behavior cannot be traced in cadmium sulphate. The metastability of the Weston cell must therefore be explained on some other ground, and this both the author and his critics now agree to find in the behavior of the cadmium amalgam, which experiences irregular changes of structure at low temperatures. The concentration of the cadmium amalgam originally used was 14.3 per cent. It is now admitted that elements with that amalgam should not be used below a temperature of 10 degs. C. The cells brought out by the European Weston Electrical Instrument Co. contain an amalgam of only 12.5 per cent and they show no metastability even at zero C."—*Zeit. fuer Instrum.*, Nov.; abstracted in Lond. *Elec.*, Dec. 21.

Simple Wehnelt Interrupter.—von Pallich.—A description of a simple form of Wehnelt interrupter in which the lead plate is replaced by a copper wire and the platinum anode by a steel wire. "Both wires are enclosed in glass tubes, that containing the steel wire being strong, and tightly surrounding the steel tip. Both wires dip into dilute sulphuric acid. The steel wire is 1 mm or 2 mm thick, and its upper end is held in a cork provided with a cup for a mercury contact. The vessel containing the sulphuric acid is surrounded by cold water to keep the temperature down. The two glass tubes with their wires are inserted in a rubber stopper provided with borings to allow the acid to flow back into the bottle in case it spurts out. A curious phenomenon noticed in the working of the instrument is that the steel wears away just where the wire emerges from the glass tube, and not in the portion more immersed in the acid. A constriction is thus formed, and the effect appears to be that its formation assists rather than retards the generation of the gaseous layer, the explosions becoming stronger and more abrupt as the work of the interrupter continues. The double adjustment possible in this type of instrument makes it particularly easy to obtain the necessary current strength."—*Ann. der Physik.*, No. 11; abstracted in Lond. *Elec.*, Dec. 21.

Method of Transverse Currents.—Stark.—An account of an investigation of the theory and practice of the transverse current method of determining resistances. Two currents traversing a conductor in two different directions between electrodes situated upon equipotential surfaces with respect to each other, can be considered as simply superimposed, if the resistance is independent of the current density and if there is no polarization at the electrodes. "In practice it is almost impossible to place the electrodes in an equipotential surface, especially in gases. In the latter the resistance does not correspond with the potential gradient owing to the internal charges. There is less conductivity near the cathode owing to the greater speed of the negative ions. This is a well-known fact in connection with incandescent lamps where transverse currents are almost inevitable."—*Ann. der Physik*, No. 11; abstracted in Lond. *Elec.*, Dec. 21.

Measuring Instruments.—Aliamet.—The conclusion of his very long, illustrated paper on electric measuring instruments at the Paris Exposition. He concludes the description of voltmeters; discusses the measurement of resistance, resistance boxes, potentiometers, direct reading ohmmeters; deals briefly with condensers and inductances; describes wattmeters; several special instruments to be used with alternating currents, as phase meters, frequency meters, instruments for plotting the wave form; instruments for the study of the magnetic properties of iron, as permeameters and hysteresis meters; thermo-electric pyrometers for measuring temperature.—*Bull. Soc. Int. des Elec.*, Sept.-Oct.

Effect of Tramways on Magnetic Observatories.—Ruecker and Glazebrook.—An abstract of a Brit. Phys. Soc'y paper by Ruecker on "The magnetic field produced by electric railways." In the case of a tramway in which the current flows along a trolley wire from the power house and returns partly through the rails and partly as earth currents, the vertical disturbing force at any point is due to the currents in the feeders and rails, and the earth currents affect only the horizontal force. Experiments show that it is chiefly the vertical force instruments which are affected by the existence of an electric railway; this disturbance is due to the wires and rails. He gives a formula for the vertical disturbing force. It increases with the length of the tramway, and for a tramway of given length it is a maximum at points on a line perpendicular to and bisecting it. In a paper by Glazebrook, Ruecker's formula is modified and utilized; among other things, he shows that a tramway of any given length at a certain distance from a magnetic observatory is many times more obnoxious to the observatory than a tramway half as long at half the distance.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Dec. 21.

REFERENCES.

Magnetometer Constant.—Chistoni.—He determines the constant of a unifilar magnetometer by placing a deflecting magnet at each of two distances from the needle. He gives two formulas, the first being rigorously correct, the second simpler, but only approximate.—*Acad. Sci. Torino*, atti 35, 8a, 1900; abstracted in *Science Abstracts*, Nov.

Localizing Faults.—An illustrated description of several methods of localizing faults in electric lines and cables, especially in difficult cases.—*Elek. Anz.*, Dec. 6.

Telegraphy, Telephony and Signals.

Wireless Telegraphy for Warning Vessels.—A note on a successful trial of a new system of signalling, designed to warn vessels of their approach to points of danger. From the shore station ether signals are sent which may be read by such vessels as are within a certain distance of the danger point and are provided with proper receiving apparatus; this may be done continuously or only in foggy weather. The sending and receiving apparatus used was a modification of the Popoff vertical air-wire system designed by Hozier and Maskelyne, but the sending apparatus is made to give forth automatically the name of the danger point or other information concerning it. This is effected by using as contact-maker, in place of the Morse key, a revolving wheel, whose periphery is cut out appropriately. Editorially it is remarked that such a system can at its best afford but little guidance to a straying navigator.—Lond. *Elec.*, Dec. 21.

Separation of Wireless Messages.—Jegon.—A description of "a differential apparatus, which, while not preserving the secrecy of wireless messages, enables the sender to communicate at will with one or another of two stations situated at different distances. The principle adopted is that already proposed, of employing mast-wires of different ranges. Four such mast-wires are employed, two at the sending stations and two at the receiving stations. Their heights are so arranged that one of them covers, say, a range of 5 miles, while the other does not. The circuits of the coherers attached to the two mast-wires are so arranged that their simultaneous action produces no effect upon the galvanometer. But at a distance of 5 miles the galvanometer will respond to a message from the sending station addressed to both coherers, as only one of them is brought into action. At half that distance, when both coherers are within range, no effect is produced on the galvanometer. Thus, at all events, something of the nature of separation by distance is obtained, though it is open to the obvious criticism that complete neutralization of the two effects is only produced at one definite value of the distance."—*Comptes Rendus*, Nov. 26; abstracted in Lond. *Elec.*, Dec. 14.

REFERENCE.

Telegraphy and Telephony.—The first part of a summary of new inventions and improvements in telegraphy and telephony during October, November and December.—*Elek. Anz.*, Dec. 13.

Miscellaneous.

REFERENCES.

Paris Exposition.—Aliamet.—An illustrated description of thermic voltmeters and registering wattmeters of J. Richard.—*L'Elec.*, Dec. 15.

Montillot.—An illustrated description of an apparatus devised by Pecquet, for registering automatically at a certain station, the rounds of a watchman; the latter can give or receive an alarm signal at all the controlling stations; at all these places he can also communicate by telephone with the central station.—*L'Elec.*, Dec. 15.

An illustrated description of the exhibit of the Popoff system of wireless telegraphy.—*Elek. Anz.*, Dec. 13.

Montpellier.—An illustrated description of dynamos exhibited by the Oerlikon Co.; a 350-kilovolt ampere single-phase alternator, the voltage being 2200 the frequency 50, the speed 250 r. p. m.; also a 1340 kilovolt ampere three-phase alternator, the voltage being 2200, the frequency 50, the speed 94 r. p. m.—*L'Elec.*, Dec. 22.

Montillot.—An illustrated description of the telephone switchboard of the British Post Office.—*L'Elec.*, Dec. 22.

New Books.

Handbuch der Elektrischen Accumulatoren. Auf Grundlage der Erfahrung und mit besonderer Berücksichtigung der technischen Herstellung. Von Paul Schoop. Stuttgart; Ferdinand Enke. 514 pages, 193 illustrations. Price, 12 marks.

The book is limited almost entirely to the lead accumulator, there being only a few pages at the end devoted to other types, and is devoted largely to the practical construction of accumulators. The author discusses the raw materials; the manufacture of the grids or electrodes; the carriers of the active materials; the material to be filled into the electrodes; the formation of the plates; the electrodes with porous partitions; shipping and erection of batteries; transportable cells; and accessories. A chapter is devoted to the capacity, efficiency and resistance of accumulators; another to comparative measurements and tests, followed by a short chapter on the theoretical considerations, and concluding with another short chapter on other galvanic combinations than those in the ordinary lead accumulator.

The practical part of the book, dealing with the construction and manufacture of the storage battery, has evidently been compiled with great care from articles in journals, patent records, and prospectuses of manufacturers. The value of this part would have been greatly enhanced if criticism had been made more freely of the methods and constructions described.

The theoretical part of the book is brief. The author does not agree with what he calls the 'phantasies" regarding free ions, but is unable to offer anything better. The book will prove of value to the practical storage battery engineer on account of the large amount of information on technical details which it contains.

Elektrometallurgie und Galvanotechnik. Ein Hand und Nachschlagebuch fur die Gewinnung und Bearbeitung von Metallen auf Elektrischem Wege. Von Dr. Franz Peters. Four volumes. Wien: A. Hartleben. 261, 292, 208, 240 pages; 72, 119, 59 and 33 illustrations. Price, per volume, 3 marks.

The author of these books, who is the editor of our German contemporary *Centralblatt fuer Accumulatoren und Elementenkunde*, remarks in the preface that although there are good handbooks on electrometallurgy and galvanic plating, a book was lacking giving a summary of all the various articles in journals and of the patents relating to the use of the electric current for producing and plating metals. For this purpose he has written these books, and has endeavored to give the literature of patents as complete as possible.

The compilation appears to have been done very carefully, so that these volumes may be used to advantage as reference books by practical engineers, inventors, and patent attorneys, whenever the question arises, whether a process is new or not; in such cases the books may save much labor.

The first volume deals with antimony, tin, bismuth, beryllium, magnesium, and aluminum, the latter filling by far the greatest part of the volume.

The second volume is a monograph on copper. The third volume deals with silver and gold, the fourth with zinc, lead, nickel, and cobalt. For each metal, first the electrolytic processes of production are described, then the methods of electroplating.

At the end of the fourth volume there are two indexes for the four volumes together, one of the names, the other of the patents; the latter are arranged according to the different countries.

Jahrbuch der Elektrochemie. Von W. Nernst und W. Borchers. Berichte über die Fortschritte des Jahres 1894-5-6-7. Halle: Wilhelm Knapp. 1894—274 pages, 163 illustration, 10 marks. 1895—300 pages, 196 illustrations, 12 marks. 1896—359 pages, many illustrations, 12 marks. 1897—411 pages, many illustrations, 15 marks.

Since 1894 this yearly review of electro-chemical progress has been published annually, appearing usually in the spring of the year. Besides the above four volumes sent to us by the publisher, there are probably two later volumes, dealing with the progress of electrochemistry in 1898 and 1899.

Dr. W. Nernst is the editor of the scientific part of the year-book. He has been well known for years as one of the leading electrochemists of Germany. When he was Ostwald's assistant in Leipzig at the latter end of the eighties, he published his two famous papers on the phenomena of diffusion and of electric conduction in aqueous solutions, which phenomena were analytically treated as simply due to the traveling of the ions, the only acting forces being the osmotic pressure and the electrostatic forces due to the charges of the ions. These views of Nernst form the fundamental basis of our modern views of the electric phenomena in a galvanic cell. Dr. Nernst has besides been extremely successful as professor and as president of the electro-chemical institute of the University of Göttingen, where a very great number of electro-chemical researches have been made under his auspices. He has obtained a world-wide reputation also as the inventor of the Nernst lamp.

The editor of the practical part of the year-book is Dr. W. Borchers, who has been for a score of years an active engineer for electrochemical and metallurgical concerns, both in Germany and in the United States. He has also done considerable work in the development of the electric furnace. Some years ago his name came prominently forward as the inventor of a carbon cell, which, however, has not proved to be of practical value. He is at present professor in the Technical High School of Aix-la-Chapelle, and has published some valuable papers and books in which he has collected a great amount of statistical data, and has given good reviews of the progress and the present conditions of electro-metallurgy.

Both Dr. Nernst and Dr. Borchers are also the editors of the weekly *Zeitschrift fuer Elektrochemie*, which is the official journal of the German Electrochemical Society; though German in name, this society is international in membership.

In the later volumes of the year-book several chapters are written by Dr. Elbs, Dr. Kuester and Dr. Danneel, who are also contributors to the *Zeitschrift.*

We have given these notes on the authors of the year-book in order to show what may be expected from it, and add at once that it is of the highest value and of extreme usefulness to everybody interested in the progress in electro-chemistry. As an index of what has been done in each year it appears to be very full. The arrangement of the material is good; each volume has a full alphabetical index of the material, and another of the authors, so that it may be used to advantage as a reference book. Furthermore, it is not at all a conglomeration of brief, dry abstracts, but is so written that anybody interested in electro-chemistry will take pleasure in reading it over in leisure hours from the beginning to the end. It represents, of course, entirely the views of the modern German electro-chemical school and shows the accomplishments and the blind side of this school in being often too enthusiastic and not sufficiently critical in the judgment of new inventions; but this is natural in such a young science.

We hope that this German year-book will find friends in the United States. For the United States will, without any doubt, play a very important part in the future development of electro-chemistry, especially electro-metallurgy. In a paper of Dr. Borchers read in 1899, he gives the value of the different materials available per year in the electro-chemical plants in the three countries which lead in this respect, as follows: The United States, $97,500,000; Germany, $13,800,000; France, $11,300,000. In this respect the United States is far superior to all other countries of the world together. There is also no doubt that, in future, electrical processes will be used more and more in metallurgy as well as in the chemical industries. The older non-electrical methods are engaged in a struggle for life; and there is no doubt that they will ultimately be vanquished. To call the attention of young electro-chemical engineers to the German year-book, which can be a strong weapon in their hands in this fight, is the aim of this notice.

Directory of Electrical Societies, Etc.

NEW YORK ELECTRICAL SOCIETY. Next meeting, Jan. 16. Lecture by Dr. Louis Bell on "Electric Illumination at the Beginning of the Twentieth Century." See Current News and Notes for further particulars.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Milwaukee, Wis., Jan. 16, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, New York, 1901.

The Electric Automobile in Paris.

BY HART O. BERG.

The high place which the petroleum carriage has taken in the automobile field of France now shows some outward signs of being challenged by its more gentle and quite offenseless contemporary, the electric carriage. For several years those far-seeing in automobile circles have been forced to acknowledge that the petroleum-driven vehicle was not entirely suited for city work, and the demands of city people have been such recently as to aid in a great degree the rapid development of electrically driven vehicles of all descriptions. There has been a big fight on in the trade against electricity, as few people in France seemed to be prepared to spend the necessary amount of money to establish central stations, without which the difficulties arising in the development of an entirely new means of propulsion were such as to frighten prospective buyers. During the past year several charging stations, if they may be called such, have been established in the outskirts of Paris, but they were so far removed from the residential centres that good service was not easily obtained. The representative of the Electric Vehicle Company established a charging station which in every sense of the word can be called a central station. This is situated at 54 Avenue Montaigne, in the very heart of Paris. This station was established, not only to take charge of the already large number of Columbia automobiles running in Paris, but was equipped to charge and look after properly all types of electrically propelled vehicles. There is ample room in this station for from 50 to 60 carriages, and at the present time the stabling and charging facilities are utilized to their limit. In fact, it has become necessary to establish a second station, and ground for that purpose has already been acquired near the Arc de Triomphe. This second central station will be large enough to accommodate 150 carriages, besides which a large space has been set apart for battery care, as it has been the object of the company in Paris to pay special attention to batteries, thereby getting the very best efficiency. The carriages virtually take care of themselves and but little attention is necessary to keep them in perfect repair. The company does not conduct any renting business, all the carriages kept in their stations being owned by individuals. They are stabled, charged and kept in repair at a very nominal cost; in fact, at a price at which it would be impossible to keep horses and carriages, and it is needless to say that the service is giving every satisfaction.

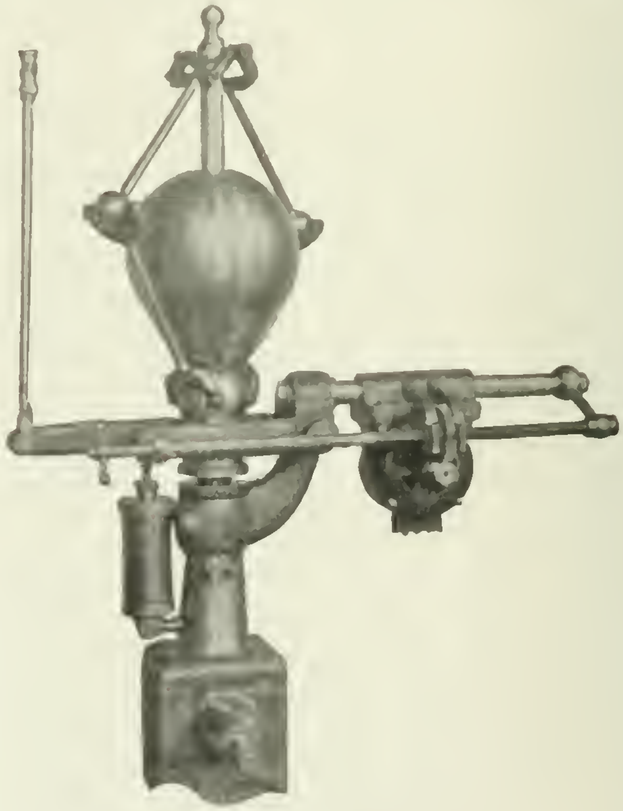
The growing popularity of electrically propelled vehicles is somewhat astonishing the petroleum enthusiasts, and many of the most prominent petroleum carriage users have one, two or three electrically propelled carriages as well. One of the most prominent men in Paris, who has a magnificent chateau some thirty miles from that metropolis, has four electric vehicles always in commission, and has even gone so far as to sell his petroleum carriages, asserting that the electric vehicles are entirely devoid of the many troubles he has had with those driven by petroleum. He has a large ten-seated omnibus, a victoria and a four-seated phæton, besides which he has a wagon, used by his gamekeepers at his shooting boxes, finding that he can save quite a number of guards by being able to send them from one place to another quickly and surely.

The great demand in France to-day is for broughams and victorias driven by men on the box. The average French automobile owner does not care to drive himself through the streets of Paris at the risk of being crushed by malicious omnibus drivers, and with no means of resenting the insulting threats of the ordinary Paris cabby. In other words, electrically propelled broughams for winter and victorias for 9 months of the year are what is being demanded by Parisians to-day. The Electric Vehicle Company has developed just what these people want, and large quantities of running gear are being shipped from the Hartford and Elizabethport factories to both Paris and London. The carriage bodies having been manufactured on the other side are now quite ready to be placed on these gears, and in a very short time the number of Columbia vehicles now running through the streets of both Paris and London will be very materially augmented.

The day of the large petroleum carriage is fast coming to an end. The petroleum voiturette, however, is becoming more and more popular, and small vehicles to hold two or four persons and weighing from 900 to 1200 lbs. are and will continue to be in increasing demand. These little voiturettes are easily handled and are bound to become more popular every year for people living a short way out of town. The speeds vary from that of a walk to 30 miles per hour, and they are so light and easily handled that accidents are more than rare. Besides this, they are very cheap to run, and where petroleum costs 12 cents a quart this item is very appreciable. The petroleum voiturette is now attaining its most simple expression, the parts being reduced to very few in number, and the first complications being rapidly eliminated by a much greater knowledge of the art. In a short time every person in Paris of any means whatever will be the owner of at least an electric brougham, a victoria and a small petroleum voiturette. The number of these three types of carriages now circulating in the larger cities of Europe seem to astonish the traveling American, but I am glad to see that the most rapid progress is coming from the United States. It has been a long time getting there, but from present indications I am quite willing to believe that not only, as is actually the case, will American electric vehicles be far superior to those built in Europe, but American petroleum voiturettes will certainly take the first place, ahead of those built in France.

Electrical Engine Governor.

The accompanying illustration shows an electrical engine governor for engines driving alternating current machinery, devised by Mr. C. G. Y. King, mechanical engineer of the Chicago Edison Company. The governor is now in successful use on the Porter-Allen engines of 400-kw and 1000-kw capacity, respectively, at the new power plant of the Commonwealth Electric Company of Chicago, and will be applied to two new Allis engines (2500 kilowatts and 3500 kilowatts) at the Harrison Street station of the Chicago Edison Company.


ELECTRICAL ENGINE GOVERNOR.

The device consists essentially of a self-contained motor-driven counterbalance weight. By supplying current to the motor, the weight of which it forms part, is moved along the counterbalance lever, thereby affecting the governing of the engine. By this means engines driving alternating current generators can be synchronized at any requisite distance from the generator, and the switchboard operator is given control of the engine regulation at all times.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The New York stock market experienced much sensational excitement last week, resulting in a semi-panic in certain railway shares and the biggest trading transactions on record, followed by a very sharp rally. Simultaneous with the tumult in New York like scenes were being enacted in London, all of which emphasize the delicate poise of the great markets of the world and their interdependence. The tractions and electrical securities did not participate in the wildness of railway trading; indeed, considerable weakness was betrayed in the general falling off in quotations. Brooklyn Rapid Transit closed with a net loss of 3⅛ points, after an active market of several weeks with soaring prices. The sales were 231,750 shares, the quotations for the week ranging from 81 to 87¾. Metropolitan Street Railway shows a heavier falling off —5¼ points—the range of prices being 165 to 174. General Electric, too, took a downward turn, and on sales of only 3,100 shares closed with a loss of 5 points, the lowest quotation being 185 and the highest 192¾. Western Union keeps at near its normal, showing a net loss of ¼ point at the close. The total number of shares sold at New York during the week was 7,511,415, against 5,028,813 the week previous, and 2,779,967 the same week a year ago. Call money closed at 3 per cent, and sixty-day loans at 4. The market for outside securities was abnormally dull, due to attention being diverted to the sensational character and developments in the stock market. Among the principal gains for the week were Telegraph, Telephone & Cable and Electric Boat pfd., 4 points; among the declines was Electric Vehicle common. There was some trading in General Carriage, but other transportation stocks were neglected. The closing quotations follow:

NEW YORK.

	Dec. 29.	Jan. 5.		Dec. 29.	Jan. 5.
Gen. Electric	193	188	Elec. Veh	19	17
Bklyn. Rap. Tran	86	82⅞	Elec. Veh., pfd	45	43
Met. St. Ry	171	165¾	Gen. Car	4¼	3½
Am. Tel. & C	—	—	Ill. Elec. Veh. Tran	1	1
West. Un. Tel	84	83¾	N. Y. Elec. Veh. Tran	6½	6¼
Am. Dist. Tel	36½	—	N. E. Elec. Veh. Tran	3¼	3¼
Com. Cable	—	—	Tel. & Tel. Co. of Am	2¼	6½
Elec. Boat	27	28½	Hud. Riv. Tel	116	116
Elec. Boat, pfd	48	47	N. Y. & N. J. Tel	173	173

BOSTON.

	Dec. 29.	Jan. 5.		Dec. 29.	Jan. 5.
New Eng. Tel	—	128	Erie Tel	100	90
Mex. Tel	2¾	2½	Gen. Elec. pfd	155	156
Westing. Elec	56	*54½	Am. Tel. & Tel	155	155⅞
Westing. Elec. pfd	—	66	Ed. Elec. Lt	—	—

PHILADELPHIA.

	Dec. 29.	Jan. 5.		Dec. 29.	Jan. 5.
Elec. Stor. Bat	88	84	Phil. Elec	5⅛	5¾
Elec. Stor. Bat., pfd	90	90	Pa. Elec. Veh	2	2
Elec. Co. of Am	9¼	9⅛	Pa. Elec. Veh., pfd	1	1
Gen. Elec. Auto	—	—	Am. Rys	33	32⅝

CHICAGO.

	Dec. 29.	Jan. 5.		Dec. 29.	Jan. 5.
Chicago Edison	145	151½	Chicago Telep. Co	235	230
Chic. City Ry	253	253	Union Traction	11¼	12½
Nat'l Carbon	16	16	Union Traction, pfd	45¼	49
Nat'l Carbon, pfd	83½	84	Northwest Elev. Com	28½	28½

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*Asked.

CONTROL OF NORTH AMERICAN.—Statements published last week to the effect that J. P. Morgan & Company had acquired possession of the North American Company, with a view to using its liberal charter in the financing of the anthracite coal deal, are not fully confirmed. The firm has for some time held a considerable interest in the company, and will probably be directly represented on the managing board by the election of Robert Bacon, one of its members, to the North American directory next month. The Morgan interest in the company is not newly acquired, and the use of the company for a joint selling agency in the coal trade has never been seriously discussed. At present the North American confines its activities to the operation of electric light and traction and lighting enterprises in Cincinnati and Milwaukee. The very broad powers conferred by the company's charter, which could probably not be duplicated, have frequently made its possibilities as a finance agency a matter of discussion. The late Mr. Villard had some large ideas in this respect.

MEXICAN TELEGRAPH COMPANY.—The Mexican Telegraph Company, capital $2,000,000, reports gross receipts from 1881 to Dec. 31, 1900, of $6,165,489; net profits, $4,531,303. Dividends paid amount to $3,122,886, leaving a surplus of $1,408,416, of which $531,654 has been invested in the plant, such investment having been capitalized and issued to shareholders in full paid stock, leaving a balance of $876,762, which is represented in first-class securities and cash in bank. The operating expenses, repairs and renewals have averaged less than 27 per cent of the gross receipts. President Scrymser says: "The results of the company's operations, covering a period of twenty years, indicate that the durability of submarine cable property surpasses that of railroads, manufacturing and similar enterprises. Also that its earning capacity, when well located geographically, shows larger receipts, with less cost of operating expenses and repairs than the class of property mentioned."

DETROIT UNITED RAILWAY COMPANY.—Articles of association of the Detroit United Railway Company, capitalized at $12,500,000, have been filed with the Secretary of State of Michigan, together with a franchise fee of $6,000. The new company will take over the franchises and property of the Detroit Electric Street Railway, Detroit, Fort Wayne and Belle Isle Railway, Detroit Citizens' Street Railway, and Detroit Suburban Railway Company. The incorporators are: R. T. Wilson, M. O. Wilson, James M. Edwards, of New York; Jere C. Hutchins and Albert E. Peters, Detroit; Henry A. Everett and Ralph A. Harmon, of Cleveland. Mr. T. J. Johnson retires from the system, selling out completely.

MORTGAGE AT BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has given a first mortgage for $3,500,000 to the Old Colony Trust Company of Boston to cover an issue to that amount of 50-year 5 per cent gold bonds. The bonds are redeemable at any time upon payment of principal and interest. The mortgagor owns and operates all the electric car lines in Birmingham, and forms a consolidation of all other local car interests. Half of the proceeds of the bond issue will be used to pay bondholders of the absorbed companies, and the rest will be turned into the treasury of the company for operating the consolidated system.

CONNECTICUT.—The Connecticut Lighting & Power Company, of Waterbury, has filed in the State Secretary's office a certificate of increase of capital from $1,000,000 to $15,000,000. The announcement is of particular interest, taken in connection with the purchase by this company of the Bridgeport Traction Company, and the recent acquirement of other large electric railroad interests in the State.

CHICAGO.—The Commonwealth Electric Company, which is the consolidation of several suburban properties, effected by the Chicago Edison Company some time ago, has listed $3,000,000 5 per cent bonds on the local exchange.

MUNICIPAL BONDS.—Tampa will issue $250,000 5 per cent 15-year water and light bonds. Waterbury, Conn., will petition the Legislature for permission to bond the city to the amount of $100,000 for the purpose of going into the business of municipal lighting.

DIVIDENDS.—The North Chicago Street Railway has declared a quarterly dividend of 3 per cent, payable Jan. 15.

Commercial Intelligence.

THE WEEK IN TRADE.—While there is nothing particularly noteworthy in the development of trade last week, the conditions, on the whole, were satisfactory; everything pointing to a period of activity and prosperity. Trade was generally quiet in all lines, interest being concentrated largely in stock-taking and the contemplation of the results of 1900. The ordinary measures of business continue to make gratifying exhibits. Bank exchanges for the leading cities outside New York show an increase of 10.4 per cent over last year and a gain of 18.2 per cent over 1899; while at New York the exceptionally heavy annual interest settlements combined with large speculation to make a gain of 42.2 per cent over 1900 and 38.4 per cent over 1899. The feature in iron and steel was the large sale of steel rails reported from the West, one lot sold in Chicago being for 25,000 tons. Structural material makers are getting good orders, and bridge builders are anticipating a heavy business. Sixty-three railways show an increase of 10.46 per cent in earnings during the third week in December, as compared with the earnings during the same period in 1899. *Bradstreet's* reports the number of failures for the week as 268, against 213 the previous week, and 229 the corresponding week last year. The copper market was very dull, prices being unchanged. Lake is held nominally at 17c., and electrolytic is quoted at 16⅝c.; casting, the same.

ENGLISH COLONIAL TRADE.—British colonies furnished last year a market for over $500,000,000 worth of British goods. The "Statistical Abstract for the Several Colonies and Other Possessions of the United Kingdom," which presents the details of the commerce and conditions of the British colonies in the year 1899, compared with preceding years, has just reached the United States Treasury Bureau of Statistics. It shows that the British colonies throughout the world imported in 1899 goods valued at over a billion dollars, and of this amount over $500,000,000 was from the United Kingdom. England's largest colony, of course, is British India. Its total imports in 1890 are given in round terms at about $300,000,000, of which $200,000,000 were imported from the United Kingdom. Next in importance is Canada, whose total imports amount to $140,000,000, but which takes only $35,000,000 in value from the United Kingdom. The chief reason of this small proportion being her immediate proximity to the United States, which can supply more promptly and conveniently her varied wants. Next in importance is the group of Australasian colonies, whose reports show on the face an importation in round numbers of over $350,000,000 in 1899, though the fact that each colony counts as "an importation" anything coming from any other Australian colony, even though merely brought across the line from adjoining territory makes this statement of Australian "imports" a misleading one. A careful analysis of the real import trade of the Australian colonies shows that their importation from countries outside of the Australian continent amount to about 55 per cent of the sum which they name as "imports." Basing an estimate upon this analysis of the 1898 figures, it may be assumed that the imports of the Australian continent in 1899 were not far from $200,000,000, of which the United Kingdom, although located on the opposite side of the globe, furnished over $130,000,000 in value. The value of the importations of the British West Indies in 1889 was about $33,555,000, of which about $13,610,000 were from the United Kingdom. The African colonies show total imports of $130,000,000 in value, of which $85,000,000 are from the United Kingdom. At the Cape of Good Hope alone the imports for the year are, in round terms, $100,000,000, of which $65,000,000 are from the United Kingdom. In none of these colonies is there any prejudice against American goods, but a warm appreciation of them.

ELECTRICITY IN SIAM.—With regard to recent events at Bangkok, United States Consul-General Hamilton King writes: "The present lighting company has increased its capacity from 10,000 to 17,000 lamps, and has installed at the present time over 10,000 lamps. The second annual report of the directors to the shareholders shows a dividend at the rate of 4 per cent for the half year. Perhaps the most interesting feature just now is the fact that the Bangkok Tramways Company, Limited, and the Siam Electricity Company are being consolidated under the name of the latter. This new company has just secured a concession from the Government to build 5½ miles of street railway line through the most promising portion of the city of Bangkok. Thus it will be seen that the Siam Electricity Company now not only controls the concession for lighting the entire city, but such concessions as have thus far been granted by the Government for building street railways. The capital of this company will be about $500,000 gold. Orders for the supplies have already been placed, and it is expected that the road will be in operation by the end of next year. Before consolidation, the light company furnished power only during the night, but since that time it is advertising electric power for both night and day use. This will probably be taken advantage of by many of the smaller manufacturing interests of the city and may in itself create quite a demand for electric supplies. In connection with this, it may be mentioned that the directors of the company have under contemplation the introduction of electric automobiles, to which they propose to furnish power. Few cities are better adapted to the use of automobiles than is Bangkok. The streets are absolutely level, and the pavement, which now covers many miles, is being rapidly extended in all directions. Besides this company, there are thirteen private electric plants installed in the rice mills of the city; two of the forts have their own plants; five ships of the navy are lighted by electricity; the navy yard is supplied with five or six portable dynamos, and a large installation is owned by the Bangkok Dock Company. Another company is just now endeavoring to get a concession from the Government to build a street railway on the other side of the river.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Jan. 1: Antwerp, 155 packages electrical material, $13,576. Amsterdam—3 cases electrical material, $176. Argentine Republic—158 packages electrical material, $6,389; 32 cases electrical machinery, $2,990. British East Indies—24 cases electrical material, $773; 19 packages electrical machinery, $6,300. Brussels—21 cases electrical machinery, $564; 2 cases electrical material, $205. Bristol—3 cases electrical material, $366. British West Indies—12 cases electrical material, $660. Chili—8 packages electrical material, $259. Central America—322 packages electrical material, $1,161. Cuba—68 cases electrical material, $2,150. Glasgow—11 cases electrical machinery, $444; 27 electrical cables, $11,116; 4 cases electrical material, $64. Genoa—50 packages electrical material, $8,844. Hamburg—4 packages electrical machinery, $2,200; 51 packages electrical material, $1,579. Havre—4 packages electrical material, $503. London—24 packages locomobiles, $7,500. Liverpool—6 packages electrical machinery, $279; 11 packages electrical material, $599. Manchester—4 packages electrical machinery, $2,165; 26 packages motor trucks, $1,200; 136 packages electrical material, $19,898. Milan—20 packages electrical material, $1,274. Mexico—47 packages electrical material, $140; 9,411 packages electrical railroad material, $14,439; 1 crate electrical material, $80; 1 motor carriage, $909. Naples—12 cases electrical material, $1,250. Peru—20 packages electrical material, $417. Rotterdam—1 package electrical material, $40. Southampton—24 cases electrical material, $1,073. St. Petersburg—2 cases electrical material, $106. U. S. Colombia—3 cases electrical material, $49. Venezuela—157 cases electrical material, $1,041.

ELECTRICAL GOODS IN INDIA.—Mr. R. F. Patterson, United States Consul-General at Calcutta, writes: "The Calcutta Tramway Company, Limited, is now preparing to change its lines from horse power to electricity, and the contract for the power station has been given to Merrs. Dick, Kerr & Company, Limited, of London, Eng. Electricity is now beginning to be extensively used in Calcutta for various purposes, such as lighting, fans to take the place of punkhas that were pulled by coolies, for driving machinery, etc., and there is an opening here for the sale of electrical machinery and goods, which our manufacturers should take advantage of. I would advise correspondence with Messrs. Kilburn & Company here, who have an electrical plant and are furnishing electricity and electrical machinery and goods; also, with the following-named firms in Calcutta, who are dealers in such machinery and goods, viz., Osler & Company, Octavius Steel & Company, and the Calcutta General Electrical Company. All machinery is now entered duty free in India, but there is a duty of 5 per cent ad valorem on goods. There is a direct line of steamships between New York and Calcutta, but a cheaper freight on machinery and goods not required for immediate use would be by sailing vessels via the Cape."

BELL TELEPHONE OUTPUT.—The American Telephone instrument statement for the month and year ended Dec. 20 shows:

	1900.	1899.	Changes.	
Gross output	63,196	53,194	Inc.	10,002
Returned	23,593	23,391	Inc.	202
Net output	39,603	29,803	Inc.	9,800
Since Dec. 20—				
Gross output	630,766	661,909	Dec.	22,143
Returned	280,703	206,654	Inc.	74,049
Net output	359,063	455,255	Dec.	96,192
Total outstanding	1,939,568	1,580,505	Inc.	359,063

GERMAN PESSIMISM.—A cable dispatch from Germany says: "A surprise has been furnished by the declaration of the president of the Allgemeine Electricitats-Gesellschaft, one of the largest electrical plants in Germany. This gentleman has said that the development of electrotechnics has reached a point where further extension cannot be expected, and that it is the duty of the company to look to the solving of new problems which might give new occupation to their workshops. The market interpreted this to mean that no more high dividends on electric shares were to be expected, unless new fields were opened. Accordingly, prices of electrical stocks broke heavily."

COPPER TELEGRAPH WIRE.—It is stated that the telegraph department of the Atchison will shortly begin the work of stringing a copper telegraph wire along its line from Albuquerque, N. M., to Los Angeles, Cal. Later a similar wire will be strung between points on the eastern end of the system. Copper telegraph wire is now in service over some distance along this route, and it is the intention to eventually complete the copper line over the whole distance between Chicago and the Pacific Coast. The Postal Telegraph Company long ago went in for copper circuits and the Western Union Company has lately put up a good deal of copper wire.

COSTA RICA.—Señor Don Mendiola Boza, of San José, has contracted with the municipal government of that city for the installation of an electric light plant. The contractor agrees to purchase in the United States the engines, dynamos, line materials and other necessary accessories, selecting the very best and most improved machinery now used for installations of the kind specified and to secure supplies of the best quality and class.

BRAZIL.—Dr. Olympio de Assis, at Minas-Geraes, Brazil, states that in his town some electric railway lines are to be constructed, and he is desirous that manufacturers of electrical apparatus and other kinds of street railway material send him price lists, catalogues, and any other information they may care to give.

General News.

THE TELEPHONE.

NASHVILLE, IND.—A telephone exchange has been installed in this city.

PHILADELPHIA, PA.—The United Telegraph and Telephone Company, of this city, with a capital stock of $10,000 has been incorporated under the laws of Delaware.

FREDERICKTOWN, MO.—The Citizens' Telephone Company, with a capital stock of $5,000, has been incorporated by H. M. Whitener, E. D. Anthony, E. L. Graham and others.

SEDALIA, MO.—The Queen City Telephone Company has offered to place telephones in residences free of charge, though it has declined to make a cut in competition with the Bell Company.

ALBANY, N. Y.—The Bath & Cameron Telephone Company, of Bath, has been incorporated with a capital of $400. Directors: Albert Crandall, A. J. Annabel and A. C. Annabel, North Cameron.

ST. LOUIS, MO.—The Central Union Telephone Company will build two additional copper circuits between Alton and St. Louis during 1901. Three lines between the two cities are now in operation.

OTTAWA, ONT.—The New Westminster & Burrard Telephone Company, of British Columbia, is looking into the question of establishing telephonic communication between Victoria and Nanaimo, B. C.

ALBANY, N. Y.—The Morton Telephone Company of Kendall, Orleans County, has been incorporated; capital, $700. Directors, M. J. Storer, of Kendall; Henry Billings and B. F. Cady, of Hamlin.

CISSNA PARK, ILL.—The Iroquois Telephone Company has built about 80 miles of line since October last year. It has now 64 subscribers and a drop capacity of 100. Mr. George E. Weese is secretary.

CRAWFORDSVILLE, IND.—The Home Telephone Company, of this city, is making arrangements to extend its service eight or ten miles into the country. It has in the corporate limits alone over 700 subscribers.

ALBANY, N. Y.—The Subscribers' Telegraph & Telephone Company, of Watervliet, has been incorporated with a capital of $15,000. Directors: D. S. Johnston and J. E. MacLean, Cohoes; S. J. Cavanaugh, Watervliet.

MORNING SUN, IA.—The Morning Sun telephone exchange anticipates considerable increase in its rural line business. It now has a switchboard capacity of 70 drops and 57 subscribers, of which 45 are of recent acquisition.

METROPOLIS, ILL.—The Cumberland Telephone & Telegraph Company, which has just begun erecting poles for a local exchange, has been enjoined from doing any further work until Jan. 14, when the Court will be asked to decide whether the City Council may grant two telephone franchises.

BOSTON, MASS.—It is learned from officials of the New England Telephone & Telegraph Company that the number of subscribers in the city of Boston proper is now 20,659. The subscribers in the Boston and suburban district number 30,800, constituting this one of the largest exchanges in the world.

KOKOMO, IND.—The Citizens New Independent Telephone Company that recently put in operation their $30,000 telephone plant in this city has met with success far beyond expectations, and is extending its lines rapidly to all the surrounding towns. The superintendent thinks 1,000 instruments will be in use by Jan. 1.

DAWVILLE, IND.—The Dawville Mutual Telephone Company now has 265 subscribers in this city, and its lines reach the homes of 140 farmers in this county. The company has recently added 50 new subscribers to its system, and is looking for a further increase of 25. Mr. O. T. Spencer is secretary and superintendent of the company.

CORYDON, IND.—The negiotiations which have been pending for some time here between Oscar Wright and Louisville, Ky., and Indianapolis parties for a telephone service for Corydon and Harrison county, have been about closed. This service will have long-distance connection through the New Long Distance Company, of Indianapolis.

WATERVLIET, N. Y.—The Subscribers Telegraph and Telephone Company has been incorporated with a capital of $15,000 to operate telephone lines between Watervliet, Troy, Albany, Rensselaer, Colonie, Green Island and Schenectady. The directors are David S. Johnston and John E. MacLean, of Cohoes; William R. Condon, Charles F. Rodgers and Clarence Strevell, of Albany; Thomas J. Cavanaugh, of Watervliet, and Edgar T. Chapman, Jr., of Colonie.

KNOXVILLE, TENN.—Mr. J. C. Duncan, general manager of the People's Telephone and Telegraph Company in this city, states that the reports which have been circulated for the last few weeks that his company had sold out to the Cumberland Telephone Company are untrue. He says that his company has almost the entire exchange business of the city, and has added 300 new subscribers in the last two months.

ELECTRIC LIGHT AND POWER.

GILMAN, ILL.—Messrs. Parker, Allen & Grenier have been succeeded by the Gilman-Onarga Electric Light and Waterworks.

MARYSVILLE, WASH.—An electric lighting plant will be installed at the new shingle mill of Donoghue, Robinson & Company, in this place.

VINCENNES, IND.—A mortgage amounting to $165,000 has been filed by the City Electric Light Company to the Royal Trust Company, of Chicago.

NEW BRITAIN, CONN.—The style of the Connecticut Lighting & Power Company has been changed to Connecticut Railway & Lighting Company.

CONWAY, ARK.—The city of Conway has purchased the plant of the Conway Electric & Manufacturing Company and it will be operated by the municipality.

OWENSBORO, KY.—A brand-new electric plant is being installed here. Westinghouse, Church, Kerr & Co. are contractors for the new machinery which is in process of installation.

CLEVELAND, OHIO.—Hobdel & Benes, architects, are preparing plans for a 12-story office building for the Citizens Banking Company. The building will be equipped with an electric lighting plant.

ALBANY, N. Y.—The Capital County Light, Heat & Power Company, of Watervliet, has been incorporated; capital, $25,000. Directors: D. S. Johnston and J. E. MacLean, Cohoes; Robert Williams, Watervliet.

ALBANY, N. Y.—The Ossining Heat, Light & Power Company, of Sing Sing, has been incorporated with a capital of $250,000. Directors: J. B. Summerfield and A. L. White, Brooklyn; J. M. Mitchell, New York.

SUMPTER, ORE.—It is reported that an extensive electric plant will be installed at once on the Bonanza mining properties near Sumpter, Ore. Electricity and water power will do the work now performed by steam at those mines.

PINE BLUFF ARK.—The City Council has granted W. H. Keyser, of Chicago, an extension to April 1, 1901, in which to comply with the conditions of the franchise granted him some months ago to build and maintain an electric light plant and street railway system.

CLEVELAND, OHIO.—The Madison Realty Company will build two large apartment houses at an aggregate cost of $375,000. They will be equipped with electric lighting plants and elevators. Teubusch & Hills, Cleveland, are preparing the plans.

HILO, HAWAII.—The Hilo Electric Company, in the Hawaiian Islands, is about to install a 250-kw Westinghouse generator, direct connected to a McIntosh & Seymour engine. The steam plant was purchased through Charles C. Moore & Company, San Francisco.

SAN FRANCISCO, CALIF.—The Independent Electric Light & Power Company's system in San Francisco will be supplemented by a large gas plant. Claus Spreckles has engaged eminent engineers and will install a gas lighting system capable of supplying the entire city.

BEN LOMMOND, CALIF.—The Ben Lommond Light Company has been incorporated with Ben Lommond, Calif., as the place of business. Directors: D. W. Johnston, J. G. Tanner, H. F. Anderson, B. Lloyd and B. Dickinson. Capital stock, $2,000; subscribed, $500.

CRESTON, IA.—The City Council and the electric light company are at war. The city will not renew the old contract unless the lighting company increases the number of lights and not the price, and the company will not do this unless the city gives a long-time franchise, which the city refuses. In consequence the lights are out.

WATERVLIET, N. Y.—The Capitol County Light, Heat and Power Company, which proposes to manufacture gas and electricity for lighting, heat and power purposes, has been incorporated. The capital is $25,000, and the company will operate in Watervliet and in the town of Colonie. The directors are David S. Johnston and John A. MacLean, of Cohoes; Robert Williams, of Watervliet; Edgar T. Chapman, Jr., of Colonie, and William R. Condon, of Albany City.

INDIANAPOLIS, IND.—The Home Heating & Lighting Company, which was recently incorporated, and whose incorporation was noted in a recent issue, will immediately begin laying out its electric light plant for the entire city, both for public and private lighting. In the central part of the city (one mile square) a conduit system will be used; outside of this district the wires will be carried overhead on poles. A substantial power house will be erected of brick, stone and iron.

THE ELECTRIC RAILWAY.

CIRCLEVILLE, OHIO.—The Scioto Valley Traction Company has made application for a franchise through Circleville.

COLUMBUS, OHIO.—S. B. Hartman, a local capitalist, has applied to the City Council for a franchise for an electric railway in this city.

TOLEDO, OHIO.—The Toledo, Fremont & Norwalk Electric Railway Company has inaugurated a freight service between Fremont and Toledo.

COLUMBUS, OHIO.—The Franklin County Commissioners have granted a franchise to the Columbus, Winchester & Lancaster Electric Railway Company.

COLUMBUS, OHIO.—The Fort Wayne, Dayton & Cincinnati Traction Railway Company has been incorporated with $200,000 capital stock by Dayton people.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company has secured right of way for an extension of its line to Smith's Ferry and Lisbon.

VAN BUREN, OHIO.—The Van Buren Council will grant a franchise to the Findlay Street Railway Company, which is desirous of extending its road through this place to North Baltimore.

CLEVELAND, OHIO.—The Cleveland City Railway Company has leased Scenic Park at the end of its Detroit street line. It will be greatly improved, and will be operated as a place of amusement.

CLEVELAND, OHIO.—The Cleveland office of Babcock & Wilcox Company has closed a contract with Youngstown & Sharon Electric Railway Company for a battery of water tube boilers of 2,000 h.p.

LIMA, OHIO.—The Western Ohio Railway Company, which is building a road to Wapakoneta and St. Mary's, has decided to extend the line from Lima to Findlay. The right of way is being secured.

EAST LIVERPOOL, OHIO.—The Salem, Lisbon & East Liverpool Electric Railway Company will be incorporated within a few days with $500,000 capital stock. Eastern capitalists have financed the project.

COLUMBUS, OHIO.—The Norwalk, Ashland & Southern Railroad Company (electric) has been incorporated by C. P. Wickham, G. T. Thomas, F. C. Jackson, J. R. McKnight and C. C. Curtis. Temporary capital stock, $10,000.

NORFOLK, VA.—Representatives of the St. Louis Car Works have practically closed a deal to acquire certain property here. The idea is to secure a location on tidewater to enable the works to compete on better terms with Eastern car builders.

COLUMBUS, OHIO.—The Mansfield, Mt. Gilead & Columbus Electric Railway Light & Power Company, has been incorporated by T. Y. McCay, P. J. Boals, Thomas E. Barrow, Lewis J. McCay and T. Y. McCay, Jr. Temporary capital stock, $20,000.

CLEVELAND, OHIO.—The Cleveland & Chagrin Falls Electric Railway Company has closed a contract with Sipe & Sigler, Cleveland battery manufacturers, for 220 cells of storage battery, which will be installed in a new station three miles east of Cleveland.

SANDUSKY, OHIO.—The Sandusky, Norwalk & Southern Electric Railway Company has assumed formal control of the properties of the People's Electric Railway Company, and the Sandusky, Milan & Norwalk Railway Company, which were consolidated a short time ago.

NORWALK, OHIO.—William H. Price, a prominent citizen, has brought suit against the sale of the Sandusky, Milan & Norwalk Electric Railway on account of the cancellation of life passes granted to himself and wife by the original company. He asks for $5,000 damages. Mr. Price assisted in building the road.

BRYAN, OHIO.—The Northern Ohio Electric Railway Company has been organized to build an electric road from this place to Defiance. Elias Bartholomew, of Toledo, is president of the company; W. B. Sherwood, vice-president and general manager, and H. C. Warren secretary and treasurer. Franchises have been secured.

CLEVELAND, OHIO.—At the January meeting of the stockholders of the Cleveland City Railway Company, a proposition will be considered to increase the capital stock of the company from $8,000,000 to $9,000,000. The increase is to pay the expense of changing the cable lines to the electric system, and providing new rolling stock and equipment.

NORWALK, OHIO.—President Comstock, of the Toledo, Fremont & Norwalk Electric Railway Company, announces that notwithstanding the fact that two companies are already projecting roads between Norwalk and Oberlin, his company will extend to Oberlin next summer. It is probable that an additional power house will be built at Norwalk.

CLEVELAND, OHIO.—The Western Ohio Railway Company, which is building a road from Lima to St. Mary's, has closed a contract for the erection of its power house at St. Mary's. A contract has been closed with the Cleveland office of the Sterling Boiler Company for a battery of boilers of 1,500 h.p. Contracts for engines and generators have not yet been closed.

SPRINGFIELD, MASS.—Local capitalists are working out a project for the construction of an electric street railway line between Palmer and Springfield—a distance of 15 miles. The line will connect with the new road from Monson to Palmer; it will give a direct line from Springfield to all the important towns in the eastern part of Hampden County, and it will fill one of the two existing gaps in the continuous line of street railway from Boston to Springfield. The promoters of the enterprise have not, as yet, organized a corporation, but will do so soon. The flotation of the entire proposed capital stock is already assured.

STEUBENVILLE, OHIO.—At a meeting of the stockholders of the Steubenville, Mingo & Ohio Valley Traction Company, the following officers were re-elected: William Hearne, president; William Lipphart, vice-president; L. S. Sands, treasurer; F. H. Eicke, treasurer. The above, with H. E. Sands, L. G. Hallock, J. H. McKee, constitute the board of directors. The road is to be extended to Brilliant, and a new park is to be constructed at Altamont. It is also proposed to organize an independent company, with $350,000 capital stock, to furnish power, heat and light in Steubenville and surrounding towns. For this purpose extensive additions are to be made in the Steubenville power house.

CLEVELAND, OHIO.—Mayor John Farley has presented his proposed 25-year franchise extension for the Cleveland City Railway Company to the Chamber of Commerce for consideration. If reported on favorably it will be presented to the Council. The following are its leading provisions: Universal transfers; six fares for a quarter for twelve years; seven for a quarter thereafter; option to the city of making free territory in downtown streets; a percentage of gross receipts starting at 2 per cent. and gradually raising to 5 per cent.; the company to pave sixteen feet of roadway; to pay half the cost of abolishing grade crossings on its lines; sprinkle its tracks and to accept the city's right to regulate its operation, including that of package and express transportation.

THE AUTOMOBILE.

AUTOMOBILE FIRE ENGINE.—The Pittsburg Fire Department has just received an automobile fire engine which cost $9200. It will be able to throw 1350 gallons of water per minute.

RICHMOND, IND.—I. H. Sedgwick, of this city, has been at work for a year or more on an automobile constructed on an entirely new principle. His device is perfected and its practicability, it is said, is admitted. He will interest local capital in his invention.

AUTOMOBILES FOR DRUMMERS.—Parkhurst, Davis & Co., a wholesale grocery firm, of Topeka, Kan., will buy automobiles for the use of the half dozen salesmen who travel in Oklahoma, Western Kansas and Nebraska. The automobiles will be used where roads are good and trains few.

THE THOMPSON AUTOMOBILE COMPANY has filed articles of incorporation with the County Clerk at Newark, N. J. The capitalization is placed at $250,000. The principal office of the company will be in Newark. J. C. Bleveney of Newark, J. S. W. Thompson of Morristown, and C. F. McGuire of Newark are named as incorporators.

THE INDIANA AUTOMOBILE CLUB has been organized in Indianapolis. The purpose is to enlist in its membership all the automobile and motor cycle owners and riders in the State for both social and business purposes. G. G. Fisher is president and Lewis Bently secretary. The club will ask the Legislature to enact a law to make the establishing of sign-boards compulsory.

LEGAL.

NEW YORK FRANCHISES.—Justice Bischoff, of the New York Supreme Court, has handed down a decision which, if sustained by the Court of Appeals, means that Metropolitan will have no right to run cars on Lexington avenue, from Forty-second street to the Harlem River, nor operate the 116th street crosstown line. The decision practically advises all property owners along the lines designated to sue for damages. The company immediately gave notice of an appeal, and was given thirty days' stay of the permanent injunction which had been granted by Justice Bischoff. House, Grossman & Vorhaus, counsel for the man who started the action, say the decision means that actions to recover millions of dollars for damages will be started. The action was brought by Louis Tekulsky, who objected to the maintenance of a transfer station in front of his property. James T. Little, of counsel for Metropolitan, says: "The Tekulsky suit is one of the few remaining 'strike' actions brought against the company two or three years ago. Under Justice Bischoff's decision we think that only the 116th street line would be affected."

OBITUARY.

MR. EVERETT FRAZAR, senior member of the firm of Frazar & Co., died at Orange, N. J., last week. He was at the time of his death Consul-General for the kingdom of Korea in the United States. He was born at Duxbury, Mass., Oct. 4, 1834. In 1858 he went to Shanghai, China, and established the mercantile firm of Frazar & Co., which has been interested of late in the introduction of electric lighting into Japan and China, one of their contracts being the lighting of the Mikado's new palace in Tokio, Japan, installing there 3,000 electric lights. From 1872 to the present time Mr. Frazar has been the resident partner in New York of Frazar & Co., his home being in Orange, where he was president of the Orange Music Hall Association, which position he held for about five years. Mr. Frazer held the following offices: President of the American Asiatic Association; director of the New Jersey Postal Telegraph Company; director of the Atlantic Mutual Insurance Company, and the Harvey Steel Company, and president of the Sims-Dudley Defense Company. He leaves a widow, two daughters and a son.

MR. T. C. SMITH died last week in his eighty-sixth year at Greenpoint, L. I. He was born in Bridgehampton, L. I. He came to New York and was apprenticed to a builder, and a few years later, after establishing a business of his own, he became Superintendent of Buildings. At the time of the Civil War he came into possession of a small porcelain factory in Greenpoint. He went to Europe, where he spent two years about the large porcelain works, and on his return he established the Union Porcelain Works, which now occupy a square block in Oakland street, Greenpoint, and whose product has long been familiar to electrical concerns. He was one of the organizers of the Seventeenth Ward Bank, and for four years was its president. For twenty-five years he was president of the Ophthalmic Hospital in New York. He was a trustee of the Greenpoint Savings Bank and of the Mechanics' & Traders' Society of New York, and he was a life members of the New York Historical Society and the Havens Relief Fund Society. He helped to organize the Manufacturers' Insurance Company. Under Mayor Low's administration, Mr. Smith was a Brooklyn Park Commissioner. He is survived by a widow, one son and three daughters.

PERSONAL.

MR. W. J. CLARK, European manager for the General Electric Co., is expected in this country.

MR. E. A. CAROLAN, of the General Electric Company, has returned from his extended business trip throughout the Far East.

MR. GEORGE WESTINGHOUSE has bought the old Ely-Copperfield mines in Vermont, and will develop them, an abundance of copper still being there, it is said.

MR. GEORGE A. MAYO, a veteran electrical engineer, etc., has just reported from Seattle, Wash. He has been up in Alaska securing some very valuable gold claims, etc., and is going back this year.

MR. HIRAM S. MAXIM, the well-known American inventor in the electrical field, etc., and long domiciled in England has just been knighted by the Queen. He is largely interested in English works for making his machine gun, etc.

MR. L. M. HANCOCK, of Colgate, Yuba County, has lately been appointed general superintendent of the Bay Counties Power Company, of California, and is busily occupied with the notable transmission enterprise of that corporation.

MR. ALEX. WYNESS, JR., has been elected secretary of the Geneseo Gaslight Company, of Geneseo, N. Y. Mr. Wyness is now secretary and superintendent of the works, and his election as secretary is a recogntion of the services which he has rendered the company.

MR. H. F. PARSHALL, the American electrical engineer who has been so actively engaged in electric railway work in England, has arrived here on a short visit. He reports very favorably on the technical and commercial success of the underground London Central Railway, of which he has been the consulting engineer since its inception.

MR. PHILIP DAWSON, chief engineer, director, etc., of Robert W. Blackwell Co., of London, is now in this country to spend a month on various business errands. He speaks hopefully but conservatively as to electric railway development in England and on the Continent. While in New York he is staying at the Albemarle Hotel.

MR. I. L. RICE.—It was announced in Wall Street this week that Isaac L. Rice, president of the Consolidated Railway, Electric Light & Equipment Company, who has been in Europe for five months, has finally completed his contract with Vicker, Sons & Maxim. From a cablegram received, the contract is in every way satisfactory, and Mr. Rice is preparing to sail for America.

MR. J. W. MARSH, vice-president and general manager of the Standard Underground Cable Company, Pittsburg, Pa., on Jan. 3 made an address before the Pittsburg Chamber of Commerce on the submarine cable business in the United States, in which he said that American manufacturers were perfectly able to take care of the work in laying the Pacific cable to Hawaii, the Philippine Islands and Japan. The address was attentively and enthusiastically received by the members of the chamber, and at the conclusion a vote of thanks to Mr. Marsh was passed.

MR. ROGER W. CONANT, who was connected with the Boston Elevated Railway for nine years as electrical engineer, has resigned to accept a position with the Gold Car Heating Company as manager of their New York office. Mr. Conant is well and favorably known to railway officials both here and abroad through his writings on subjects pertaining to electrical and mechanical engineering. He is a graduate of the Massachusetts Institute of Technology and has been engaged in practical railway engineering for many years. His resignation from the Boston Elevated Railway was received with regret, the management expressing their appreciation of his work and heartily wishing him success in his new undertaking.

EDUCATIONAL.

VIRGINIA MILITARY INSTITUTE.—The new plant just installed in the Virginia Military Institute at Lexington, Va., is to be used entirely for experimental work in the Department of Physics. It includes one 7-kw Wagner rotary converter driven by a 10-hp Otto gas engine, and a storage battery of 15 cells.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—The students of the senior class taking steam engineering at the Massachusetts Institute of Technology are now in the midst of one of two boiler tests which are carried on as a part of the work in the engineering laboratory. The first one is to last 96 hours and the second 88 hours. The students are divided into watches of four, each watch serving for eight hours. The boilers on which the first test is being made are 100 horse-power each, are 16 ft. long, 60 ins. in diameter and have 84 3-in. tubes which are cleaned every 24 hours. Two of the four boilers have Hawley down-draught furnaces and two have Sheffield shaking grates. Every 12 hours, and at the end of the 96 or 88 hours, the four are cleaned, the ash-pit cleared and the water brought to the position of the start; then the data are collected and recorded upon blanks by every student, and the students from these calculate the results of the test. The three watches of the day begin at midnight, at 8 in the morning and at 4 in the afternoon. The chemical analysis of the coal is found, and the heat of combustion of it in B. T. U. The total evaporation from and at 212 degs. F. per pound of dry coal, per pound of combustible, and per square foot of heating surface per hour. The coal burned per square foot of grate surface per hour is found. The boilers are rated in horse-power developed according to the American Society of Mechanical Engineers' standard. This test is the end of the first term's work of the Engineering Laboratory.

Trade Notes.

THE SKENE AUTOMOBILE COMPANY, of Lewiston, Me., has been succeeded by the Skene American Automobile Company.

THE U. S. ELECTRIC CONSTRUCTION COMPANY has succeeded to the business of Cronin David, Syracuse, N. Y., dealer in electrical supplies.

THE STANDARD ELECTRIC COMPANY, Cincinnati, Ohio, has moved to a new location at 113 West Third Street, now occupying the entire six-story building.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, Philadelphia, Pa., has issued its monthly calendar blotter for January. The company is sending it to the trade, accompanied by circulars descriptive of an electric pressing iron.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, Mass., announces that it has increased its storage capacity for its electric light business and will carry a largely increased stock. It will thus be enabled to fill orders with promptness.

ACCUMULATORS FOR ISOLATED PLANTS.—The storage battery plant at the residence of Mr. Archibald Rogers, Hyde Park, N. Y., is described and illustrated in the Electric Storage Battery Company's circular No. 63. This is a model and interesting plant.

THE LUNKENHEIMER COMPANY, of Cincinnati, is distributing a daily calendar with figures 4 ins. high. Although it is not what one would call an attractive calendar, it cannot be hung in an office without attracting attention, and it will keep Lunkenheimer's valves, whistles, oil cups, etc., constantly in mind, particularly the whistles.

STEAMSHIP FORCED DRAFT.—The boilers of the new eighteen-knot Ward Line steamship "Morro Castle," having 442 sq. ft. of grate surface, are equipped for forced draft furnished by four special Sturtevant fans having wheels 66 ins. in diameter, driven by direct connected double enclosed engines designed to run at 480 revolutions per minute.

I-T-E CIRCUIT BREAKERS.—The Cutter Company, Nineteenth and Hamilton Streets, Philadelphia, Pa., in a circular, makes an important trade announcement with reference to its I-T-E circuit breakers. Those interested in these instruments will do well to send for a copy of the circular, from which they will learn something of advantage to themselves.

WALSH'S SONS COMPANY, Newark, N. J., who are dealers in scrap iron metals and second-hand machinery, including motors, engines, boilers, etc., have issued for 1901 a desk calendar and dairy pad combined, each leaf containing the dates for one week. The back of the calendar is taken up with calendars for 1901 and 1902. The whole presents a very neat appearance and is more than ordinarily useful.

HOUSEHOLD AND EXPERIMENTAL SUPPLIES AND NOVELTIES.—Messrs. J. Elliott Shaw & Co., 632 Arch Street, Philadelphia, Pa., have just issued catalogue and price list No. 9 of household and experimental supplies and novelties. The contents cover a broader ground than the title indicates. Almost everything in the electrical line is handled by this firm. The catalogue contains 234 pages and is provided with a very complete index.

THE CARLISLE & FINCH COMPANY, Cincinnati, reports business exceedingly good, particularly in electrical novelties. The demand for its sparker dynamos for gas engine ignition is very heavy and the company has orders ahead for several weeks. This company has just filled a number of important searchlight contracts, some for the United States Navy and some for the United States Army.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, has closed a contract with the Manix Dry Goods Company at Nashville for a complete lighting plant consisting of two 11 x 14 Buckeye engines direct connected to two 62½-kw generators, together with complete marble switchboard and other appliances. The same company has just installed a complete lighting and power plant for the Eureka Foundry Company in Cincinnati.

THE STEPHENSON MANUFACTURING COMPANY, of Albany, N. Y., reports a steadily increased business on its bar belt dressing, not only among belt users throughout this country, but abroad. The foreign orders are coming to it as a direct result of free samples sent to various countries upon request of the recipients, who, after testing the sample, order without hesitation. These samples are sent by mail to all who will take the trouble to write for them.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, Cleveland, Ohio, is just completing an exchange of 400-drop capacity for the Salamanca Telephone & Telegraph Company, Salamanca, N. Y. An exchange of 1000-drop capacity is nearly completed at Hornellsville, N. Y., and work has just been started on a 1000-line exchange for the Corning Telephone Company, Corning, N. Y. The company is also furnishing considerable equipment to the Chagrin Falls Telephone Company, Chagrin Falls, Ohio, which is rebuilding its system.

CALENDARS.—The New England Electrical Works, Lisbon, N. H., have issued a calendar for 1901, the prominent feature being the trade mark of the company, which, being printed in red ink on a yellow background, makes a very attractive appearance. The company notes that it is manufacturing fine magnet wire. The Chase-Shawmut Company has issued a neat monthly calendar for the first year of the new century. The card upon which the calendar is mounted contains a half tone view of the switchboard of the Edison Electric Illuminating Company, Savannah, Ga.

THE NORTHERN ENGINEERING WORKS, Detroit, Mich., report a steadily increasing business in cranes. Their shop has been well filled during the entire year. Much of their product has gone abroad, but the bulk of it has been placed in the best American shops. They manufacture a variety of styles of electric traveling cranes, as well as hand-power, pneumatic and other types. The company has installed considerable new machinery during the past year and contemplates adding more new equipment. A new structural shop for making their own girders was added during the year.

"ABOUT A GOOD PRINT SHOP" is the title of a striking pamphlet, vertical oblong, 7 ins. x 14 ins., issued by Griffith, Axtell & Cady Co., catalogue makers and embossers of Holyoke, Mass. It advertises excellently the ability of the concern in embossing, color printing and all the arts of design; each page, printed on one side only, being an illustration of some branch of their work. The cover is quite noteworthy, bearing the slim figure of a youthful herald embossed in gray, green and gold. The back cover is the same, with the color scheme reversed. The whole is tied with gold thread and wrapped loosely in oil paper.

GOOD FEELING BETWEEN EMPLOYER AND EMPLOYEES.—The Vallee Bros. Electrical Company, Philadelphia, Pa., entertained its employees at a banquet on the evening of Jan. 2 as a mark of its appreciation of the successful results of the past year, obtained largely through the fidelity of its employees. The affair proved to be most enjoyable, both to the members of the firm and employees. At the conclusion of the supper speeches were made by a number of the employees, voicing the good feeling existing between themselves and the firm, and suggestions were made that will no doubt accrue to the benefit of the firm and its customers. There were 22 persons present, including all the members of the firm.

THE KENTUCKY INCANDESCENT LAMP is the subject of a circular being sent out by the Kentucky Electrical Company, Owensboro, Ky. These lamps are said to be the only ones manufactured in the South, and are guaranteed to maintain candle-power and efficiency and give a satisfactory life if burned at rated voltage on a steady current. They are also guaranteed to be non-blackening. The company's railway lamp has a special filament, consuming 4 watts per candle, and, it is stated, is in every way adapted to meet the severe conditions imposed by railway service. The Kentucky Company also manufactures slow and medium speed dynamos and motors, both of the open multipolar type and the semi-enclosed multipolar type.

IDEAL ENGINES.—Messrs. A. L. Ide & Sons, Springfield, Ill., send us a list of recent sales of Ideal engines for electric work. The aggregate number of engines in this list is 57. Among the machines are the following: One 300-hp, belted type, for the Northwestern Fixture Co., Klondike; one 175-hp direct connected, and one 100-hp direct connected for the Urbana Light, Heat & Power Company, Urbana, Ill.; one 125-hp belted engine for the electric light company Albuquerque, N. M.; two engines for Daniel Adamson & Co., Dunkinfield, Eng.; one 250-hp belted engine for the City Gas & Electric Company, City of Mexico; one 150-hp direct connected engine for the Lake City Electric Company, Lake City, Ia., and one 250-hp direct connected engine for the Lincoln Gac & Electric Company, Lincoln, Neb.

ELECTRIC MINE LOCOMOTIVES.—The subject of electric mine locomotives is handled in a very interesting and attractive manner in a handsome catalogue recently issued by the power and mining department of the General Electric Company. The catalogue, which contains 46 pages, is very handsomely illustrated with views of various types of mine locomotives and of actual installations. The first section is devoted to a description of the advantages of mine haulage; in the second section is given a detailed description of the General

Electric Company's standard locomotive and includes illustrations of the various types of machines, together with the various component parts, and tables of dimensions and other engineering data. The cost of mine haulage by electric locomotives is also discussed and figures given. At the back of the catalogue is given a list of General Electric mine locomotives in actual use. This list shows that there were, at the time of its compilation, 177 electric locomotives in use. The cover of the catalogue is a very artistic production and the printing and all the mechanical work is of the company's usual high class.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 1, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

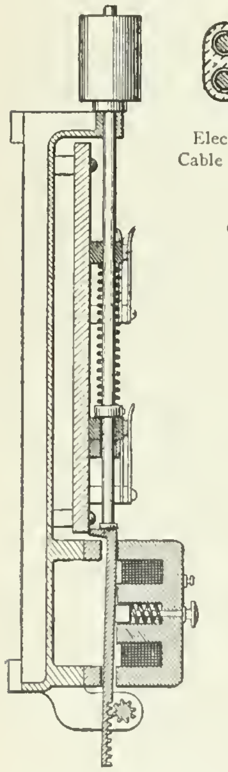
664,865. BURGLAR ALARM; J. H. Howard, Kansas City, Mo. App. filed Oct. 5, 1899. A door mat containing parallel metal disks normally separated, but adapted to make contact to close an alarm circuit when pressure is put upon them.

664,904. MICROPHONE; August Herman Skold, of Stockholm, Sweden. App. filed Dec. 22, 1897. A diaphragm has a number of contact plates on one face, by means of which a corresponding number of granular carbon contacts may be thrown in series, thereby increasing the intensity of the current fluctuations.

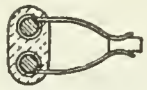
664,907. ELECTRIC ELEVATOR CONTROLLER; B. S. Stephens, New York, N. Y. App. filed March 17, 1899. Separate hand ropes are used to open and close the circuit, and one of them is connected to the belt shifter.

664,915. ELECTRICAL DEVICE FOR DETERMINING THE RESISTANCE OR CONDUCTIVITY OF BODIES; H. E. Warren, Newton, Mass. App. filed Jan. 27, 1896. A Wheatstone bridge comprising an arm having variable resistances, whose values are arranged in geometrical proportion having a ratio of 10, an arm formed by the resistance to be measured, a slide-wire forming the other two arms, arranged in a circular path, a movable contact arranged to engage said wire to balance said bridge, a pointer controlled by said contact, a scale so graduated that said pointer when said bridge is balanced, shall indicate on said scale a decimal part of the unknown resistance, a telephone in circuit with said bridge, and a current-detector device in said telephone circuit.

664,939. OUTLET BOX; J. Fountain, Jr., Elizabeth, N. J. App. filed Oct. 27, 1900. The holes of the box providing for the entrance of pipes and conductors are normally closed by disks which can be easily broken out.



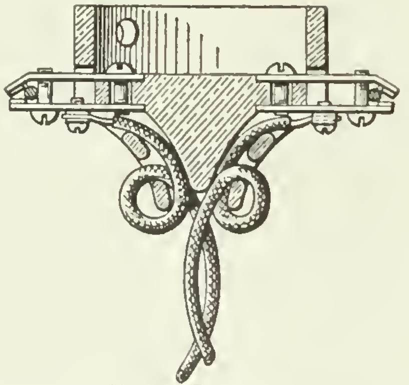
664,986.—Electric Switch.



664,966.—Electrothermostatic Cable for Fire Alarms.

664,941. TELEPHONE ATTACHMENT; G. W. Ganow, Phillipsburg, Pa. App. filed July 2, 1900. The receiver is attached to a holder and normally held directly in front of the transmitter so that it must be pushed aside to use the telephone; this movement changes the circuits.

664,948. ELECTRIC METER; Caryl D. Haskins, of Newton, Mass. App. filed July 29, 1899. A storage battery watt-hour meter provided with a magnetic clutch whereby either of two registering devices may be cut in or out, one device registering while charging and the other while discharging.



665,120.—Rosette.

664,953. ELECTRICAL RESISTANCE BOARD; W. R. King, Newark, N. J. App. filed July 21, 1900. The segments on the face of the board are each provided with two sockets in which to secure the ends of a resistance coil.

664,966. ELECTROTHERMOSTATIC CABLE FOR FIRE ALARMS; A. Munker, Schoeneberg, Germany. App. filed April 14, 1900. At intervals in the cable the two wires composing it are provided with springs which are normally held apart by a fusible block.

664,971. INCANDESCENT LAMP; Edward Riordan, of New York, N. Y. App. filed April 5, 1900. The filament is connected at its middle point to a conductor, which latter is connected to a contact point in the base. By means of a suitable key socket one or both sections of the filament may be kept in circuit.

664,986. ELECTRIC SWITCH; G. H. Whittingham, Baltimore, Md. App. filed March 19, 1900. An electro-magnet serves to connect a power device with the movable part of the switch and to retain said movable part in any position to which it may have been moved by the power.

664,902. TROLLEY FOR ELECTRIC RAILWAYS; L. D. Chabut, Pittsburg, Pa. App. filed June 14, 1900. Details whereby the trolley wheel is confined to the wire until it is released by the hand rope.

665,027. PRINTING TELEGRAPH; H. Mahnken, New York, N. Y. App. filed March 6, 1900. Details.

665,040. AUTOMATIC FIRE ALARM; A. R. Thompson, Indianapolis, Ind. App. filed Sept. 22, 1899. A pair of spring arms are mounted between two terminals and held out of contact therewith by a fusible link.

665,051. ELECTRIC TRACTION; S. G. Bennett, Wolverhampton, Eng. App. filed Oct. 13, 1900. The plough passes between hinged contact pieces which are forced toward each other by springs.

665,065. FUSE HOLDERS; W. R. Cook, Pittsburg, Pa. App. filed April 18, 1900. A cylinder carrying a plurality of fuse wires is rotated after the destruction of each fuse by a device which engages with the fuse itself.

665,087. CONTROLLER FOR ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed Sept. 25, 1900. (See Current News and Notes.)

665,094. MEANS FOR ELECTRICAL CAR PROPULSION; J. H. Hertner, Cleveland, Ohio. An alternating current motor is used for propulsion, while a continuous current generator is driven by said motor to furnish current for operating several magnetic clutches for varying the speed.

665,120. ROSETTE; A. A. Moffitt, Pawtucket, R. I. App. filed Oct. 16, 1900. The rosette contains a number of openings through which the flexible conductor is threaded to remove the weight from the binding screws.

665,127. CONTROLLER FOR ELECTRIC MOTORS; G. H. Parmalee, Johnstown, Pa. App. filed July 25, 1900. (See Current News and Notes.)

665,134. TELEGRAPH OR TELEPHONE CALL MECHANISM; E. E. Salisbury, Chicago, Ill. App. filed March 21, 1900. Details.

665,139. CONTROL OF ELECTRIC MOTORS; B. C. Shipman, Johnstown, Pa. App. filed May 29, 1900. (See Current News and Notes.)

665,143. CONTROL OF ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed June 5, 1900. (See Current News and Notes.)

665,144. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed June 16, 1900. (See Current News and Notes.)

665,156. DOUBLE POLE SWITCH; R. E. Wood, Baltimore, Md. App. filed Aug. 28, 1900. A modification of the snap switch.

665,195. STORAGE BATTERY; A. G. Eneas, Boston, Mass. App. filed Oct. 9, 1897. An electrode comprising a conducting core, a number of independent rigid porous partitions movable thereon, and active material interposed between the partitions.

665,248. SYSTEM OF ELECTRIC TRACTION; L. M. Maxham, Boston, Mass. App. filed April 28, 1900. One end of a plug is immersed in mercury to which the current leads and the plug is raised by a magnet on the car to close the circuit to the working conductor.

665,251. MOUTHPIECE FOR TELEPHONE TRANSMITTERS; W. S. Moore, Indianapolis, Ind. App. filed May 21, 1900. The mouthpiece is constructed to inclose the mouth and nostrils of the speaker, and connects by means of a tube with the transmitter, the object being to prevent other persons from hearing the conversation.

665,324. MEANS FOR CONTROLLING ELECTRIC MOTORS; J. Green and G. C. Thom, Johnstown, Pa. App. filed June 15, 1900. Two electric motors having independent field and armature connections and designed to operate different mechanisms are combined with a switch for connecting either motor to a single controller at will.

665,362. DRIVING MECHANISM FOR DYNAMOS; W. L. Bliss, New York, N. Y. App. filed April 2, 1900. Details.

665,369. TROLLEY; H. Lachenmeyer, Dusseldorf, Germany. App. filed Feb. 20, 1900. The wheel is inclosed on each side by a cruciform guard mounted independently of the wheel and adapted to retain the wire in the wheel.

665,305. ELECTRICAL TRANSFORMER; Arthur Francis Berry, of London, Eng. App. filed July 23, 1900. The core is composed of built-up laminated iron plates arranged radially, and each having a large hole therethrough. Through the holes extend a coil composed of two concentrically arranged sets of separately insulated conductors; the inner set being arranged in annular rows around a centre one, and the conductors in the outer set being annularly arranged around the inner ones. The inner conductors form the primary and the outer ones the secondary, junction pieces coupling up the lengths of conductors to form the required primary and secondary windings.

665,318. ELECTRIC MOTOR CONTROLLER; F. W. Garrett, Johnstown, Pa. App. filed Aug. 24, 1899. (See Current News and Notes.)

665,319. ALARM DEVICE FOR ARMATURE SHAFTS; F. W. Garrett, Johnstown, Pa. App. filed Sept. 16, 1899. (See Current News and Notes.)

665,320. CONTROLLER FOR ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed March 26, 1900. (See Current News and Notes.)

665,321. METHOD OF CONTROLLING ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed March 26, 1900. (See Current News and Notes.)

665,322. SAFETY DEVICE FOR ELECTRIC MOTOR CONTROLLERS; F. W. Garrett and G. H. Parmalee, Johnstown, Pa. App. filed June 16, 1900. (See Current News and Notes.)

665,337. ELECTRIC RAILWAY MOTOR; F. A. Merrick, Johnstown, Pa. App. filed Dec. 30, 1899. (See Current News and Notes.)

665,350. ELECTRIC MOTOR CONTROL; B. C. Shipman, Johnstown, Pa. App. filed Aug. 5, 1899. (See Current News and Notes.)

665,352. ELECTRIC FUSE BOX; E. W. Stull, Johnstown, Pa. App. filed March 21, 1900. (See Current News and Notes.)

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ELECTRICITY ON THE FARM

The brief and pithy description given in our pages this week by Mr. A. D. McNair of his experiments with an electrically-moved grazing pen will, without doubt, be read with great interest by many of our readers. The application of electricity on the farm is still one of the lagging branches of the art, but it need not always remain so; and it is significant to note that Mr. McNair, for sources of current, points to the cross-country trolley lines that, as a feature of the new century, are now developing in every direction.

We are not sufficiently experienced in farm life to offer any opinion of value on the sheep-raising results of Mr. McNair's work, but we can heartily commend the frankness with which he admits the reasons and causes for discouragement. The great fact remains that all these ideas of electrical application in pastoral and agricultural work have to be tried; and it is certainly no reflection on electricity that alfalfa is not altogether successful as an exclusive food for sheep. It is to be hoped that these and many other such experiments will be tried and renewed, for in that way only can the true value of electricity on the farm, and its limitations, be ascertained.

THE LONDON UNDERGROUND.

A good deal of interest centers in the bids for the electrical equipment of the old Metropolitan steam underground system in London, especially as it has become quite an international contest. Note is made of the situation in our pages this week, with special reference to the proposal to use three-phase apparatus on the track. One can but admire the boldness and courage with which that method has been put forward for such an intricate network of tracks, as well as in view of the difficulties connected with obtaining torque for rapid acceleration and varying speed in order to maintain the schedule. It is true, the system has been applied with apparent success on mountain work, as noted in these pages already, and in mining as well. But to argue from that to the heavy, complicated traffic of the Metropolitan is not easy. Nor is it quite easy to understand that the system would, as alleged, be so very much cheaper.

ALTERNATING CURRENT GENERATORS.

In this issue appears the first of a series of articles on the constructional details of European types of alternators. The writer, Mr. C. F. Guilbert, is a recognized authority on the subject of alternating-current machinery, and in the article gives the result of a painstaking and exhaustive study which he made of the alternators exhibited at the Paris Exposition. In the succeeding articles each of the various types, which are almost entirely inclusive of European makes of alternators, will be taken up in detail and its special constructional features described and commented upon. The series will include a table giving complete data relating to no less than 30 alternators, the data comprising more than 50 entries for each type, under the heads of constants of machines, field, armature and tests. The competency of the author and the exhaustiveness of the study he has made, will give to this series a position of unique importance in the literature of the subject.

ELECTRICAL EQUIPMENT OF HIGH-POWER GUNS.

The article in another column by Mr. Grahame H. Powell on the electrical equipment of high-power guns will be found to have a double interest, first, of a general nature through showing the latest stage of the evolution in high-power guns for fortifications, and second, as another illustration of the admirable adaptability of the electric motor for power purposes. At present army officials are hampered by lack of funds for the proper electrical equipment of fortifications, each of which should be supplied with a central electrical generating plant that advantage may be taken of the electric motor for all power purposes, including electrical transportation for the service of guns and other purposes. It is sincerely to be hoped that Congress will soon see the wisdom of providing funds for this almost indispensable adjunct of a modern fortification.

Maxwell's Law.

Dr. Fleming, in a recent letter to the London *Electrician*, points out some very interesting electro-chemical relations. Maxwell's law is that the square of the index of refraction of a substance should be equal to its permittivity, which latter is also variously termed its dielectric constant, or its specific inductive capacity. In many substances this consequence of Maxwell's electro-magnetic theory of light is well maintained, but in some materials there is a wide discrepancy, the observed permittivity by electric test being much greater than that corresponding to the index of refraction. The index of refraction is obtained with electric waves having a frequency of hundreds of trillions per second, whereas in experimental measurements of the permittivity the frequency is either zero or only a few dozen per second. In the case of water, for example, the index of refraction is about 1 1-3, and the permittivity by Maxwell's law should therefore be about 1¾, whereas, it is really found to be over 50. Prof. Fleming shows, however, that when the temperature of these discrepant substances is lowered sufficiently the discrepancy seems to disappear. Thus when water is reduced to the state of ice, the observed permittivity falls to between 2 and 3.

This effect of temperature is accounted for in a very interesting way. It is assumed that on the electron theory of matter, atoms are either essentially positive or essentially negative, and that a hydrogen atom is positive, while a hydroxyl atom is negative, and the combination of two such atoms into a molecule of water leaves a negative electron at one end of the molecule and a positive electron at the other. When the water is subjected to steady or to slowly reversing electrification, not only is the electric stress transmitted elastically, as in the ether, but the molecules are oriented like compass needles, and this orientation is equivalent to an augmentation of the electric displacement, and gives to the medium a considerably increased apparent permittivity. With very great speeds of alternating electromotive intensity, the molecules have not time to orient and the permittivity tends to be reduced to that which corresponds to the observed index of refraction. Similarly, at low temperatures, the molecules are less free and become interlocked in groups, which are devoid of a tendency to become oriented, so that the permittivity then approaches that of the unoriented molecules even at very low speeds of electrification. This very fascinating hypothesis is only one more instance of the tendency which is being manifested to unite and correlate electric and chemical theory.

The Two Sides of the Shield.

One of the most interesting features of the Institute dinner last week was the difference of opinion among the talented speakers, for the most part past presidents of the Institute, concerning the progress of the electrical arts in the new century. We have become so inured to the superficially informed and his electric infant, that it was almost a shock to hear two distinguished engineers, conspicuous for their hard practical sense and for the deep and strong marks they have left upon the art, unite in the prediction that the work of the twentieth century in electricity would be largely the mere extension of what has already been begun. And yet, looking at the matter dispassionately, and putting aside the natural tendency to glorify our own, we must admit that there is a semblance of truth in their contention. In this hour of self-sufficiency a statement of the grounds upon which such a contention may be based is not inopportune.

The nineteenth century has been pre-eminently a century of great advances well begun. It has marked the Renaissance of science and industry after the dreary and hopeless Dark Ages—ages which lingered in industry and material advancement later than they endured in art and literature. The science of the seventeenth and eighteenth centuries bears to that of the nineteenth about the same relation that the pre-Raphaelites bore to modern art. But the world was slow of advancement and civil and religious liberty had to be wrought out by the sword before science could flourish. Little profited it a man to spend his life in toilsome investigation when the publication of his results only opened the pathway to the stake or proclaimed him an outcast among his fellows. It took Luther and Cromwell and the French Revolution to give us our heritage of mental freedom, without which the achievements of the century just past could not have been.

It is small wonder then that the smouldering, repressed fire of intellectual activity burst out into splendid brilliancy so soon as the time was ripe. The first half of the nienteenth century witnessed more startling developments in science and invention than any similar period within recorded time. The next 25 years was almost equally startling, while the last quarter of the century has been pre-eminently a period of enormously rapid growth. Even in our own electrical field the progress has been in very large measure the logical development by means of the dynamo of theses which had long before been laid down. When therefore one is confronted by the question as to the real stage of development of electrical art and science, he may well look back a bit and realize that even the last quarter of our last century has been in great measure a time of harvest rather than of sowing. And it has been not barren of new ideas, yet so far as the great fundamental facts are concerned, Faraday gave the world more light than all those who have thus far followed him. There is ample work for another generation even if there should be within its lifetime not a single brilliant discovery or radical innovation. So we should not be surprised or disappointed if it turned out that the most startling progress of the next half century should be along lines other than electrical, perhaps in chemistry or medicine.

With all the tremendous scope of electrical discovery and invention, it is a bit disheartening to realize that our theories as to the real nature of electricity are even now little in advance of where they were a hundred years since. We still talk glibly of positive and negative charges, as one would of red or blue paint, and to explain that the said paint is on atoms or corpuscles rather than on pith balls as of yore is only to sift our ignorance through a finer sieve. The general equations of potential and of fluent functions have been deftly applied to electrical and magnetic investigations, but the physical facts on which the relevancy of the process is based, have not yet been disclosed. We can explain in well-chosen polysyllabic terms why the frog leg taught Galvani its lesson, but in solemn fact, save in differences of terminology, Galvani knew the rationale of the phenomenon as well as we. Ask your scientific friends what heat is, and nine out of ten of them will in effect say that it is a mode of molecular motion, but if you pursue the inquiry a bit further you will get only a glimpse of circling arguments in a haze of definitions. To tell the truth, while electrical arts have made progress that has been the wonder and pride of the last few decades, electrical theory has hardly gotten beyond its swaddling clothes. The steam engine was invented, and much of its theory worked out by Carnot's skillful hands, while the thermal theory had not advanced beyond the stage of caloric.

In matters electrical we are in the main still blundering about in a similar stage of uncertainty. It was a century and a half from Huyghens to Fresnel, and three-quarters of a century from Rumford to Joule, so perhaps we should not marvel if it should take half the twentieth century to gain the tremendous generalization that shall interlink electrical and mechanical stress. At present there is not really even a well-defined theory about which to gather experiments, and even some of our cleverest investigators are simply adding epicycle to epicycle in a maze of orbital arguments. Thus electricity may be said to be at once old and young, full grown and barely learning its first steps. The material benefits of the present century may owe an immese debt to electricity the giant, but his feet are still of clay.

COMMUNICATION WITH THE PLANETS.

A letter which appeared in the New York *Sun* over Mr. Tesla's signature, and is reprinted elsewhere in this issue, discusses the possibility of communicating with Mars or other planets. Mr. Tesla is reported to possess unmistakable experimental evidence, many months old, that the transmission of a message to Mars or some other planet, is possible and easily practicable. If this were certain it would be of very considerable importance. We have apparently no evidence, as yet, that any of the sister planets in our solar system are inhabited at all. As to Mars, it is doubted by some astronomers as to whether the Martian gravitational force, being roughly only one-third of the earth's gravitation, will permit of the retention in its atmosphere of any known gas specifically lighter than carbonic acid. In fact, it seems to be a matter for discussion as to whether the Martian polar caps may not be frozen carbonic acid. Even if the Martian atmosphere were similar to our own, it is a purely gratuitous assumption at the present time that there are intelligent beings within its confines, capable or desirous of entering into communication with the dwellers on our own earth. However, everything is possible that cannot be disproved, and if Mr. Tesla can show how to produce electrical disturbances of reasonably appreciable magnitude at the surface of Mars across the 50-odd millions of miles which intervene at our nearest mutual approach to that sphere, it is a matter of interest to see how it can be done.

The letter commences with a correct statement of the relative amount of power which would fall upon an area 528 ft. square, normal to a vector distance of 50,000,000 of miles from a radiating centre. That is to say, the power received on this area of one-hundredth of a square mile would be one three-quintillionth of the power radiating from the source, assuming no loss in atmospheric absorption. Next follows a vague description of an electric oscillator consisting of a conducting surface above the earth as one armature, the earth's mass as the other armature, and a source of sudden high electric potentials between the two. Five millions of horse power is a very large activity to produce in an oscillator, and we may be pardoned for questioning this magnitude, unsupported by measurements. An oscillator of ordinary dimensions is well known to radiate many kilowatts for very brief intervals of time, when excited by a good induction coil, so that it is conceivable that an oscillator might be possible which should radiate with a momentary activity of 5,000,000 of horse power, and without any large total consumption of energy, just as the momentary horse power of a cannon is enormous in quantitative comparison with the total energy expended in the explosion.

Granting then, provisionally, the possibility of constructing a 5,000,000-hp oscillator for momentary impulses, we are next assured that if a similar oscillator be constructed on the distant planet, and properly attuned, the energy radiated from one and received by the other does not diminish as the square of the distance, but that the ratio of received to transmitted energy varies inversely as the distance. We think that there must be some mistake about this. When a radiation takes place from a point source, the wave sheets are expanding spheres, and their power decreases as the square of the distance from the source. When the radiation is cylindrical, the wave sheets are expanding cylinders, and their power decreases as the distance. When the radiation is in a parallel beam, the power in a non-absorbent medium is constant. Consequently, Mr. Tesla's statement that his proposed radiation power diminishes with the distance, seemingly implies that the radiation is to be of the cylindrical type.

While it may be possible, theoretically, to distribute electrification upon the surface of a globe in such a manner that its release and discharge may give off radiation of the cylindrical type, we think that it is not possible to produce such cylindrical radiation from a single point of disturbance on the surface of the globe. In other words, it seems that any electrical disturbances that can be produced by an oscillator on the surface of the earth, must give rise to waves which at great distances are sensibly spherical, and which dissipate their powers as the square of the distance. An oscillator anywhere on the earth's surface, discharged impulsively, will give rise to solitary waves of invisible light, the movement of which will be directed, as in wireless telegraphy, mainly over the earth's surface radially from the oscillator, but in a minor degree radiation will be thrown outwards into space in waves whose envelopes are very complex near the earth's surface, but which tend to become spherical as the distance from the earth increases. We fail to see what the capacity of the condenser formed by the earth and a neighboring planet has to do with this question, since the electric disturbance is not communicated to any such condenser, but merely to a condenser on the surface of the earth.

Unless, therefore, we are entirely wrong in our premises, we think Mr. Tesla is mistaken in his ideas of the mechanism of transmitting electric radiant energy from one planet to another. We hope that Mr. Tesla will publish a precise description of the phenomena which he observed, and which led him to suppose that ultraterrean causes were at work. From his well-known experimental skill, a description of his observations before some scientific body would doubtless be extremely interesting. Our readers cannot but agree to some extent with the editorial article in the New York *Tribune*, which, speaking for the lay public, ventures to say: "It is to be regretted that the first news of the incident was not given to a scientific society of standing, rather than to a philanthropic organization or an ordinary newspaper. The former method was pursued by Faraday, Henry, Hertz and other early investigators, and has also been adopted by Marconi, Röntgen, and many modern devotees of science. Indeed, it may be said to be the universal practice of the more advanced and successful students of nature's laws. The great advantage of such a course is that the question and criticism which are thus instantly evoked promote an exact knowledge of the facts and a sounder interpretation of them than is otherwise possible. If, for instance, Mr. Tesla had honored either the New York Academy of Sciences or the American Institute of Electrical Engineers with a report of his experiments, several obscure points in his story would have been cleared up promptly, and perhaps the suggestion would have been made that it is more rational to look for a purely terrestrial cause for the observed phenomenon than to go hunting for one out in interplanetary space. In the final event it is the scientific expert, and not the average newspaper reader, that must pass judgment on such a revelation."

A New Century Dinner of the Institute.

A very successful dinner in place of a regular meeting, was given by the American Institute of Electrical Engineers on Jan. 9, at the well-known Arena on West Thirty-first Street, when nearly one hundred members and their friends gathered for the occasion. Mr. Carl Hering, president of the Institute, took the chair, and a list of those present would include, with very few exceptions, those who have been active and prominent in the affairs of the Institute since its birth. After the dinner, there was a brief series of admirable speeches on "Electricity in the Last Century and in This." President Hering made the start in a pithy address, and was succeeded by Dr. N. S. Keith, the veteran founder of the Institute, who told the story of its humble creation in 1884, and cast a rough horoscope of its condition in 1984. Speeches were made by ex-presidents of the Institute as follows: Kennelly, Crocker and Sprague, the first making an eloquent review of the science and art, and the last two agreeing more or less in the view that the nineteenth century had been a period of unparalleled electrical activity, and that the present century, without seeing any very great new wonders, might be devoted merely to work along the lines already familiar. Prof. Hallock, of Columbia University, spoke very happily and brilliantly of the relations between electricity and physics in general. At the close of the dinner the wish was universally expressed that the affair might be made annual, it being now two years since the last of the kind in New York City. The dinner committee were Messrs. W. J. Hammer, R. T. Lozier, Max Osterberg and T. C. Martin. It may be noted that great amusement was caused during the evening by the reception of a fraternal message from the Martian Institute of Electro-Etherical Engineers, to whose president, named Jones, a reply "collect" was sent by President Hering.

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The Recent Curious Erie Telephone Deal.

As the result of the extraordinary change in Erie Telephone affairs, noted recently, the following is a complete list of new directors elected, classified as to representation:

Representatives Old Colony Trust Company Syndicate: Gordon Abbott, Walter Abbott, Philip Dexter, William Endicott, Jr., Frederick A. Farrar, E. E. Foye, Reginald Foster, Francis R. Hart, T. J. Harper, J. A. Parker, E. A. Phippen, J. G. Stearns, Charles S. Tuckerman. Old Board: Albert B. Chandler, Charles J. Glidden, Davis S. Greenough, J. W. C. Pickering, A. C. Russell. T. T. & C. Co. of Am.: Charles E. Adams, Frank A. Cutting, J. L. Jones, William J. Latta, Martin Maloney, Frank Tilford, Henry R. Wilson.

The above gives the Old Colony Trust Company 13 of the 25 directors. The retiring directors are as follows: Representing the Telephone, Telegraph & Cable Company: George Crocker, Harrison E. Gawtry, Daniel O'Day, John B. Stauffer, Charles R. Morse and W. H. Gelshennen. Representing the old board: John C. Burke, Wesley A. Gove, James H. Mills, Levi Sprague, Harvey A. Whiting. It is proposed to shortly reduce the present number of directors to about a dozen members, the Old Colony Trust Company still controlling the board. Its chairman is a director in the Bell Company.

The whole story of the transfer of Erie control back to Bell interests, as told in these columns last week, embraces many points of mystery. One "independent" telephonist, expressing an opinion, said that he believed that the Erie had been deliberately "unloaded" as a trap for those who bought it, to tie up the money they had in hand for new work and to swamp them with further responsibilities. This, however, does not appear altogether intelligible. The capital of the Erie Company is a little over $10,000,000. After its expansion to that figure the Telephone, Telegraph & Cable Company of America secured control by purchase, at $115 per share, of $5,000,000 of the $10,000,000 issued capital. It is understood that the larger part of this new $5,000,000 had really never been placed. A portion of it had to be taken from the stock market, and in buying for control the price advanced to $122. The Philadelphia company then had the financing of Erie's affairs. Another $5,000,000 of stock was offered to shareholders which was not taken to any great extent, and the Philadelphia people were unable to take their half of the new $5,000,000. When the Erie people found themselves burdened with a debt of $7,500,000, and the Philadelphia people unable to finance it, arrangements were made to return the company to Boston. Two syndicates were formed. One syndicate loaned the Erie Company $7,500,000 upon $10,000,000 of stocks in the sub-companies as collateral, at a net rate of about 6⅛ per cent. A second syndicate purchased 29.000 shares of Erie stock from the Telephone, Telegraph & Cable Company of America at $100 per share, and these 29,000 shares, together with 21,000 shares held by the Cable Company, were deposited in trust to secure the control of the company in accordance with the wishes of the syndicate advancing the money.

It is understood that dividends will continue, probably at the present rate of 5 per cent, for the company is earning more than this amount.

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Electric Railways in Mexico.

Of the numerous Mexican electric railroad projects now in a fair way of realization, one of the most important is the conversion of the existing horse road into electricity in the prosperous city of Guadalajara, on the west coast of Mexico, and the building of a network of trolley lines in that city will soon be an accomplished fact. The existing track is only 6 miles in length, but 34 additional miles will be laid with rails within the municipal limits and equipped with electric motive power. American capital is at present being raised for the purpose of carrying on the enterprise, and specifications are being drawn up for the equipment, etc.

Power will be derived from the River Santiago at a point where the water gives a head of over 200 ft. in a barranca or cañon, situated some 8 miles from Guadalajara. It was originally proposed to begin operations by developing 2000 horse-power, and generators aggregating 1500 kilowatts were to be installed in the power house. It is believed, however, that with the many favorable responses which are being received from the various large cotton mills and other industrial concerns in the vicinity, which at present make use of steam power, the promoters will feel justified in doubling the above-mentioned capacity of the power plant at the outset of operations.

Twenty-two cars will be at first employed on the roads, which number will be gradually increased until 70 are in constant utilization. Great secrecy is being pursued in the negotiations, but it was stated this week, on excellent authority, that the initial equipment —contracts for which will be let inside of six weeks—will mean an expenditure of at least $500,000.

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Long Distance Electric Railway in Germany.

Emperor William is interesting himself actively in the development of electric traction on ordinary railways. A special dispatch of Jan. 13 says that he has been watching during the past few months the excellent results achieved by heavy electric trains between Berlin and Zehlendorf, and that as a result of his observations he has been discussing with Privy Councillor Rathenau, who is director of the Allgemeine Electricitats Gesellschaft, the possibility of revolutionizing the present system of traction. His Majesty is convinced that electricity must in the future be the motive power of passenger trains, especially express trains, between Berlin and the other German and other European cities. He thinks, however, that steam might for the present be retained for freight and local trains.

Herr Rathenau has issued a report by request of the Emperor, in which he states that some of the leading industrial and financial firms, including Siemens & Halske and Krupp, of Essen, have founded a studiengesellschaft under the chairmanship of Dr. Schulz, president of the Imperial Railway Bureau, to investigate the problem. This syndicate has appointed a technical committee, of which Herren Slaby and Rathenau are presidents, and a sub-committee to deal with the details of traffic, architecture and mechanics. These will examine data and confer. It is expected that the result of their labors will be the establishment during 1901 of a so-called lightning service on the military line from Berlin to Zossen, which Gen. von Gossler, Minister of War, has placed at the syndicate's disposal for purposes of experiment. It is hoped to prove the feasibility of making 200 or 250 kilometres an hour.

Each train will consist of a single car, accommodating about 50 persons. The Allgemeine Electricitats Gesellschaft and Siemens & Halske are each building an experimental car, which generally resembles the ordinary European sleeping car. If the experiments succeed on the Berlin-Zossen line, which is only about 30 kilometres long, it is intended to start a quarter or half hourly service between Berlin and Hamburg. The distance will be covered in rather less than an hour. The Emperor has ordered the State Department to assist the studiengesellschaft as much as it possibly can.

European Types of High-Tension Alternators—I.

By C. F. Guilbert.

Among the various branches of electrical design and construction, that dealing with high-tension alternators has at the present time a leading importance on account of the predominating position which alternating currents are assuming. In this branch the Paris Exposition was particularly instructive, owing to the diversity of the types of machines there exhibited. At the invitation of the editors of this journal, the writer will present in a series of papers the result of a careful study which he was enabled to make of the types of alternators shown at the Exposition. Before, however, taking up the various machines for examination in detail, some general considerations will be offered indicating the present status with respect to the design of alternators and the ideas pertaining thereto which at the present moment prevail.

GENERAL CONSIDERATIONS.

a. One of the points most clearly brought out by the Paris Exposition is the triumph of three-phase currents with respect to alternating-current generators, which remark applies even to machines intended solely for electric lighting. Single-phase and two-phase alternators occupied an exceedingly minor position. There were only two single-phase alternators exhibited, of which one, a Helios machine, also gave three-phase currents. There was but one two-phase machine, that of Farcot, and it should be added that in this case the machine was necessarily a two-phase for the reason that it was constructed for service on existing two-phase circuits.

b. Another particularly interesting point brought out was the relatively minor part played by the inductor type of alternator. The only manufacturers who exhibited this type in machines of large capacity were the Oerlikon Works, Alioth et Cie. and Farcot, and in each case the requirement they corresponded to was that of a heavy machine for direct connection without the use of a flywheel to single cylinder engines. If there is added to the above several small alternators of Siemens & Halske, of Vienna, and the Maison Gramme, of Paris, we have at the most a total of eight inductor alternators. The almost entire employment of large units of low angular speed has contributed not a little to this minor showing. The advantage conceded to inductor machines has been their high peripheral velocity, which permits a sufficient width of poles in alternators of high angular speed. Velocities of from 115 to 130 ft. per second are, however, commonly now obtained from the usual type of machines owing to the adoption in construction of square or ribbon section. The inductor type still answers to the requirement of peripheral speeds comprised between 165 and 355 ft. per second, such as may be necessitated in the case of alternators direct-connected to steam turbines. An alternator of this kind operated by a steam turbine was to have been exhibited in the French section in the space of Sautter et Harle, but unfortunately was not finished in time to figure at the Exposition.

c. As has been stated before, most of the alternating current machines exhibited were of low angular speed. Leaving aside the inductor machines in the space of the Oerlikon Works and Alioth et Cie., and several belted machines of a capacity not exceeding 200 kw, none of the alternators shown at Paris had a speed exceeding 126 r. p. m. All the slow-speed alternators were naturally for direct connection to the driving engine. As is well known, direct-connected slow-speed alternators necessitate either, first, a design such that the rotor shall be sufficiently heavy to act as a flywheel, or, in other words having dimensions considerably larger than demanded by the requirements of the magnetic circuit; or, second, the addition of a special flywheel, or finally, a design such that the magnetic circuit will employ usefully all the metal provided. Most of the direct-connected alternators exhibited may be classified under the first head, while others, such as those of the French Thomson-Houston Company, Siemens & Halske, Schuckert, and the Societe Generale de Nancy employed flywheels, though in only one case—for the reason, among others, that the frequency was very low (25 p. p. s.)—did the weight correspond to that required by magnetic considerations. The third solution was adopted by only one constructor, Farcot. The use of the low speeds—a condition imposed by direct-connection to steam engines—has led to the adoption of peripheral velocities rarely exceeding 100 ft. per second, and in many cases not reaching 80 ft. But even with velocities thus small the width of the pole perpendicular to the axis is still relatively large, while the width of the machine parallel to the axles is generally small; when the frame of the stator is not much wider than the length, this gives a machine an appearance graceful to the eye. Such are the Helios, Charleroi, Creusot and Kolben alternators, as well as some others.

d. The majority of manufacturers appear to pay special attention to drop. This is one of the questions of the day upon which an instructive light was thrown by the machines exhibited at Paris. It is admitted at the present time that the value of an alternating current machine—with exceptions, of course, in special cases—depends on the drop, not only with respect to inductive, but especially with respect to non-inductive circuits. The amount of drop was generally around 5 per cent for non-inductive loads, and up to 15 per cent as a maximum for inductive loads; some machines, however, attained a maximum of only 10 per cent, among which should be mentioned a three-phase alternator of the Societe l'Eclairage Electrique, which has a drop of only 10 per cent with a power factor of .5. The matter of drop is intimately related to the material of the cores and pole pieces. In most of the alternators exhibited these parts were of solid steel, and the saturation in the field magnetic circuit was very high—at the point corresponding to no load being in the middle, and sometimes even beyond, the bend of the curve of magnetization, as in the case of the Labour and Lahmeyer machines. The employment of high magnetizations, while evidently reducing the drop, is not without objection. It necessitates in particular a very exact knowledge of the curve of magnetization of the material employed; a very accurate calculation in designing is required, not only with respect to the field, but also—and this it is which renders the calculation difficult—with respect to the armature reaction; finally, alternators with poles highly saturated will not carry a large overload, or even normal load with a power factor smaller than that used in the calculations, even though a larger drop would not be objected to, on account of the enormous increase of exciting current that would be necessary.

To resume, such alternators have not, notwithstanding the great advantage of very small drop, the flexibility in power of alternators of less saturation, which constituted the majority of machines with steel poles at the Exposition, or, alternators with laminated fields and very low saturation. Among manufacturers who continue to use laminations in the field, two—the Allgemeine Elektricitats Gesellschaft and Farcot et Cie.—can be placed aside on account of their employment of the Hutin and Leblanc amortisseur for the purpose of facilitating the operation of alternators in parallel. The alternator of the Allgemeine Electricitats Gesellschaft belongs in addition to the class of saturated alternators and is, therefore, to be classified with those of small drop. The other manufacturers employing laminated fields in alternators with separate poles are the Oerlikon Works, the Fives-Lille Cie., Siemens & Halske, the French Thomson-Houston and Boucherot et Cie. If we except the two last mentioned—the first on account of the alternator having been designed for operating rotary converters, and the second on account of the machine being asynchronous—we see that the use of laminated fields is on the point of being abandoned. Steel poles, moreover, play an important role in synchronous operation, for their effect is like that of the Hutin and Leblanc amortisseur in diminishing cyclic fluctuations, though at the expense of a greater loss of energy. But a single three-phase alternator, that of Kolben & Co., of Prague, has laminated polar extensions.

e. To the question of drop may be added that of compounding. The advocates of compounding reproach the partisans of alternators of small drop and consequent high saturation, on the poor utilization of the armature on account of the small weight of copper in that part of the machine, and favor machines of small gap and an almost equal division of copper between the armature and the field. A second reason which militates in favor of compounding is one almost inseparable from the first, that of asynchronism; that is to say, of the operation in multiple of alternators without their being constrained to preserve synchronism. Two solutions of the general problem of compounding and of asychronism were presented at the Exposition—one by Leblanc, whose work in electricity during the past 10 years has gained the admiration of the engineers of the entire world, and that of Boucherot, also widely known for his work in alternating currents. A third solution, that of Prof. Blondel, was to have figured at Paris in the exhibit of Sautter et Harle applied to an alternator of high peripheral speed. We shall have occasion later on to return to the two first mentioned solutions.

f. It seems that few manufacturers have paid attention to the armature from the point of view of its reaction. The importance of reaction is, however, the preponderating factor in drop with highly inductive loads and, in the writer's opinion, should be diminished with a decrease in saturation of the field, since a small decrease of the first may give rise to an important decrease in exciting current for full load. The armature reaction in alternators is analogous, up to a certain point, to that of induction motors, and its reduction can be obtained not only by the reduction of the ampere-turns per centimetre of armature, as is generally admitted, but also, other things being equal, by a division of the armature into a larger number of teeth per pole. This idea has been very happily utilized in the alternator of the Allgemeine Elektricitats Gesellschaft, the armature of which has 10 teeth per pole, or 5 per phase. There may also be mentioned the Ganz alternator and one of Siemens & Halske, of Berlin, which have each three teeth per pole and per phase. The teeth per phase of all the other alternators ranged from 2.5 to 2 and 1.

g. The employment of large units renders possible the use of bars with connectors for the armature winding. Two manufacturers, whose three-phase alternators, it may be added, were the largest at the Exposition—the Allgemeine Elektricitats Gesellschaft and Siemens & Halske—used such bars for the armature. The arrangement of the Allgemeine Elektricitats Gesellschaft, of which the scheme will be given later, is most ingenious and marks a development which ranked as one of the most important at the Exposition. The arrangement most used for the winding of the armature with coils is the ordinary one well known. There was, however, a general tendency to place all of the coils of the same phase in the same order, and thus avoid errors in connections. Among alternators employing this kind of winding there may be mentioned those of Brown-Boveri, Ganz & Creusot. Most manufacturers used large coils—that is to say, corresponding to one complete coil per pair of poles and per phase; two, however, employed one coil per pole and per phase. These were the Societe l'Eclairage Electrique and the Liege Company.

h. We cannot leave the subject of armature winding without saying several words on the type of perforations in the armature. In general the perforations were open either to the full width of the groove in order to admit the use of form-wound coils, or for only a small portion of the width. Some manufacturers, however adhered to tunneled windings. These were Brown-Boveri, Rieter and the manufacturers of the Labour & Heyland machines. The metal separating the tunnels from the gap is very thin, especially in the Brown-Boveri machines. Whether tunnels or teeth are used, they have generally a rectangular section with angles more or less rounded. Only one type of machine exhibited—the Lahmeyer—employed a circular section.

i. The gaps employed were quite variable and ranged from one-fifth to one-half inch. Many manufacturers provided means for equalizing the gap in case of its becoming necessary through wear or other cause.

j. The voltage employed in the machines exhibited was almost always 2200 volts at the terminals, but this followed almost entirely from the fact that this was the voltage adopted for the Exposition circuits. In reality, the natural voltage of the type shown is from 2000 to 600 volts, though one machine of 7500 volts was exhibited by the Oerliken Works, and another of 30,000 volts, which held the high-tension record at the Exposition, was shown in the space of the Societe l'Eclairage Electrique.

The points above enumerated were the principal ones observed during a close study of high-tension machines exhibited in the various sections of the Palace of Electricity. In addition to the features of a general nature, many machines presented special features worthy the attention of engineers. To complete the subject we shall, therefore, give a description in detail of each machine. In order, however, to limit the space the dimensions and all principal data of the more important machines will be assembled in a table, and in the specific descriptions we shall content ourselves with pointing out the most interesting features of the high-tension machines, devoting particular attention to the new class of compound machines.

Wireless System in Hawaii.

Wireless telegraphy between Honolulu and the various islands is reported in practical working order. The stations on the various islands have all been established, and the tests made show that everything is in perfect order. On Jan. 3 commercial messages were to be received. The service will include all the islands except Kauai. There are three stations, one at Honolulu, one at Hilo, and one on the Island of Lanai. Lanai is the connecting station between the two others.

Electrical Communication with the Planets.

Mr. Nikola Tesla, under date of Jan. 9, has addressed the following letter to the New York *Sun:*

In your issue of Tuesday, Sir Norman Lockyer, in commenting on my observations, is reported as having stated: "Communication with Mars is absolutely outside the domain of practical science."

Before I had obtained with electrical oscillations results such as were outlined in a recent article I would have unhesitatingly agreed to this statement, but now I have the unmistakable experimental evidences before me that the transmission of a message to that or some other planet *is* possible, and, what is more, easily practicable.

Necessity of avoiding technical details, unintelligible to the general reader, compels me to illustrate the advantage of the new means of communication over the old by a comparison which, though not exact, is sufficiently correct to convey an approximate idea. Suppose that the entire available power of Niagara, about 5,000,000 horse-power, should be turned into an electric arc and transformed into an equivalent amount of radiant heat and light energy to be used for the purposes of signalling. Assume, further, that the observer in a planet at a distance of 50,000,000 miles would be able to utilize integrally the energy falling upon 100th of a square mile of the planet's surface. This would be a difficult, if not impossible task, but if he were successful he would then only have 1-3.140,000,000,000,000,000th of that horse-power available for the operation of his instrument.

On the other hand, let us examine how much energy could be conveyed by the methods and apparatus I have devised. In this case we should provide a conducting surface, connect it through a coil to the ground, and impress electrical oscillations upon this system. By availing ourselves of certain adjustments and artifices we should, according to my experiences, encounter no insuperable difficulties in setting up a movement of electrical energy equivalent to a rate of 5,000,000 horse-power, with but a small *actual* expenditure of energy. Supposing the observer in the planet should avail himself of similar means; we should then have, as in my system of energy transmission or telegraphy without wires, two resonating attuned circuits connected through a condenser. A great advantage would be at once secured, since the energy does not diminish with the square of the distance, as with light, heat or Hertzian rays, but in a linear proportion to the same.

Estimating the capacity of the condenser formed by the earth, the planet and the intervening medium, I find that we should be able to transmit in this manner to Mars, at intervals, energy at the rate of 1-50,000th of a horse-power, which in the tuned circuit on the planet, by skilful construction and adjustment of the apparatus could be intensified to a rate of one-fifth of one horse-power, and a considerable portion of this accumulated energy would be available for the operation of the receiving instrument.

The attainment of this enormous rate of energy delivery is made possible by the fact that in using these novel means we should not dissipate the energy of the transmitter uselessly in all directions through space, as we should when employing rays. We should simply transmit electrical stresses through the medium. It is as if we had a weightless, elastic bar extending from our globe to the planet, and as if we were transmitting energy by pushing this bar back and forth. The above rough estimate is obtained by ignoring the disturbing influences of the sun and of other planets, but by making all due allowances we could still convey to its place of destination an amount of energy many million times that possible with radiant light or heat. As far, then, as our ability of communicating with Mars is concerned, far from believing it impossible, we are justified in considering it practicable. Why should Sir N. Lockyer doubt that the energy would reach the planet? Does not the fact that electric disturbances are produced in the earth by changes in the sun offer a sufficient warrant? While I do not consider myself infallible, I feel confident that I am neither capable of mistaking earthquakes for novel electrical manifestations, nor incapable of noting what might have escaped the attention of others. I did not state that I had obtained a message from Mars. I only expressed my conviction that the disturbances I observed were of planetary origin. It does not follow that they could be detected by magnetic instruments. These are delicate only in a certain sense; in another sense they are very crude. Sir Norman Lockyer asks what ground I have for assuming Mars inhabited? I do not hesitate to admit that I am convinced of it. Perhaps part of my conviction is derived from the perusal of Sir Norman Lockyer's admirable papers. I am sorry he attaches no value whatever to my observations.

Notes on Electrical Development and Experience in the Cripple Creek Mining District, Colorado.

By J. R. Cravath.

THE word "district" is commonly and aptly used by those familiar with this (the greatest) gold mining camp of America. The Cripple Creek District includes two large towns (Cripple Creek and Victor), six smaller towns large enough to warrant electric lighting service, a score or more of large regular dividend-paying mines, and hundreds of claims in various stages of development. Such a condition of affairs, with towns and mines close together, naturally would seem to be conducive to electric power transmission, and so it is. Coal is worth, at the mines, from $6 a ton up (principally up) at the mines on the mountain side where it is needed. Water is also scarce.

There are at the present time two companies in the business of supplying electric power in the district and a third about to enter the field. Although but a comparatively small per cent of the mines are run by electric power the power houses now running are well loaded up considering the time they have been in the field. When one considers that the camp is ten years old and that for eight years mining operations have been going on upon an extensive scale, while the oldest power company has been in the field only since the summer of 1898 and the amount of electric power is comparatively limited, it is not surprising that the per cent using electric power should not be larger. It is surprising, however, that the idea should exist which does among many of the miners that they can generate their own steam power cheaper than they can buy electric power. This idea is of course based entirely on ignorance of what steam power actually costs, and will be eradicated in time. Then, too, steam plant employees have opposed any change which jeopardized their positions. However, as there is not enough electric power to go around, perhaps it is a good thing that all do not want it at once. Power rates in the district are from $0.04 to $0.02 cents per kilowatt hour approximately, as near as can be stated in a general way. The large mines, as a rule, cling to their established steam plants. The small users are, after all, the most desirable customers of the power companies, as to secure the business of large mines requires low rates, and neither of the power companies is fixed at present to handle many very large induction motors. The smaller and newer mines make the best customers, as they have no large steam plants to throw away when they adopt electric power, and the small motors they use do not cause serious fluctuations in the load.

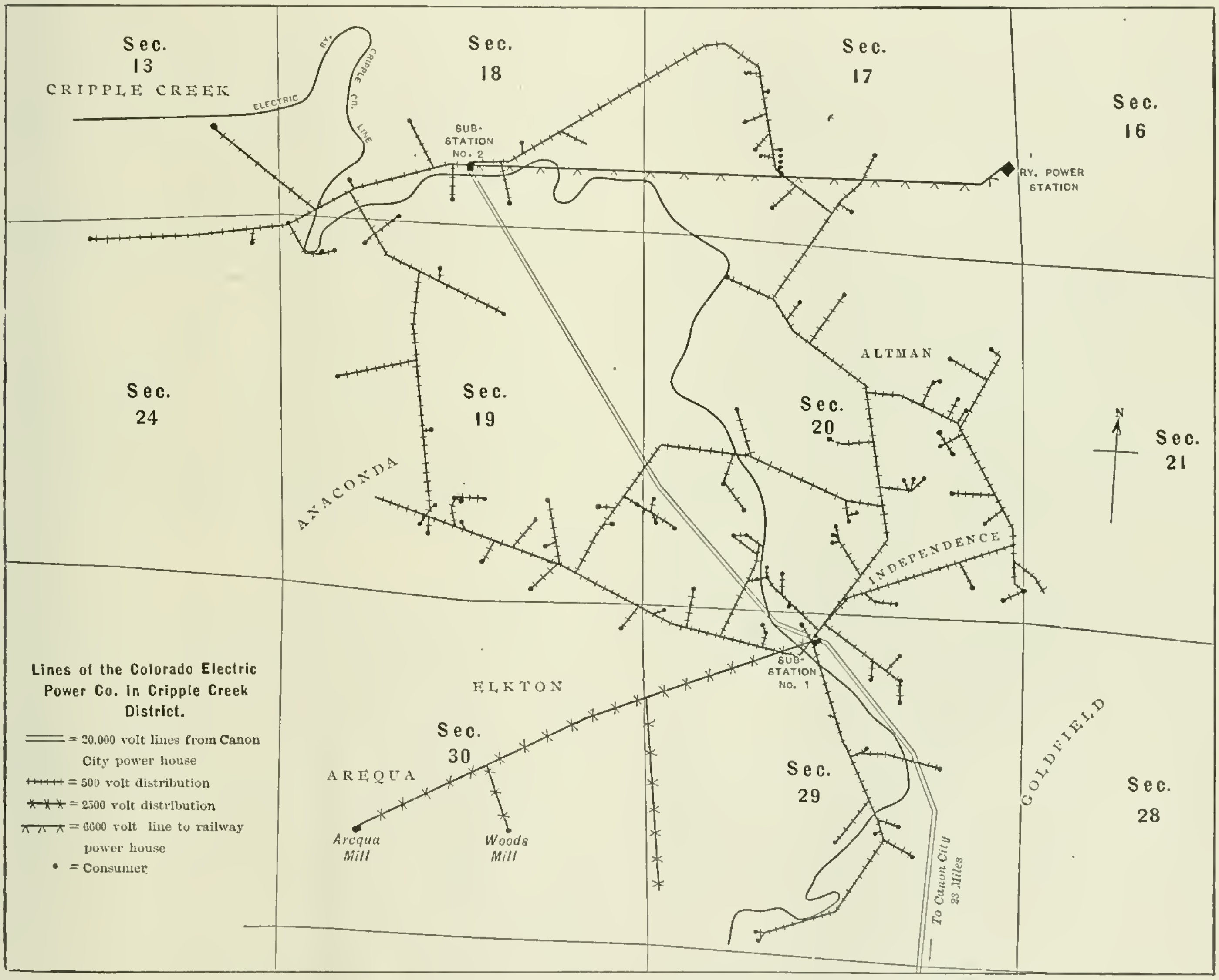


Fig. 1.—Map of Distributing System of Colorado Electric Power Company.

Aside from lighting, the principal use of electricity in the Cripple Creek mines is in driving air compressors, pumps and hoists. The air compressor and pump load is, of course, a fairly steady one, and is a desirable one, from the power station standpoint, not only because of its constancy, but because a mine owner is more likely to realize how much it costs him to run his air compressor by steam than how much his steam hoisting costs him. Nevertheless, hoisting is a very important feature of the electric power business.

Although there are several kinds of induction motor mine hoists in the district, one general type has by common consent been settled upon as the most suitable for the work. In this the motor is geared to the winding drum and in starting the motor resistance is introduced into the armature circuit. The motor is controlled by a street railway type of controller and levers are provided with the hoist, one of which applies a band brake to the drum, the other works a friction clutch which can disconnect the motor from the winding drum. The General Electric hoist controller, which was the first of this type, using resistance in the armature circuit, has provisions for reversing the motor and helping the bucket going down. The Westinghouse controller only operates the motor to lift the load and does not reverse, but depends on the weight of the bucket and use of the brake to effect the descent. It is found that starting these induction hoist motors by introducing resistance in the armature circuit takes much less current and affects the voltage of the supply circuit much less than the use of an auto-converter or reactance coil in the field circuit for starting, as used on some of the older hoists, and the gain in this respect fully pays for the added complication of collector rings on the armature shaft which the use of resistance in the armature circuit necessitates.

There are as yet no mine locomotives in the district, as the conditions do not as yet require them; so that branch of electrical mine work is not represented.

Electric drills have not been introduced yet, but as there are several good designs now on the market they will probably be used in the near future.

The running of ventilating fans in mines and mills is another application of electric power, and this will probably become more important if electric drills are introduced and compressed air is not used in a mine.

The plants and distribution systems of the companies now in the field are very substantially constructed with a view to permanency and reliability. They were not built until the permanency of the camp as a gold producer was well assured, and were built as a sound investment proposition. Of the three plants, one generates power 24 miles away with a steam plant, one has a steam plant in the district, but is identified closely with the railroad, which furnishes coal, and the third will use a water power 11 miles distant.

THE COLORADO ELECTRIC POWER COMPANY

has its power house 24 miles away, at Cañon City, on the Arkansas River, where coal and water are cheap. Power is transmitted from Cañon City to the district over a 3-phase 20,000-volt line. There are two sub-stations in the district from which power is distributed at several voltages. The greater part of the distribution is direct from the sub-stations to the motors at 500 volts, 3-phase. There is also a 2500-volt line running out of one sub-station to some distant mines and a 6600-volt line running out of another sub-station to supply the electric railway power house. The map (page 77) of the company's distribution system in the district shows how extensive is the use of electric power in the mines. The distances can be judged from the township section lines, which are one mile apart. The 20,000-volt transmission line comes in from the south, as shown, and branches at sub-station No. 1. One branch goes into sub-station No.1 and the other cuts across the hills, as straight as practicable, to sub-station No. 2. The stations are a little more than a mile and a half apart. As shown by the map, the 500-volt secondary distribution system forms a network, tied together in as many places as possible. The 500-volt secondary lines, from the two sub-stations, are run in parallel. Thus full benefit is obtained from all the transforming apparatus in both the sub-stations and from all the copper in the lines.

Sub-station No. 1 has four 200-kw transformers, three in use and one in reserve, stepping down from 20,000 to 500 volts. It also has four 100-kw transformers stepping up from 500 to 2500 volts to supply the Arequa mine and Woods mill, at distances of 7581 and 6180 ft. respectively. At sub-station No. 2 are also four 200-kw transformers stepping down from 20,000 to 500 volts for local distribution. There are also four 200-kw transformers, reducing from 20,000 to 6600 volts for transmission 8200 ft. to the electric railway power station, where it is again stepped down, and supplies rotary converters to run the electric railway. This double transformation for the railway load is not altogether an ideal arrangement, especially as the present center of distribution of the electric road is much nearer the point where the first transformation occurs than the electric railway power house, but it was desired by the railway company to put the converters in its steam plant and also to utilize some apparatus it had when run by a water power plant several miles east of the district, which subsequently proved insufficient. All the sub-station transformers enumerated are oil insulated Westinghouse, except four Stanleys supplying the railway, and one 100-kw reserve General Electric.

The transmission line from Cañon City is a little less than 24 miles long. It is over a mountainous country and might be expected to be troubled from lightning, but there have been few interruptions from this cause. No static discharge wires are run on the line, but every 5 miles a bank of Wurts cylindrical non-arcing-metal lightning arresters are placed, 16 in series, on each line. They are enclosed in porcelain, put in a box and placed on a pole. Choke coils and a similar bank of arresters are put at each end of the line. The line is composed of three No. 3 copper wires on Mershon-glass insulators, 6 ins. in diameter, and triple petticoated. These have given good service, the only trouble experienced being an occasional crack in the glass between the tie wire and the pin through which the current leaks and burns up the pin. These cracks are usually due to people shooting or throwing stones at the insulators. The wires are spaced 50 inches apart, two on a cross arm and one on a pin on top of the pole. At corners the insulators are reinforced by a second insulator placed some distance away from the main insulator and tied to it. The results of the operation of this line have been very satsfactory as to reliability. Only one interruption of consequence has occurred in the past eighteen months. This was due to a bad location of the line in a creek basin. A mountain freshet washed the poles out from under the wires one night at 11:45. The next morning at 7 the damage was repaired and the line operating. Current is kept on the system 24 hours a day, every day in the year, and all repairs and alterations are made with current on the line. Since the washout spoken of the line was changed from the creek bed to a safer location with out interruption of service. The plan adopted in changing insulators and handling the 20,000-volt live wire is to connect the live wire, which is to be handled, with a nail in the pole at a point below where the linemen stands when working with the line. This jumper makes a better ground than the lineman's body, consequently he is unharmed. In a damp climate there might be danger of burning the pole up through the ground, caused by the jumper, but no such trouble is experienced in the dry climate of Colorado unless the jumper is left on too long.

N. T. Wilcox, superintendent of the company, although somewhat doubtful at first as to the possibility of giving a reliable 24-hour service the year round over a single 20,000-volt circuit, now considers the line a success in that respect, and the service as reliable as that from any plant. That such results are being attained by a line of this voltage and length over the mountains is a matter of encouragement to all about to enter the long-distance transmission field. One man spends his entire time patroling the long distance line. No small part of this company's success is due to careful, experienced supervision and maintenance of all lines and apparatus. The loss in the line and step-up and step-down transformations is 18 per cent. It is stated that since last summer current has not been off the 20,000-volt line a second. During the lightning season in the summer the line current sometimes follows a lightning discharge across the arresters and causes a partial short circuit for a few seconds. This interferes with the operation of the rotaries more than with any other apparatus.

The 20,000-volt fuses for each transformer in the sub-stations are small copper wires, 23 ins. long, over which a soft rubber tube is slipped. These fuses are stretched between porcelain insulators. The insulators are mounted in rows on two rafters 23 ins. apart up near the roof of the sub-stations. These fuses are very successful as arc breakers. Facilities are provided for quickly cutting out a transformer and substituting the fourth or reserve transformer. Plugs cutting out the 20,000-volt primary fuses, for safety in replacing fuses, are put on the ends of long sticks for insulation. In case the fuses on one transformer blow, the other two legs of the circuit will usually carry the load for a short time until the reserve transformer can be switched in. Then the fuses can be replaced at leisure. The frequency employed on the system is 30 cycles. On the 2500-volt secondary circuit Stanley fuse blocks are used in which the fuse is passed through a hard fibre tube.

An inspection of the 500-volt secondary distribution lines reveals the fact that lightning is a much dreaded enemy, even on low-pressure wires. The original plan for 500-volt pole lines was to put up a cross arm with three pins on it for the three-phase circuit and fasten barbed wire by staples directly on each end of the cross arm and to the pole top. The copper wire usually stretched more than the iron and in time a mixup between the two would result. Then brackets were put on the ends of the cross arms, as indicated by Fig. 2, and the barbed wire was put on the brackets. This was much better, but the present practice is to put the cross arm 18 ins. from the top of the pole and put a single barbed wire on top of the pole.

The sub-stations require very little attention. One or more employes live near each. At No. 1, is a storeroom, and a book-keeper is on duty during the day. At No. 2 an employe and daughter live, and the girl is able to replace fuses and take care of any ordinary trouble, or at least telephone to No. 1 if there is anything she cannot remedy. A solenoid relay is kept in the secondary circuits at sub-stations which sounds a gong in case current is cut off. A private telephone line is run under the 20,000-volt line from Cañon City power house to the two sub-stations.

The company now supplies about 125 properties (mining and milling) with power, or light, or both. All motors are induction type. The largest are 100 horse-power, of which there are four, all on continuous work. The hoists have motors ranging from 30 to 5 horse-power. There are 65 hosts connected. Lights in mines and mills number about 1500.

In the district and on the 24-mile transmission line there are now 6 men employed. One of these has the duty of patroling the transmission line every other day. One mounted inspector is kept constantly on the go in the district looking over lines, apparatus and meters. The company owns and maintains nearly all the electrical apparatus, which it supplies with power, and charges a rental along with the power bill. Meters are the most prolific source of trouble as their locations around mines are not usually ideal, either as to stability of support or freedom from dust. The result is they need constant attention. The Thomson meter is used.

In spite of the large number of induction motors the voltage on the 500-volt network, as shown by a Bristol recording voltmeter chart at sub-station No. 1, is very small for a power circuit.

The power house at Canon City has three units, consisting each of 30-cycle, 500-volt, 3-phase Westinghouse alternators direct connected to Hoover-Owens & Rentschler Corliss compound condensing engines, two of which are usually run. The exciters are independently engine driven. In the transformer room are four 500-kw step-up transformers for the transmission line. Each of the three transformers, regularly in service, has a double throw switch on its 500-volt primary side so that the load can be thrown from it to the reserve transformer on a moment's notice. The 20,000-volt secondary circuits from each transformer can be opened by switches which give a 4-ft. break. In spite of the fact that the load consists largely of induction motors these switches open the 20,000-volt circuit satisfactorily, which contrasts somewhat with the experience of the La Bella plant, noted later in this article. A track runs alongside the transformers, so that any one of them can be slid out onto a truck and moved out on short notice. This feature is of value in case one catches fire. The switchboard is supplied with voltmeters, ammeters, indicating wattmeters and recording wattmeters, on both generator and totalizer panels. Automatic circuit breakers are used at the time the machines are thrown in parallel (they are always run in parallel), but on account of the sudden fluctuations of the load at occasional intervals the circuit breakers are blocked up after the machines are thrown in circuit and fuses are depended on entirely. H. H. Wilson. chief engineer of the plant has done considerable work in the way of experimenting with synchronizing schemes and now has a very simple and easily worked method. Instead of throttling the engine to get the unloaded machine in synchronism with the loaded ones before throwing in, an adjustable weight is put on the engine governor. The engineer starts up the engine, opens the throttle wide and then adjusts the weight on the governor until the machine is in synchronism. After the machine has been thrown onto the bus-bars the weight is put back to running position and the engine takes its share of the load. Another valuable attachment on the engine governor is an oil dash pot with a valve by which the governor can be made sluggish or sensitive. It is well known that it is easier to synchronize with a sluggish governor than with a sensitive one, because the variations in engine speed do not come so frequently. With an adjustable valve dash pot the sensitiveness can be adjusted at any time at will.

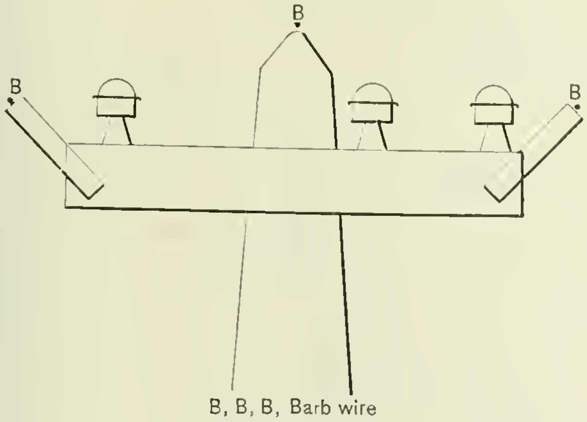


FIG. 2.—POLE LINE CONSTRUCTION.

This company has recently begun commercial incandescent lighting in Canon City in addition to its Cripple Creek load. This is done from the same bus-bars. Some may smile at this and have visions of a very fluctuating incandescent service, but the writer can testify that the night he spent at Canon City, in a hotel lit from this power house, there was much better service as to steadiness of light than there is in the majority of electric lighting plants. The service is supplied from the 500-volt bus-bars by a Scott transformation from 3-phase to 2-phase 2300 volts. Stillwell regulators are used in the light circuits.

To operate the station 24 hours it takes 12 men, divided into eight-hour shifts. Six men are on the day shift and three men the other two shifts.

The work of this successful company has been thus reviewed at length because of the many engineers who are figuring on transmission schemes of this nature at the present time. Although the conditions are somewhat exceptional the engineering results are worth knowing.

The company, of which D. V. Donaldson, Colorado Springs, is president, is largely owned in that city. J. G. White, of New York, is also a director. N. T. Wilcox is general superintendent.

THE LA BELLA MILL, WATER AND POWER COMPANY

began operations in August, 1899. It derives its power from a steam plant, at Goldfield, in the midst of the Cripple Creek District. Being owned by parties interested in the Florence & Cripple Creek Railroad, over which most of the coal for the district comes, it is enabled to get its coal at a very much lower rate than other concerns in the district and is able to produce a kilowatt hour of electrical energy at figures that compare favorably with compound condensing plants in the central states. The station is well designed and equipped. Coal is brought in on a railroad siding above the power house roof and dumped into storage bins, from whence it is fed to traveling weighing-hoppers, and then to Babcock & Wilcox automatic chain grates under Babcock & Wilcox water tube boilers. A crusher is also provided for emergencies. The coal handling machinery was furnished by C. W. Hunt & Co. The generating units are McIntosh & Seymour compound condensing, medium speed engines direct connected to 600-kw 3-phase 6600-volt General Electric revolving field generators. Two units are running and a third going in.

The switchboard is about to be changed to a more satisfactory arrangement than that at present in use. The main, circuit-breaking, 3-pole switches in the 6600-volt mains are of the type carrying a copper and a carbon contact on the end of a long stick and giving a 33-inch break. Owing to the inductive effect of the large number of induction motors on the power circuits this 33-inch break is not always sufficient to break the arc and it streams across the gap to the detriment of everything around. In place of these, oil break switches will be put in and all 6600-volt wires will be kept off the switchboard and the high tension switches placed below the board instead of passing up the back of the board to switches at the top of each panel in dangerous proximity to the low voltage instrument wires, as now.

The company sells power to electric lighting sub-stations, owned by a separate corporation, at eight towns; Cripple Creek, Victor, Goldfield, Independence, Altman, Cameron, Gillette and Anaconda. The 6600-volt current is taken direct to sub-stations in each town where it is transformed to 110 volts on a 3-wire system. A trouble man is kept at each sub-station to look after lines and transformers. In one station direct current arc machines are driven by induction motors. Seventeen mines and five sampling mills are supplied with current by this company. The company usually makes a contract with the mines, which includes maintaining all the electrical apparatus as well as supplying power. It also runs an air compressor in its power plant for near-by mines. In some cases the electrical apparatus is bought by the mines, in others simply rented. The principal power business is driving air compressors and hoisting. The hoists are General Electric induction motors connected through friction drive to a winding drum. In starting the motors resistance is put in the armature circuit, which is subsequently removed. The distribution over the district is at the same voltage as that of generation, viz., 6600. Two cross arms are used on a pole line carrying a single 3-phase circuit. On the lower cross arm are three pins with insulators for the 3-phase circuit. On the top cross arm are three barbed wires for lightning protection, which is grounded as frequently as a good ground can be found. This company is under the general management of Asa Fisher, vice-president, and Herbert S. Sands is chief engineer.

THE PIKE'S PEAK POWER COMPANY.

This company is one of the companies controlled by the Woods Investment Company, which owns various mines, mills and other properties in the district. The chief engineer of the undertaking is R. M. Jones, formerly of Salt Lake City. A water power, coming from the western slope of Pike's Peak, is being developed. Most of the work is done, with the exception of the power house. Water, under about 1000 feet head, will drive 4 Pelton wheels direct connected, each to General Electric 400-kw 3-phase generators. The transmission voltage will be 12,000. Much of the power supplied by this plant will be used in the Woods Investment Company's various properties.

Electric Traction in Naples, Italy, and Vicinity.

NAPLES, Italy, during the past year has been the centre of much activity in electric traction matters. At the present time the transformation of the horse car lines at that city is approaching completion, and the first of several electric lines leading from the city to towns in its vicinity has just commenced operation. It is, however, in projects for lines in Neapolitan and neighboring provinces that the activity has most manifested itself. An account of a few of these will be given further on.

Until a short time ago there were but two lines of street railways in Naples electrically equipped, and both of these are over such steep grades that horse traction would have been entirely out of the question. One of these lines runs from the Museo, a central location in the eastern part of the city, to Vomero, a new residence district being developed on the heights above the old city. The other has its course between the Museo and Torretta, a square at the edge of the western side of the city and near the tunnels which pierce the heights that form a natural boundary to the city on the west. The latter road is part of the system of the Tramways Napolitani Company, which controls practically all of the urban lines.

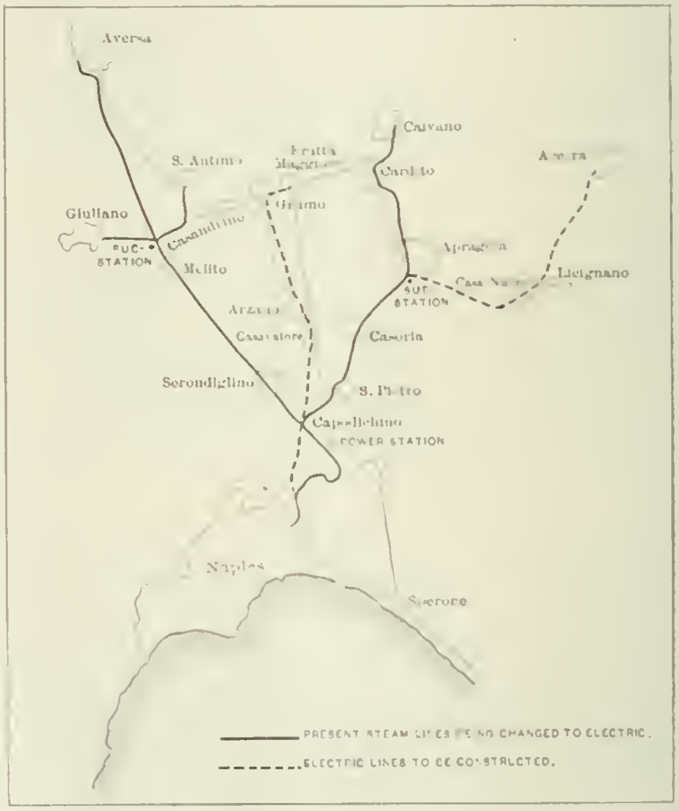
The latter line climbs and descends the steep side of Sant' Elmo, whose amphitheatrical slopes, lined in part with handsome modern buildings, and elsewhere covered with century-old houses, furnishes the beautiful background of Naples. The line reaches its highest elevation near the celebrated monastery of San Martino, and on one side descends toward the Museo, and on the other toward Torretta. Every portion of the road is over steep gradients which at times reach 7½ per cent. It is planned to extend the Museo end of the line down Via Roma, the principal avenue of Naples, to the Piazza Dante in the heart of the business portion of the city. The Sant' Elmo line is 5 miles long and has a single track with 15 turnouts. It is provided with two trolley conductors in order to avoid complication in overhead fittings at the turnouts. The track is bonded with Chicago rail bonds. At present there are in use 15 motor and 10 trailer cars, each of the former being equipped with two General Electric 57 50-hp motors. Both electric and hand brakes are installed on each car. This road has been in operation several years without the slightest hitch, notwithstanding the severe service and the lack, at first, of an experienced operating personnel. Until the new power station of the Tramways Napolitani Company was completed, this and the Vomero line obtained current from the Naples central station at a cost of 2.8 cents per kilowatt-hour.

The transportation problem in Naples is much complicated by topographical considerations. The city lies in two natural amphitheatres and a considerable proportion of the streets are extremely steep in grade—in some cases the street surface being disposed in the form of steps with long lands. The two sections of the city are separated by a high spur of Sant' Elmo which at the fishermen's quarter of Santa Lucia almost reaches the water's edge. While the western portion of the city is much smaller than the ancient or eastern part, yet beyond it lies the populated slopes of Posilippo, and two tunnels connect it with growing communities on the other side of the towering natural wall which forms the western boundary of the city. All lines serving this section converge to the east of the spur before mentioned, and use in common a double track. The congestion thus entailed has been rendered more acute owing to the horse cars very frequently becoming stalled in going up the steep grade by Santa Lucia. This section of the system is the first to be electrically transformed.

There are about a dozen horse car lines and several steam tram lines, wholly or partly located within the city, and all of these will soon be run by electric power, which will be supplied from a central power house, now in course of construction, having the following equipment: Ten cylindrical steel boilers, each having two corrugated furnaces and 20,000 square feet of heating surface; 20 Green economizers, each having 32 tubes of 6000 square feet of heating surface—the tubes being kept clean by an automatic arrangement operated by electric motors, and 3 duplex steam pumps, each having a capacity of 60,000 to 100,000 gals. per hour.

When completed the power house will have five steam engines, as follows: three horizontal condensing tandem-compound engines, each developing from 1000 to 1500 horse-power, and each direct coupled to a 600-kw dynamo; two engines of the same type developing from 500 to 750 horse-power and each operating a 300-kw dynamo; and an engine of the same type developing from 400 to 600 horse-power for the operation of the boosters. There will be four boosters, ranging from 27 to 41 kilowatts capacity. All the electrical generating machinery and the switchboard have been supplied by the Société Anonyme d'Electricité (Schuckert).

The feeding system will consist of underground cables supplied by Siemens & Halske. The voltage supplied direct to the feeders will vary from 575 to 625 volts. The portion of the line nearest the power stations will be fed direct; the more distant stations will be fed from four centres, each feeder to these centres containing a booster. For the return circuit system there are five centres, from which the return current will be conducted in insulated copper cables to the negative bus-bar at the power house, this bus-bar also being connected to the track. At each centre there will be installed an inverted booster. Two trolley wires will be used over all single tracks in order to avoid complication in overhead fittings, and incidentally to reinforce the conducting system; the trolley wire will have a section of 53 square mm. The double track line has a length of 17 miles and the single track line a length of 20 miles, which latter includes the Sant' Elmo and Vomero lines above referred to. The total length of the trolley wire is 63 miles; Schuckert overhead material is employed.



ELECTRIC TRACTION SYSTEM IN AND ABOUT NAPLES.

Three types of rails are used. First, Hitwick rails weighing 77 lbs. per yard, with a counter rail weighing 24 lbs. per yard, the length being 27 ft.; second, Phœnix, weighing 125 lbs. per yard; third, Vignole rails, weighing 50 lbs. per yard, and having a length of from 25 to 30 ft.

The rolling equipment will consist of 203 motor cars, equipped with General Electric 58 motors, and furnished by the Mediterranean Thomson-Houston Company. Each car will provide for 20 passengers in the interior and 18 on the imperialé. The cars and trailers will be equipped with both hand and magnetic brakes, and the latter provided with an electric coupling for making connection with the motor car braking circuit.

We are indebted for the above information to Mr. G. R. Dery, chief engineer of construction of the Tramways Napolitani Company.

The map shows a system of lines leading from Naples to towns in the vicinity, which lines are now being laid down or already existed as steam lines and will be transformed for electric traction. The work is being done by a company having its headquarters in Brussels, Belgium, and known as the Société Anonyme des Tramways Provinciaux de Naples. The power station is at Capodichino and is provided with three engines, each of 350 horse-power. One engine is direct connected with a direct-current generator of 225 kilowatts, another is direct connected to a three-phase machine of 225 kilowatts, and the third is direct connected on one side with a three-phase machine and on the other side with a direct current machine and kept in reserve. The direct current machine will feed to the lines in the vicinity of the power station and the three-phase machine will transmit current at high tension to sub-stations where it will be transformed to direct current at 550 volts, this being the operating voltage of the entire system.

The first line to be opened will be that to Aversa, which is to be put in operation during the present month. The rolling stock for this line consists of 12 motor cars, each equipped with four motors and both hand and electric brakes. The total length of the lines indicated in the map will be about 35 miles. All the lines will be built and equipped by the Union Electricitats Gesellschaft, of Berlin, and we are indebted to its engineer in charge, Mr. D. N. Heineman, for the information given above.

The fares on the Neapolitan line range from 3 to 6 cents first class and from 3 to 4 cents second class. Each line is divided into sections, and the fare paid depends upon the number of sections over which a passenger rides. On the horse cars now in use the only distinction between first and second class seats, aside from location in the car, is that the former have dirty cushions.

The price of coal ranges from $9 to $10 per ton at Naples, and several projects have been put forward to transmit power to Naples for electric railway and lighting service from waterfalls, of which there are many in the mountain ranges occupying the central part of the Italian peninsula its entire length. One of these relates to a development of a power on the Volturno River, near Capriata, and about 20 miles distant from Naples. It is estimated that a minimum of 3400 horse-power may be developed at a total cost of $500,000, and that the total annual cost of a horse-power delivered in Naples would be $34. According to late advices, a company with a capitalization of $2,800,000 has been formed to carry out this work. The money will be furnished by a syndicate of Northern Italian bankers, and the construction placed with a well-known German firm of electrical manufacturers.

Before passing to projected electric railway lines, it is interesting to note that a storage battery car lighting system has been successfully operated for some months on the light steam railway line between Naples and Cumae. The storage battery is contained in the baggage car and consists of 18 Tudor cells, each cell, with its receptacle, weighing 122 pounds and having a capacity of 360 ampere-hours. First and second class cars are provided with three lamps of 12 candle-power, and third-class cars with two lamps. The battery is charged at Fuorigrotte, on the outskirts of Naples, from a 7-kw dynamo. There are four batteries in constant use during the summer for that number of trains, and two batteries are kept in reserve.

An agreement has recently been entered into at Naples between Engineer A. Caneva and M. Van Dorpe, representing a Belgium financial syndicate, with respect to an electric line from Naples to Benvenuto. On March 11, 1900, royal approval was given to a plan for an electric railway in the provinces of Naples, Benvenuto, Avelinno and Caserta, and traversing more than a score of communes. The power station will be constructed at Arpaia.

Another project relating to the Neapolitan provinces is that of Engineer A. Micole, who has proposed an interurban electric road connecting Taranto, Manduria and Lecce with a branch to Monopole and another to Nardo, a total length of 110 miles. This railway will have 38 stations and serve directly a population of 317,000, with 185,000 more within a radius of ten miles. The plan is to provide for two power stations, delivering current at 15,000 volts. The total expenditure is estimated at $4,800,000, or a cost of $44,000 per mile for installation. In order to guarantee this expenditure, annual subventions for the entire period of the concession of 70 years are asked per mile, as follows: $1,700 from the State, $335 from the provinces of Bari and Lecce, and $167 from the communes interested. This annual subvention will assure the necessary capital charges at the rate of a cost of $44,000 per mile. This guaranteed, it is estimated that the cost of operation will be met if the annual receipts amount to only $1,330 per mile, and there is every reason to believe that this income would be much exceeded.

The Mediterranean Railway Company is considering a project for a double track electric railway, starting from Naples and extending to Rome, and having a total length of 125 miles. A greater part of the road will be over partially level ground, including a section of 30 miles along the Roman Appian Way between Terrcicina and Cisterna. Owing to the small grades it is expected that with electric traction the time between Naples and Rome may be reduced to three hours.

A concession has been asked for an electric railway line from Capua through Santa Maria and Caserta to Maddaloni, power to be obtained from the falls on the Volturno, on which river Capua is situated.

Electrical Equipment of High Power Guns.

By Grahame H. Powell.

In order that its latent power for destruction may be developed, the modern high-power seacoast gun must not only be properly aimed, but in these days of quick steaming and manœuvering vessels, must be aimed rapidly, and in this fact electrical power finds a new application.

The aiming of such a gun requires two distinct operations. The movement of the carriage in azimuth and the elevation or depression of the gun. The weights to be moved are large, the moving parts of a 12-in. gun and carriage weighing approximately 440,000 lbs.

Up to the present time, all the gun carriages installed in our fortifications have been designed for the use of hand-power only in their manipulation, but this was found to be so exhausting on the gun crew, as well as the cause of numerous delays in service, that a series of experiments were instituted at one of the fortifications in New York harbor with a view to the development of an efficient electrical apparatus for the purpose.

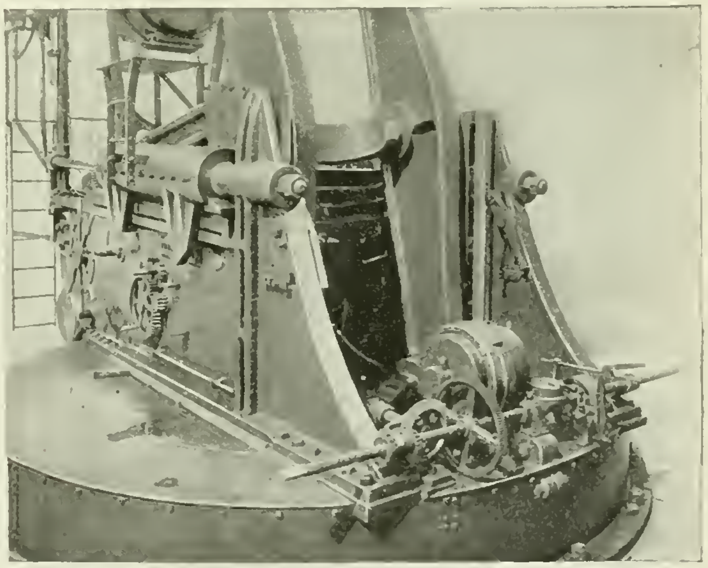


FIG. 1.—TRAVERSING MOTOR.

The result of these experiments has been most gratifying, and the Government is about to equip a number of the large-caliber guns with electrical power apparatus.

Each artillery fortification is equipped with a central station for lighting the magazines and operating searchlights, and so on, and the current required for power will be supplied from this source.

The equipment for each carriage consists of one 3-hp motor, direct connected by spur gearing to the crank shaft of the traversing mechanism, and a 5-hp motor for operating both the elevating mechanism and the retraction gear. On a disappearing carriage the gun is raised from the loading or "down" position to that for firing by the action of the counterweight, and when fired the energy of recoil returns the gun to the loading position. This operation is entirely distinct from the elevating and depressing of the gun in aiming, and a pinion on the motor shaft is arranged to be thrown by a hand lever from mesh with one gear to the other, being secured in each position by a safety catch.

The traversing motor is placed on the forward part of the carriage, as shown in the illustration (Fig. 1), while the elevating and retracting motor is attached to the left side of the chassis, as seen in Fig. 2. In future constructions the latter motor will probably be placed between the cheeks of the carriage so as to be better protected from mechanical injury.

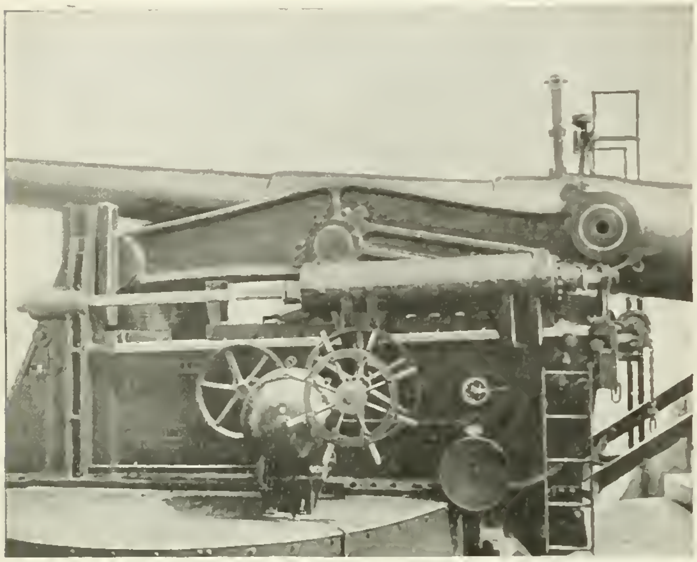


FIG. 2.—ELEVATING AND RETRACTING MOTOR.

The motors are each of the iron-clad type, dust and water proof, and all wiring is enclosed in spiral steel-armored cables. On the main crank shaft of the traversing gear is placed a drum, and to this is applied a mechanical hand brake, which is used to overcome the tendency of the carriage to settle back when stopped quickly at a particular point, due to the great weight and inertia. The brake is found to be very convenient and effective in quickly laying the gun in azimuth, as it enables the operator to slowly approach the desired reading and stop on the exact minute of arc before entirely shutting off the current.

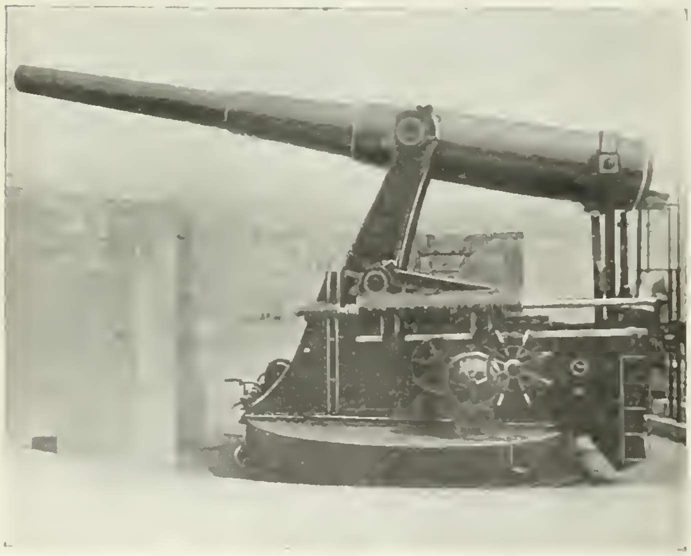


FIG. 3.—GENERAL VIEW, SHOWING BOTH MOTORS.

A very effective form of operating switch which is used consists of two levers and two push buttons, so arranged that one lever corresponds to a movement of the muzzle of the gun to the right and the other to the left. Either lever is readily grasped in the fingers of one hand while the thumb is used to press either the "fast" or "slow" button. Two of these switches are used, one being located conveniently near the traversing motor on the forward part of the carriage for use in indirect laying, and the other on the sighting platform for direct laying, so that in practice the operator can follow a moving vessel through the telescopic sight and keep the gun constantly trained upon it. A similar switch for controlling the elevating mechanism is placed on the side of the carriage, as this operation is not one that would be performed by the man training the gun. Actual experience has shown that by means of the power apparatus described, it is possible to change the direction of the gun by as small an arc as one-half degree, while the carriage can be traversed through the entire field of fire, 120 deg. in 28 seconds. This enables the operator on the sighting platform to follow a moving target through any possible evolution, and still keep the gun trained on the vessel; and if, at the same time, the distance of the target is accurately determined at regular intervals by means of a range finder it is possible to keep the enemy constantly "covered" and be ready at any instant to deliver the fire of the gun.

The central station is located in some protected place, and frequently in the older fortifications, in the casemates, as it is essential that the lighting and power plants should have complete protection as possible from the enemy's fire. Rooms so protected will in many cases be somewhat lacking in light, ventilation and dryness as compared with commercial plants and consequently the installation must be so designed as to minimize the effects of moisture.

Steam is employed as the motive power in most cases, though in a number of instances oil engines are used. In the former case, the disposition of the exhaust becomes a matter of importance as the escaping steam might easily lead to the position of the plant becoming a target for the enemy.

Another source of possible danger, which would not, of course, arise in a commercial plant, is the breaking of the glass storage battery jars due to the concussion from the guns, and it has been found necessary to place cushions, such as hard rubber, on the edges of the jars beneath the supporting lugs of the plates to distribute the weight and prevent strains due to changes in temperature as these strains make the jars sensitive to shock.

The electric light and power installations throughout are on the direct-current two-wire system, and lamps and motors are designed to operate on 110 volts. The wiring is sometimes overhead, and at others in conduits, depending upon the local conditions.

The steel armor-piercing projectile for a 12-in. gun weighs 1000 lbs. This is placed on a shot truck in the magazine, which is then placed on the ammunition hoist, operated by a small electric motor, raised to the level of the loading platform, and from thence run to the breech of the gun.

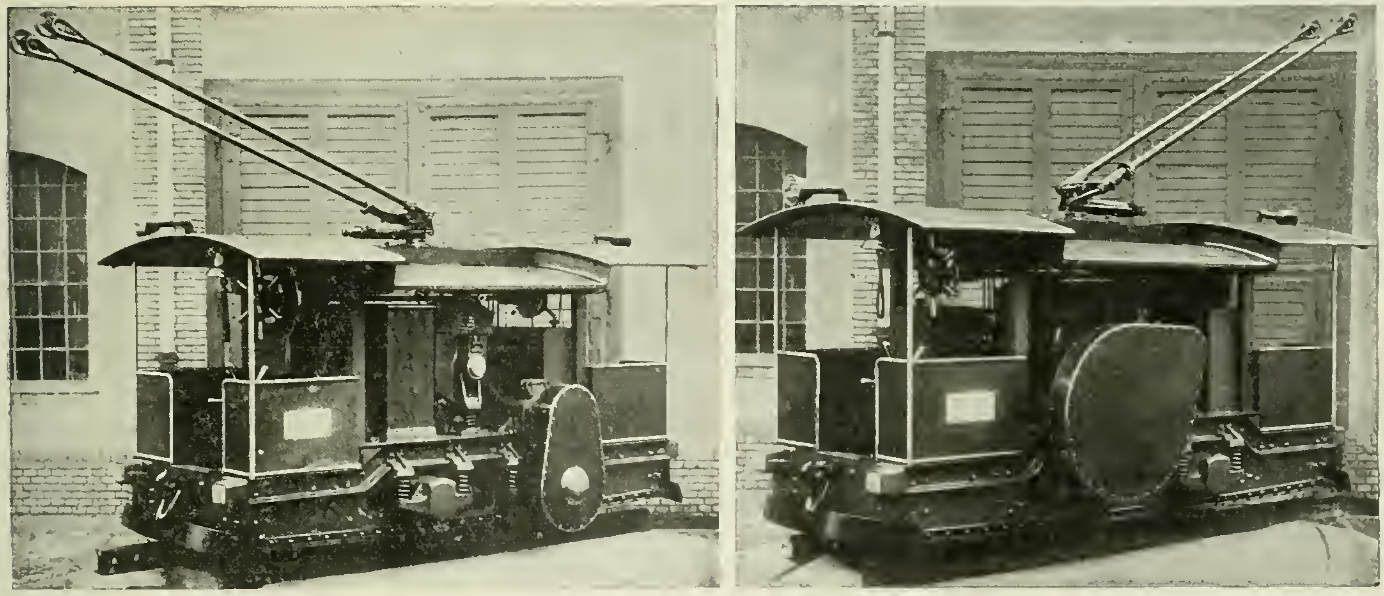
Proposed Three-Phase Motors for London Underground Road.

INTENSE interest has been aroused during the past week in American, English and European electrical circles generally by the statement that Ganz & Co., of Buda Pest, with their bid to equip the old London underground road—the Metropolitan steam system—with three-phase apparatus, were likely to get the contract for which other well-known manufacturers were bidding, with direct-current apparatus. Among the bidders are the British Thomson-Houston (General Electric) Company, the Westinghouse Company, J. G. White & Co., Dick Kerr & Co. (Prof. S. H. Short), and others equally well known. As to the situation at the present critical moment, a special cable dispatch from London, of Jan. 13, says: "Ganz & Co., of Buda Pest, with a proposal to do the work for £300,000 ($1,500,000), have not only far underbid their American, British, German and French rivals, but have submitted a system which railway authorities here think unapproached by that offered by any one of the eight other aspirants for the big contract. Sir William H. Preece, the consulting engineer of the company, who will spend this week in Buda Pest inspecting the suggested plan, said: 'Messrs. Ganz's scheme marks a distinct revolution in traction ideas. It is a radical departure from anything ever before projected in the way of electrical transportation. While nothing is yet definitely decided, the uniqueness of the system in question, together with its cheapness, has naturally forced it forward for prominent consideration.' Mr. Lemuel Bannister, vice-president of the Westinghouse Company, said: 'The Ganz alternating-current system has been experimented with in the United States during the last 15 years, and our English friends may be sure that if it had been worth adopting it would long ago have been put in operation on American railroads. In fact, the Westinghouse Company controls the patents for the system, and the Ganz firm could not install it without our consent. If the District Railway desires to indulge in the luxury of experimenting, Yankee engineers have nothing to attract them; but if it desires a system founded on a demonstrated practicability, there is no danger that the contract will get away from the United States.' "

The details of the Ganz plans and proposals are not known here, nor have they been given out yet in England, so far as we are aware. Herewith is shown, however, their three-phase locomotive, with which some details are given. The three-phase system has been put in operation, it may be remembered, on the Burgdorf-Thun road by Brown, Boveri & Co., and on the Jungfrau road by that concern also, and the Oerlikon Works. The equipment of such a road as the London Metropolitan, with its intricate switches and connections, and with four tracks in places, involves questions of a nature far more difficult to solve than anything of the kind ever before attempted.

The locomotive shown in the accompanying illustrations, for which and details we are indebted to Mr. A. Hausegger, their engineer, was made by the Ganz Company for the Hungarian State Iron Mine at Vajda-Hunyad. The body is made of forged iron, and is supported on four bearings by eight springs. The driving power is furnished by a 12-hp three-phase motor, with a maximum capacity of 18 hp. The speed is 800 r. p. m. at 300 volts, and a frequency of 42. The motor is suspended by two spiral springs, and is pivoted by two arms on the gearing shaft; the latter shaft drives one axle of the locomotive by double gearing, and the other by means of chains—in this way the whole weight of the locomotive being utilized for tractive purposes.

The motor has a stationary field and a revolving armature. The latter is provided with three collector rings, which, by means of carbon brushes, are connected to the motor starter, consisting of a controller and a rheostat. The trolleys, it must be carefully noted, are used, the rails forming the third conductor. The weight of the locomotive is 8000 lbs., the speed 7 miles per hour, the pulling effort 600 lbs.



FIGS. 1 AND 2.—THREE-PHASE LOCOMOTIVE.

Consolidation in Montreal.

An electrical consolidation in the city of Montreal is now in process of organization. A new company, to be known as the "Lighting & Power Company of Montreal," is to be formed with a capitalization of $25,000,000, to take over all the light and power companies of the city. The companies which will, it is said, be absorbed, are the Chambly Manufacturing Company, the Royal Electric Company, the Montreal Gas Company and the Lachine Rapids & Hydraulic Company. The Quebec Legislature will be asked to change the Chambly Company's charter so as to give it the power to absorb the present existing companies. This will obviate the necessity of obtaining a new provincial charter.

An Electrically Moved Grazing Pen.

By A. D. McNair.

THE experiment here recorded is primarily an agricultural experiment, and only incidentally an electrical one. The writer, having become acquainted with the remarkable productiveness and high feeding value of alfalfa, conceived the idea of grazing it at that stage of growth when it has a maximum feeding value, and in such manner that none of it would be tramped under foot. This meant that the alfalfa must at least reach the bloom stage, and would therefore be from 1 to 2 ft. high.

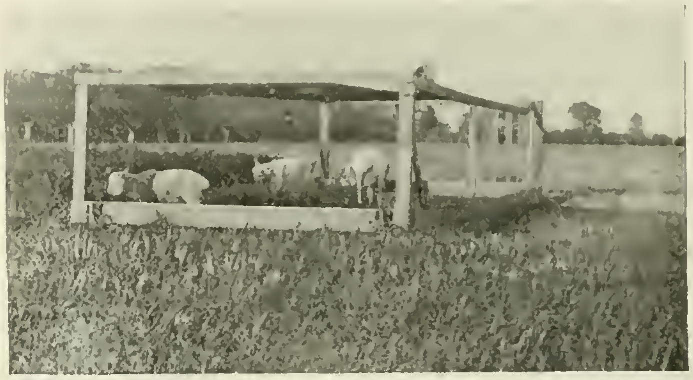


FIG. 1.—ELECTRICALLY-PROPELLED SHEEP PEN.

To accomplish the desired result the writer proposed to construct bottomless pens, mount them on castor wheels, fill them with sheep or other animals, and cause the pens to be drawn across a field of alfalfa or other forage crop at a snail's pace, so that the animals might eat clean the approaching forage before they could get their feet on it; and allow the forage to grow up behind, ready for another grazing when it should reach another maximum stage of growth.

An interview with Prof. C. D. Smith and Prof. J. D. Towar, of the Michigan Agricultural Experiment Station at Lansing, resulted in arrangements for trying the experiment under the direct supervision of the latter. The experiment was a very small one, owing to the fact that only one-tenth of an acre of alfalfa was available for the purpose. Only one grazing pen was needed, and its sole occupants were a Dorset ewe and her twin lambs.

The apparatus consisted of a pen one rod long and 8 ft. wide, constructed of 2 x 4 in. bottom rails and corner posts, and 2 x 3 in. top rails, and braced with 1 x 3 in. pieces at each corner, the four sides of the pen being inclosed with poultry netting. Also, four iron castor wheels 8 in. in diameter, one under each corner of the pen; two galvanized iron wires, No. 16, one attached to each forward corner of the pen to draw it across the field; two swivel pulleys tied to stakes driven in the ground; two iron spools mounted on a ⅞-in. shaft and fastened to the latter by set-screws; a train of gearing consisting of two spur gears and one worm gear; one belt and pulley and a one-tenth hp, 100 volt, General Electric single-phase alternating current motor, with the ventilating fan taken off and a small pulley wheel put in its place. The galvanized iron wires ran from the pen to the spools on which they were wound, via the swivel pulleys, as shown in Fig. 2. A method of moving a system of two or more pens is shown in Fig. 3, while the actual electrically-propelled pen is seen in Fig. 1.

This arrangement was not strictly necessary in drawing one pen, but would be necessary where several pens are drawn by the same motor. The reduction in speed between the motor armature and the iron spools was in the ratio of 75,000 to 1, approximately. It was desired to start the experiment on May 1, 1900, and continue it till Oct. 1. The pen was indeed started on May 1, by hand, the mechanical and electrical equipment not being ready till midsummer.

The strip of alfalfa was exactly one rod wide and 16 rods long, hence the pen, one rod long, just spanned the width of the strip. It was agreed to graze this strip four times between May 1 and Oct. 1. (It had been cut for hay four times the previous year), which meant a daily movement of 6.87 ft. and a grazing of 6.87 × 16½ = 113.35 square ft. of alfalfa daily.

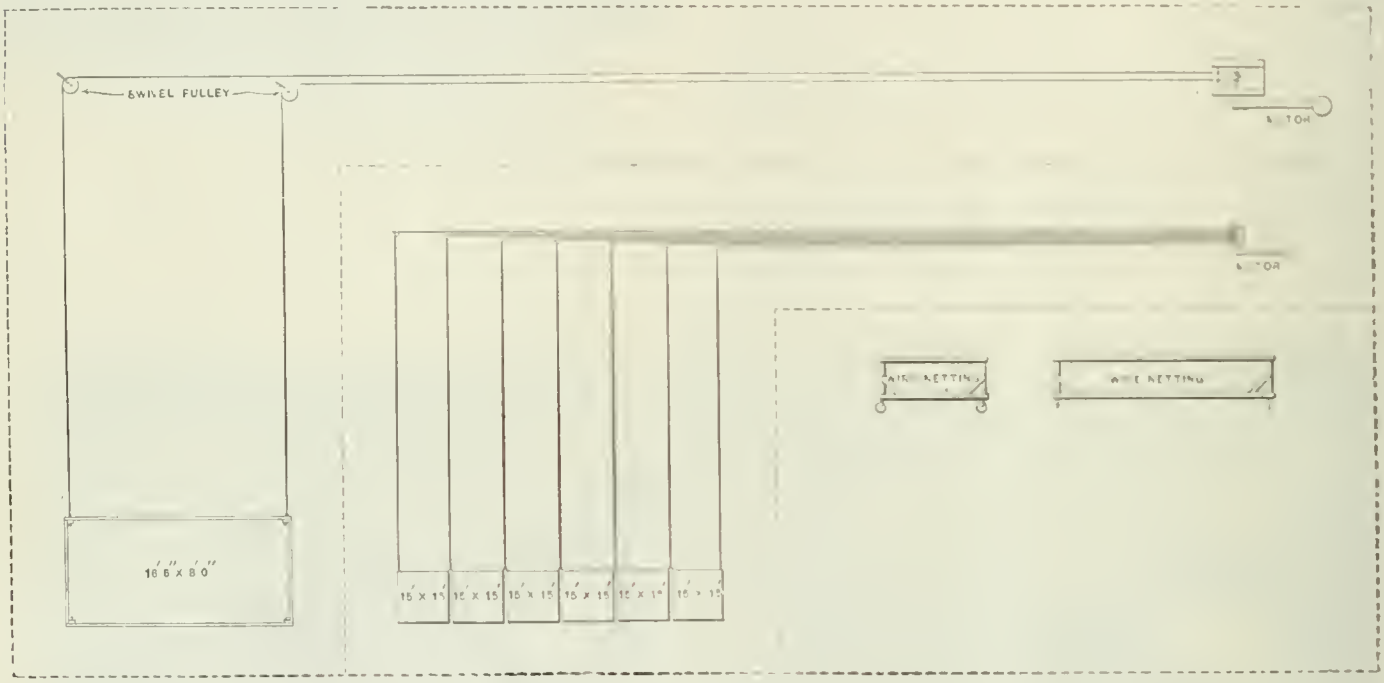
Water was carried to the pen daily by an attendant, and a piece of rock salt was placed where they could lick it when they chose. A strip of canvas covered a portion of the pen and proved a protection against cold rains in May and the hot sun of midsummer. The combined weight of the two lambs on May 1 was 45 lbs., and on Aug. 1, three months later, it was 131 lbs., or a total gain of 86 lbs. A supplementary ration of oats, amounting to 70 lbs. in three months, was given for the sake of variety.

On July 20 the ewe was taken away, after which time the lambs would not eat the alfalfa as fast as it came to them, and it was decided to cut some for hay and allow the lambs to catch up. Fifty lbs. of hay were thus secured. Had the lambs been butchered on Aug. 1 we should have been satisfied with the results. We had obtained 86 lbs. of flesh from a one-tenth acre of ground, which, at 5 cents per lb., was worth $4.30. Deducting 60 cents' worth of oats, we still had a return of $3.75 from a tenth acre, or at the rate of $37 per acre. Two months yet remained until Oct. 1, and the writer expected to see a total increase of 120 lbs. by that time. This, even deducting the value of the oats would have been worth $5, or at the rate of $50 per acre. We were soon, however, to be disappointed. The lambs commenced to "scour" soon after Aug. 1, and went from bad to worse until they died. This turn in the tide was undoubtedly due to grazing alfalfa "too exclusively." Alfalfa is a very nutritious plant, but all animals need a variety of food, and this must be provided under any successful regime.

Concerning the electrical movement of the pen, the apparatus worked all right, and drew the pen about 2½ ft. per hour until the motor got wet from a dashing rain and the coils burned out. It was never desired to keep the pen in motion all day. It was thought that one hour in the morning, another at noon, and another at night would be sufficient time for the animals to graze. This grazing at intervals is a good thing within movable pens for special reasons. Animals might lie down against the rear side of the pen and block the motion, but if they are accustomed to eating at regular periods they will arise at a signal and eat as the pen commences to advance.

It will naturally be asked: How much power is required to move these pens? There are no official data to give. No electrical or mechanical measurements were made by the authorities at Lansing, though it is trusted they will be made another year. The writer, however, made a mechanical measurement, which, though with crude instruments, is believed by him to be substantially correct. The measurement was not of the pull of the pen at Lansing, but of a heavier pen (15 x 15 ft.), built at Dansville, N. Y., in the summer of 1899. The average pull at a snail's pace, on this pen on a level clover field was 90 lbs., including friction of swivel pulleys and spool shaft.

Assuming this figure to be correct, assuming also 16 such pens in one system (enough for 100 ewes and 100 lambs), and assuming a forward movement of 25 ft. per day, which allows 30 square ft. of forage for each ewe and each lamb daily, the total work of movement per day will be 25 × 16 × 90 = 36,000 ft.-lbs. Assuming, further, that the total movement per day is made in three actual running hours, or 180 minutes, the power will amount to 36,000 ÷ 180 = 200 ft.-lbs. per minute.



Figs. 2 and 3.—Diagrams Showing Method of Operating Sheep Pens. End and Side Elevations of Pens.

It is quite probable that one-tenth hp of electrical energy will move this system of pens if a good train of gears is provided. Such a train might consist of two worm gears and a spur gear. The calculation of efficiency of this train of gears and motor would probably be as follows:

Efficiency of electric motor............50 per cent.
" " first worm gear ....40 " "
" " second worm gear ......40 " "
" " spur gear ....80 " "

Total efficiency equals .80 × .40 × .40 × .50 = 6 4-10 per cent.

One-tenth hp equals 3300 ft.-lbs. per minute. Six and four-tenths per cent of 3300 equals 211.2 ft.-lbs. per minute, which is 11.2 ft. lbs. per minute more than would be required.

It remains to be seen whether this electrical system of grazing is commercially feasible. It is in its experimental stage. It is open to some objections which may or may not prove formidable, but it also has several advantages. If it is immediately practicable anywhere it will be along the lines of electric railway which are fast threading their tracks along country roads. It is the belief of the writer that 1000 lbs. of flesh per acre of ground is by no means the limit that can be obtained by this method of grazing.

Telegraph Operators in the Philippines.

By F. E. Grain.

A MOST pressing need for telegraph operators has existed in Luzon, Panay, Cebu, Negros, Mindanao, Gimeras and other of the leading islands of the Philippine Archipelago, where Government lines have been put in recently. The linemen have been putting in new lines much faster than the operators can be furnished to supply the stations. Very many of the stations which were fitted up with a view of permanent occupancy have already been abandoned because of lack of telegraph operators. The Government is constantly sending over new men, but not fast enough to meet the requirements, for hardly a day passes that a new station is not opened in some part of the archipelago. Within a very few months the work of connecting all of the islands by cable will begin. The United States cable ship "Burnside" has a considerable portion of this cable aboard, and, with Manila as a centre, the cable lines will extend to the most remote points in the Philippine group. At the present time the only islands joined by the cable system are Panay, Cebu and Leyte, which are wired with Luzon. The establishment of the new connections so as to connect all of the numerous islands of the Philippine Archipelago will necessarily call for the employment of additional stations, and of course a telegraph operator in each station, and in some cases, where there is much night work, there must be two operators. The advent of the cable lines also means that there will be additional stations established in the interior of the different islands. At present the island of Luzon is well provided with stations and the interior can be reached at any time. Panay Island is also liberally dotted with telegraph stations, and the movements of the troops can be known at all times to the department commander. Still there is a severe handicap due to shortage of men on both of these islands. The writer recently met the telegraph operator of San Jauquin, one of the coast stations, going into Iloilo, where he had been ordered to report to take charge of the office at Jaro. There was no other way to get a man for the Jaro station than to close up the San Jauquin station. I stopped over at Tigbauan one night and found the operator ill with fever, and his superior officers were trying hard to get a man to take his place so as to "relieve" him and permit him to go to the hospital. But none could be had for several days, and, the Tigbauan station being a central point, several branches depending upon it for transmission of messages by telegraph or telephone, the office could not be closed and the ill operator stuck to his post until finally a man was secured by closing up an office of minor importance.

The Government is sadly in need of experienced operators, and when the new cable lines are established the need will be greater than it is at present. There are now, to the knowledge of your correspondent, a number of important offices closed simply for lack of men. One of the reasons why many men do not enlist for this service is that the pay does not seem to them to be as much as it ought to be.

The pay is indeed low, but it must be remembered that the Government provides everything, including rations, lodging, medical attendance, clothing, etc. The pay of a first-class private in the signal corps is $20.40 per month. Many operators enter the service in this capacity, although some are not thoroughly qualified and are obliged to enlist as second-class privates, in which case the pay is a little lower. After a short service, however, the second-class private is usually appointed a first-class private. In a year or so he becomes a corporal, with a slight increase in pay and privileges. In course of time he may become a sergeant, in which case his pay begins to jump upward, and if he passes through the stages to chief operator he will find that he is drawing a salary of $40 to $50 per month, and nearly all clear gain.

The writer has been here about a year in the field and has met with many operators direct from home, most of whom are glad to get the outing offered as a change from the confinement of office work in their former occupation. Often the new man arrives and instead of being put directly into an office he is ordered to join the linemen, in which case he usually finds that he has some rough soldiering to do. All his work is performed with a rifle slung to his back or a revolver in his waist belt, ready to drop and take shelter and open fire upon any enemy in the brush. Linemen are particularly distasteful to the rebels of the islands, and they take every opportunity they can to harass the little bands of workers who are stringing wires across the newly garrisoned country. Ordinarily a guard of from six to eight men accompany the linemen, in which case there is not so much danger of molestation.

There are periods of the year in the group during which the heavy gales sweep the islands from shore to shore, carrying everything before them. I have witnessed the disastrous effects of several of these gales. Shortly after the gale begins, the operators, linemen and all prepare to make repairs. As soon as the gale shows signs of abating, the operators and the linemen secure the services of dozens of natives and then the work of replacing broken poles and repairing insulators and wires begins, so that in a day or two the lines are once again in operation. Often the enemy take advantage of the gales to do further damage to the lines. If natives are caught near the lines by soldiers or linemen the orders are to shoot any who are acting suspiciously or have tools in their hands for cutting wires. But when the gales rage the native can readily sneak up to the lines and help the gales in their work of destruction by tearing down weakened poles and breaking insulators with rocks, so that the extent of the destruction is sometimes very great and the loss heavy, for the reason that supplies of cross-arms and insulators are not in abundance here, although poles can be cut from the forests readily.

Applicants for appointment to the signal corps of the army in the Philippines must be physically sound. I have seen many good men rejected from some defect of the eyes or lungs. Even before the applicants are put through the test examinations in the United States concerning their knowledge of line work, telegraph operating, signalling, etc., they are examined physically. This is a severe climate on most men, and few can escape the ravages of one or more of the numerous fevers of the islands. There appear to be fever microbes in the air, for the men never drink any but boiled water, and every precaution is taken to prevent fevers. Yet I have seen many of the men stretched out day after day on the floor or ground of their tents suffering from fever. Often the fever hangs on for many days and will not cease until the man is sent to the hospital for an ice bath. The ice bath drives the fever out of his system and puts him on his feet for a few months, when he is likely to get another touch. Series of such fevers bring on typhoid. But it may be two years or more before anything of the sort occurs, and before the two years have expired the man is usually relieved and sent to a station in the United States. It is believed that definite plans have now been made so that the men will have to serve only eighteen months in the Philippines, when they will be relieved and permitted to serve a year in the United States before again returning to the islands.

LINEMEN CROSSING BAMBOO BRIDGE.

But it is not only telegraph operators that are in great need by the Government for Philippine service. Electrical sergeants are in very great demand. The Government is sending to American firms for considerable electrical apparatus, and electrical sergeants are required to set it up and see that some one is instructed to operate the machine. The Government will put in electrical apparatus on the same lines as in the forts in America. The principal electrical apparatus will be in the line of lighting.

The Government has an electrical training department for electrical sergeants at Fort Monroe, Va., but in the present emergency and need of men, competent electricians are taken direct into the service and assigned to duty in the Philippines. The Government is planning to put in permanent barracks in about a hundred different places in the islands, and in nearly all of these electric apparatus of some sort is to be put into service for lighting and for other purposes, pretty much after the plans of the barracks in the United States. Arrangements have been made for sanitary engineers to put in the proper piping, baths, closets, drainage systems, etc., and the barracks are evidently to be made clean and healthful and fitted with modern conveniences. In each of these barracks an electrical sergeant will be required to supervise the electrical devices and machinery in general, including probably the pumping machinery, the steam engine, the ice-making plant and all that concerns the power and mechanical system of the station. It is a post of importance and trust. The sergeant of course would be given several helpers, some of whom would be soldiers, civilians and natives. As to the requirements of a man who can fill a position of this kind, they are quite numerous. The Government expects that the applicant has had at least two years' experience in an electrical shop of some sort, where he either manufactured electrical devices or operated them. The American manufacturers of electrical devices are sending to these islands the best and most modern patterns of machines, and the electrical sergeant undoubtedly would be the only man at some of the posts who would understand the machine. All would therefore depend upon him to get the machine running correctly. If he is a blunderer, the chances are that the entire equipment of the plant will constantly be at fault, while if he is a competent electrical engineer, the best of service may be expected. Some of the electrical machines arriving here get pretty well smashed up and new parts have to be made; and the electrical sergeant must be capable of drawing new plans for the broken portion or to so repair the fractured parts as to make the piece suitable for service again. No help in this direction may be expected from the natives. They will do well enough to fire a boiler, cut wood, haul ashes, clean machinery, and do ordinary laboring work, but if you give one of them a broken piece of machinery to repair the chances are that he will wind the parts with thin split bamboo or tie them together with a piece of string.

One electrical sergeant I met here was formerly a fireman on a steam road, but he managed to pass the examination for the post of electrical sergeant through the good education he had received in a technical school. He knew all about the parts of machinery, their names and application, and therefore managed to deceive the examining board. But when he got here and had to go to work with the wrench and adjust armatures, reset commutators, repair the connections of brushes, etc., he found himself in a new field and was lost. He managed to pull through, however, by hiring a civilian electrician who happened to be here, to help him out.

The examining board is very careful about the selection of men that are naturally mechanical. They require that the applicant proceed with tools to take apart some machine and put it together again in their presence. If they see that he breaks off the side or the head of a screw with a screw-driver, or that he tries to turn the screw the wrong way, the fact counts against him. If he barks his knuckles in turning off a nut, then it is concluded that he is not familiar with handling the wrench.

Book knowledge, that is, such as one gets by reading books on industrial, direct and alternating current electricity, construction use and care of dynamos, engines, belting, tools, etc., counts, however, for considerable with the examining board. Applicants who have been industrious enough to take one, two or three years' course of instruction from some electrical correspondence schools find that they are received well by the committee. Men who have taken an interest in visiting large electric light plants for the purpose of seeing how the works are conducted, and have made notes of improvement and advantages, are also pleasing to the members of the board.

The Government desires men who are about 25 to 30 years of age for its electricians, it seems, for it does not appear to consider it worth while to take very young men who have not had the advantage of business or mechanical experience. Nor does it want very old men, for the reason that the work is by no means light in these tropical climates, and a man must be brisk and young to stand the hardships.

Electrical sergeants in the service here must be ready to shoulder the rifle whenever necessary, for often it is known that there is certain electrical apparatus of Spanish design in the possession of the enemy at certain points, and it is desired to capture the plant. Then the electrical sergeant is taken along to oversee the removal of the equipment by means of bull carts and drag sleds. The apparatus is usually found in service for signalling on the beaches; the light, being very strong, is seen great distances, often from one island to another.

An Electric Freight Wagon to Haul Ten Tons.

One of the largest electric automobiles extant is that built for the Say Sugar Refinery of Paris recently by the Société des Etablissements Postel-Vinay, well known to electrical engineers as the manufacturers of the Thomson-Houston apparatus for the French Company of that name representing General Electric interests in France. This automobile was constructed to convey loads of 10 tons from the owners' works, in the Boulevard de la Gare, to the various railway stations in Paris. The station to which it most frequently runs is the Chapelle, which is nearly four miles from the works. This vehicle was a competitor in the last "heavy weight" trials, where it established an excellent record in spite of the unsuitable working conditions imposed upon it. Its performance during these trials showed a mean consumption of 88 watt-hours per ton-kilometer, and after a run of about 21 miles the average voltage of the cells had dropped from 2.3 to 1.9 volts.

Fig. 3 gives a general idea of its complete appearance. Fig. 2 shows the driving gear. Fig. 1 is an elevation of the wagon and shows the position of the controller and the steering gear. A massive girder frame is suspended upon the front and rear axles by strong leaf springs. Two motors are each independently geared by double gearing to the half axles in bearings. A magnetic brake of the Sperry type of flat engaging friction surfaces is provided upon each axle, the one part being fixed to the axle and the other part being fixed to the bearing. The whole of this mechanism is mounted upon a solid casting which carries the side springs and which is also connected to the rear member of the wagon frame by a double spiral spring suspension. The weight of this driving mechanism is 4 tons.

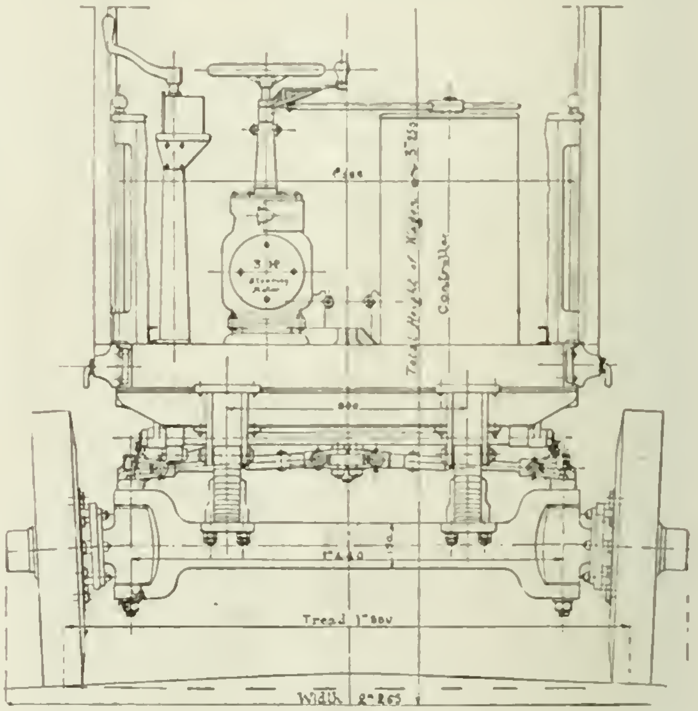


FIG. 1.—ELEVATION OF WAGON.

The battery, which weighs 1¾ tons, is placed in a large box beneath the centre of the frame. The total weight of this box and batteries is 2½ tons. The cells are connected up in two groups of 42 elements each, for the convenience of charging. Their capacity is about 320 ampere-hours. They are of the Phœnix type, with cylindrical electrodes 8 mm in diameter and about 500 mm (nearly 20 inches) high. The controller is fixed on the left-hand side, in front of the driver.

It is operated by a lever mounted on the steering pillar, and is of the makers' trolley car type, slightly altered. It operates the series or parallel connection between the motors and the electric brakes.

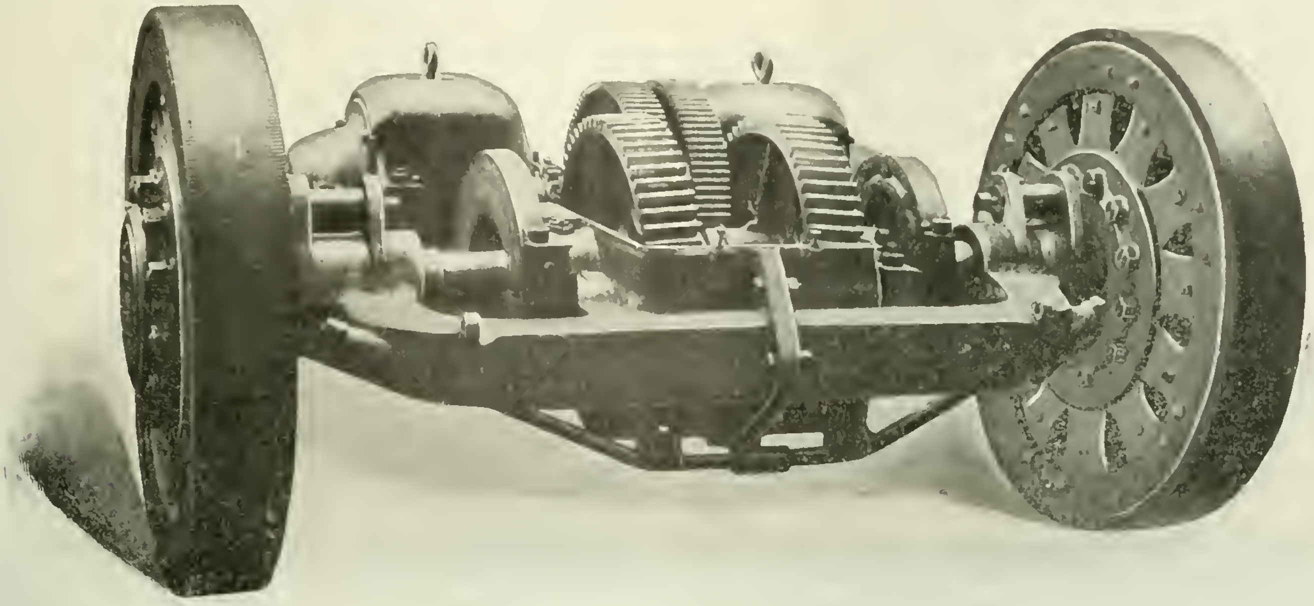


FIG. 2.—DRIVING GEAR ELECTRIC FREIGHT WAGON.

The steering gear is worked by means of a hand wheel, but the actual movement of the front wheels is effected by a 3-hp electric motor. The driver moves the steering wheel in the direction in which he wishes to go, but the motor causes the necessary deflection of the steering wheels. It is said that the system was the cause of a good deal of trouble at first, but that it now gives complete satisfaction.

The motors are of a familiar four-pole type, with slotted drum armatures. They each give 10 horse-power normally, but are capable of developing 30 horse-power for several minutes, or of giving five times their normal torque on occasion. Their weight is about 990 lbs. each, and their normal speed is 800 r. p. m.

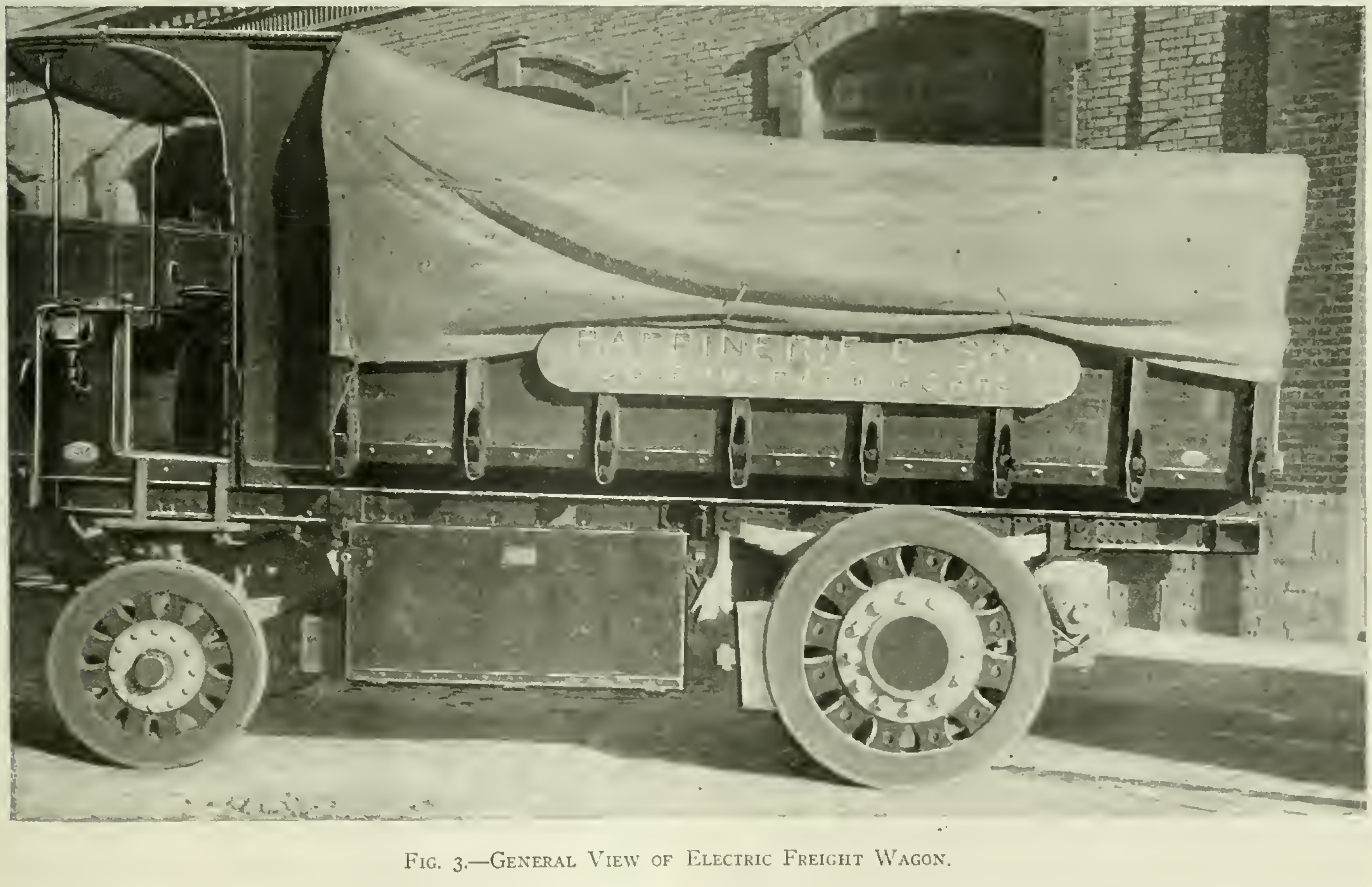


FIG. 3.—GENERAL VIEW OF ELECTRIC FREIGHT WAGON.

The complete wagon weighs 12 tons empty, and it carries a load of 10 tons. Of the total weight of 22 tons laden, 15 tons is carried by the rear wheels. The speed at which it travels is about 5 miles per hour. The mechanical band brakes on the rear wheels are operated by the hand wheel, shown on the right-hand side of the driver's seat. The maximum pressure of the brake blocks is about 2 tons.

The New French Submarine Boat.

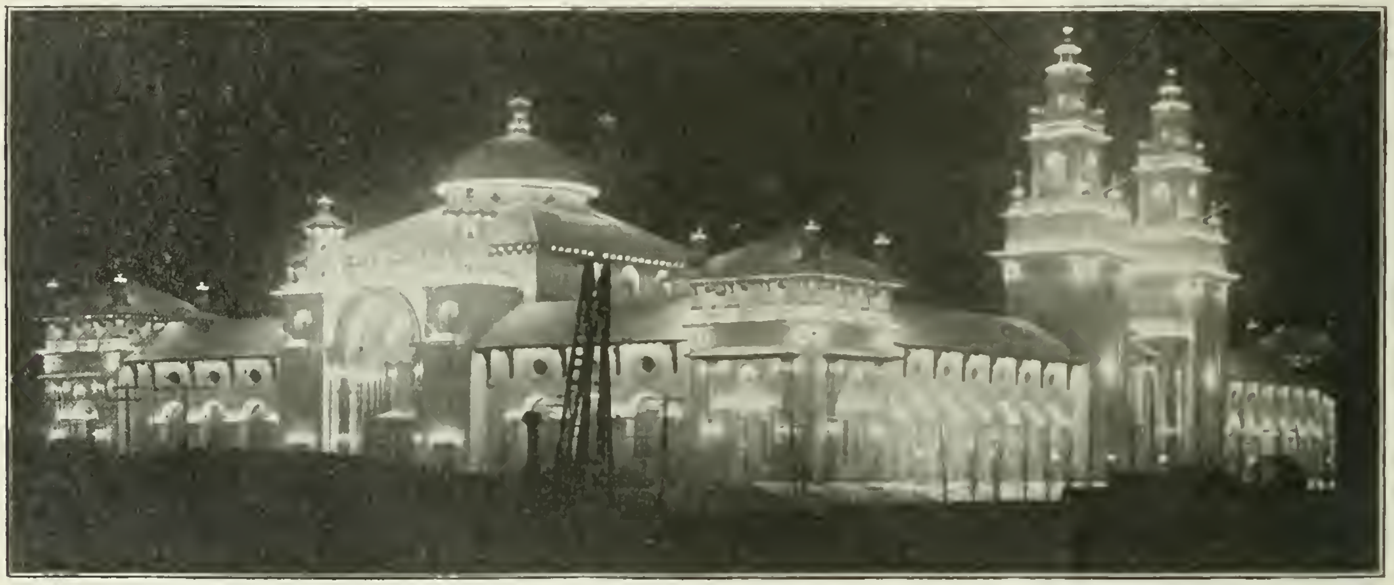
The *Figaro* describes a voyage of two hours in the submarine boat Morse during the trials at Cherbourg on Monday, Jan. 8. "In less than two minutes," says the correspondent, "the vessel reached a depth of 18 ft., when she performed her evolutions with ease and perfect safety. By means of an ingenious instrument, the periscope, floating invisibly upon the surface of the water, everything above was visible. The problem of the supply of air has been solved satisfactorily, and the crew was able to remain submerged for 16 hours without fatigue of the lungs."

Pan-American Decorative Lighting Effects.

By Frank C. Perkins.

The lighting effects at the Pan-American Exposition are expected to surpass anything of the kind previously attempted, and it was with great interest and anxiety that the engineers and officials awaited the trial of the electrical decorative effects on the Machinery and Transportation Building, now practically completed. The use of a 25-cycle alternating current for incandescent illumination was considered by many engineers as thoroughly impracticable, but the results of the tests have shown it to be entirely satisfactory. The Electricity Building is now nearly completed, the wiring is about finished and the color decorations are progressing rapidly. Mr. Henry Rustin, chief of the electrical and mechanical bureau, is to employ a special method for manipulating the decorative incandescent lamps of the various buildings. By introducing an automatic motor-controlled water rheostat in the high-tension polyphase alternating circuit just before entering the transformers, he will gradually increase or decrease the supply to the decorative lamps, producing the effect of the theatre dimmer. In this way, from a point in the Electricity Building all of the lights trimming the various buildings may be operated, the strength of the light being gradually increased until the full candle power is reached. This almost imperceptible increase in the power of the lights as they are turned on, will constitute one of the most charming effects of the whole scheme, of which the visitor will never tire. The illustration herewith shows the Machinery Building illuminated. It is 500 ft. long, and it is nearly 200 ft. to the topmost points of the towers surmounting it. The architectural features are outlined with thousands of 8 and 16 cp incandescent lamps, which bring out the beauty of the colors to great advantage. The Electric Tower is being wired with thousands of border lights, and the staff is being rapidly placed in position on the lower part of the structure. This tower will be the most beautiful spectacle of all, rising as it will to the height of 391 ft., and bearing upon its summit a statue of the Goddess of Light. It has recently been decided to increase the number of focusing lamps to 100, and these will be placed in the basin in front of the tower, where the usual electrical fountain effects will be produced with such changes in design as have been worked out by the engineers in charge. Some of the illuminated water effects will reach an altitude of nearly 400 ft., and the space illuminated will be about 2000 ft. long by nearly 700 ft. in width. The Park Lake will be illuminated by a special electric fountain, while the shores are to be festooned with many electric lamps. The Fore Court, Approach and Bridge, just beyond the lake, as well as the Esplanade, which will hold 250,000 people, are also receiving attention, and the electrical illumination of these great areas has been most artistically arranged. The illumination is not to be of the nature of a fierce, dazzling glare from arc lamps, but the lighting will be so soft and agreeable, that while pleasing in the extreme the iluminations of this grand court and buildings will not produce the effect such as one gets in trying to look at too strong a light. This desirable end is to be attained by the exclusive use of incandescent lamps in all exterior decorations. The arc lamps are to be used only in the buildings, and about the outer edge of the grounds. The Fountain of Nature in the Esplanade is to be surmounted with beautiful statuary, while the illumination of this fountain will be extremely attractive, and floating incandescent lamps will be used in all of the fountain basins, giving great variety and novelty to the decorations and increasing the fairy-like effect at night. The water effects in the fountain display will require the use of more than 2,000,000 cubic ft. of water per hour, while the total number of incandescent lamps used in and about the Court of Fountains, Plaza and Esplanade will reach nearly a quarter of a million. This does not include the arc lamps used in the buildings and around the grounds, nor the many incandescent lamps used on the Midway and by private exhibitors. More than 250 tons of wire will be used in and about the Court of Fountains, which represents a total distance to be wired of about 400 miles.

The energy generated on the grounds will consist of about 5000 hp, and will include the use of gasoline engines, oil engines, natural gas engines, gas under boilers producing steam for compound and triple-expansion engines, as well as the utilization of the electric power from Niagara. The latter will consist of about 5000 hp, which will be conducted over aluminum wires from Niagara Falls, where the new 5000-hp generators will be installed in ample time for the Exposition.



Machinery and Transportation Building, Pan-American Exposition.

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New Transmission Line at Niagara.

Long before the Pan-American Exposition opens, Buffalo will be connected with Niagara Falls and the central station of the Niagara Falls Power Company by the second transmission line now in course of construction and nearing completion. The expectation is that it will be in operation within a month. It will be recalled that the present transmission pole line carries six copper cables, each having 19 strands. The cables are bare, and the number used provide for two three-phase systems. The new line is being strung with three cables of aluminum, and this is the first aluminum cable installed by the Niagara Falls Power Company. It is made by the Pittsburg Reduction Company. The size of the cable is 300,000 cm, and each cable is made of 37 strands. The diameter of the aluminum cable is, of course, larger than that of the copper cable.

In the route to Buffalo this new line follows the course of the old line to the south boundary of the village of Tonawanda, and at the point where the old line crosses over the tracks of the New York Central Railroad the two lines diverge, the new one following an entirely new right of way to the terminal station on Niagara Street in Buffalo. This new right of way is 30 ft. wide, the same width as the old right of way, and it runs in a straight line along the west side of the New York Central tracks for a distance of 14,830 ft. to Ontario Street, Buffalo, where it turns down Ontario Street and follows that thoroughfare for a distance of 7000 ft. to the terminal station on Niagara Street. By this new route the transmission line construction is shortened 3.18 miles. The fact that the aluminum cables are lighter than the copper cables allows a stretching out of the spans, and whereas the spans on the old line are about 75 ft. from pole to pole, on the new line construction the poles are set at an average of 112½ ft. apart. The poles used average 35 ft. long, which gives 22 ft. clear of the ground.

The insulators used on the new line were made by C. S. Knowles, of Boston, Mass., and are shaded, instead of being white, like the insulators on the old line. The pin shank under the new insulators is 2¼ ins., while the pin under the old insulators is but 2 ins.

When the old transmission line was constructed, the route taken through North Tonawanda was very crooked, and during the construction of this new line efforts have been made to straighten out the old line, with considerable success, and many of the short turns have been eradicated. These changes were made in order that the transmission line might be as straight as possible, as on a line so constructed there is less liability of the cables pulling away from their proper position. After the new line leaves the old line it runs practically in two straight stretches to the terminal station.

Copper Line. New Aluminum Line.

VIEW ALONG NEW TRANSMISSION LINE.

When the transformers and other apparatus used in connection with the Niagara-Buffalo transmission were installed, they were designed to be operated for a transmission under either 11,000 or 22,000 volts. The voltage so far used in this transmission has been 11,000, but on the completion of the new aluminum transmission line the voltage on both of the transmission lines is to be raised to 22,000, at which voltage Buffalo may receive 30,000 horse-power from the Falls.

Manning the Submarine Boats.

The Navy Department expects that the six new submarine torpedo boats of the Holland type will be finished in April and May. It will then be necessary to man them, and the Bureau of Navigation is giving attention to the question of securing competent crews. There appears to be a concurrence of views among the naval officials that men who enlist for service in the navy should not be assigned to such work without their consent, and the Navigation Bureau will recommend that special service enlistments for these vessels be authorized. A memorandum explaining the necessity of enlisting men especially for this work is being prepared by the Navigation Bureau and it will be submitted to President McKinley by Secretary Long.

The Elektron Theory.

In a recent number of the London *Electrician*, Prof. J. A. Fleming gives, in connection with a discussion of the variation of dielectric constants with temperature an extremely clear presentation of the elektron hypothesis.

Starting with Larmor's fundamental conception of the elektron as a strain center in the ether, elektrons being either positive or negative, he assumes with Larmor that atoms are collocations of elektrons in stable orbital motion. In a saturated chemical molecule or atom we must then postulate that the positive and negative elektrons are equal in number. We may take this to be the case in those chemically inert substances the paraffins and saturated hydrocarbons and other symmetrical atoms or molecules not containing chemical radicals. We must assume that, whatever may be the nature of the ether strain which results from an application of electric force, it is of such kind that it causes, or tends to cause, a displacement of positive and negative elektrons in opposite directions. This displacement is instantaneous and of a purely elastic type, so that, whether the force is reversed slowly or rapidly, the ratio of the whole electric strain to the electric stress, *i. e.*, the dielectric constant, remains the same. Accordingly, the existence of electric force in a dielectric creates an ether strain and slightly distorts the configuration of the elektronic groups which form the material atoms of a dielectric. The elastic reaction to the stress is the same or nearly the same whether it is reversed billions per second, as in the case of a ray of light passing through the dielectric, or very slowly, say 100 times per second. For these substances, then, Maxwell's law is fulfilled.

Consider next a substance such as *water*. Chemical arguments lead us to regard the molecule of water as capable of fission or partition into two non-identical masses—viz., H and (HO), which are, respectively, the semi-molecules of hydrogen and hydroxyl. These masses, when free, constitute the *ions* of water, and when free carry electric charges. Hence, on the elektronic theory they must each be regarded as collocations of electrons, but the H groups or masses contain more positive elektrons than negative and the (HO) groups more negative than positive.

When united to form the water molecule, the collective mass H(HO) possesses an *electric moment*—that is to say, it is equivalent to a mass having a positive charge on one part and a negative on another. All chemical facts lead us to believe that the union between the O and the H in the semi-molecule of hydroxyl (HO) is far more intimate than the union between the H and the (HO) in water. Accordingly, under the action of electric force the water molecule will be *oriented* in space like a small magnet in a magnetic field. This orientation is equivalent to an additional electric displacement over and above that due to mere strain of the elektrons in the molecule or of the ether in the same place. According to the theory here suggested it is this orientation of the molecules which bestows the abnormal value upon the dielectric constant.

We have next to explain on this theory why these abnormal values of dielectric constant become normal on lowering the temperature sufficiently. Thermodynamic theory seems to indicate that sensible heat is the result of mass movements of molecules. Hence as the temperature is lowered the molecular agitation is quieted down and the molecules may unite into larger groups or aggregations. It is then easy to see that these larger groups of molecules will cease to possess an electric moment, just as groups of equal small magnets united pole to pole so as to form closed magnetic circuits cease to possess a magnetic moment as a whole. Accordingly, external electric force can no longer orient these molecular groups, and their power to contribute to augment the normal dielectric constant disappears. Hence at very low temperatures, if ice consists of molecular aggregates of water molecules, it should have, as in fact it has, a dielectric constant not very different from that value due to a very rapidly reversed electric force when at 0°C., viz., a value lying between 2 and 3. Also, it is easy to see why on this theory high frequency in the electric force reversals leads to the same result as very low temperature.

In the case of the high-frequency alternating electric force (billions per second) the inertia of the water or ice molecule prevents it from orienting. The only effect of the electric force is to produce ether strain and strain of the elektrons forming the molecule. At very low temperatures the molecules do not orient, because they are bound up in groups and have no resultant electric moment.

We also find experimentally that for such bodies as water, alcohol, etc., there is a temperature at which the large or abnormal dielectric constant has a maximum value. The decrease of dielectric constant at and above a certain temperature may be explained by the gradual breaking up of water molecules having an electric moment, and therefore capable of being oriented, into *ions* having no electric moment. The gradual increase of conductivity in ice accompanying this dielectric change as it is heated is easily explained in the above theory because the ions at once move under the electric force, and moving ions constitute electrolytic conduction.

This theory seems to fit in fairly well with most of the observed facts as regards the influence of temperature and frequency upon the values of the dielectric constants of insulators and electrolytes, and to obtain support from the results of the dielectric measurements at low and increasing temperatures. It is a curious fact that the more complicated and heavier molecules, such as those of the alcohols and glycerine, have their abnormal dielectric constants reduced to smaller and normal values by an increase in the frequency of the alternating impressed electric force not at all sufficient to similarly affect the abnormal dielectric constant of a lighter molecule, such as that of water.

CURRENT NEWS AND NOTES.

POSTPONEMENT.—Owing to the illness of Dr. Louis Bell from "grip," his lecture on "Electrical Illumination" before the New York Electrical Society at the Edison Station, Elm and Duane Streets, this city, on Jan. 16, was postponed. The lecture will be given shortly under the same auspices, of which due notice will be afforded the members.

TELEPHONY IN AMERICA.—An interesting statement shows the number of Bell telephone instruments outstanding Dec. 20 as 1,952,816, or 976,408 stations. The net output of instruments in the year was 372,311, implying an increase of 372,311, or 186,155 stations —possibly 165,000 to 175,000 subscribers in the year. A large number, but not so many as in 1899.

TELEPHONE LINE PATENTS.—The Bell Telephone interest has purchased the patents of Dr. M. I. Pupin on means for rendering telephone lines distorsionless in long distance and submarine service. It is said that $500,000 will be paid for the patents, and in addition $7,500 per year to Dr. Pupin during their life. This system, which was commented on in our issue of May 26, 1900 (page 774), consists in distributing along a line at definite intervals, inductances of definite values.

AMPERE'S PORTRAIT.—One of our contemporaries has been misled into printing as a portrait of Ampere a bogus presentment which, it may be added in extenuation, is the one almost invariably to be found in both English and French books. A real portrait of Ampere shows a countenance unusually strong in all of its traits—to such a degree, indeed, as to produce an effect of homeliness. The bogus portrait probably proceeded from the imagination of an artist who had a commission to illustrate a popularly written electrical work, and shows a weak and commonplace countenance impossible to associate with a man of Ampere's genius.

DIRECT-CURRENT DYNAMO AUXILIARY POLES.—In a patent granted Jan. 8 to W. von Siemens and August Rotth, of Berlin, Germany, an auxiliary pole system is described for slotted drum armatures, having for its object the suppression of sparking. In a two-pole machine two poles are used, located in the opening between each pair of pole tips. The auxiliary poles are of a horseshoe shape, the two legs being separated from one another a distance equal to a multiple of the distance between the individual teeth of the armature. The windings of the supplementary poles are included in series with the working inductors, the two sets of windings being in parallel relation.

SYSTEM OF TRANSFORMER COOLING.—In large high-tension transformers some system of cooling is necessary. In one type this is obtained by making the secondaries hollow; in another, oil surrounding the windings is cooled by coils of pipe located in oil away from the windings, in this case oil spaces being provided between the coils. In some cases it is not practicable to make a secondary conductor hollow, and there are objections to the second method described. In a patent issued Jan. 8 to W. S. Moody and W. L. R. Emmet, a system is described in which the openings between the coils which formerly served as open oil spaces, contain tightly fitted flat tubes of thin drawn brass, through which a circulation of cooling fluid is maintained. These flat tubes serve mainly to take the heat direct from the coils, but they extend out beyond the coils and core into the surrounding oil where they absorb a portion of the heat conveyed to the latter from parts of the core and portions of the coil not in proximity to the surface of the flat tubes.

MARTIAN EDDY CURRENTS.—Mr. Willam A. Eddy, the famous kite flyer, says that since 1892 he has drawn from his kite wire hundreds of electric signals, both regular and irregular, which may have come from some planet, and that the signals have been usually in groups of three, regularly timed, as from a Morse sounder. When the ends of the kite sustained steel wire, separated by silk strands, the sparks jump at 12-second intervals. Then there are mysterious disappearances of all electric action for several minutes. These electric sparks come from a high point in the air, not near to the low tension electric currents of trolley and live wires. Mr. Eddy is about to begin a careful series of measurements of these spark lengths. He has been trying to decipher these signals for many years. Mr. Eddy points out that electricity is superior to light, because an interruption can be transmitted, while light suffuses around a dark shadow, especially if the shadow is of small diameter. The existence of eddy currents in Mars had not previously been suspected.

NERNST LAMP HEATER.—In a patent issued Jan. 8 to C. D. Raab, of Kaiserlautern, Germany, a Nernst lamp heater system is described, based upon the employment of a third conductor which in a sense corresponds to the neutral of a three-wire system. On one side of the neutral an ordinary incandescent lamp is connected; on the other side we will assume there are two Nernst lamps in parallel, their two heaters being in series. In starting up, a switch is thrown to bring into circuit the two Nernst lamps, and, at the same time, the two heaters, which are in series with the neutral. All of the current in the circuit at first passes through the incandescent lamp and the heaters; when, however, the Nernst bodies become conductive, if the resistance of the incandescent lamp is equal to the parallel resistance of the two Nernst lamps, the neutral will carry no current, and the heaters thus become de-energized. Then, by throwing the above-mentioned switch to its second position, the incandescent lamp is switched out of circuit. The specifications describe the application of the principle to polyphase circuits, and gives various modifications of detail, including means for automatically cutting out the incandescent lamp.

COMMUTATOR FOR SINGLE-PHASE CONVERTER.—Single-phase alternating-current machines having commutators, such as rotary converters or double-current machines, are open to the objection of more or less serious sparking at the commutator, this sparking being due to the fact that current in coils undergoing commutation is not uniform during the revolution, while at the same time the resultant armature reaction varies, thereby varying the field strength under the pole tips. A condition for no-sparking requires that the brushes should be moved back and forth on the commutator during each revolution, so that the coils of the armature as they pass under the brush may be in a position with respect to the field of the machine, such as will induce therein an e. m. f. which will more or less balance that produced as the coil passes out from under the brush. If the machine is operated as a rotary converter, for example, the brushes during one portion of the revolution would require to have a positive lead and at the other almost a negative lead corresponding to the alternating generator and motor action of the machine. In a patent granted Jan. 8, Prof. Elihu Thomson provides for this condition by the use of a commutator having segments of various widths, the segments being spaced close together in some portions of the commutator and wide apart at others. The commutator being revolved at a uniform angular velocity, there would be caused what amounts to a variable velocity of the segments, whereby armature coils in advance of a neutral position first undergo commutation, then coils behind this position similarly are commutated. By this arrangement several commutator coils may be caused to pass under the brushes at times during the revolution when the least sparking will take place due to commutation.

ELECTRIC POWER IN PIPE MAKING.—The Carnegie Company has purchased 5000 acres of land at Conneaut Harbor, Ohio, where it will expend $12,000,000 on a plant for making pipe. Electric power will be used throughout the works, and motive power supplied by gas engines run by blast furnace gases.

UTILIZATION OF BLAST FURNACE GASES.—An electrical generating plant at Hoerde, near Dortmund, Prussia, is operated by gas engines utilizing the gas from the blast furnaces of a rolling mill. The plant, when fully completed, will generate 6400 hp. The current generated is employed for electric light and power purposes in the rolling mill. An indication of the success in Europe of the system of using blast furnace gases for power generation is contained in a statement that the Cockerill Company received during the Paris Exposition about 70 orders for duplicates of the gas engine of this type, which was there exhibited.

CANADIAN NIAGARA FALLS POWER.—The matter of the transmission of power from Niagara Falls to Toronto, Ont., has been taken up by two local corporations, the Toronto Street Railway Company and the Toronto Electric Light Company. While three power companies intend to operate at the Falls, the Ontario Power Company has been the most active in endeavoring to find its market away from that district. A subsidiary company will, it is understood, be formed to purchase this power, with the object of selling it in Toronto and Hamilton. The other companies interested are the Canadian Power Company (which is the American Niagara Falls Power Company under another name) and an English syndicate.

THE CATARACT POWER COMPANY, of Hamilton, Ont., has been making extensive alterations to its power house, distributing lines and transformer station. Having found it necessary to increase its plant, the company has just installed two new 3000-hp turbines, manufactured in Milan, Italy; two 2000-kw S. K. C. generators, ten 400-kw step-up transformers, three 300-kw rotary converters and a chloride storage battery equipment. It has also built a second transmission line. A new building is nearing completion which will contain the rotary transformers, arc light apparatus, new battery equipment and the switchboards. It is the intention of the company to close down the power houses of the Hamilton Electric Light Company, the Hamilton Street Railway Company and the Hamilton Radial Railway Company, and to distribute altogether from the step-down station in the city; the incandescent, arc, power and railway services being supplied from the one building.

COLLECTING LOCOMOTIVES.—President Stone, of Purdue University, has announced the purpose of the trustees to secure for preservation a collection of typical American locomotives. A time has now come, he said, when certain classes of locomotives which have long seen service on American roads are giving way to new and heavier machines. In the natural order of events, the old are being converted into scrap with the result that forms which have been familiar to past generations are in danger of complete disappearance. In view of this fact it has been thought wise for the university to employ its good offices in preserving samples of such machines as represent distinct types, and to this end the co-operation of railways has been invited. It would seem that a similar plan might well be followed by Cornell, Columbia, or some other foresighted, self-respecting university in the collection of early electric cars and electric locomotives. They are now to be had as junk.

COST OF ARC LIGHTING.—Some time ago an opinion was expressed in these columns that the usual rate charged for street arcs is too low in this country; "that the prices in the majority of cases at the present time are entirely too small on the basis of a fair division of cost between the public and private central station customer; and that in very many cases where the central station man believes he is getting a profitable rate an analysis of cost would show that the private consumer is being made to pay in excess in order to balance unrecognized losses in the street lighting service." Commenting upon this statement, our London contemporary, *Lightning,* says: "If the American manager will supply arcs at the best price he can get, and the English engineer only at the lowest price that pays, this may account in some measure for there being so many more on the other side of the Atlantic. Also, if our contemporary be correct in its judgment, it must be admitted that the municipal station with its carefully worked-out figures at the disposal of every one who is competent to make good use of them, has at last done some service to the industry."

PNEUMATIC TUBE SERVICE.—Judge Morton, in the State Supreme Court, at Boston, recently refused an injunction on the petition of J. B. Mulholland of Lewis, N. Y., and others, to restrain the Boston Pneumatic Transit Company from continuing its work on the construction of an underground pneumatic tube system in Boston for the purpose of carrying packages, parcels, mail, etc., the work on which is nearly completed. The action was brought on the ground that the contract of the Boston Pneumatic Transit Company, with the American Pneumatic Service Company, to do the work for $157,000, is illegal, as it was secretly made by the same trustees acting for both the contracting companies, in alleged violation of the fiduciary relation which they hold toward the plaintiffs as stockholders in the Massachuetts company, for whose benefit, as well as the other stockholders, they hold the Boston company in trust. The application was denied. A pneumatic tube company, which has petitioned the incoming Connecticut Legislature for incorporation will have, it is stated, $1,000,000 capital, purposes to run a main tube from New York to Hartford, through Bridgeport, New Haven, and Meriden. One of the features of the project is said to be the practically instantaneous delivery of newspapers from New York to various cities in Connecticut. Details of this curious scheme are not forthcoming.

LIGHTHOUSE ETHERIC SIGNALLING.—The following recent special cable dispatch from London is given for what it is worth: "An invention which, if it may not go some way toward making lighthouses obsolete, is expected to be of much value in the prevention of shipwrecks was shown yesterday at Southend-on-Sea, before marine authorities and navigators. They were all much struck by the possibilities of the invention. It is an automatic system of signalling, and will warn ships of their approach to dangerous rocks and coasts in all weathers, when a flashing light might not be seen and the boom of the foghorn might be unheard. A metallic conductor is fixed on an elevation ashore or a lightship or a reef or lighthouse. From this etheric waves are transmitted over a zone which has a radius of seven miles. All vessels within that area, fitted with receivers, are warned of their proximity to danger. A bell rings and the receiving instrument records the name of the place which is being approached. The automatic part of the machine consists of steel bearings, with a number of teeth which pass over a Morse transmitter. No operators are needed at all. The machine works automatically. In its elementary principle the system resembles Marconi's wireless telegraphy, but in detail the system is essentially different. A syndicate is already taking up the invention, which will shortly be put on the market."

ELECTROLYTIC LEAD REDUCTION.—The Electrical Lead Reduction Company has resumed manufacture in its new building at Niagara Falls, which replaces that destroyed by fire last March. The new plant has a capacity about ten-fold that of the one burned down, occupying a building 182 ft. by 140 ft. The electrical machinery equipment consists of two Westinghouse motors of 300 hp each direct-connected to a Westinghouse direct-current generator of 250 hp. The process consists in the electrolytic reduction of lead from galena (sulphide of lead) to the form of a sponge. The sponge may then be compressed into the form of storage battery plates, or converted into litharge, red lead, lead peroxide or white lead. One hundred lbs. of spongy lead will yield 108 lbs. of litharge, 110 lbs. of red lead, 116 lbs. of lead peroxide or 125 lbs. of white lead. Sulphuric acid is a by-product of the process, 800 lbs. of acid being produced for every ton of lead reduced. The present capacity of the factory is 10 tons per day, but this may be extended to 40 tons, and there is sufficient ground space for an eventual capacity of 100 tons. At present the product is confined to litharge for use in rubber manufacture and storage batteries. The galena is procured from Joplin, Mo., and is concentrated before being shipped to 80 to 85 per cent metallic lead. About five days are required to reduce the raw material to spongy lead. The sponge is then washed and burned in a furnace to litharge, the product being 99.36 per cent pure, while the highest grade of litharge manufactured by former processes is 98.12. Plant is now being put in for rolling and stamping the sponge into storage battery plates.

WIRELESS TELEGRAPHY FOR SPANISH COLONIES.—A Madrid dispatch says that the Spanish Government is projecting the establishment of wireless telegraphy in Spain and Morocco and in the Canary Islands.

CALCIC CARBIDE PLANT IN ITALY.—It is proposed to utilize a water power of 100 ft. on the River Liri, situated between Rome and Naples, Italy. The horse power available is 2600, but this may be increased to 4000. The Compagnie Electrio-Metallurgique, employing the Gin and Leleux process for the manufacture of calcic carbide, will undertake the development.

ELECTRIC POWER FOR THE CANADIAN PACIFIC.—A conference was held recently at Rossland, B. C., between the superintendent of the Canadian Pacific Railway and the directors of the West Kootenay Power & Light Company, in reference to using electric power for hauling the Canadian Pacific Railway trains between Rossland and Robson, where there are exceptionally steep grades. It is estimated that 2,000-hp. will be required for this purpose.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—At the 150th meeting of the Institute, to be held at 12 West Thirty-first Street, Friday, Jan. 25, the following papers will be presented: "Air-Gap and Core Distribution," "The Magnet Flux and Its Effect Upon the Regulation and Efficiency of Dynamo-Electric Machinery." Part III.; by Prof. W. Elwell Goldsborough, of Purdue University. Also "A New Page Printing Telegraph," by William B. Vansize, of New York City. This will be illustrated by lantern slides.

AUTOMOBILES ON FERRYBOATS.—The fact that the Treasury Department has construed the law in relation to the carrying of combustibles on steamers carrying passengers so as to exclude gasoline automobiles from ferryboats has induced Senator Platt to introduce a bill in the Senate, amending the act so that the restrictions shall not apply to motor vehicles, provided the fire in such vehicles be extinguished before entering the boats and not relighting the fires until after leaving the boats. Chief Croker of the fire department and G. E. Murray, chief of the Bureau of Combustibles, in the department, say that the proposed law is a wise one, and that there is no danger in permitting the automobiles to go upon the ferryboats. The members of the Automobile Club of America hope the bill will become a law, as, without it, their pleasure riding is much curtailed. Representatives of the New York, Baltimore, North Jersey, Philadelphia, Long Island, Westchester, Rhode Island, Bridgeport, Massachusetts, Brooklyn, Pennsylvania and New Jersey automobile clubs have met in this city to discuss means for placing sign-posts upon the leading highways of the country. It was decided to place the boards a once on the road to Boston, from New York, by way of Bridgeport, New Haven, Springfield and Worcester; and from Boston to Providence and to Newport. Signs will also be put on the road from New Haven to Providence, and from the same city to Philadelphia, via Princeton and Trenton, and on the road from New York to Albany, and out on Long Island.

ELECTRIC TRANSMISSION IN ITALY.—A concession has lately been granted for water rights on the Lete River in the Province of Caserta, about 28 miles distant from Capua The minimum power utilized will be 1700 hp at the turbine. During ten months of the year the power will range from 1200 to 5400 hp, effective. The electrical energy will be transmitted to Capua, Santa Maria, Caserta, Aversa and Maddaloni, where it will be utilized as follows: 200 hp at Capua for the central station now operated by steam; 250 hp at Santa Maria for the same purpose; 350 hp for electric lighting in Caserta, which at present depends upon gas of a bad quality and high price; 150 hp at Maddaloni, where petroleum is at present a luminant. The remainder of the power will be utilized for house lighting in Aversa and for street and house lighting in the vicinity. The five centres named have a population of 100,000 inhabitants. The total cost of this project is estimated at $214,000, of which $89,000 will be required for the water power development and $48,000 for the electrical equipment. The total charges on the plant, including operation, interest and depreciation, etc., is estimated at $27,200, or on the basis of 1250-hp, an average of $21.60 per hp a year. These figures would appear to indicate that the project if carried out will prove very remunerative in consideration of the prices at present paid for illumination in the places mentioned. At Capua and Santa Maria, the two central stations, both now operated by steam power, have an income from street lighting of $14,000 per year. At Caserta the present illuminant is a poor quality of gas, the cost of which is $2.75 per 1000 ft. It is estimated that the present cost of lighting by petroleum at Maddaloni, public and private, is $14,000 per year. In this connection it may be noted that petroleum in Italy is subject to customs and other dues which brings the price to about 15 cents per quart. The cost of public lighting alone to Aversa and neighboring communes, petroleum being at present used, is $18,000 per year.

Letters to the Editors.

Cosmic Electrical Phenomena.

To the Editors of Electrical World and Engineer:

Sirs:—The interesting discussion in the London *Electrician* by Prof. Rucker, Prof. Fitzgerald and Dr. Lodge, of sun spots, magnetic storms, comets' tails, etc., which is abstracted in your Digest of Dec. 29, brings to mind a talk given by me in January, 1894, before the electrical section of the Franklin Institute. The title was "Cosmical Electricity." Considering the electrification of the air, I quote:

"It is a legitimate thought, it appears to me, that the electrification of the air may in large measure be due to influences outside of the earth itself. Let us assume a vast nebulous mass as having been the origin of the solar system by cooling and condensation according to the nebular theory, and if for any reason that nebulous mass have a small charge or be at a potential difference with respect to other gaseous masses in space, the diminution of surface during shrinkage would gradually increase the potential of the charge, provided it could not escape through the surrounding ether. This charge would increase in potential until the finer particles on the outside of the mass were repelled outwards with a force equal to the centripetal tendency or gravity. A dispersion of such particles would ensue, and result in a fall of potential. The dispersion and accumulation of charges would occur periodically while the hot mass of gas was shrinking and the particles sent off would be condensed vapors, liquid or solid, forming a charged cosmic dust proceeding in a radial direction from the central mass, etc."

Again, concerning the improbability or direct induction between earth and sun:

"Now the distance between the sun and a planet, such as the earth, is so great that it is not probable that any considerable static inductional effect could exist between them even if they were at great differences of potential. On the other hand, electrifid particles repelled periodically from the sun would reach the earth's atmosphere. It has been suggested that the coronal streamers seen during total eclipses, particularly during the active or sun spot period, may consists of electrified particles leaving the sun. If so their lack of visibility, beyond a few diameters from the sun, would not forbid the assumption being entertained as a rational one, that the streams may pass outward indefinitely until they encounter some obstacle like the earth. But auroral displays are frequent only when the solar activity is greatest, etc."

Further concerning auroras there appears: "Can we not consider that, during an aurora, the earth is passing through a coronal stream and developing, as it were, a secondary aurora (corona?) either by directly encountering in space the electrified particles from the sun or by induction from streams of such particles near the earth's course?"

The probable influence of such streams on terrestrial magnetism was then mentioned, and a further brief statement in regard to the sun's action as a charged body followed, after which comes: "During these actions the earth passes through or near to electrified streams, and an aurora or earth 'corona is developed.' "

After this are given considerations which go to show that auroral streams are frequently nearly radial to the earth, with observations of a magnificent aurora in April, 1883.

With regard to the possible effect of the earth's magnetic field upon auroras it is said: "Now, if a discharge is taking place under critical conditions in a high vacuum, the relation of its path and direction to a magnetic field in the vacuum may determine the continuance or cause a stopping of the discharge, etc.," or cause its deflection.

Brief reference is made in the paper to the effect of the higher rays of the spectrum in causing electric discharges and the possible bearing of this fact on the case. As to comets' tails:

"Again, if the sun be a highly electrified body, might it not be possible that cometary masses may owe some of their illumination to the distribution of electricity as they approach toward or recede from the sun? Here again the radial direction of the comet's tail is suggestive, etc."

In this paper a talk was given long before the electron theory was in existence. In my lecture on "Electricity at High Pressure," given before the New York Electrical Society March 29, 1899, these views were further developed, as follows:

"Auroral displays are shown to be probably dependent upon solar disturbances; an earthly coronal stream perhaps developing in response to some vast sun spot disturbance. I am tempted to think that possibly the flame gases of the sun actually reach the upper atmosphere of the earth and break down the insulation of the layers already under electric stress, or themselves bring electricity which disturbs the conditions of our air. The earth may, in fact, be brushed by an invisible prolongation of a coronal streamer, the effect of which, acting like ionized gas, or flame gases, or gases through which an electrical discharge has been passed, is to make the upper thin air conduct and relieve its accumulated electric stresses, etc." The possible like origin of comets' tails is again referred to.

Some three years ago I suggested the possibility of invisible radiation of the nature of cathode rays or Röntgen rays from the sun reaching the outer air, being prevented from reaching us by the absorptive power of the air, but I have not the reference at hand now.

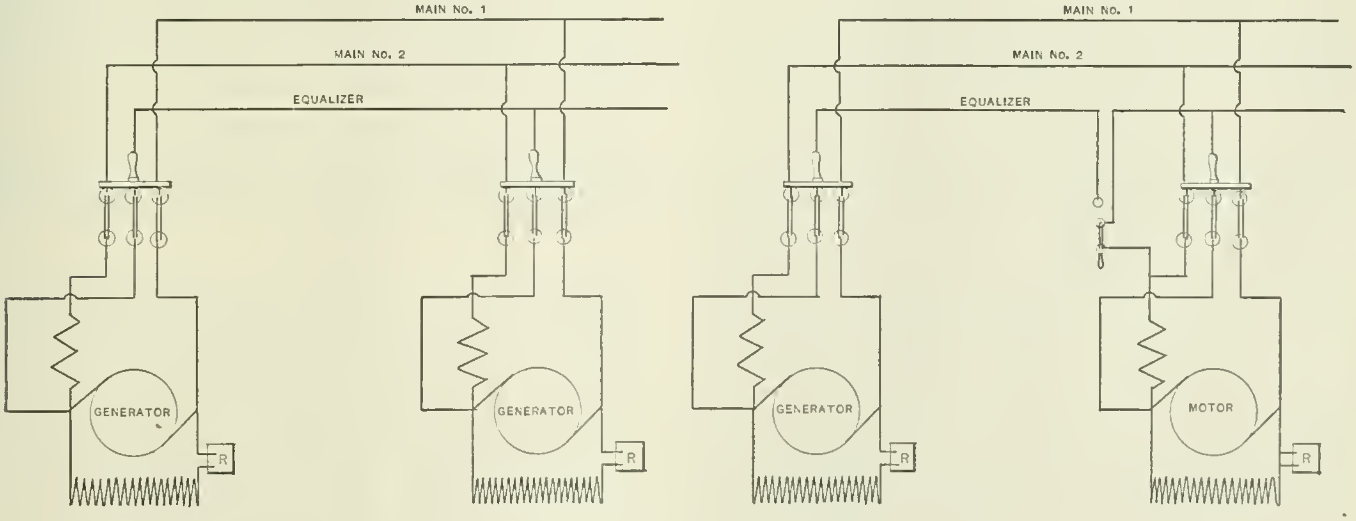
Swampscott, Mass. Elihu Thomson.

Compound Dynamos as Motors.

To the Editors of Electrical World and Engineer:

Sirs:—It seems to me that the statement of J. T. Freeman, in your issue of Dec. 22, with reference to the behavior of one of his generators when operated as a motor, is explained when he says that they are compound wound. The method of starting the generator to operate as a motor is undoubtedly to first bring it up to voltage as a dynamo, connect to the other generator, and then disconnect the friction clutch. The results are exactly what ordinarily takes place when the machines are operating as generators, and one for some reason should tend to take more of the load than the other.

This action is that the current passes along the equalizer wire (Fig. 1) from the generator to the motor. In the case of both machines acting as generators, the current would pass through the series winding of the "weaker" machine, building up its field and causing it to take its share of the load by reason of the higher e. m. f. generated. At the same time, the current through the "stronger" machine is diverted from its series windings; therefore reducing it on field, tending therefore also to equalize the load between the machines. In the case, however, where one of the generators is operated as a motor, the current does not flow through the wire (Fig. 2), but flows straight from one brush to the other by means of the equalizer wire. It is therefore evident that the generator is no longer operating as a compound machine, but as a plain shunt generator, therefore explaining the excessive drop noted.



Figs. 1 and 2.—Diagram of Connections.

In the case of the plain shunt motor, it was connected across the mains, and the current has to pass through the series windings. To obviate all the trouble, connect according to the diagram of Fig. 2. The method of operation is as follows:

Bring up both machines to voltage, close the single-pole switch in position shown in diagram; then close the main machine switches and quickly disconnect the clutch. *Be sure to close the single-pole switch in the other position* when operating both machines as generators, as serious trouble might follow when left running with switch in the wrong place.

F. Broili.

San Francisco, Cal.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to the letter by J. T. Freeman in your issue of Dec. 22, I would suggest the following as an explanation of the drop in voltage:

When the compound dynamo begins to run as a motor, its series field and the motor armature itself act through the equalizer as a shunt to the series field of the compound generator, thereby lessening the current through it and reducing the voltage. This is illustrated by the accompanying diagram. When the motor is loaded its back e. m. f. diminishes and the shunting of the series field of the generator becomes more pronounced with an increased drop of voltage.

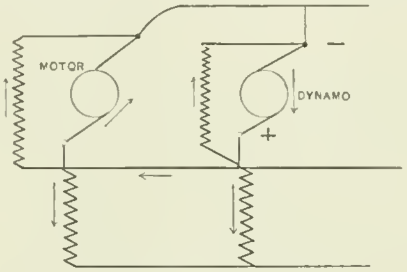


Diagram of Connections.

Walter O. Pennell.

Philadelphia, Pa.

The Inventors of the Telephone.

To the Editors of Electrical World and Engineer:

Sirs:—The article appearing in the Electrical World and Engineer of Jan. 5, 1901, giving the result of a vote upon twenty-five greatest names in electrical science and invention during the nineteenth century by the membership of the American Institute of Electrical Engineers was most interesting, and as an ex-associate member of the Institute, I beg the privilege of a few remarks in criticism of the result, as given.

Among the names there enrolled I failed to find that of Prof. Elisha Gray, a name well-known to electrical engineers of America, and better known abroad than several of those mentioned for honors. Prof. Gray was president of the International Electrical Congress held in Chicago during the World's Fair of 1893, and filled the position with honor and ability.

Waiving the claim of priority, Prof. Gray is conceded by many to be entitled to at least the same honor as Bell for the discovery and invention of the telephone, as evidenced at the International Exposition in Paris in 1889, where Gray and Bell both received like honors and medals as co-inventors of the speaking telephone.

If the telpehone comprised the only invention of Gray, the fact that he had invented as perfect and practical an instrument as Bell's —and at the same time—would have entitled him to as much honor as Bell for such a wonderful discovery as the telephone. But Prof. Gray has other inventions, among which his harmonic multiple telegraph and telautograph are prominent.

I think it an injustice to Prof. Gray that his name does not appear among those at the head of the list of honor. Prof. Gray certainly deserves better of his countrymen. "Honor to whom honor is due."

NEW YORK. WILLARD M. MINER.

Iron Pipe for Interior Wiring.

To the Editors of Electrical World and Engineer:

Sirs:—I notice on page 43 of your Jan. 5 number an article by Mr. H. Ward Leonard in which he would seem to take unto himself the credit of having been the first to have placed electric light wires within iron conduits or pipes for interior lighting purposes, referring to the Cable Building in this city as an instance of his prior use of such method. It is surprising that Mr. Leonard would make a statement of this kind, as it is not warranted by the facts. If he would look up his correspondence at about that time he will find that he wrote to me and asked if he could make arrangements to use the system of conduits as advocated by myself, and my reply to him was at that time that, inasmuch as I had no patent on the system, he could use it at his own pleasure. As early as 1888, as the records will show, I was seriously criticized in a very general way for refusing to use paper conduit or brass-armored paper conduit, although I very plainly stated my reasons, which, though condemned at the time by Mr. Edward H. Johnson and other high authorities on the question of interior electric lighting, have since been proven absolutely unassailable. The methods now almost universally adopted are the ones then advocated by the writer.

It is always interesting to note in the development of all matters relating to electricity, how those who have the courage of their convictions originally and express them are condemned, not because the methods advocated are not good, but because they are more expensive from a commercial standpoint, and then, when experience proves that the first cost is not the first and only consideration, those who were the first to condemn are ever eager and ready to claim priority and advance as an original idea, the advocacy of something which, on its face, should have been plainly perceived years before.

Mr. Leonard, to my mind, shows very clearly that he knows whereof he speaks on the subject of fires from electricity arising from faulty interior electric light wiring, as his remarks, particularly relating to "leakage current," can be fully substantiated by some 200 investigations made by myself as to the cause and origin of fires attributed to electricity. In nearly every case the evidence warranted the conclusion that it was the "leakage current" that caused the fire and not a short circuit or the heating of the conductor. The fires that have occurred from short circuits and overloading the capacity of conductors have, in my experience, which has been a fairly wide one, been extremely rare. FREMONT WILSON.

NEW YORK CITY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of the Maximum Ampere Turns Which Can Be Placed on a Given Spool.—OSNOS.—In practice it is often necessary to modify a finished machine for a special purpose; for instance, it may be desired to produce a very strong field, then the question arises, What is the maximum number of ampere turns which can be placed on the given spool, how much copper is required and what size of the wire is to be chosen. He develops the following formulas, which seem practical for such purposes:

$$(1) \qquad s = \frac{(At)\, l}{E\, c\, z}$$

$$(2) \qquad (At)^2 = x\, y\, z\, S\, L\, \frac{c}{l}$$

and if the specific gravity of copper is 9 and the specific conductivity of copper is 55,

$$(3) \qquad W = 164 \times 10^{-6} . \frac{(At)^2\, l^2}{L\, z}$$

in which S is the cross-section of one side of the spool, available for the windings, s the cross-section of the bare wire in sq. mm., l the average length of one winding in meters, L the admissible loss in watts per spool, (At) the ampere turns which can be placed at this loss, x the ratio of the cross-section of the bare wire to that of the insulated wire, y the ratio of the space available to that really occupied by the windings, z the ratio of resistance of a coil in cold to that in the heated condition at the loss L watts, c the specific conductivity of copper, W the weight of copper per spool in kg. The method of calculation is as follows: An available wire of known diameter and known thickness of insulation is assumed for the approximate determination of x; y must be taken from experience for this wire; Z is best taken from the results of tests of similar machines. (At) is then calculated from (2) and s from (1). If the value of s, thus found, agrees with the assumed wire, the wire is the correct one, otherwise another wire must be chosen. The method is explained in a numerical example.—*Zeit. fuer Elek.*, Dec. 23.

Commutatorless Dynamo.—ASHER.—A description of a continuous current dynamo or motor, which he claims will operate, and which has neither commutator, brushes nor slip rings. The armature is of laminated iron without windings; the field is as usual; stationary windings are also threaded through the pole pieces so as to produce (he claims) poles in the armature which are shifted toward those of the fields. The armature is then alleged to rotate as a motor or to generate continuous current in these polar windings when used as a dynamo. (As a little thought will show, it is inoperative, both as a motor or as a dynamo, as the two windings together will merely produce a single resultant, stationary field in the armature.)—*West. Elec.*, Jan. 5.

REFERENCE.

Large Generating Unit.—An illustrated description of a large engine with direct-connected alternator for a Brooklyn electric lighting station. The engine and generator have a nominal capacity of 4000 hp., but are designed to carry for short periods overloads up to 7500 hp. The alternator will deliver three-phase currents at 6600 volts, with a frequency of 50.—*Eng. News*, Jan. 3. (See E. W. & E., Jan. 5.)

LIGHTS AND LIGHTING.

Nernst Lamp.—An article on the work done by the (British) Nernst Elec. Light, Ltd. (Digest, Dec. 29). Several forms of Nernst lamps worked out by this company are described and illustrated.—London *Elec. Rev.*, Dec. 28.

POWER

Power from Blast Furnace Gas.—The conclusion of the long serial, noticed before in the Digest, on "Practical Consideration Involved in the Generation of Power by Blast Furnace Gas." The conditions most suitable for economic utilization of the gas in boilers and stoves are the reverse of those most advantageous when it is applied for the development of power by direct combustion in the cylinders of gas engines. The successful application of blast furnace gas to internal combustion engines requires that the crude gas must be cooled, for the following reasons. The cooler the gas, the greater its density, and the smaller the cylinder required to develop a given power. Any excess of moisture carried by the gas in the form of steam is reduced through precipitation. The temperature must be rendered constant as well as low. The dust and any tar must be more or less perfectly prevented from entering the cylinder of the engine. The variations in pressure where the closed top furnace is the source of gas supply must be overcome. Some numerical data are given, characteristic analysis of blast furnace gas from furnaces in different districts in Great Britain. When a suitable compression is arranged and the ignition tube is sufficiently highly heated, these varieties of furnace gas produce 1 ihp hour with an expenditure of from 67 to 95 cubic feet, as compared with 500 to 700 cubic feet when burned in boiler furnaces. The mean pressure upon the piston is greatly dependent upon the two factors of compression and ignition. "The reason why the subject is of such great importance to electrical engineers, of course, resides in the fact that, after providing the power required for blowing engines, there will in all cases be an enormous surplus of power, costing even less than that derived from waterfalls in other lands; hence it will be possible to carry on such profitable and growing industries as the manufacture of aluminum, calcium carbide, carborundum, alkalies, pure copper, etc., in addition to the supply of light and power to the adjoining district, at a minimum of cost."—Lond. *Elec. Rev.*, Dec. 28.

Thury High-Tension Direct-Current System.—Perkins.—A brief illustrated article on the power transmission plant at Renturia, Spain, where this system is used. There are three groups of direct connected turbines and dynamos, the latter being direct-current machines for series operation and supplying a constant current at 65 amperes with a varying potential, the maximum being 5200 volts. The transmission line has a length of 9 miles. The receiving station in Renturia includes six series direct-current motors, two of 130 hp each for general power distribution, three of 50 hp each for operating paper-making and paper-pressing machinery, one of 60 hp for operating the tolls in the repair shops of the paper mill. "It is claimed that the series direct-current system adopted was decided upon on account of the special advantages it presented for operating of paper-making machinery. Perfectly constant speed is guaranteed, and at certain times, when it is found necessary, the speed can be changed according to the needs of this line of manufacture."—*Elec. Rev.*, Jan. 5.

REFERENCES.

French Transmission Plants.—Perkins.—The first of a series of illustrated descriptions of high tension power transmission plants in France; the present one deals with the 300-kw single-phase plant at Allevard les Bains, the voltage of transmission being 2400, the length of the transmission line 5 kilometers.—*El'ty*, Dec. 26.—An illustrated description of the water-power plant at Engins, which supplies current to Grenoble and Voiron. There are two low-tension 375-kw three-phase alternators, the current is transformed by three-phase transformers to 15,000 volts for transmission.—*El'ty*, Jan. 9.

Electrically Driven Hoists.—A long illustrated communication, in which a detailed account of some recent tests of electrically driven hoists is given, in two tables.—Lond. *Elec. Rev.*, Dec. 28.

TRACTION.

St. John's Street Railway.—The road opened in May in the town of St. John's. An illustrated description of Newfoundland. Power is obtained from a chain of lakes some 9 miles distant, the transmission being over two distinct three-phase circuits, which are transformed at the sub-station in St. John's to two-phase. The power station is equipped with an 1800-hp turbine, to which are connected two 600-kw three-phase alternators. A 50-hp turbine runs two Westinghouse 15-kw 110-volt exciters. The sub-station has four 100-kw transformers supplying current to two 200-kw rotary converters for the railway service and four 150-kw transformers supplying current for light and power. Six miles of track are operated, on which are used six 32-ft. cars equipped with two 30-hp motors and controllers. —*St. R'y Jour.*, Jan. 5, and Internat. Ed., Jan.

Automobile Trials.—A long communication, in which it is said that the recent Chislehurst trials of automobiles do not seem to have been scientific in their nature. If a test of different batteries is wanted, the following trial is suggested. Suppose four different kinds of cells to be submitted for tests on a road trial, a vehicle should be selected to run with, say, 44 cells; 11 cells of each competitor should be formed into a battery to work the car. With one voltmeter and four contacts, the drop of voltage in each set of cells is measured. "From these readings immediately a cell falls in e. m. f. to a fixed limit, which may be to 1.85 at its lowest, then by dividing the distance traversed, or the hours of running, by the weight of the cell, we get the true value of its tractive power." Further life tests are required; if the life of a cell is short, this is no drawback, provided its price is correspondingly low. Long runs are not necessary for automobile trials, as for the purpose for which electric automobiles are most suitable, light, pleasant vehicles for medical and business men are wanted, making daily trips not exceeding 20 miles, often less than 10.—Lond. *Elec. Rev.*, Dec. 28.

Regulating the Voltage of Automobile Batteries.—Weber.—The voltage of an automobile battery of 42 cells decreases from 84 at the beginning of the discharge to 75.6 at the end; or from 88.2 to 71.4. He says that for different purposes it would be desirable to be able to regulate the voltage. This can be done by an adjustable resistance; if 80 is assumed as the normal voltage, the battery may consist of 44 cells, so that at the end of the discharge the voltage is 79.2. As the whole current passes through the resistance, a rather large capacity must be chosen. It may also be used in charging as series resistance; this has the advantage that the battery can be charged from 110-volt installations; this advantage does not exist in another device, namely one in which several cells can be separated from the battery; for instance, the regular battery may consist of 40 cells, and four more cells, perhaps of smaller size, can be added one by one when the voltage of the regular battery decreases below 80; the disadvantage is that the arrangement becomes somewhat complicated.—*Elektrochem. Zeit.*, Dec.

The Electric Railway of the Future.—Bell.—The writer thinks that it is possible that automobiles may make serious inroads into street railway traffic, but on the other hand, they may have no more effect than bicycles, which five years ago threatened to affect the income of street railways disastrously, but which now are no considerable factor. He thinks the future may show fewer elevated railways, and fewer overhead trolley lines, especially in large cities. He looks for an increase in agricultural and other industrial railways, especially those capable of carrying light freight and passengers. He also believes that higher speeds will soon be very common.—*St. R'y Jour.*, Jan. 5, and Internat. Ed., Jan.

A Review of the Electric Street Railway.—Crosby.—An illustrated article on the development of the electric street railway. He compares the transportation afforded by electric railways to that formerly available. There are at present about 3,000,000 car miles made per day in the United States, and about 12,000,000 passengers carried per day. He estimates that the saving in time for these passengers amounts to 792,000 hours per day. He then calculates the money value of these hours to the community, and also the saving in operating expenses for electric power, and finds the total is about $200,000 per day. He gives some reminiscences of the early electric railways. The engravings show the growth of street cars and miles of street railway track for ten years, the growth of the city railway systems of Buffalo and St. Louis during different epochs, and views of old and new street cars.—*St. R'y. Jour.*, Jan. 5, and Internat. Ed., Jan.

Capacity and Rating of Railway Motors.—Storer.—An article on the new system of rating railway motors employed by the Westinghouse company, based on the capacity of the motor under different conditions. To illustrate the method, a practical example is given in three figures, showing the characteristic curves of the motor, the iron loss curves in terms of watts and voltage for different currents, and the performance of the motor under an assumed set of conditions, which are scheduled speed, 15 miles per hour, weight of car and equipment, 15 tons, frequency and duration of stops, four per mile and five seconds each; average voltage, 500; rate of acceleration, 1½ miles per hour; rate of braking, 2 miles per hour, rolling friction, 20 lbs. per ton. He then discusses the curves and results secured by this method, and compares it with that proposed by Mr. Lundie in the October issue of that journal.—*St. R'y. Jour.*, Jan. 5, and Internat. Ed., Jan.

Electric Railway Equipments.—An illustrated description of electric railway equipments made by the (British) Brush Elec. Eng. Co. The motors for narrow-gauge roads have four different windings, giving, respectively, 17 hp, 25 hp, 30 hp and 35 hp. A characteristic curve is shown of the 25-hp motor. The rating is based on a rise of 115 deg. F. after one hour's run at rated load. The bearings are arranged so that the lower half of the motor can be dropped with the armature therein, or the armature can be allowed to remain in the upper half. The ventilation is very good. The company makes a large type of motor for standard gauge service, rated at 35 hp, as well as numerous types of single motor and series parallel controllers.—*St. R'y. Jour.*, Internat. Ed., Jan.

Third-Rail Insulator.—An illustrated description of new third-rail insulator, the body being made of "reconstructed granite," held to the ties by malleable iron cleats, and the rail being fastened by malleable iron clips. Reconstructed granite is a material made by pulverizing natural granite, moulding it into shape and fusing the whole together. The insulator is easily repaired and is very rigid.—*St. R'y. Jour.*, Jan. 5, and Internat. Ed., Jan.

Germany.—An article containing some notes from Germany. The annual report of the Berlin Electrical Works is noticed. This company furnishes all the lighting, power and railway current used in Berlin, owing to the fact that it is the only company with the right to lay conductors along public property. A table is given showing the relative current consumption for lighting, power and railways for the past five years. Enormous development is shown in the railway consumption. The present length of cables laid by the company is 2265 kilometers. The cost of production of current for the company is 1.22 cents. Increased demand for current is expected on the introduction of the Nernst lamp. At a recent meeting of the Electrotechnical Society of Vienna, Poschenrieder gave a talk on the evolution of the Grätz Street Railway from 1878 until 1899. This was a horse car line. It is now some 32 kilometers in length and operated by electricity from a steam power house. The traffic has been increased 91 per cent and the receipts 45 per cent by the introduction of electricity. The director of the Munich Institute, Dr. Ebert, has allowed the erection of trolley lines near this installation, but has specified that the company shall furnish galvanometers unaffected by the stray magnetic fields if they become objectionable. This has been complied with by the company. The earth's field has been considerably distorted by the various electric circuits, but as this effect would have been produced by the light and power service, no action has been taken against the railway company, and an auxiliary observatory has been erected in the country. The recent introduction of electricity on the railways of Vienna has been followed by some accidents which have caused the adoption of certain safety regulations. Telegraph and telephone lines are to be taken down, and until their removal will be protected by guard wires. Public notices are to be posted up and the children instructed in the schools against the dangers of broken wires, and watchmen are to carry insulated pliers. The Great Berlin St. R'y Co., owing to difficulties with its mixed trolley and battery service, called upon Prof. Roessler to make an investigation. His report (Digest, Dec. 8, 29), condemns the system as being impracticable, as in a successful mixed system the accumulators must be charged sufficiently to carry a car across the dead section before entering it, and must be again fully charged after each discharge. The unreliability of the voltage and the variation in the charging and discharging currents, with the corresponding inefficient operation of the motors have been responsible for the condemning of the system.—*St. R'y Jour.*, Int. Ed., Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Maximum Demand System of Charging.—An editorial on the experiences with this system in Great Britain. "The Brighton scale is the logical one, and has worked out well, because it has been applied in its entirety by Mr. Wright. In other places, however, the initial charge is really too low (12 cents first hour and 6 cents after, say) and this robs the demand principle of its most important feature. Again, in Edinburgh the huge success of the municipal supply has been attained on a uniform charge reduced as quickly as possible. Glasgow, we believe, used, and has discarded or is discarding, the demand indicator. Many of the companies manage to do without it, and they, above all, are keenly interested in financial results. The cost of indicators for small consumers and the trouble of testing and resetting also enter into the question, while the admitted secular change in the glass bulb makes it necessary to recalibrate the instruments after being first brought into use." It is said to be "a pity that the individual consumer and consumers as a class cannot be made to understand that in the long run they must benefit by the demand scale. Expediency has, however, often to take the place of logic and technical soundness, and there is no doubt that a feeling is growing that the immediate benefit of supply to influential tradesmen and householders is lost owing to the initial price."—Lond. *Elec. Rev.*, Dec. 28.

Electric Installation of a Metallurgical Plant.—Gohs.—A very long and well-illustrated description of the electric plant for lighting and power purposes of the Donetz-Jurjewka Metallurgical Co. in Southern Russia, the works of which comprise a blast furnace plant, steel works and a rolling mill. The direct current system at 250 volts is used. There will be eight steam-driven 125-kw direct-current generators, connected in parallel; six have been installed at present. From the bus-bars all the motors and arc lights are supplied with current at 250 volts; for the incandescent lighting of the mines the three-wire system at 2 × 125 volts is used, the distribution of the 250 volts pressure being accomplished by a 3-kw balancer. Enclosed motors are used throughout. Groups of motors are controlled from watch boxes (like the signal towers along railroads); in these are placed all the controllers, switching apparatus and measuring instruments. Two types of enclosed motors are used; in one type, for smaller capacities, the case consists of sheet zinc with a lid at the top, which enables the brushes and commutator to be examined; the other type has an entirely closed armor of cast iron, with two lids at the sides. The arrangement of the motors for the different power purposes is described in detail, with many illustrations.—*Elek. Zeit.*, Dec. 13.

Water Loads for Electric Plants.—Warrilow.—An illustrated article in which, after some remarks on the growing tendency to install large generating units and the resulting necessity of extra precautions for reliable running, attention is called to the advantages of simple water loads for tests of dynamos. Lead plates are suspended in a tank of water and connected to "one pole of the circuit," while the other pole is connected to the tank. The distance between the lead plates and the tank sides is the same all around, the load adjustment being effected by reduction of the distance between the plates and the tank bottom. The arrangement, which has proved successful in practice, is described in detail and illustrated.—Lond. *Elec. Rev.*, Dec. 28.

ELECTRO-PHYSICS AND MAGNETISM.

Direct Current Arc Phenomena.—An account of the brief discussion which followed the paper of Duddell, abstracted in the Digest Jan. 5 and 12. Also a long editorial on this paper. Among other things his experiments with arcs produced between metal electrodes are mentioned; he found that a shunt containing a certain amount of capacity would inevitably extinguish the arc, and with astonishing promptness. It was known that metal arcs can be extinguished or prevented from arising by means of a condenser shunted across the spark gap. "In fact, the effect had been utilized for some time in the construction of induction coils. But it was certainly unsuspected that an advantage might be derived by closing the shunt a very brief interval after opening the spark gap, a consequence of Mr. Duddell's researches that has been pointed out by Prof. G. F. FitzGerald. Experiment shows that when constructed according to this arrangement the spark length of an induction coil can be increased many times above its normal length."—Lond. *Elec.*, Dec. 28.

The Thermic and Electric Conductivity of Copper Containing Phosphorus or Arsenic.—Rietsch.—An account of an experimental investigation. Matthiessen and Holtzmann found 40 years ago that the electric conductivity of pure copper is considerably diminished by small additions of phosphorus and arsenic. For instance, an addition of 2.5 per cent of phosphorus at 18.9 degs. causes the diminution of the conductivity of copper from 93 to 7.24, the conductivity of silver being 100. He tested the Wiedemann-Franz law, according to which the thermic and electric conductivities are proportional; Kohlrausch has shown that this law is not strictly correct. From numerous measurements he found that small additions of phosphorus or arsenic cause the thermic conductivity of copper to decrease at a higher degree than the electric conductivity. This discrepancy from the Wiedemann-Franz law is in the opposite direction from that found by Jaeger and Diesselhorst in mixtures of metallic substances. —*Ann. der Physik.*, vol. 3, 1900, p. 403; abstracted in *Elek. Zeit.*, Dec. 13.

Roentgen-Ray Tubes.—Rollins.—A continuation of his serial, in which he points out that it is not the vacuum that determines the fitness of a Roentgen-ray tube; it is the conditions of the terminals and the generator. If energy enough is used, the cathode stream units are rushed through a tube at atmospheric pressure, producing brilliant X-light. He complains that manufacturers continue to supply physicians with apparatus constructed on incorrect principles, while he has given exact rules for constructing efficient apparatus.—*Elec. Rev.*, Jan. 5.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Production of Lead from Solutions and the Formation of Spongy Lead.—Glaser.—An account of an investigation, the results of which are summed up as follows: It is possible to get lead in the form of solid plates by the electrolysis of salt solutions. The formation of spongy zinc and spongy lead in slightly acid and neutral solutions is due to the same reason, namely, the formation of basic salts. Additions which can dissolve or reduce these basic salts prevent the formation of spongy lead or zinc. In an alkaline solution spongy lead is formed if, besides the lead cations which are present in a very small number, hydrogen is developed ("secondary formation of spongy lead"). An addition of hydroxyle ions causes a diminution of lead cations. It is possible to get lead in solid form from alkaline solutions.—*Zeit. fuer Elektrochemie,* Dec. 13, 27.

E. M. F. Between a Salt and Its Non-Saturated Solution.—Campetti.—When a crystal of, say, Na Cl is dropped into water or its own non-saturated solution, the chlorine ions fly off more rapidly than the sodium (according to their migration velocities). The liquid immediately surrounding the crystal thus becomes negatively charged and the crystal is positively charged. This accelerates the outflow of Na and retards that of Cl ions, so that presently there is a tendency toward equalization. On the whole the liquid is negative to the crystal. The e. m. f. is of the same order as that between a more and a less concentrated solution of the same salt. (This description of the process corresponds exactly to Nernst's theory of the production of the e. m. f. in a concentration cell.)—*Accad. Lincei, Atti,* July 15, 1900; abstracted in *Science Abstracts,* Dec.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Testing Direct Current Meters.—Feussner.—An illustrated description of the methods used in the German Reichsanstalt for testing direct current meters. The arrangement of the laboratory, the instruments, etc., is described in detail; current from storage batteries is used throughout, up to 10,000 amperes being available. The tests are always made with the meters enclosed in their cases, as the heating of the single parts with the case differs entirely from that without the case. It has been found practical, before the real test, to determine first the resistance of series and shunt coils; also of a separate series coil if any, and to calculate from that the consumption of watts in the apparatus for the indicated maximum current and the normal voltage. The real test of the meter is made as follows: A quantity of electricity or of electric energy, which is measured by standard instruments, is supplied to the meter and readings of the meter are taken before and after the test. The ratio of the measured to the indicated electricity or electrical energy is called the "constant" of the meter; this, however, is incorrect, as this "constant" depends upon various circumstances. Special attention is called to the sources of error arising from indications of the meter without energy being supplied to it or from the fact that some meters do not register before a certain value of load is reached; both are bad sources of error. The value of the constant of the meter is determined at the same time with its dependency upon the load and the duration of the supply; this is done as follows: First the resistance of the shunt is measured with the bridge and the insulation of the parts carrying current is tested. The shunt is then connected for an hour to a source of e. m. f. of the voltage indicated on the meter; it is found whether there is registering at no load. The constant of the meter is then determined for one-fifth full load, one-half full load and full load; the meter is then supplied with full load for an hour and readings of the meter are taken at the beginning and the end of this time. For the determination of the resistance of the series coil the voltage at the series coil terminals is also measured during this time. Finally the constant of the meter is again determined for decreasing load, first for full load, then for half load and for a fifth load.—*Elek. Zeit.,* Dec. 13.

A New Alloy for Standard Resistances.—van Aubel.—An article on an alloy made by Kulmiz, consisting of copper, zinc and aluminum, which has been examined by the German Reichsanstalt and appears to have properties which are superior even to constantan and manganin. The only question which has not yet been decided is how great is the variation of the electric resistance with time. The temperature coefficient between 18 degs. and 25 degs. C was found to be very small and negative, between the limits —0.00001 and —0.000002. Measurements of the electric resistance between — 4 and + 60 degs. C. have shown that the alloy has a maximum resistance in the neighborhood of 20 degs. C.; at lower temperatures the temperature coefficient has a small positive value; at higher temperatures a small negative value. (This does not seem to agree with the foregoing statement.) The thermoelectric force of the alloy with copper "is 0.56 microvolt between 20 degs. and 45 degs. C., and 0.62 microvolt between 20 degs. and 65 degs. C., for a difference of 1 deg. between the seams" (this is not clear). This e. m. f. is smaller than for constantan-copper and manganin-copper couples.—*L'Eclairage Elec,* Dec. 15. For a fuller description see *Zeit. fuer Instrumenten kunde,* June, 1900.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Multiple Wireless Telegraphy.—An abstract of a lecture delivered by Prof. Slaby before the German Emperor, in which he gave an account of some interesting new inventions. He "has been devoting his attention for a considerable time to devising a means of Hertzian signalling between several independent pairs of stations without the messages interfering with one another, and he has now apparently solved the difficulty. The method employed seems to be simple tuning." During the lecture Prof. Slaby signalled to two stations, one eight miles distant and the other about two and a half miles distant. Messages were received from these two stations in the lecture room simultaneously. For both sets of the receiving apparatus on the lecture table the lightning conductor on the chimney of the Schiffbauerdamm electric lighting station was utilized as an air-wire "without removing its earth connection." The lecturer explained that the arrangements were such that the waves in the two cases were of an exactly predetermined length, and that the two sets of apparatus were each tuned to a different wave length. From the station eight miles distant the waves had to pass through Berlin from southeast to northwest and were naturally attenuated by the number of chimneys and high buildings. In order to intensify the received wave, Prof. Slaby showed another invention which he called a "multiplikator," a word which may be translated as "intensifier." This is a resonator, the action of which Prof. Slaby explained by analogy with a tuning fork which emits only a weak note until it is placed on a suitable sounding board. The resonator increases the potential of the received wave, and renders it easier to detect on the receiving apparatus.—Lond. *Elec.,* Dec. 28.

MISCELLANEOUS.

Mineral and Metal Output of the United States in 1900.—The very full annual statistics, covering the complete issue. The total value of the metals produced in the United States in 1900 was $509,800,992, as compared with $496,057,320 in 1899. The value of the output of non-metallic substances was $755,680,991, as against $645,754,305 in 1899. The production of aluminum by the sole producer in this country was 7,150,000 lbs., valued at $2,288,000, as compared with 6,500,000 lbs., valued at $2,112,500, in 1899. With a steady demand at high prices the output of copper exceeded the great record of 1899, the total output being 615,576,802 lbs., in comparison with 581,319,091 lbs. in the previous year, these figures including the copper contents of by-product, copper-sulphate. The weaker markets, particularly abroad, resulted in a decreased output of zinc last year, the production being 122,850 short tons, as compared with 129,675 short tons in 1899. The total production of copper sulphate in 1900 was 76,959,486 lbs., valued at $3,770,278, compared with 67,903,370 lbs., valued at $3,530,975, in 1899; of the 1900 output 42,250,758 lbs. was recovered as a by-product. The production of carborundum was 2,660,000 lbs., valued at $239,400, against 1,741,245 lbs. and $156,712 in 1899. The production of artificial graphite was 845,000 lbs., valued at $67,600, against 405,870 lbs. and $32,475 in 1899. The manufacture of soda amounted to 395,902 metric tons at $6,655,113, against 387,020 tons and $5,925,276 in 1899. There are a great many short articles on special metals and the metal markets of 1900, with a very large amount of statistical information; but there seems to be no information given about the extent to which electrical methods have come into use.—*Eng. and Min. Jour.,* Jan. 5.

Century Reviews.—An illustrated review, by Fournier d'Abbe, of the general progress of electric science and industry in the last century; also separate article, by Miller, on telegraphy and telephony; by Pierce, on the electric light; by Rae, on electric traction. Also two interviews with Edison and Tesla on the electrical outlook. Edison says that the progress in telegraphy will lie particularly in the adoption of greatly improved methods of automatic sending and receiving in type letters; there will also be greatly improved telegraph line construction; the improvement in lighting will come largely in the increased efficiency of the incandescent lamp. Tesla expects great progress from the skillful utilization of electric tuning or resonance effects, with circuits carrying oscillating currents of high frequency.—*West. Elec.,* Jan. 5.

Philippines.—G. D. Rice.—An article on "Some improvements needed in the Philippines." Attention is called to the abundance of water power which is not utilized there at present. The electric lighting company of Manila has arranged to double its plant; there are at present 1000 incandescent street lights and 200 arc lights in Manila. There is quite a demand for electric motors in the Philippines; also for tools to be used in electric work, etc.—*West Elec.*, Jan. 5.

REFERENCES.

Electrical Engineers in the War.—Crompton.—An illustrated paper, read before the (British) Inst. Elec. Eng. on "The Electrical Engineers R. E. in South Africa" and their work done in lighting installations, telephony and telegraphy.—Lond. *Elec.*, Dec. 28; *Lightning*, Dec. 27; in abstract in Lond. *Elec. Rev.*, Dec. 28.

Physiological Effects.—Waller.—An illustrated abstract of a Royal Society paper "On the blaze currents of the frog's eyeball." The paper is of a physiological nature.—Lond. *Elec.*, Dec. 28.

Magnetic Separator.—Some notes on a patent of Gates for a magnetic separator for removing from gold-bearing sand the magnetic iron which it always contains.—*El'ty*, Dec. 26.

Paris Exposition.—Reyval.—A well-illustrated description in detail of a three-phase alternator of the French Thomson-Houston Co., the capacity being 1000 kilovolt-amperes with a power factor of 0.9. The pressure at the terminals is 5,500 volts, the armature is star connected, the e. m. f. per phase is 3,170 volts, and the current at normal inductionless load is 105 amperes. The frequency is 25 periods and the number of poles is 40.—*L'Eclairage Elec.*, Dec. 22.

Paris Exposition.—Dary.—An illustrated description of the electric launch of Smit and Zoon; the power is supplied by a battery of 80 Tudor cells, giving 360 ampere-hours.—*L'Elec.*, Dec. 8.

Bainville.—An illustrated description of an arc lamp of the Soc. Ind. des Tel.—*L'Elec.*, Dec. 8.

Armagnat.—An illustrated description of measuring instruments of the British and American sections.—*L'Eclairage Elec.*, Dec. 15.

Reyval.—An illustrated description of a new type of the Phœnix storage battery, with special data on construction and capacity.—*L'Eclairage Elec.*, Dec. 22.

New Book.

Lezioni di Elletrotecnica. Dettate Nel R. Museo Industriale Italiano in Torino da Galileo Ferraris. Volume Primo. Fondamenti Scientifici dell'Elletrotecnica. Torino: Roux Frassati e Co. 432 pages, many illustrations. Price, 15 lire.

This is the first volume of the late Prof. Galileo Ferraris' lectures on electrical engineering. It is devoted to the scientific foundation of electrical engineering and is a concise treatise on the mathematical theory of electricity and magnetism.

The introductory chapter deals with vector analysis, and gives an outline of the potential theory, first under the supposition of any forces which have a potential; then for forces which act according to Newton's law. The second chapter deals with electrostatics and the simplest laws of an electric current, as Ohm's law, Kirchhoff's rules, Joule's law. The third chapter takes up magnetism and the magnetic field due to magnetic masses. The fourth chapter is devoted to a discussion of electromagnetism or the mutual relations between electric and magnetic phenomena. The fifth chapter deals with alternating current phenomena. The sixth and last chapter is devoted to the propagation of electromagnetic waves. Maxwell's fundamental formulas are given and explained by application to special cases; then follows a description of the experiments of Hertz, and finally Poynting's theory of the propagation of the energy is discussed. There is an appendix on electric and magnetic units.

It will be seen that the entire field of the theory of electricity and magnetism is covered by Ferraris' lectures. The exposition of the theory is admirably lucid and concise. This was made possible mainly by the free use of vector analysis and the symbols of the calculus. Special cases are calculated only when they illustrate the general phenomena and when the calculation is brief; long mathematical calculations, as for instance, those which Kirchhoff employed so often in his lectures, are not given. The development of the subject thus becomes very clear, and gradually the reader is guided from the old electrostatic theory to the modern views based upon Maxwell.

The arrangement—the use of the theory of electrostatics as a starting point and foundation for the chapters which follow—may perhaps appear somewhat old-fashioned. We have become accustomed to ignore in a way the old theory of electrostatics. Hertz's exposition of the theory of electric and magnetic phenomena appears to us more modern, starting, as he does, directly from Maxwell's fundamental equations—as axioms not requiring any proof—and then showing that from them all laws of electricity and magnetism can be deduced in accordance with the experimental facts, his exposition of the theory concluding with electrostatics—just the opposite to the order adopted by Ferraris. But it should not be forgotten that Ferraris' method corresponds to the historical development. And, besides, our disdain of electrostatics may be rather premature. Very recently we noted the following remark by Oliver Lodge: "The whole subject of electricity demands reconsideration in the light of the facts now known concerning the existence of elektrons, or at least of negatively charged corpuscles smaller than atoms. The old facts and theories remain true, but a further step can be taken; and a glorified electrostatics, that once despised subject, seems likely to dominate the field."

To prevent any misunderstanding, we may say that, in its contents, Ferraris' lectures form a highly modern and up-to-date book. It is of course impossible to describe in a brief review the beauties of the book as the work of an artist, although its main value may lie just in this feature; for Ferraris proves an eminent artist in the exposition of mathematical physics. For this reason we hope that the lectures of the most famous Italian electrician, since the days of Galvani and Volta, may find a place in the library of American engineers, interested in the history of their science.

Electric Automobiles in New England.

Early last year an account was given in these pages of the work in Boston of the New England Electric Vehicle Transportation Company, and note has also been made from time to time of its successful operations at Newport, R. I. With the active resumption of general business in the Fall, the regular work in Boston took on new vigor and activity.

Some idea of the rapid growth of the business can be gathered from a statement of the facts that about 250 vehicles are now owned and operated by the company. Many additions to the central station on Tremont Street, Boston, have been made, and sub-stations have been established in the suburbs of Boston and at Newport and Narragansett Pier.

From the nature of the climate of the New England States, it is necessary to use several types of vehicles for passenger service, and although this is a fact, the company has been enabled to keep about 80 per cent of its vehicles in commission. About 15 per cent are in storage, not being adapted to winter use, and about 5 per cent are undergoing repairs.

The popularity which electric cabs have gained in Boston is such that an average of 200 calls are received and filled each day, and as many more are turned away, because of the inability of the plant with the present equipment to furnish more carriages. A most important branch of the electric automobile service in Boston is the transportation of merchandise. In operation the ability of the electric delivery wagons to work in all kinds of weather, to quickly thread their way through thickly-crowded streets, and their speed on streets where traffic is less heavy, have proved them to be most economical and desirable for transportation purposes, not only for the class of goods ordinarily sold by the large department stores, but for commodities requiring specially quick delivery. To the latter class belong newspapers, and it does not take a very long delay in their distribution to make a heavy loss. The New England Company furnishes vehicles for the transportation of both these classes of merchandise (as well as for others), and the capacity of its equipment has been reached several times. Even now the demand is far in excess of the company's present ability to supply vehicles.

On Sunday, Dec. 30, 1900, a bus line from Deerfield Street to Scollay Square was started by the Boston Transit Company, the New England Electric Vehicle Transportation Company furnishing the vehicles therefor. The operation of this class of vehicles had its beginning at so recent a date that no useful data concerning it can be obtained at the present writing.

The following figures may be of interest to statisticians: During the six months prior to Oct. 1, delivery wagons operated by this company covered about 130,000 miles over the streets of Greater Boston, making 254,851 stops for the delivery of packages, papers, etc. In November of the present year the electric cabs run by the company covered on an average 726 miles per day, the maximum mileage made by a single cab in one day being 66½ miles. The maximum mileage for a single cab for the month was 600 miles. In the same month the delivery wagons run by this company for two Boston concerns covered 27,909 miles, making 59,967 stops for the delivery of merchandise, the highest daily average for one delivery wagon being a fraction over 53 miles. The highest mileage made by any one delivery wagon for the month was 1381 miles, making 2395 stops for the purpose of delivery of merchandise.

The Swedish-American Telephone Switchboard Apparatus.

The Swedish-American Telephone Company, of Chicago, has recently secured additional manufacturing facilities and also doubled its floor space, and is now prepared to furnish full exchange equipment of either the magneto ring-down type or full multiple and central energy switchboards from a 10-capacity line to a 10,000-line exchange. In the "full multiple central energy" switchboards all signals, both line and keyboard signals, are of the luminous type, consisting of a miniature incandescent lamp placed behind a ⅜-in. opal glass bull's eye, and self-restoring in action. The cord circuit signals are of the same luminous type, and each pair of cords is equipped with two, the full supervisory system of signals One of these signals works only in connection with the answering plug, and the other works only in connection with the calling plug, thus enabling the operator at any instant to tell at a glance the exact state of connection at that moment This does away with the necessity of the operator going into the circuit after the connection has once been made, and the subscriber is not relieved from the annoyance of having conversation interrupted by the operator, but the operator's time is saved.

The keyboards are equipped with ringing key and operator's cam, or with a combination key, which performs both operations. In this board the strips of drops and jacks are placed in the lower panels, and above them are placed the multiple jacks. The multiple jacks are made in strips of 20 each, each jack being placed on 7-16-in. centers. Each jack consists only of sleeve and tip springs, and they are therefore entirely free from inside contacts. On this system there are no contacts anywhere in the subscriber's circuit, it being an absolutely continuous circuit from the subscriber's instrument to the jacks in the switchboard. The only contact in the entire circuit is that of the switch hook at the instrument, and the contacts made between the plugs and the jack springs in the switchboard; but over the latter contacts no current is broken, as none of the common battery current ever flows over the jacks or through the cord circuit. These switchboards, even in their smallest units, are true universal boards, that is, any board, no matter how small, can, if desired, be increased to a full multiple swtichboard of any capacity simply by adding new sections and without any change in those installed other than the addition of the multiple jacks and wiring of the same.

The operation of this system is as follows: To signal the exchange, the receiver is taken from the hook, on which the line signal is at once lighted; when the operator answers by inserting the answering plug in the jack, this light at once goes out. On ascertaining the number required, the operator makes a busy test on the multiple jacks, and not finding the line busy, inserts the plug and rings the subscriber. At once the supervisory lamp of that cord circuit lights and remains lighted until the party called answers. When conversation is finished and both receivers are restored to their hooks, both lamps in the cord circuit are lighted. This condition, of both lamps lighted, is the only positive signal to the operator to disconnect. Should one or both of the parties desire other connections when they have finished their conversation, the slow movement of the switch hook up and down will flash either one or both of the signals in the cord circuit, which will be a positive signal to the operator to connect herself at once with that circuit to find out what is wanted. In other words, through the use of this double supervisory system, there can never be, as far as the operator is concerned, what might be termed a "position of doubt." Each line is equipped with a small relay, and this relay controls all of the signals used in handling connections, whether those of the cord circuit or the line signal. Other than this relay, there is no relay or coil of any sort anywhere in the system, and the cord circuit is entirely free from them.

This system is even more simple than the old style magneto multiple board system with local transmitter batteries. The busy test is very novel and efficient, and is applied by the subscriber himself, and not by the operator when the call is answered. The instant the receiver is taken from the hook to signal the exchange the line will test busy. This, therefore, assures the subscriber the exclusive use of his line when he wishes it, there being no period of time when his line is unprotected.

Another important feature is the entire absence of the objectionable "click" in the receiver. This system is a true common battery system, requiring but one set of storage batteries (of 11 cells), where usually two sets are required, each of equal size. It is also a two-wire system, and requires no third wire, or what is its equivalent, a ground connection at each instrument.

What, after all, is the most important part of a common battery system is the talking circuit, and the Swedish-American Company guarantees its system to give perfect results with the instruments located as far as 30 miles from the exchange, and at this distance they will work perfectly when connected at the switchboard, through toll lines or to instruments working on the local battery, or any other common battery system.

A New Automobile Exchange and Storage Plant.

The early years of the twentieth century seem destined to witness a remarkable expansion in the automobile field. In fact, to the close observer it is already evident that the movement has acquired considerable momentum, even at this early period. The increasing number of horseless vehicles, the rapidly growing number of repositories for their special care and storage, and the growth of interest in the subject shown by the general public, all tend to indicate the way the wind is blowing.

One of the first of the new automobile repositories to open its doors for business this century, and probably the most elaborately finished one yet erected, is that just completed by the Automobile Exchange & Storage Company, and which is located at 133-5-7-9 West Thirty-eighth Street, New York City. The company, as its name indicates, was organized to store, charge, care for, sell, exchange and act as agent for manufacturers of all classes of automobiles. At present it has but the one exchange and storage depot, an exterior view of the front of which is shown. The company, intends, however, to increase the number of its storage, exchange and charging depots as fast as the volume of its business demands. It is already preparing to build a depot farther up town which will have more than four times the floor space now available in the one just completed. This second station, it is expected, will be ready about May 1 next.

AUTOMOBILE EXCHANGE AND STORAGE WAREHOUSE.

The Thirty-eighth Street depot was built especially for the use of the company. It covers a ground space of 100 ft. x 100 ft. It is lighted from the top by several large skylights. The front of the building, seen in the illustration, is largely composed of glass and oxidized copper, which gives a very pleasing effect. This arrangement makes a particularly airy and light depot. Later another story will be added, which will increase the available floor space to 20,000 sq. ft. The building is divided into several sections by hardwood partitions. One part is devoted to a reception room for visitors. This room is comfortably furnished and its tables are supplied with all the latest periodicals on automobiles. Back of the reception room are the offices and back of these are some 60 or more lockers for the use of patrons who keep vehicles in the building. In another corner is a machine shop, furnished with a lathe, drill press, emery wheel, work bench, vise, etc., where repairs can be made. An air compressor and storage tank are also placed in the machine shop. The compressed air is used to supply the required pressure in the gasoline tanks of steam vehicles. Power is supplied to the machines and air compressor by means of a 5-hp General Electric motor.

Artificial light is supplied by enclosed arc and incandescent electric lights. Every precaution has been taken in the construction of the building to eliminate the possibility of fire, and the efforts of the company have been rewarded by the unqualified approval of the board of fire underwriters. This makes it possible for patrons to get the lowest fire insurance rate on their vehicles.

Another feature is the space in the front of the building set apart for the permanent exhibit of new vehicles by manufacturers. This space is divided off by brass railings. The company is prepared to take care of, store, charge and repair all kinds of automobiles, both for pleasure and business use. It makes a specialty of keeping a line of slightly used automobiles of various makes on hand for sale at greatly reduced prices.

A wash stand for vehicles, some 18 ft. by 21 ft., is provided; also three charging boards for electric vehicles. At each of these boards four electric vehicles can be charged at the same time. Each board is equipped with four Queen-Wirt ammeters having a capacity up to 150 amperes. The current is supplied from the mains of the Edison Illuminating Company's three-wire system. In short, the depot is most complete in all respects.

The officers of the company are: A. P. Morison, president; Andrew Morison, vice-president; Morris Putnam Stevens, secretary and treasurer; E. S. McCool, manager; J. O. MacDonald, superintendent; Charles R. Smith, chief of electrical department.

Hot Wire Measuring Instruments.

Mr. Camillo Olivetti, the well-known instrument manufacturer of Ivrea, Italy, read a paper at the recent annual meeting of the Institute of Italian Electrical Engineers, having for its subject, "Hot Wire Electric Measuring Instruments."

The wire used in such instruments, he said, must answer the requirements of a large co-efficient of elongation, high resistivity, small temperature co-efficient, great mechanical strength and unalterability from chemical and physical causes while at high temperature. Platina silver alloy is mentioned as the substance which answers most nearly these requirements. The specific resistance of this alloy is 32 microhms, its co-efficient of elongation 15×10^5, its temperate co-efficient 26×10^6, and its tensile strength varying from 35 to 90 kilogrammes per square mm., according to the diameter. While this type of instrument has not the high precision of laboratory instruments, yet it can be made to have a precision which reduces errors to less than one-half of 1 per cent. One of the greatest advantages of this type is that it may be used indifferently with direct and alternating current. The largest diameter of wire which Mr. Olivetti uses in his instruments is .016 in. If wire much heavier than this is used the elevation of temperature due to a current flowing is slow, and the normal condition is not reached until a considerable length of time has elapsed after the instrument is put into circuit.

As it is not advisable to pass more than five or six amperes through a hot wire instrument, when used as an ammeter, a shunting arrangement is required. In order that the shunt shall not introduce errors, it must have a practically constant temperature co-efficient.

During the lecture Mr. Olivetti showed a hot wire instrument multiplying arrangement invented by Signor Arcioni, whereby the elongation of the wire is magnified 3200 times. Moreover, the geometry of the movement is such that the scale of the instrument is nearly proportional to the current. In order to avoid the influence of variation of temperature, the instrument is fixed on a basis having a co-efficient of expansion equal to the average co-efficient of expansion of the wire and a portion of the multiplier. In the voltmeter type the wire is wound on two small pulleys. In a 7½-in. dial instrument the voltmeter takes a maximum current of .1 ampere. In ammeters the difference of potential is .22 volts. Mr. Olivetti stated that these figures are the lowest yet attained in hot-wire instruments.

Low Water Alarm and Blow-off Valve.

The low-water alarm, shown in Fig. 1, is attachable directly on top of a boiler, or can be piped to any location most convenient to the engineer. It is stated to be a positive indicator of low water. This device has been made by the Crane Company, Chicago, Ill., for the past ten years, but was recently improved to meet the requirements of the laws in some States stipulating that low-water alarms "shall be of a type capable of being tested by the inspector of workshops and factories." The illustration is of the improved form. Fusible gaskets that melt at 270 deg. are furnished with these alarms. Gaskets to fuse at higher temperatures are made to order.

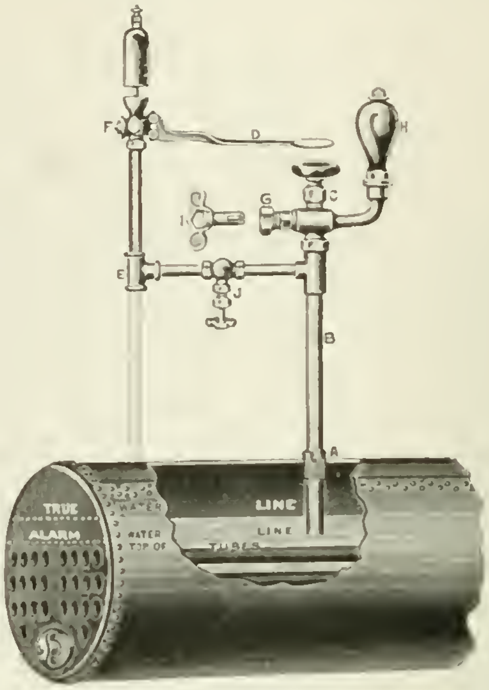


FIG. 1.—LOW-WATER ALARM.

Fig. 2 shows a blow-off valve made by the same company, and designed to overcome the trouble generally experienced with the ordinary blow-off valves and cocks. The feature of this valve is that the seat is on the outside, which prevents the lodgment of sediment at this point. The projection on the under part of the disk prevents any discharge until the seats have become widely separated; this also prevents wire drawing. These valves can be made in either angle or globe patterns.

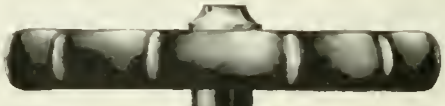


FIG. 2.—BLOW-OFF VALVE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In the money market time money was offered more freely and there was also a better demand. Rates are quoted at 4@4½ per cent for 30 to 90 days and 4½ per cent for longer periods on mixed collateral. Commercial paper was in better demand from out of town, transactions being based on quotations of 4½@5 per cent for prime double names. Call money is quoted at 2½@5 per cent as the extremes. In the stock market there was great speculative activity, but prices receded from the extreme advances made early in the week. Transactions for the week broke all records, the sales aggregating 8,614,500 shares, against 7,511,415 the week previous, and 2,779,967 the corresponding week last year. Tractions and electric stocks are higher, and the sales indicate considerable activity as compared with the market of the previous week. Third Avenue stock took an upward jump last Thursday, touching the highest price since the property changed hands. It advanced 10 points compared with Tuesday's prices. On Saturday there was heavy buying of Manhattan Elevated, accompanied by reports that the property had been leased to the Metropolitan Street Railway Company for a 6-per-cent guaranteed dividend per annum. It was stated in some quarters that the report was regarded as practically confirmed. In outside securities the week was an unusually dull one, heaviness being a pronounced feature of the market. Electric Boat preferred showed a considerable number of sales, which were confined, however, to odd share lots, which changed hands between 49 and 50. Total sales did not exceed 150 shares. General Carriage sold at 3⅛ to 3½. Among the net declines are Telegraph, Telephone & Cable, 2 points, and Electric Boat, common, and General Carriage, 1 point each. Electric Boat, pfd., made a net gain of 2 points. Following are the closing quotations in New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Jan. 5.	Jan. 12.		Jan. 5.	Jan. 12.
Gen. Electric	188	190	Elec. Veh	17	16
Bklyn. Rap. Tran	82⅞	86¾	Elec. Veh., pfd	43	35
Met. St. Ry	165¾	170⅞	Gen. Car	3½	3¼
Am. Tel. & C	—	93	Ill. Elec. Veh. Tran	1	¾
West. Un. Tel	83¾	86¾	N. E. Elec. Veh. Tran	3¼	3¼
Am. Dist. Tel	—	30	N. Y. Elec. Veh. Tran	6¼	4¾
Com. Cable	—	165	Tel. & Tet. Co. of Am	6½	4¾
Elec. Boat	28½	27	Hud. Riv. Tel	116	116
Elec. Boat, pfd	47	49	N. Y. & N. J. Tel	173	174

BOSTON.

	Jan. 5.	Jan. 12.		Jan. 5.	Jan. 12.
New Eng. Tel	128	129¾	Erie Tel	90	53
Mex. Tel	2½	2¾	Gen. Etec., pfd	156	—
Westing. Elec	54½	56	Am. Tel. & Tel	155⅞	163
Westing. Elec., pfd	66	67	Ed. Elec. Lt	—	—

PHILADELPHIA.

	Jan. 5.	Jan. 12.		Jan. 5.	Jan. 12.
Elec. Stor. Bat	84	78	Phil. Elec	5¾	5⅞
Elec. Stor. Bat., pfd	90	80	Pa. Elec. Veh	2	2
Elec. Co. of Am	9⅛	9⅝	Pa. Elec. Veh., pfd	1	1
Gen. Elec. Auto	—	—	Am. Rys	32⅝	32½

CHICAGO.

	Jan. 5.	Jan. 12.		Jan. 5.	Jan. 12.
Chicago Edison	151½	150	Chicago Telep. Co	230	245
Chic. City Ry	253	255	Union Traction	12½	12
Nat'l Carbon	16	16	Union Traction, pfd	49	48½
Nat'l Carbon, pfd	84	83	Northwest Elev. Com	28½	28¾

TROLLEY DEAL IN CONNECTICUT.—The New Haven Road has just purchased through the People's Tramway Company, of Danielson, Conn., the Webster & Worcester Street Railway Company. The purchase gives to the People's Tramway Company control of the trolley lines from Danielson, Conn., to Worcester, a distance of 40 miles. The company recently acquired the Putnam & Thompson Street Railway Company, and later took over the Webster & Dudley system, the latest purchase of the Webster & Worcester completing the circuit. The New Haven Road will extend the People's Tramway line in time to Norwich, thus connecting with the steam road along the Thames to New London, and forming a continuous line from Norwich to Boston, a distance of 120 miles. The People's Tramway system will run express trains, freight, mail, baggage and passenger coaches over the newly acquired line. The express trains will make stops only at Putnam and Webster in the through run from Danielson to Worcester, and will run at an average speed of 35 miles an hour. A smoker will be added to the through trains. The Tramway stock is $400,000, Webster & Dudley $50,000, and Worcester $150,000, making, with the bonded debt, an outlay of $1,000,000. The road when completed will cater to fully 120,000 people. Railroad and trolley men see in the move taken by the People's Tramway Company a step in the programme of the Consolidated Road to occupy the trolley field ahead of the electric road companies. By taking over the new lines the New Haven Road stops competition at Worcester and controls all of the trolley business of Eastern Connecticut. The line will be used as a feeder to the steam roads at Worcester and Norwich.

LIGHTING AT ROCHESTER, N. Y.—Announcement is made that a strong syndicate has purchased all the stock of the Rochester, N. Y., Citizens' Light & Power Company, whose plant was recently partially destroyed by fire, and proposes to extend the business locally at once. A week ago it was learned that the Rochester Gas & Electric Company had purchased the Hinds Flour Mill property, abutting that owned by the Citizens' Company, both of which have valuable water power rights. The syndicate which has purchased the Citizens' Company is made up of the following: Anthony N. Brady, of Albany and New York; William K. Archbold and Paul K. T. Brady, of Syracuse; A. M. Young, of New York, and the Westinghouse Company, of Pittsburg. The Archbold-Brady Company, of Syracuse, has the work of reconstructing the burned-out plant. A telegram from Rochester says: "The stock of the Citizens' Light & Power Company has been secretly purchased by the well-known Elkins-Widener-Whitney syndicate, and a big corporation war with the Rochester Gas & Electric Company seems probable. The deal was made through John Archbold, a relative of John D. Rockefeller. All but two of the Citizens' Light & Power Company stockholders sold out at a low price before there was any general knowledge of the deal. The Rochester Gas & Electric Company must have had some intimation, as it has leaked out that the company has bought the Hinds mill, with all rights, giving them ownership of five-eighths of the total water power of the city. It is announced that the Elkins syndicate will have a new plant in shape in 30 days, and actively bid for local lighting contracts."

BOSTON ELECTRIC LIGHT.—Mr. J. P. Morgan has advised his Boston representatives to do no more in regard to the local electric light negotiations, but treat the proposed consolidation as indefinitely abandoned. On Jan. 11 a message was received by the Massachusetts House of Representatives from Governor Crane, accompanied by a communication from the Gas and Electric Light Commission, stating that the proposed lease of the Edison Electric Light Company to a third corporation under a guarantee of 10 per cent on $3,000,000 of stock, was in violation of the Anti-Stock Watering laws of the State and detrimental to public interests. The communication was referred to the Committee on Manufactures. The action of the Commissioners would seem to have put an effectual stopper for the present, on the project of J. P. Morgan & Co., of New York, to lease the Boston Electric Light Company and the Edison Company and combine the interests, as noted already in these columns.

DIVIDEND.—The Electric Company of America directors have declared the regular semi-annual dividend of 50 cents a share, payable Jan. 31. The regular quarterly dividend of 2½ per cent on Brooklyn City Railroad is payable Jan. 15. Directors of the Edison Electric Illuminating Company, of Boston, have declared a regular quarterly dividend of 2 per cent and 1 per cent extra, payable Feb. 1. The previous quarterly dividend was 2 per cent and 1 per cent extra. The United Traction Company, of Albany, N. Y., has declared a regular quarterly dividend of 1¼ per cent, payable Feb. 1. The United Traction Company, of Pittsburg, has declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Jan. 21.

INCREASE OF CAPITAL.—The Buffalo & Niagara Falls Electric Light & Power Company, of Buffalo, has filed with the Secretary of State a certificate of increase of capital stock from $200,000 to $500,000. The company has a paid-in capital of $200,000, and debts and liabilities of $164,905.

Commercial Intelligence.

THE WEEK IN TRADE.—Business expansion and trade improvement continued last week, according to reports to the commercial agencies. Relatively best reports come from the iron, steel, lumber, leather and drug trades, but there has been some enlargement of wholesale distributive trade on spring account in the South and Central West. A special feature is the generally good tenor of reports as to collections from all Western and Southern points. Railroad earnings continue very encouraging, and the report as to earnings in the last month of 1900 indicate that the railroads of the country have recovered some of the percentages of gain shown earlier in the year. *Dun's Review* says of the iron and steel trade: Construction of bridges and buildings, together with contemplated track elevation, crowds the capacity of all concerns making structural shapes of iron and steel. Orders for locomotives, cars, rails, and all forms of railway equipment are also abundant, and there is no sign of reaction in the industry. Plate and sheet mills have large business, and merchant steel is in brisk demand. The Carnegie Company proposes to erect a pipe plant on Lake Erie, and many other concerns are extending facilities. Competition is keen, however, and increased operations fail to affect prices. The *Iron Age* reports an increase in pig-iron production to 250,351 tons weekly, which is the largest amount since July, and new furnaces have been added since the statement was issued. In the metal market copper was quiet and featureless. Lake copper is quoted at 16¾ cents; electrolytic in cakes, wire-bars and ingots, at 16¼ cents; cathodes, 16 cents, and casting stock, 16⅛ cents. In the machinery market the large engineering firms report a satisfactory condition of affairs. On the other hand, the smaller dealers in machine tools, engines, boilers, etc., do not appear to be satisfied with the state of trade. They report business rather slow. The number of business failures during the week, as reported by *Bradstreet's*, was 322, against 268 the week previous, and 295 in the corresponding week last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York, for the week ended Jan. 9: Avestad—9 boxes electrical material, $129. Brazil—21 packages electrical material, $665; 4 packages railroad material, $601; 1000 ft. cables, $210. British East Indies—58 packages electrical machinery, $540. Bolivia—1 case electrical material, $43. British West Indies—12 packages electrical material $455. Barcelona—3 cases electrical material, $107. Belfast—8 packages cables, $2,118. British Australia—72 cases electrical material, $2,026. British possessions in Africa—49 cases electrical material, $4,039. Christiania—18 cases electrical material, $227. Central America—58 packages electrical material, $791. Chili—82 cases electrical material, $2,371; 6 cases electrical machinery, $200. Cuba—52 cases electrical material, $1,852. Hayti—3 cases electrical material, $41. Havre—17 cases electrical material, $1,002; 3 cases electrical machinery, $175. Liverpool—39 packages electrical machinery, $3,647; 118 packages electrical material, $4,571. London—49 packages electrical machinery, $15,016; 42 packages electrical material, $2,727; 19 cases motor vehicles, $22,367; 15 reels cables, $5,500. Marseilles—46 cases electrical material, $3,370. Manchester—193 packages electrical material, $19,709. Mexico—36 cases electrical material, $983. New Zealand—2 cases electrical material, $51. Porto Rico—36 packages electrical material, $2,336. Peru—10 packages electrical material, $641. Reval—7 packages electrical material, $590. Ramsgate—24 cases electrical material. $2,000. Santo Domingo—4 cases electrical material, $41. St. Petersburg—1 motor carriage, $640. U. S. Colombia—114 packages electrical material, $780.

THE MORRIS ELECTRIC COMPANY, of New York City, is reported to have obtained a $100,000 contract for the furnishing of various material, equipment, etc., required for a trolley road now in course of construction in the vicinity of Buenos Ayres. The principal items enumerated in the contract are a $60,000 lot of feed wire and a $15,000 lot of trolley wire. Several hundred headlights have also been requisitioned for the same road. The Demerara Electric Railway Company is said to have placed fair-sized orders for weather-proof and trolley wire. Recent shipments of the Morris Company includes 50,000 carbon brushes, for the Cape Town tramways. These brushes were manufactured by the Speer Carbon Company, of St. Mary's, Pa. Three hundred car wheels, made by the Rochester Car Wheel Works, of Rochester, N. Y., have been forwarded to the Havana Electric Railway Company, and 1,800 trolley poles were shipped last week to G. & T. Branniff, the well-known Mexican contractors of the City of Mexico. The poles were manufactured by the Electric Railway Supply & Equipment Company, of Cincinnati. Fifty-nine cars of four-way conduit made by the Potomac Terra Cotta Conduit Company, of Washington, D. C., are now ready for shipment to the Havana road.

WESTINGHOUSE APPARATUS.—The Washington office of the Westinghouse Electric & Manufacturing Company has made the following sales recently: Two 800-kw 440-volt, 2-phase engine type generators, and 2500-hp of type C induction motors for the new glucose plant, which is now being erected by officials of Standard Oil Company at Cliffside, N. J.; three 100-hp, type C, 2-phase induction motors, to the Rosemary mills, Weldon, N. C.; one 75-hp, type C, 2-phase induction motor, to the Paterson Textile Company, Weldon, N. C.; one 75-kw rotary field generator and complete equipment to Druid Hill Park, Baltimore, Md.; two 50-kw 125-volt belted generators, Hotel Rennert, Baltimore, Md.; one 30-kw, 125-volt engine type generator, and a number of motors, to Morton Reed & Co., Baltimore, Md.; one 110-kw belted and one 100-kw engine type generator to supply light and power in the Calvert Building, Baltimore, Md.

ELECTRIC CANAL OPERATION.—An oft-told story is renewed in the following dispatch from Pittsburg: "Thomas N. Fordyce, of Detroit, who has leased the Miami & Erie Canal from the State of Ohio, has placed an order for electric motors with the Westinghouse Company which, for the present, will amount to $150,000. When his entire system is completed the investment here for machinery and supplies will go close to the $500,000 mark. Mr. Fordyce made a contract with the Board of Public Works of Ohio, which has control of the canal, for a lease of 30 years. The canal runs from Toledo to Cincinnati, a distance of 244 miles. It was built in 1825, and mules, all these years, have been pulling the canalboats up and down the State, laden with freight, and in the early days with passengers. The mule is to go out of service, and electric motors are to take his place." The news is not confirmed fully.

A. L. BAGNALL, of the American firm of Bagnall & Hilles, of Yokohama, Singapore and Manila, which concern has been instrumental in introducing a fair portion of the American electrical machinery now installed in Japan, British East Indies and the Philippines, is now in this country with a view to placing important contracts for various plants required in the Orient. Mr. Bagnall, who since his arrival in the United States has been somewhat indisposed, is at present residing in Vineland, N. J. He is making his New York headquarters at the offices of the New York Insulated Wire Company, 15 Cortlandt Street, where he is expected to be to transact business during the latter part of this week or the beginning of next.

MACHINE TOOLS FOR MANCHESTER.—Henry F. Loud, general manager of the British Westinghouse Electric plant at Manchester, England, has invited representative tool manufacturers of the United States, Germany and England to offer bids for over $500,000 worth of machine tools. The contract for the engines has already been awarded to the Westinghouse Machine Company. The contract for lathes and other equipment will be one of the largest of its kind ever made.

THE AMERICAN BRIDGE COMPANY announces the following appointments: E. W. Stearns has been appointed manager of the East Berlin, Ct., plant; Frank S. Moore has been appointed manager of the Lafayette, Ind., plant; all the Pittsburg plants have been consolidated into one, and J. W. Walker appointed as manager; Mr. C. A. Billings having been appointed assistant treasurer for the New York district, H. W. Post has been appointed manager of the Post & McCord plant.

MACARTNEY, M'ELROY & CO., of London, England, whose New York office is in the Havemeyer Building, have been awarded a contract for the supplying of 25 miles of overhead track for the Portsmouth (England) Corporation Tramways. The same concern are reported to have secured a $500.000 contract for track construction for the Brighton road. The trolley poles to be utilized by the Port Natal Tramway Company will be shipped by them on the first outgoing steamer to South Africa.

BAILEY & GOBLE, Dundee, N. Y., have a contract for an electric-light plant at Morris Run, Pa., which is to be completed on Feb. 15. They will buy at once the following apparatus and supplies: One 30-hp high-speed automatic engine, one 20-kw 220-volt multipolar generator, with switchboard instruments. They will duplicate this equipment later on. They also want three tons of No. 0000 to No. 12, triple-braid wire, line material and indoor fittings, all purchases to be paid for within 10 days.

TO IMPROVE LIGHTING PLANTS.—President Randall Montgomery, of the Consolidated Gas, Electric Light and Youngstown & Sharon Electric Railway Company, has announced that his company has decided to expend $200,000 in making improvements to the lighting plants, which the company owns in Youngstown, Sharon and Sharpsville. Power will be generated in Youngstown for operating the cars on the Youngstown & Sharon Electric Railway.

IMPROVEMENT AT MASON CITY, IA.—On Jan. 1, 1901, all the property and franchises of the Mason City Electric Company, which owns the lectric light and power, gas and hot water heating plants in Mason City, Ia., were purchased by W. E. Brice, of that city. During the coming year $50,000 will be expended in extensions and improvements.

THE BOSTON ELEVATED RAILWAY COMPANY, in installing its third-rail system, is using a special form of Ætna insulator for the third-rail support. It is made by the Albert & J. M. Anderson Manufacturing Company, of Boston, who also made the third-rail supports for the Northwestern Elevated and the Lake Side Elevated systems in Chicago.

EXTENSION IN BRITISH COLUMBIA.—Engineers are at work preparing plans for developing additional water power at Bennington Falls, British Columbia, for the West Kootenay Power & Light Company, and contracts are about to be let for additional machinery.

General News.

THE TELEPHONE.

DOVER, DEL.—The Maryland & Delaware Telephone & Telephone Company, of Baltimore, has been incorporated, with a capital of $50,000.

WILMINGTON, DEL.—The Overland Telephone Company, of Lehighton, Pa., has been incorporated at Dover, with a capital stock of $15,000.

EAST LIVERPOOL, OHIO.—The Central Union Telephone Company announces that many of its wires in this place will be placed under ground.

MEXICO.—An increase of 377 is reported in the number of subscribers to the Mexican Telephone Company on Nov. 30, as compared with the same date in 1899.

SIDNEY, IND.—The Sidney Telephone Company, of this city, has been incorporated. The capital is $13,000. The board of directors is headed by S. J. Fisher.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has increased its capital stock from $10,000 to $20,000. The plant will be enlarged to accommodate new subscribers.

MANSFIELD, OHIO.—The Central Union Telephone Company is adding new switchboards and increasing its facilities here. The company has over 1100 subscribers in Mansfield.

ALBANY, N. Y.—The Colonial Telephone Company, of Newburg, has been incorporated, $125,000. Directors: Harry A. Bartlett, V. Schoonmaker and W. G. Taggart, Newburg.

BOSTON, MASS.—The Pacific Coast Telephone Company made a net gain of 1491 subscribers in December. Total connected Dec. 31, 85,744, of which 21,324 are in San Francisco.

DOVER, DEL.—The Telephone Company of America has been incorporated to manufacture telephones and telephone supplies, etc.; capital stock, $5,000,000. The office is at Washington, D. C.

ALBANY, N. Y.—Steuben County Telegraph & Telephone Company, of Bath, has been incorporated; capital, $2,000. Directors: J. H. Bowlby and W. D. Carroll, Bath; D. F. Ward, Savona.

ALBANY, N. Y.—The Cattaraugus Telephone Company, of Cattaraugus, has been incorporated, with a capital of $1,000. Directors: S. F. Burger, Frank Crawford and H. B. Easton, Cattaraugus.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has now completed connections of its systems between the twin cities, and subscribers in Pittsburg are now able to converse with those across the river.

MONROE CITY, MO.—James B. Gray and I. P. Stevens are preparing to build a telephone line from this city to Ely via Huntington, a distance of eight miles. The right of way has been granted them. This will give Monroe City six telephone lines.

CANTON, OHIO.—The Stark County Telephone Company is preparing to commence work on its exchange in this city. Lines to Massillon, Alliance, Akron and other towns will be built at once and connection will be made with every town in the county.

INDIANAPOLIS, IND.—The city authorities have entered into new contracts for the year with the Central Union Telephone Company and the New Telephone Company, service to cost $1,800, divided as follows: Central Union, $1,038; New Company, $762.

ALBANY, N. Y.—The Southern Tier Telephone Company, to connect Addison and Corning, N. Y., with Lawrenceville and Tioga, Pa., has been incorporated; capital, $1,000. Directors: B. F. Toby and F. O. Camp, of Lindley, and M. William Manley, of Presho.

CHURUBUSCO, IND.—One of the most enterprising newspapers in Indiana is the *Churubusco Truth*. This paper is not only housed in its own building with a modern plant, but has constructed and operates over fifty miles of telephone lines, by which the news of the county is gathered.

CLEVELAND, OHIO.—The Cleveland Telephone Company (Bell) has opened two new branch exchanges. The new South exchange, with a capacity of 3000, has 600 lines installed, and the Ridge exchange, with the same capacity as the South, has 700 subscribers. The new exchanges relieve the West and Main exchanges.

NEW ORLEANS, LA.—The Mississippi Railroad Commission has assumed jurisdiction of the telephone companies now operating in the State, and after thorough consideration of the methods of business now in vogue and the alleged abuses that prevail, has taken steps to regulate and make uniform the entire system of charges. The maximum rate for long distance service between places within the State has been lowered from $1.50 to $1, and no charge may be made in excess of 35 cents within a county.

MINNEAPOLIS, MINN.—The Western Electric Telephone Company has purchased the entire stock of the Iowa & Nebraska Telephone Company, valued at $100,000. This includes the exchanges at Sheldon, Sibley, Estherville, Spirit Lake and Cherokee. The Western Company operates 2700 miles of line in this State, Minnesota and the Dakotas. The telephones and switchboards of the Bell Company have been used, which give connection at junction points with the Bell Company lines.

KNOXVILLE, TENN.—The Cumberland Telephone Company has just closed a deal with Wexler & Roller, of Bristol, Tenn., for their telephone lines in Bristol and those extending to Gate City, Va., Bloomingdale, Peltier, Blountville and Indian Springs, Tenn., and also the line to Rogersville, Tenn. This practically gives the Cumberland Company full control of the telephone business in Upper East Tennessee. Extensive improvements will be made, giving first-class connections with this city.

BALTIMORE, MD.—A party of Washingtonians came to Baltimore a few days ago to inspect the new switchboard of the Maryland Telephone & Telegraph Company. The Washington Telephone Company and the Maryland Telephone & Telegraph Company are operated by the same people, and the trip was arranged to show the complete equipment of the company and its ability to satisfactorily transact business, prior to the consideration of its application for a franchise in Washington, which will shortly come before the Senate. This application has already been favorably acted upon by the House and the Senate committees.

WARREN, OHIO.—The Warren & Niles Telephone Company held its annual meeting a few days ago and the following directors were elected: W. Hdye, George B. Devoe, Jules Voutrout, Jr., C. C. Clawson, J. J. McLean, C. W. Devoe and M. S. Clapp. During the year lines have been extended to Leavittsburg, Kinsman, Vienna, Mineral Ridge, and a new switchboard has been installed at Warren. Long-distance connection has also been secured through the lines of the United States Telephone Company. During the year 322 subscribers were secured in Warren and Niles alone, making 1120 in the two places. The company is soon to move to new offices.

SHELBYVILLE, IND.—The telephone rivalry has assumed startling proportions in this city again. The attempt of the Bell Company to run out or cripple the home company has proven futile, and in order to maintain its hold with its patrons the Bell Company is now making yearly contracts at the rate of 50 cents per month for residence telephones. The Home Company will pay no attention to this, but will continue to extend its service. The latest move in this direction is the building of a line across the country to Greenfield. The result of this four years of warfare is that Shelbyville now has more than 1000 telephones, with lines reaching every corner of the county.

ELECTRIC LIGHT AND POWER.

ONARGA, ILL.—The Onarga Electric Light and Waterworks have been succeeded by the Gilman-Onarga Electric Light and Waterworks.

STEUBENVILLE, OHIO.—The Steubenville Electric Light Company has decided to replace all its old style arc lamps with enclosed arcs.

CLEVELAND, OHIO.—It has been decided that a county electric lighting plant is an absolute necessity, and bids will probably be called for in the near future.

MT. STERLING, KY.—The Mt. Sterling electric light plant has changed hands. It was owned by a resident company, but is now controlled by a syndicate of Wilkesbarre, Pa.

LINDSAY, ONT.—The Council for the town of Lindsay has approved of the submission to the rate payers of the town of a by-law authorizing the corporation to operate a municipal street lighting plant.

CAMBRIDGE CITY, IND.—The Cambridge City Light & Power Company, of this city, has been incorporated with a capital of $8,000. The directors are W. H. Doney, W. A. Ereintz and A. R. Feemster.

NORFOLK, VA.—Mr. E. Tatterson has the contract for the new power house for the National Gas & Construction Company, of Philadelphia. The structure will be located at Norfolk, Va., and will cost $22,000.

OTTAWA, ONT.—Messrs. Ely & Turner, of Wiarton, Ont., propose installing an electric light plant in that town, and have asked permission from the municipal authorities to erect poles and wires on the streets.

COLUMBUS, OHIO.—Director of Public Improvements Kauffman has presented to the City Council an estimate of the cost of a municipal lighting plant. The Columbus Electric Light & Power Company's city contract expires on Sept. 1, 1901.

WELLSVILLE, OHIO.—Local business men are planning to organize a new lighting company to furnish incandescent lights to stores and residences. They are making a canvass, and if enough subscribers can be obtained the plant will be built.

DURHAM, N. C.—Gen. J. S. Carr, of Durham, is at the head of a company of capitalists having in view the development of several water powers in Western North Carolina. The company will be known as the North Carolina Electrical Power Company. The capital stock is $100,000. This amount will soon be increased by the addition of new stockholders.

BOURBON, IND.—I. N. Hawkins has been appointed receiver for the Bourbon (Ind.) Electric Light Company at the instance of E. J. Marckie, of Chicago, who loaned the company $4,000 with which to make improvements. This plant was built by the town authorities and there has been a constant dispute as to rates. The plant cost $18,000 and mortgage bonds for that amount are outstanding against it.

OTTAWA, ONT.—Next spring work will be commenced, at Ottawa, on a large pulp mill and electric power house at the Chaudiere Falls. Plans are now being prepared for the new buildings, and application has been made for the incorporation of the new company, which will be capitalized at $1,000,000. It is the intention of the company to develop electric power for rental as well as for the operation of the mill.

SPRINGFIELD, OHIO.—The city Board of Public Affairs has passed resolutions placing a contract with the Springfield Light & Power Company for 260 arc lamps at the rate of $73 each per year. The company will probably accept the proposition, although it has been making a stand for $75 per lamp. The new company which proposed to furnish lights at $70 withdrew its bid as it was unable to secure the necessary financial backing.

CINCINNATI, OHIO.—General Manager W. F. White, of the Cincinnati Edison Electric Company reports the year just closed the most satisfactory in the history of the company's business. The entire commercial load, including incandescents, arcs and motors, increased 100 per cent. The city street lighting load increased over 45 per cent. The company placed about 40 miles of duct under ground during the year and has put in a storage battery. The company has also greatly increased its station capacity and has erected and moved into a magnificent new office building on Government Square.

THE ELECTRIC RAILWAY.

NEW CASTLE, IND.—A. D. Ogburn and other local capitalists have been granted a 50-year franchise for an electric railway in this city.

SHELBYVILLE, IND.—The Indianapolis, Morristown & Rushville Electric Traction Company has received a franchise from this city for 30 years.

ROCHESTER, N. Y.—The State Railroad Commission will, on Jan. 25, give a hearing in this city on the application for a franchise for the Buffalo, Rochester & Niagara Falls Electric Railway.

MARION, IND.—It is proposed by the City Council to purchase the local power plant of the Union Traction Company, to be used in supplying the city with electric light and power at the cost of production.

OTTAWA, ONT.—A meeting of a number of capitalists was recently held in Essex, Ont., and they decided to ask the Ontario Government for a charter for an electric railway from the city of Windsor, Ont., to a point on the lake shore.

INDIANAPOLIS, IND.—Electric fountains have become so popular and especially attractive for amusement parks, the Indianapolis Street Railway Company will erect one or more in each of the parks of this city over which it exercises control.

NELSON, B. C.—Mr. Geo. H. Collins, of Greenwood, B. C., has sold to Nelson capitalists all his interests in the Greenwood & Phœnix tramway and the Phœnix Electric Light Company. The new owners purpose commencing operations in the spring on the tramway which is to connect Greenwood with Phœnix.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company, which has held the contract for lighting the city streets for several years for $7,000 a year, has recently filed a suit in equity to compel the city to contract with the company to light the streets for another five-year period, beginning with Jan. 1, 1901. This company failed to secure an injunction prohibiting the City Council from issuing bonds and constructing a municipal plant, and the new $50,000 municipal plant, equipped throughout with Westinghouse electrical apparatus, will begin lighting the streets about March 1.

TORONTO, ONT.—A few minutes past midnight on Jan. 1 the Toronto Electric Street Railway Company inaugurated the new century by starting a new 1600-hp generator and a large engine to drive the street cars of the company. The generator is one of the best in the company's power house, and in a patriotic vein it has been christened the "Father O'Leary," in honor of the brave Catholic chaplain of the first Canadian contingent to South Africa, which has recently returned to Canada. The generator was built by the Siemens & Halske Company, of Chicago, and is one of the neatest pieces of machinery in the power house of the Toronto company.

READING, PA.—The employees of the United Traction Company went out on strike on Jan. 8. The trouble arose over the question of reorganizing the Employees' Union. The wages of the men were raised to 15 cents an hour, but about a dozen of them was laid off. The dismissed men asked for the reason, but the company, it is stated, declined to give it. The new union requested an explanation, and when it was not forthcoming ordered a strike. About 150 men quit work. The strike continued until late in the night of Jan. 10, when the difficulties were adjusted by an agreement to arbitrate. All the strikers went back to work on the morning of Jan. 11.

THE AUTOMOBILE.

THE SOUTH CAROLINA AUTOMOBILE COMPANY has been commissioned at Columbia, S. C., by W. H. Rose, J. S. Moore, E. B. Clarke, W. H. Lyles and W. B. Smith Whaley. The capital stock is $10,000.

ALBANY, N. Y.—The Fleming Motor Vehicle Company of Ossining has been incorporated; capital, $10,000. Directors: P. G. Fleming, Elizabeth, N. J.; Angel Afanador, Brooklyn, and W. J. Brewster, East Orange, N. J.

NEW YORK CITY.—The Automobile Club of America has taken new club quarters at 753 Fifth Avenue, corner of Fifty-eighth Street, close to Central Park. The governors have decided that all new active members after March 1 shall pay $100 entrance fee, and associates $50.

LEGAL.

FRANCHISES IN OHIO.—The attorney general of Ohio has brought suit in the Supreme Court to test the validity of perpetual franchises in that State. The case in point is that of the State against the Cincinnati Edison Electric Company, being an action in ouster. The important feature is that the Supreme Court will be called upon to pass on the perpetual franchise claims of various corporations in streets of municipalities.

LIGHTING CONTRACT.—The Court of Appeals at Albany has confirmed judgment in favor of John L. Lawrence against the Suburban Electric Light Company, of Valley Stream, and others, appellants. The appeal was taken by the Suburban Company from a judgment of the Appellate Division of the Supreme Court confirming a judgment of the Special Term declaring the lighting contract with the town of Hempstead null and void. The plaintiff is a tax payer who brought this action in February, 1898, to set aside the contract on the ground that the Town Board of Hempstead had no authority to make such a contract for the reason that the lighting district comprised parts of the villages of Lawrence and Far Rockaway.

OBITUARY.

MR. R. SCHAEFBAUER, well known as an arc light inventor, expert, etc., was shocked to death on Jan. 14 at the factory of the Sterling Arc Light Company while conducting some experiments there. He appears to have been closing a circuit and to have thus received the full force of a high-tension current. Mr. Schaefbauer leaves a widow and family. He was a man of great ingenuity and of an agreeable personality, and his sudden death inflicts a severe loss on the electrical community.

MR. GEORGE H. RAE.—It is with deep regret we record the death of Mr. George H. Rae, an electrical engineer and son of the well-known electric railway pioneer, Mr. F. B. Rae, now practicing in New York. "Bert," who was widely acquainted in the Western electrical field, went to the Philippines in September, 1899, and at Manila enlisted in the battalion. He was killed on Dec. 30 last at Kuion, in the Island of Luzon. Deceased was only 26½ years old. The bereaved family have the condolence of a host of friends.

PERSONAL.

MR. J. H. WHITAKER, electrician of the Northern Pacific Railway, has resigned to become city electrician of Tacoma, Wash.

MR. F. J. SPRAGUE has returned from a most interesting English trip, and as ex-president, was one of the speakers at the annual dinner of the American Institute of Electrical Engineers last week.

MR. W. C. KERR, vice-president of Westinghouse, Church, Kerr & Company, of New York City, has just returned from a business trip to England. He was one of the speakers at the Cornell dinner at the Waldorf last week.

PROF. S. H. SHORT is to lecture on Jan. 29 on direct current generators before the Manchester section of the Institution of Electrical Engineers. The meetings are held in the New Physical Laboratory at the Owens College, Manchester.

MISS F. O. WARD.—Formal announcement was made last week of the engagement of Miss Flaurence Oliphant Ward, the only daughter of Mr. George Cray Ward, vice-president of the Commercial Cable Company, to Lieut. Henry Hughes Hough, U. S. N.

MR. HOWARD LEE DAVIS has been appointed superintendent of the Hudson River Gas & Electric Company, with headquarters at Tarrytown, N. Y. Mr Davis has been in the testing department of the General Electric Company's works at Schenectady.

MR. E. H. JOHNSON has been confined to his bed by serious illness in this city, but is now so far recovered as to be able to sit up and engage more or less actively in business affairs. His complete convalescence is expected very shortly, much to the pleasure of a host of friends.

MR. G. W. HUBLEY, superintendent of the Louisville Electric Light Company, Louisville, Ky., has been appointed agent for the Consolidated Telpherage Company of New York, and will represent that company's interests in Kentucky and Indiana in addition to his present connections.

DR. ELISHA GRAY, who has lately been conducting work in marine telephony at Boston with some very satisfactory results, was a visitor in New York last week, and a caller at the American Institute of Electrical Engineers. His work is being closely followed by the Lighthouse Board and other marine authorities.

MR. HUGH H. HARRISON, the electrical engineer formerly connected with J. G. White & Company, has formed, with Messrs. F. Battles, of Philadelphia, and G. G. Heye, of New York, the firm of Battles, Heye & Harrison, which will deal in municipal bonds and high grade unlisted securities. They will have offices in New York and Philadelphia.

MR. J. M. HOLLISTER, who had charge of the Western Electric exhibit at the Paris Exposition, read an interesting paper on the Exposition before the Chicago Electrical Association. It dealt intelligently and comprehensively with the general topic and went into details with regard to the many exhibits which have already been illustrated and described in these pages.

MR. T. A. EDISON is rather "under the weather" and feeling the effects of a long strain of continuous hard work at his Orange laboratory. He is to leave for the far South on Jan. 24 for a few weeks' vacation. On his return he will present, through Dr. Kennelly, before the American Institute of Electrical Engineers, a paper on some important advances upon which he has recently been engaged.

MR. FRED DE LAND, president of the Federal Telephone Company, of Pittsburg, furnishes the New York *Commercial* with a racy attack on the "independent" telephone movement, and intimating that many independent companies "are kept alive by Bell funds." In electrical circles the Federal Company is popularly regarded as itself a Bell organization. Mr. De Land's letter is spicy literature.

MR. MAXWELL A. KILBERT, of Wendell & McDuffie, of New York City, left this week for an extended trip throughout Mexico, where he goes for the purpose of closing some important contracts for the supplying of material, equipment, etc., for electric roads, etc., about to be constructed in that part of the world. Mr. Kilbert, who will be absent fully three months, purposes visiting Monterey, Guadalajara, the City of Mexico, Pueblo and Vera Cruz.

MR. HENRY A. COIT, the telephone promoter of St. Louis and Terre Haute, was in Chicago on business connected with his company at Terre Haute (the Citizens' Telephone Company). Mr. Coit was the organizer and is now the general manager of that company, which has its exchange of 3000 numbers now nearing completion. The apparatus is being manufactured by the American Electrical Telephone Company, and is to be the very latest in design and workmanship. Mr. Coit has recently completed some exchange and toll lines in Nebraska.

PROF. R. A. FESSENDEN.—A dispatch from Norfolk, Va., of Jan. 10 says: "Prof. Fessenden, connected with the United States Weather Bureau, is here for the purpose of making some experiments with wireless telegraphy. His experiments will be made along this coast, and stations will be established at Capes Hatteras and Henry and at other coast points north of Cape Hatteras. This marks the first serious effort on the part of the Government to communicate storm warnings to vessels at sea off that dangerous locality. It is intended also to send storm signals to the life saving stations along the east by this means when the wires are disabled, as is frequently the case. The towers to be erected along the coast will be manned by experts under the personal supervision of Prof. Fessenden, who will have full charge of all the experiments. If the tests are successful the entire coast will be similarly equipped."

Trade Notes.

FIRE DAMAGE.—Fire in the cellar of the J. S. Nowotny Electric Works, Cincinnati, Ohio, caused damage to the extent of $3,000.

THE CAPITAL CITY MOTOR CO. (INC.) has succeeded to the business of Miller & Balser, electrical contractors in Washington, D. C.

CALENDAR.—The Shultz Belting Company, of which Mr. A. B. Laurence, 113 Liberty Street, New York, is manager, has issued a very interesting calendar for the new year. The subject of the illustration is a very attractive young lady.

B. F. STURTEVANT COMPANY.—In order to provide facilities for conducting its rapidly increasing local business, the B. F. Sturtevant Company has just removed its Chicago office to much larger quarters at 281-289 South Clinton Street.

THE ELECTRIC APPLIANCE COMPANY, Chicago, calls attention to the new hotel telephone which it is manufacturing. This instrument is built in such a manner that the possibility of tampering by unauthorized persons is practically eliminated.

SELF-OILING ENGINES.—The Ball Engine Company, of Erie, Pa., in Catalogue M., of recent issue, describes and illustrates the belted and direct-connected self-oiling engines manufactured by it. The illustrations of these machines are particularly clear.

THE BRILL CONVERTIBLE CAR, manufactured by the J. G. Brill Company, Philadelphia, is the subject of a twenty-four page pamphlet just brought out by the company. This car was awarded the Grand Prix at the Paris Exposition of last year. The car and its uses are fully described, and its construction very clearly illustrated.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, Boston, Mass., since being awarded a medal at the Paris Exposition, has received so many inquiries in regard to its goods, and especially as to its lamp renewer and Morse adjuster, that it is looking for good agents to represent the company in every large city.

A CATALOGUE OF AIR HOISTS and other pneumatic hoisting appliances is issued by the Northern Engineering Works, crane builders, Detroit, Mich. This catalogue is intended as a supplement to this company's crane catalogue. It has 16 pages and cover, 6 ins. x 9 ins., numbered 32, and contains descriptions of the various types of pneumatic hoists and cranes made by this company. Dimension tables and diagrams showing air consumed, etc., are given in detail.

THE ELECTRIC MACHINERY COMPANY, of Minneapolis, Minn., has bought out the Warren-Medbury Company of Sandy Hill, N. Y. Office fixtures, drawings, patterns, stock, etc., have already been shipped to Minneapolis. The Electric Machinery Company will enlarge its plant and continue the manufacture of the well-known line of inductor alternators formerly carried on at Sandy Hill, N. Y.

POWER HOUSE EQUIPMENT.—The Columbus (Ohio) office of the Westinghouse Electric & Manufacturing Company has closed a contract for the entire equipment of the new power house of the Columbus & Buckeye Lake Traction Company. There will be a sub-station near Columbus and one near Newark. The voltage will be raised to 15,000 volts alternating current and transmitted to rotary converters at the sub-stations, where it will be stepped down to 500 volts direct current. The power house equipment will cost about $160,000.

MR. HENRY H. HUMPHREY, consulting electrical engineer, St. Louis, Mo., is getting his share of the rapidly expanding foreign business. One of his most important contracts is for a large electric light and power plant at Cape Town, South Africa. For this plant alone 1000 horse-power of motors, air compressors, water works pumping machinery and a refrigerator plant are called. This large equipment is for the De Beers Explosives Works. Mr. Humphrey recently moved to the Chemical Building, where he has better facilities for carrying on his work.

MR. CHARLES E. MILLER, 97 Reade Street, New York, has taken additional loft space at the above address, and is arranging an extensive sample room, where he will display a full line of parts, fittings and sundries for automobiles and cycles. Mr. Miller is able to make prompt deliveries on very short notice, and is continually adding to his stock any new articles that come on the market. He has on exhibition a complete line of automobile supplies, motor cycle supplies, etc., at the Cycle and Automobile Show being held at Madison Square Garden this week.

SAFETY DEVICES.—The D. & W. Fuse Company, Providence, R. I., has this month issued a revised and very complete price list of the non-arcing fuses and safety devices that it manufactures. The booklet is very neatly gotten up and fully illustrated, and is in every way a convenient little guide on the subjects. Supplementing this price list the company has issued a series of pamphlets, each treating more fully than the general booklet can the several distinct branches of its business, low tension non-arcing fuses, junction and transformer cut-outs, service switches, telephone protectors, plug type fuses and subway boxes. Each of these is also illustrated.

EDUCATIONAL WORK.—In a circular letter issued by the D. L. & W. R. R. to its employees, the following reference is made to the International Correspondence Schools, Scranton, Pa.: "Having personal knowledge of the benefits to be derived by a course of study in any of the branches offered by this school, the good effects it is producing, and the satisfaction it is giving to railroad men on other lines, and knowing also its high standing as an educational institution, we confidently recommend it to all employees of this company who desire an improved education and a general knowledge of railroading, and urge them to avail themselves of this opportunity."

PARIS AWARD.—Messrs. Mathias Klein & Son, Chicago, enjoy the unique distinction of having received from the Paris Exposition an "Honorable Mention" for an exhibit of their goods about which they knew nothing until they were notified of the award. It seems that a full equipment of Klein linemen's tools form a part of the collective exhibit in the United States section and had been purchased by the commission from a New York agency. The goods were entered under the firm's name, and when the firm was notified of the award it was naturally nonplussed until an inquiry brought out the above facts. Since the goods were taken out of regular stock and were not intended for exhibition purposes, the firm feels highly complimented over the result.

FAN MOTOR CATALOGUE.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has just issued its fan motor catalogue for the season of 1901. The catalogue embraces fan motors and ceiling fans for alternating current. The various styles of these fans are illustrated. The catalogue contains a list of parts to facilitate ordering. It also contains a telegraph code for the same purpose. There is one page that will be particularly interesting to manufacturers of machines of this class, and that is an outline of the patent situation. From this it appears that all the motors mentioned in the catalogue are manufactured under license from the owners of the Tesla induction patents. In addition to this license the Emerson Company owns thirteen United States patents, covering valuable features embodied in the machines. The catalogue is ready for distribution, and will be sent to any electrical dealer or central station upon request.

"THE LIVING AGE."—Boston's long-established weekly magazine, the *Living Age*, opened its 228th volume with the first Saturday of January. The editors of the magazine have been singularly successful in retaining the characteristics which gave the periodical its original hold upon the reading public, and at the same time broadening its scope and introducing new elements of variety and timeliness. All the conditions of periodical publication have greatly changed since Mr. Littell established his magazine in 1844, but the old *Living Age* has held its place and is even more indispensable to-day to alert and cultivated readers than it was half a century ago. It is still the only weekly magazine in its field, and its frequency of issue enables it to reproduce the most important articles from foreign, and especially from British magazines, reviews and literary weeklies, with a freshness impossible under other conditions. Literature, art, science, biography, travel, poetry, public affairs, and the best fiction in short and serial stories find a place in its well-stored pages, and there is not a single weekly number which does not contain something which intelligent readers of whatever special tastes would be poorer for missing. The magazine is published by the Living Age Company, Boston.

THE CUTTER COMPANY, Nineteenth and Hamilton Streets, Philadelphia, and 120 Liberty Street, New York City, has just issued a new I-T-E circuit breaker catalogue which is a very complete exposition on the subject of circuit breaking devices. The catalogue is divided into six sections, each section being printed upon a paper of a different color so as to facilitate reference, all the instruments of one type being brought together, and making the complete book extremely valuable to the engineer. Part "A" is devoted to plain overload instruments, for the protection of light, heat and power circuits; part "B" is devoted to "no voltage" instruments, for the automatic cutting off of apparatus from idle lines; part "C" is devoted to plain underload instruments, for the protection of storage batteries; part "D" is devoted to combined overload and no voltage instruments, for the protection of motors from overload; part "E" is devoted to combined overload and underload instruments, for the protection of storage batteries; part "F" is devoted to the laminated edgewise instruments, specially designed for railway work. Illustrations are given of all of the various types, and templates showing base and switchboard mountings are included wherever possible, together with full data as to mounting, etc. In addition to the types described and illustrated, the Cutter Company announces that it is prepared to build instruments to meet special requirements upon receipt of specifications. A copy of this catalogue will be sent by mail to any one interested.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 8, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

665,421. MACHINE FOR RESTORING INSULATED WIRE; J. B. Flemming, Detroit, Mich. App. filed Jan. 13, 1900. A machine that simultaneously scrapes off the old insulation, straightens the wire and applies new insulation thereto.

665,423. ELECTROMAGNETIC CUT-OUT; B. Fleming, Lynn, Mass. App. filed Nov. 24, 1899. Details of a cut-out for arc lamps.

665,426. ART OF OBTAINING CHLORATES BY ELECTROLYSIS; William T. Gibbs, Buckingham, Canada. App. filed Sept. 9, 1895. A process consisting in subjecting a chloride in solution while flowing continuously through each of a series of cells, to the action of an electric current between two electrodes in each cell; imparting heat to raise the temperature to a degree suitable for the decomposition of hypochlorites; and regulating the temperature and flow of solution. The necessary heat is derived from the current flowing. The current is from 2 to 4 amperes per square inch of electrode surface, and the temperature not exceeding 400 degs. F.

665,427. ELECTROLYTIC APPARATUS; William T. Gibbs, Buckingham, Canada. App. filed Sept. 9, 1895, and Oct. 8, 1900. Apparatus for the electrolytic production of chlorates from chlorides in which each cell has one wall faced with platinum or substance resistant to the action of chlorine, this constituting one electrode. The other electrode consists of a bundle of vertical rods or wires.

665,437. FLUID PRESSURE REGULATOR; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 22, 1899. A fluid pressure governor for an electrically operated compressor, comprising a movable contact controlled by fluid pressure, a magnet in circuit therewith, and a short-circuiting by-pass around the contacts completed by the magnet when the circuit is closed.

665,449. BRUSH CARRIER; C. W. Larson, Schenectady, N. Y. App. filed Oct. 23, 1899. A brush carrier constructed in accordance with the invention is caused by a reverse movement of the armature shaft to be moved so that the lead of the brushes is changed to the proper point for the new direction of rotation of the armature and commutator.

665,450. ELECTRIC BRAKE FOR VEHICLES; J. N. Mahoney, New York, N. Y. App. filed Feb. 12, 1900. The power to supply the brake is produced by the motors when they are run as generators on a short circuit.

665,459. LAMP TERMINAL; G. B. Painter, Schenectady, N. Y. App. filed June 20, 1898. A centre contact for lamp bases consisting of a sheet metal strip doubled upon itself and made cylindrical, being closed at one end and open at the other and anchored in the insulating material of the lamp base.

665,470. SUPPORT FOR OPERATORS' INSTRUMENTS; G. A. Rutherford, New York, N. Y. App. filed Dec. 24, 1897. A head support for a telephone instrument provided with a button arranged to support the instrument in proper relation to the ear.

665,486. DYNAMO ELECTRIC MACHINE; E. Thomson, Swampscott, Mass. App. filed Oct. 25, 1900. (See Current News and Notes.)

665,492. ELECTRIC SWITCH; C. L. White and F. W. Cole, Chicago, Ill. App. filed March 30, 1899. Details.

665,494. LAMP SOCKET; H. C. Wirt, Schenectady, N. Y. App. filed July 9, 1898. Refers to the shape of one of the terminals.

665,514. ELECTRIC SWITCH; W. Ely, Providence, R. I. App. filed Aug. 13, 1898. Details.

665,539. MEANS FOR GENERATING ELECTRICITY FROM AXLES OF LOCOMOTIVE TRUCKS; M. Moskowitz, New York, N. Y. App. filed March 13, 1900. The dynamo is mounted on a movable platform fixed to the pilot and is adapted to swing on a centre when the front axle, from which it is driven, swings to pass around a curve.

665,540. MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES; M. Moskowitz, New York, N. Y. App. filed March 13, 1900. Same arrangement as preceding for application to cars.

665,541. ELECTRIC LIGHTING SYSTEM; M. Moskowitz, New York, N. Y. App. filed April 13, 1900. A pole changing switch for use on car lighting system in which the generator is driven from the axle.

665,548. TELEPHONIC SYSTEM; L. W. Pullen, Camden, N. J. App. filed May 23, 1899. A signalling system utilizing the wires of a telephone system.

665,573. TRANSFORMER; W. S. Moody and W. L. R. Emmet, Schenectady, N. Y. App. filed Oct. 26, 1900. (See Current News and Notes.)

665,582. LAMP SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 14, 1900. An insulating lining for the cap of a lamp socket made of flexible material so that it can be forced past the retaining lugs which hold it in place when once adjusted.

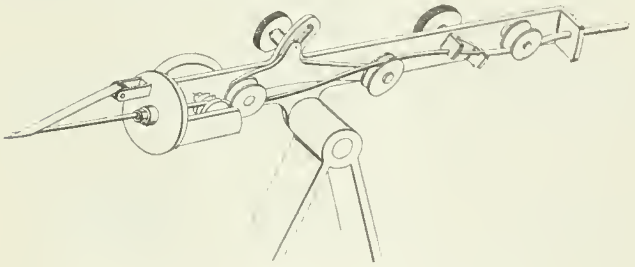
665,586. DIRECT CURRENT DYNAMO ELECTRIC MACHINE; W. V. Siemens and A. Rotth, Berlin, Germany. App. filed Jan. 6, 1900. (See Current News and Notes.)

665,609. ELECTRICAL BATTERY; C. B. De Lamarre, Biloxi, Miss. App. filed Aug. 15, 1900. Details.

665,625. PRIMARY BATTERY; H. S. Amwake, Camden, N. J. App. filed March 2, 1900. The plates of the battery have V-shaped lugs which rest in V-shaped sockets in the edge of the jar.

665,636. ELECTRIC CABLE; R. K. Gray, London, Eng. App. filed May 23, 1900. An insulating coating of plastic material is interposed between the conductor and a coating to prevent displacement of such material.

665,639. TELEPHONE TRANSMITTER; Takeo Iwata, Tokio, Japan. App. filed Oct. 25, 1899. Two carbon cups containing a loose mass of granular carbon have their open ends opposite a diaphragm, one cup on each side of the diaphragm. The carbon exerts a light pressure whereby each of the cups is caused to vary its resistance simultaneously. A membrane loosely attached is interposed between the mouthpiece and the microphonic arrangement, which acts as a damper of unnecessary disturbances of the air which would otherwise interfere with the purity of the vibrations received on the microphone.



665,421.—Machine for Restoring Insulated Wire.

665,664. SYSTEM FOR HEATING CONDUCTORS OF THE SECOND CLASS; C. D. Raab, Kaiserslautern, Germany. App. filed April 30, 1900. (See Current News and Notes.)

665,667. ELECTRICAL MEASURING INSTRUMENT; L. B. Atkinson, Cardiff, Eng. App. filed June 8, 1900. Details of an instrument in which the position of a float on a body of liquid is caused to vary by the flow of current to be measured.

665,676. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; E. T. Greenfield, New York, N. Y. App. filed July 9, 1900. Removable disks are temporarily inserted in the entrance holes of the junction box.

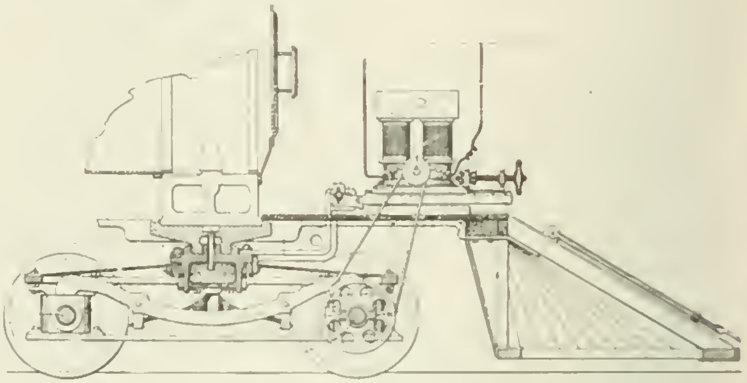
665,677. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; E. T. Greenfield, New York, N. Y. App. filed July 9, 1900. Details adapting the box for attachment to the ceiling.

665,679. ELECTRIC BATTERY; R. E. Hall, Bridgeport, Conn. App. filed Dec. 15, 1899. The oxide of copper is contained in a chamber having two porous walls and two transparent walls, the vessel being inserted in the battery jar.

665,704. ELECTRIC FURNACE; G. S. Strong, New York, N. Y. App. filed April 4, 1896. The material to be acted upon is fed through tubes and itself forms the electrode; it is heated by the same current which supplies the arc immediately before it enters the furnace.

665,734. TYPE PRINTING TELEGRAPH; A. Franke, Berlin, Germany. App. filed Jan. 18, 1899. Details.

665,782. PRIMARY BATTERY; H. K. Hess, Philadelphia, Pa. App. filed Jan. 11, 1899. A piping system for conveying the liquid to the cells.



665,539.—Means for Generating Electricity from Axles of Locomotive Trucks.

665,783. PROCESS OF REGENERATING SPENT ELEMENTS OF PRIMARY BATTERIES; H. K. Hess, Philadelphia, Pa. App. filed July 13, 1899. The spent liquors of a two-liquid battery, with the decomposed zinc, are placed in a regenerator so that when a current is passed through the regenerator the chromic acid and sulphuric acid will be regenerated and the zinc collected in suitable pans.

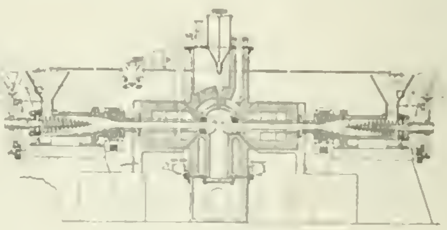
665,784. APPARATUS FOR REGENERATING SPENT ELEMENTS OF PRIMARY BATTERIES; H. K. Hess, Philadelphia, Pa. App. filed Aug. 9, 1899. Apparatus for carrying out the preceding method.

665,788. ATTACHMENT FOR TELEPHONE; D. Laing and G. M. Ferry, Duquesne, Pa. App. filed May 2, 1900. An arm having a universal joint and adapted to carry the transmitter and receiver.

665,798. ELECTRICAL MEASURING INSTRUMENT; Camillo Olivetti, Ivrea, Italy. App. filed Aug. 9, 1900. In the core carrying the winding is a cylindrical bore eccentric to the axis of the core and half filled with a semicircular plug. A shaft with two radial soft iron rings at an angle is pivoted so that its centre coincides with the centre of the bore; the chamber containing the rings, which latter have their edges in close proximity to the surface of the bore, is closed air tight. Current in one direction through the winding causes the rings to be attracted by the plug in one direction, and, when reversed, in the opposite direction, and the close fit causes the pointer attached to move slowly.

665,801. ELECTRIC BURGLAR ALARM; J. W. Rough, Orleans, Ind. App. filed April 2, 1900. Details of an alarm system by which, in addition to the alarm, a photograph of the intruder is obtained and a phonograph is set loose to call out any desired words.

665,810. APPARATUS FOR GENERATING ELECTRICITY; J. Stretch, East Orange, N. J. App. filed May 21, 1900. A platform carrying a dynamo is caused to traverse a circular track by the wind acting against a sail also carried by the platform, and the motion is utilized to drive the dynamo.



665,704.—Electric Furnace.

665,827. MANUFACTURE OF STORAGE BATTERY PLATES; J. L. Creveling, New York, N. Y. App. filed May 23, 1900. A process of producing a porous plate consisting in spraying molten metal against a collector and causing the sprayed metal, before it reaches the collector, to pass through an oxidizing flame.

665,848. TELEPHONE SWITCH; N. Bassett, Philadelphia, Pa. App. filed May 3, 1900. Details of a device to prevent the accidental leaving open of the circuit by failure of the user to replace the switch lever to the initial position or contact.

665,856. ELECTRIC BURGLAR ALARM SYSTEM; E. Biedermann and L. A. Heine, Chicago, Ill. App. filed April 23, 1900. Details.

Supplement to Electrical World and Engineer

MARCH 2, 1901

Berliner Microphone Patent Declared Invalid.

At Boston, on Feb. 27, in the United States Circuit Court, Judge Brown handed down a rescript, giving the gist of a fuller decision to be filed later, declaring the famous Berliner microphone patent invalid.

At Washington, on May 10, 1897, the United States Supreme Court gave out a decision denying the motion of the Government to have the Berliner patent, No. 463,569, of Nov. 17, 1891, set aside on the ground of unnecessary and improper delay in its issuance, it having been filed in 1877, and further because the company had acquiesced and helped in the delay, in order to defraud the public of its rights. The suit originated in the United States Circuit Court for the District of Massachusetts, where it was decided in favor of the United States. Upon appeal to the Circuit Court of Appeals for the First Circuit, this decision was reversed, and the contention of the Berliner claimants upheld. From this opinion the United States appealed to the Supreme Court. The details as to the alleged laches of the Patent Office and the Bell Company are familiar to all acquainted with electrical history. The claims of the patent are as follows:

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and therefore increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy, and adapted to increase or decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly-held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephone transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephone transmitter, a vibrational plate provided with one or more apertures, as and for the purposes set forth.

6. A speaking-telephone transmitter comprising a diaphragm or disk sensitive to sound-waves, combined with a rigidly-held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

The present decision was handed down Wednesday in the cases of the American Bell Telephone Company against the National Telephone Manufacturing Company and the Century Telephone Company. The actions were tried together. They were brought with a view to having the defendants enjoined from making use of or selling telephones whose validity was involved, related. Appeal from Judge Brown's decision lies, if taken, to the United States Circuit Court of Appeals and not to the Supreme Court.

The Court's decision, which is given below, was read from the bench in the presence of counsel and several others who were interested in the case.

The Court holds that the patent is invalid for want of invention and patentability, and because it was anticipated by Edison and Bell. The proceedings have been dismissed and a decree ordered entered for the defendants.

The substance of the decision follows:

The decree in these cases must be for the defendants. I find the Berliner patent invalid.

Because, at the date of the application, June 4, 1877, Berliner had not made the invention covered by the patent issued to the American Bell Telephone Company on Nov. 17, 1891. It is conclusive that Berliner had not invented and did not intend to apply for a patent for a constant-contact speech transmitter. I find as a matter of fact that Berliner did not before June 4, 1877, succeed in transmitting speech; but, on the contrary, was convinced by his experiments that speech could not be transmitted by the apparatus of the patent in suit. I find also that he did not at that date intend to describe or claim the apparatus as a speech transmitter. In view of the original application the complainant's case cannot be established without proof of successful experiments by Berliner. The invention set forth in the patent lay in experiment. In inventions of this class, the true date of conception is the date at which the experiment succeeds. The complainant concedes that Berliner did not make new apparatus, but reproduced substantially the old Reis apparatus. Proofs that the Reis apparatus or Berliner apparatus, or the Morse key, is operative in the hands of experts does not establish invention by Berliner. He is not entitled as an inventor of apparatus to claim whatever may be found to be within its capacity, because his sole claim to invention is based upon an alleged discovery of a new capacity in old apparatus. If he did not discover this, nothing new remains that he did discover or invent. He did not "embody" an invention in apparatus unless he succeeded in making the old apparatus perform Bell's process upon the current.

Berliner's caveat of April 14, 1877, does not establish invention and does not count as a reduction to practice. It proves a project. Later caveats, the application, the record in the patent office and other evidence show the failure and abandonment of this project. If it is obvious to Berliner or to persons skilled in the art, upon a reading of Bell's patent, that the Reis apparatus could perform Bell's process, then the case fails as to invention. The complainant's case as to invention must rest upon the ground that what was stated in the caveat was not obviously and necessarily true; that experimental verification was necessary, and that Berliner did verify his project by successful experiment, resulting in discovery of facts before unknown. The proof is strong to the contrary.

The second ground of the decision is that the invention described in the patent is radically different from the invention described in the application. The Court says: A comparison of the two documents leaves no doubt on this question. The application expressly disclaims speech transmission by the instrument of the patent; and claims as a speech transmitter a double-pin instrument, operating to make and break contact of electrodes. The patent calls for constant contact of electrodes and an unbroken current; the application for an interrupted contact and a broken current. The original application by changes purporting to be amendments has been completely transformed into an application for a distinct invention. This transformation is of the most remarkable character and was made after Edison's carbon constant-contact speech transmitter was invented and described in a printed publication. Such amendments would be illegal, even if Berliner had made the invention before June 4, 1877.

The amendments made prior to 1880 cannot support the patent as they did not introduce constant contact of electrodes. If they did, they are illegal as introducing a different invention. At the time of the rewritten specification of 1880, the invention had then been in use for more than two years; *i. e.*, since June, 1878.

The third ground of the decision is to the effect that the invention was previously patented by Berliner. Berliner in 1880 took out a patent which covered the speech transmitter of the patent in suit, applied to its appropriate use in a "system"; *i. e.*, with a receiver. The effect of claim four of the 1880 patent was to give a monopoly of this instrument applied to its appropriate use without additional invention in making this application. By granting the patent of 1880, the commissioner exhausted his power to issue a second patent whereby the patentee could control all use of this instrument as a transmitter. Having been protected for 17 years in the use of this transmitter with one receiver, Berliner was not entitled to further protection for use with any and all receivers.

The fourth ground is that Edison was the prior inventor. Aug. 8, 1887, is the earliest date of Berliner's amendment affecting this controversy. Berliner's amended application is anticipated by Edison's application of July 20, 1877, and by the Philadelphia *Press* article of July 9, 1877. The burden of proof is upon the complainants to anticipate Edison. They cannot sustain it. Assuming Berliner's application as of June 4, 1877, he is anticipated by Edison's application of April 20, 1877.

The claims which cover all forms of variable-contact transmitters are embraced in the Bell patent, as well as in Bell's liquid transmitter and in various devices of Edison's. The patent discloses nothing presentable as an art, method or mode of operation.

The method is "by causing the sound waves to vary the pressure," so as to strengthen and weaken the contact. "Causing" is accomplished by placing the apparatus where there are sound waves. This is not patentable as an art or method. Producing sound waves is no part of the method whereby existing sound waves are caused to vary. The patent covers no art or skill acquired in keeping the electrodes in constant contact.

If Berliner made a discovery it was simply a discovery that such minute variations of contact as could be produced between metallic electrodes would transmit speech to a limited extent. If Berliner or others have succeeded in finding that metallic electrodes can be balanced so delicately that they will transmit speech, this is not a discovery that is embodied in the defendant's transmitters.

The attempt to expand Berliner's unsuccessful experiments and caveat first into an invention, and next into a broad claim for an art, method, principle or process, exhibits a remarkable degree of ingenuity, but is not convincing.

The Court concludes: "I am of the opinion that the defendant's transmitters are an invention substantially distinct from that disclosed in the Berliner patent; that the conception by Edison of the use of carbon for speech transmission preceded Berliner's conception of the use of solid metallic electrodes; that from his first conception Edison diligently proceeded upon a line of experiments that led to an invention of remarkable character which borrows nothing from Berliner, has no substantial resemblance to what is shown in the Berliner patent and cannot be identified with it by any ingenious use of language. The defendants owe nothing to Berliner.

"The bill is dismissed."

Under the depressing influence of this decision American Telephone & Telegraph stock, quoted on the Boston Stock Exchange, went off from 162 to 157, but was not particularly weak, and gave early signs of rallying, on the ground that the "independents" would no longer be able to work the public on the score of "sympathy" and "monopoly," but must stand up to a square fight. On the other hand, "It is a great victory," said Judge James M. Thomas, president of the Independent Telephone Association, when in New York City on Wednesday night. "Capital that has been withheld from the telephone business will undoubtedly be put in it now by men who were afraid of the outcome of this suit. The Bell Company's stock may hold up for a time, but this is bound to affect it eventually. It will be beneficial to the public generally, in that it will encourage independent telephone enterprise. Here in New York the Knickerbocker Company and in Boston the Massachusetts Company will be encouraged to go ahead. The Court sustains every defense we set up. We had six chances to win, and we won on all six. That is certainly a decisive victory."

President Z. S. Holbrook, of the Massachusetts Telephone & Telegraph Company, which has lately completed an independent exchange in Boston, says: "The Berliner decision, while it affects the validity of the patent which the Bell people desired to have extended, nevertheless was dependent upon one telephone of a certain construction. The decision now opens up telephony to the world. The decision should have no effect upon the company's standing and the break in the shares is of sentimental effect. In fact, I have recently offered a reward of $500 to any one who would construct a telephone on the Berliner patent and make it work."

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DR. ELISHA GRAY.

Without question, Dr. Elisha Gray, whose sudden death occurred this week, was among the notable electrical inventors of the past century, while his early activity in the industrial field of electrical application was attended with important results. It is to be regretted that his later years were darkly embittered by the feeling of injustice done him in the matter of the telephone; and that he should have died a very poor man. The absence of wealth did not bother him much; but he did not hesitate to express the belief that more credit for the great invention of the telephone was his due. His own language, written within a few days of his death, is quoted elsewhere in this issue. And yet the evidence in support of the claim of fraud against him cannot be called strong, based as it practically is on the extraordinarily improbable story of Wilbur. But while that affidavit, discredited by its own author, is regarded by many as a clever contribution to the literature of magazine "short stories," by others it is taken simply as a proof of the corruption by which a great genius was cheated out of his rights. We fear that the Bell-Gray controversy will linger like the Morse-Vail, and others, such as that on the invention of the dynamo-electric machine, of which we are reminded at this very juncture by the arrival from England of a private pamphlet issued in behalf of Wilde. These disputes are, it would seem, inevitable; they are none the less deplorable.

NORTHWESTERN ELECTRICAL CONVENTION.

At the recent Convention of the Northwestern Electrical Association two topics appeared to engross largely the minds of the members, judging from the lively interest manifested in their discussion. These related to threatened legislation adversely affecting Wisconsin central stations—representatives of which form the main body of the membership of the Association—and competition from gasoline street lights. It seems that a necessity exists for increasing the revenues of the State, and among the interests singled out for increased taxation are central stations and electric railways, a bill now pending proposing to increase the present levy on these by 50 per cent. The main interest in the discussion, aside from its local bearing, lay in bringing up the question of publicity of central station accounts. Some of the members objected to the method of assessing a tax on income, the exposure of which without an accompanying statement of expenses, would in some instances give rise to public agitation on the score that the showing indicated undue profits.

There is little doubt that much of the strength of the municipal ownership movement in the West and elsewhere is due to false ideas as to the profits derived from electric lighting. Viewing electricity supply as a public utility, the matter of the profits enjoyed from the business has, particularly in the West, been considered as coming within the province of the people for discussion, and, if need be, for action—which thus far, when adverse, has consisted in the establishment of a municipal plant or the granting of a competing franchise, thereby in many instances destroying the investment in the private plant affected. In popular discussion which so often leads to such calamitous consequences, the central station unhappily occupies a weak position in that any claims as to exorbitant profits, whether in direct statement or as deductions from comparisons with other plants, are apt to receive credence from the people as against what will in most cases be considered as merely *ex parte* statements from the other side.

If, on the other hand, publicity were given to central-station accounts, as is done in Massachusetts, not only would there be a check in the first instance on demagogic charges, but means would be furnished the fair-minded to determine, both directly and by comparison of plants, if a central station is open to criticism on the score of undue charges. Moreover, the mere publicity of accounts would allay the jealous suspicion with which central stations are viewed when conducted on the principle that, as in purely private business, their balance sheets are to be carefully guarded from the public. To our mind, the greatest boon that could be conferred on the central-station industry would be the enactment of laws in all States similar to those under which, in Massachusetts, central-station accounts are given publicity in annual reports.

As to competition from gasoline street lighting, the discussion abstracted in the convention report indicates that thus far it has not assumed a serious aspect. It is not a little astonishing that the underwriters have permitted this dangerous method of illumination to be applied in interior lighting. In the discussion a number of instances were reported of fires resulting from the use of gasoline for interior lighting, this testimony in itself being sufficient to call for an investigation by the insurance interests.

The Victorian Era.

That period of time which will always be known as the Victorian Era and which coincided almost exactly with three-quarters of the nineteenth century, has come to a close this week with the death of aged Queen Victoria, than whom a more noble and virtuous sovereign never occupied a throne. We join at such a season in the universal grief, and offer sympathy with our English friends in this hour of their deep national affliction. The electrical inventions of Victoria's reign have done much to bring the English and American peoples together; the historian must go back far into Colonial records to find such cordiality as now exists, a cordiality to which the influence of the Queen contributed powerfully. Long may such relations continue through the days of Edward VII.!

We note of late a strain of depression in the language held by contemporary English statesmen and journals as to the British outlook as the good old Queen passes away. They seem to feel that with her death end the days of progress, prosperity and expansion that have endured these 50 years, and that now the troublous times begin. Such sentiments strike us as rather morbid, especially if we compare the position of England now with what it was at the beginning of the last century. Even if she never added an inch to her territory, England has infinite possibilities of growth under her own flag; and while her stolid indifference to new competition in arts and industries has lately been a puzzle, she has within herself the rich elements of a splendid recuperation. That England should thus hold her own under Edward VII. is all that patriotic Americans wish for her; so that both countries may go forward in mutual respect, generous rivalry and a swifter development than ever of all the boons of civilization, neither last nor least of which are the arts and sciences that we date from the Englishman, Faraday.

Mail Tube Systems.

It is announced from Washington that the Post Office Committee of the House in reporting the Postal Appropriation bill has left out the item for pneumatic tubes. It appears that the Government has been paying $225,000 a year for this service. In New York the expense has been $160,000 for five miles; in Philadelphia the distance is three-quarters of a mile, and in Boston it is half a mile. Apparently the trouble and cost have been such as to beget a prejudice in the Committee that could not be overcome, Chairman Loud saying that they thought the Government "was not getting enough for its money." This action has been taken in spite of the fact that a special committee of experts and well-known business men appointed by the Postmaster-General reported recently in favor of extensions in other cities after an exhaustive investigation. The Merchants' Association of New York has also protested against discontinuance, and has begged the New York delegation in Congress to ask and work for the maintenance of the system, on the score of its undeniable advantages.

It has always seemed to us that while the tube system is an indispensable feature of mail service in cities, it need not be pneumatic. The tube system is independent of all delays of the street traffic, weather, parades, etc., and can be availed of instantly at any hour of the day and night. But the pneumatic method which is apparenly very expensive, and evidently gives a great deal of trouble, can be readily supplanted and replaced by simple electrical apparatus; and it is really surprising that the new departure in this direction was not made long since. We note that a plan has just been put forward of this kind for adoption in one of the largest cities in the Union, and there is no good reason why it should not work out admirably. It is but another development of the traction work in which electricity has more than proved its ability to do the tasks that compressed air could not do; and running in tubes the motors would operate under most favorable conditions. We trust sincerely that the tube mail transportation will not be abandoned, but for the more expeditious delivery of mail, be extended under electrical conditions in all the large cities. The field is an excellent one for electrical occupation.

Cosmic Electrical Phenomena.

A letter from Prof. Elihu Thomson, appearing in our correspondence columns last week upon the subject of cosmic electric phenomena, shows that the suggestions of an electrical origin for terrestrial magnetic storms, solar coronas and auroral streams have been floating in the minds of observers on both sides of the Atlantic for several years past. It seems to have been noticed, and to be now demanding general recognition, that an enormous mass of matter like the sun, insulated in space and undergoing violent changes of superficial energy is likely to give rise to powerful electrical phenomena in addition to thermal and chemical phenomena. It would certainly seem strange, when the matter is regarded from this standpoint, if the electric charge of the sun should remain undisturbed from year to year in view of the enormous activities which are taking place upon his surface.

It may require much time to learn the magnitude and nature of the solar electric forces, but it is readily conceivable that a globe of such dimensions insulated in space might develop an electric charge which would be enormous by comparison with any that we are capable of measuring or observing on the surface of the earth, and at the bottom of its atmospheric ocean. Even the earth on which we live might, as a mass, be the seat of an enormous electrification relatively to other planetary bodies without our being in any way rendered cognizant of the fact. What seems, however, to be particularly noticeable in the suggestions of Thomson, Lodge and Fitzgerald, is that the behavior of the enormously big is capable of being explained by electrical conditions postulated for the almost inconceivably small. In other words, it would seem that the explanation not merely of solar coronal streamers, terrestrial magnetic storms, auroræ, and allied phenomena, may be accounted for on the recently created electron theory; but, also, perhaps, the more fundamental phenomena of mass-inertia and universal gravitation.

According to the electron theory, it would seem that all electric conduction currents in matter are due to the motion of electrons or ions or minute sub-atomic particles of matter in their natural electrified state. A very small amount of such ionized matter can carry a relatively large amount of electricity. Electrostatic induction currents, such as occur in condensers when charged with alternating electromotive forces, or in the ether when traversed by light and Hertzian waves, are not due to the movement of ions, but to the elastic behavior of the medium under electric stress. A relatively small quantity of ionized matter in the cathode-ray state, projected from the sun into space, and impinging upon the earth dissymmetrically might, it is suggested, act as an irregular current sheet dissymmetrically enveloping the earth, and so give rise to magnetic disturbances; while the projection of ionized matter from the earth itself into space under solar cathodic-ray stimulus might, perhaps, account for auroral streamers.

The immediate danger of the future seems to lie in working a willing horse to death, and in trying to account for too much by the electron hypothesis, thereby deluding ourselves into the belief that matters are accounted for, and an aching void of knowledge filled which is only hidden from sight and temporarily veiled by ingenious hypotheses. But the electron theory does not seem to have met with any refutation thus far.

Wireless Telegraphy.

From time to time we see published reports on wireless telegraphy of an exceedingly interesting, promising and uninstructive character, from which, however, we have vainly endeavored to extract a definite view of the situation. In order that we may stand acquitted of ultra-conservatism and of making light of important advances, we subjoin a few typical dispatches bearing on recent progress in the art, which summarize with substantial accuracy the sources of exact knowledge which have recently become available:

Exhibit I. "Prof. Jabez Q. Slowman, of Oshkosh University, has invented a new form of receiver for wireless telegraphy which is destined to supplant the costly and complicated apparatus of Marconi and his followers. It is contained in a common cigar box, and has a sensitiveness of no less than 100,000,000 watts. Pending the granting of the Professor's European patents, we are unable to describe the details of his marvelous apparatus by which messages can be sent from Oshkosh to London." Exhibit II. "Sig. Spaghetti, of the Royal Italian Marine Cavalry, has recently succeeded in demonstrating by novel apparatus of his own invention that the notions of wireless telegraphy hitherto held are based upon an entirely erroneous conception of the phenomena. He finds that the electric impulses are depolarized in the upper regions of the atmosphere, and hence instead of using the tall masts which have been responsible for so many failures, he employs a conductor extending vertically downward into the earth, thus utilizing the conducting central core of our planet. The Minister of War has ordered the distinguished inventor to Spezzia to continue his experiments." Exhibit III. "Lieut. Von Limburger has recently devised a new field wireless telegraph equipment of unequaled sensitiveness and power, constructed entirely of aluminium and weighing only 243.4 kilos. In the recent manœuvers it was successfully used between Wurstburg and Gansestein, a distance of more than 21 kilometres. Lieut. Limburger's invention has been adopted by the War Department, and the inventor has been decorated with the Order of the Green Parrot."

Our esteemed readers can find scores of similar exhibits, equally rich in corroborative detail, in the daily press, and can appreciate the interest with which we await further particulars. Meanwhile, in those corners of the world in which the wireless telegraph is really needed things appear to remain *in statu quo*. In pursuing our inquiries, we found that a number of wireless telegraph sets had been sent to the seat of war in South Africa, and had been successfully used in communicating between war ships sufficiently far removed from the firing line. Meanwhile the search for De Wet goes merrily on, and the only Boers found are discovered after the manner of carpet tacks on one's bedroom floor. It is all very interesting and instructive, of course, to learn that the wireless telegraph is at the front, but what is it doing there? Also in the Chinese campaign, we found that what little communication was established at all was due to the dexterity of the wideawake little Japanese in running telegraph wires. In the practical work of a campaign, the new method seems as yet to have found no place. We learn that our army authorities are doing some capital experimental work, but in spite of the work done nothing published here or elsewhere seems to indicate very startling success in the line of military communications. For special commercial purposes between fixed and not too distant bases the outlook seems rather better, but of definite achievements we hear but little. An exception to the rule should be made in the case of Prof. Fessenden's work for the Weather Bureau, which promises to result in the first real practical application of wireless telegraphy in this country to useful purposes.

High-Tension Alternators.

An article by M. Guilbert, continued in this issue, is interesting for the many points of comparison suggested between European and American alternators, as well as for suggestions concerning alternators generally from all parts of the world. Some of the differences between American and European practice are apparently merely incidental, while others are brought about by the imperative logic of local exigencies. Thus, as an illustration of the first point, in this country there are a large number of two-phase alternators, while in Europe two-phasers are comparatively rare.

The development of the alternator in the days when it was a belt-driven machine, was in the direction of very high speeds of rotation. When the size of the machine increased, the belt had to come off and the alternator had to be directly driven by the engine. This union necessitated considerable readjustment between the two components. The engine had to be speeded up as far as it could safely go, and the alternator had to be reduced in speed to match. The result is that most large engine-driven alternators turn more slowly than they would if their designer had a free hand to select their speed.

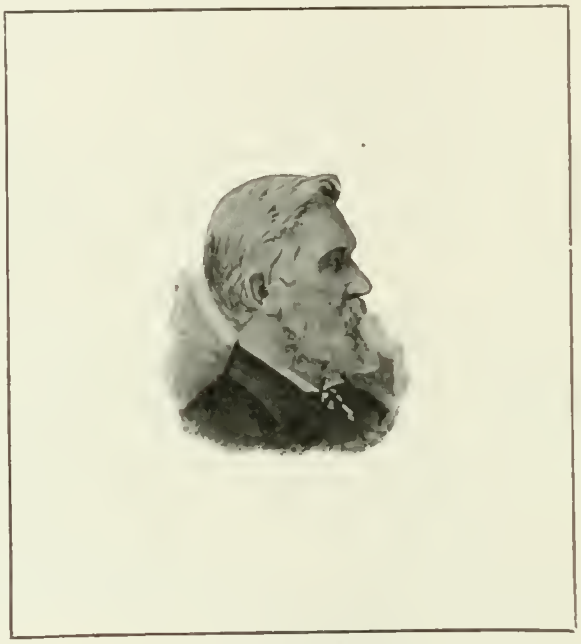
One of the main difficulties with alternators is their regulation, and a small drop of pressure at full non-inductive load, and particularly a small drop of pressure at full inductive load, is only obtained at considerable cost. If, however, automatically self-compounding machines can be constructed in large sizes we may expect a considerable reduction in the amount of copper employed in both field and armature. Several such plans have been tried with fair success on smaller sizes of machines, but no large alternators seem as yet to have been built that are automatically compounded for variation in the power factor as well as for variation in the load.

If the steam turbine proves successful in large sizes, as we all hope it may, the steam engine instead of being a laggard in speed, will be a runaway driver, and the opposite tendency will have to be met by designers in alternators with few poles, high speed and light construction. If the steam turbine is really successful in large sizes —and it gives every promise of being so—we may expect to see a rotary engine and direct-driven alternator occupying but little floor space and moving at high rotatory speeds with but very little vibration and less attention, with an output per pound of plant weight as small as that of alternator weight alone at the present time. In that case the locomotive engine might in time perhaps become the sole survivor of the reciprocating steam engine.

Death of Dr. Elisha Gray.

It is with much regret that we announce the sudden death at Newtonville, Mass., on Jan. 21, of Dr. Elisha Gray, at the age of 66. He had been in Boston for some time past, pursuing his work in marine signaling and telephony with Mr. A. J. Mundy, and was visiting at Newtonville. On Sunday afternoon he complained of a chill, and consulted a doctor. He dropped dead on Monday, his complaint being stated as neuralgia of the heart. Only last week he was a visitor in New York, on Jan. 15, and spent the afternoon visiting the offices of the Electrical World and Engineer and the American Institute of Electrical Engineers. It was a very stormy day, and when remonstrated with for his recklessness in traveling around in such weather, he took it good naturedly, appealing to his robust appearance as proof of his powers of endurance, but saying he was extremely careful not to overtax his strength. Thus passes away a man who has long been in the forefront of American electrical invention and industry, and around whose work bids fair to breed a controversy not unlike that between the supporters of Morse and of Vail over the telegraph.

Dr. Gray was born at Barnesville, Ohio, on Aug. 2, 1835, and for many years of his early life he was a carpenter's apprentice, and learned blacksmithing and boat-building. He was even then a great student of natural science. At 21 he went to Oberlin College, and there pursued five years of work, mostly in physical science. At about his 30th year he became interested in electrical mechanism. His first invention was an automatic self-adjusting telegraphic relay. He followed this soon after with a telegraphic switch and annunciator for hotels, a private telegraph line printer, and a telegraphic repeater.


THE LATE DR. ELISHA GRAY.

With E. M. Barton he organized the firm of Gray & Barton, out of which sprang the Western Electric Company. During the years 1873-74-75 his attention was much absorbed in developing a system of so-called electro-harmonic telegraphy for transmitting sounds over the wires of the telegraph. The basis of this system was the discovery of the law of vibration by which a sound produced in the presence of a magnet will cause a magnet of similar adjustment to respond to its tone. Mr. Gray was led to his most valuable discoveries in this line by a domestic incident. In a paper before the American Electrical Society, of Chicago, on "Transmission of Musical Tones," read March 17, 1875, he says: "My nephew was playing with a small induction coil, taking shocks for the amusement of the younger children. He had connected one end of the secondary coil to the zinc lining of the bathtub, which was dry. Holding the other end of the coil in his left hand he touched the lining of the tub with the right. In making the contact his hand would glide along the side for a short distance. At these times I noticed a sound was proceeding from under his hand at the point of contact, having the same pitch and quality of the vibrating electrome. I immediately took the electrode in my hand, and, repeating the operation, found to my astonishment that by rubbing hard and rapidly I could make a much louder sound than the interrupter or electrome. I then changed the pitch of the vibrator and found that the pitch of the sound under my hand was also changed, agreeing with that of the vibrator."

On Feb. 14, 1876, Prof. Gray filed a caveat at Washington with the expectation of perfecting the "art of transmitting vocal sounds telegraphically." As is well known, contemporaneous workers in the same line were Prof. Dolbear and Prof. A. Graham Bell, the latter of whom, though possibly anticipated by Gray's caveat, was granted a broad patent for speaking telephones on March 8, 1876. Of late years there has been a fierce controversy entering at some stages into the telephone litigations, over an alleged betrayal in the United States Patent Office of Gray's caveat by an examiner named Wilbur to the Bell attorneys and to Prof. Bell himself, for a money consideration. Wilbur before his death backed and filled so often as to his affidavit that he had sold out, that not even the Government suit to invalidate the Bell patent for Patent Office laches could render him respectable or credible; but the story, it must be confessed, remains an article of faith with many, and had no more strenuous believer than Dr. Gray himself. It may be noted that Bell and Gray were given equal honors for the telephone at the Paris Exposition of 1889. One unfortunate thing that tended to increase Dr. Gray's soreness was the fact that in spite of his undoubted priority as a telephone inventor, he himself received little pecuniary reward. The Harmonic Telegraph Company, with the Gray inventions and claims, went into the possession of the Western Union Company, which, by conceding the Bell claims of the American Bell Telephone Company, by the famous contract of 1879, netted several million dollars during the life of the patents, without otherwise raising a finger. Dr. Gray has said that he never received personally a clear $100,000, and it galled him acutely to think that he was deprived of both proper fame and a fair pecuniary return, under circumstances which he believed to be deeply tainted with fraud. On this very point, in connection with the list of great electrical names of the last century, he lately wrote to the editors of this journal, as follows: "I should place Faraday first, especially for his discovery of magneto electricity. Henry second, because he made the work of Morse possible. Morse third, because, not so much as an inventor as a promoter of what has proven to be one of the greatest civilizing agencies of the nineteenth century. Lord Kelvin, because of his service to the science and to the world, especially in making ocean telegraphy a success. Helmholtz, not so much for his contributions to electrical as to science in general, especially his researches in acoustics which were of such value in leading up to the discovery of the underlying principles of the telephone, a discovery which in its results for civilization was the greatest one of the nineteenth century. It was a discovery rather than invention, as almost any kind of an electro-magnetic instrument would talk when once the fundamental principle was announced This is why there were so many claimants; every inventor went to his scrap heap and some of them found apparatus that could be made to talk now that they had been taught how.

"In the matter of the telephone, I should first place the man at the head of the list who discovered first the principle and method of operation. It lies between Bell and myself. I first described it in my caveat. Bell first made it a few days after the filing of my description. I then gave it to him, because he first made it, but now I have evidence which convinces me *beyond a doubt* that I showed him how. The public does not know this as I do, and I, therefore, do not expect a verdict in my favor."

In addition to his work on the telephone, Dr. Gray spent much of his time in late years in the development of a telautograph system, which has been fully described and illustrated in these pages and which exhibited his wonted inventive ability and ingenuity. Although the device has not gone yet into general use, he brought it to a high degree of practical utility. Within the past 18 months he had spent considerable time in Boston in the development of a system for signaling by bells, etc., with the aid of telephones, through water, at distances up to 12 miles. This work again has been very successful, and bids fair to be the basis of new lighthouse warnings and ship protection, as well as of use in naval operations.

Dr. Gray in 1893, in connection with the World's Fair at Chicago, was the organizing chairman of the International Electrical Congress of that year. Recently he published a popular book on electricity, the large sale of which was a cause of much gratification to him. In personal appearance, Dr. Gray was quite striking, and in any assemblage he would have been picked out as a notable personality, with his tall, sturdy figure, long white hair, overhanging brows and bright, keen eye. He was an agreeable companion and very cheery and humorous, except that in late years a feeling of having been hardly dealt by in the matter of the telephone seemed to hang over him like a cloud that he could not banish. He left a widow and a son.

Notes on Electric Light and Power Work at Butte, Mont.

By J. R. Cravath.

BUTTE, Mont., has a peculiar interest to electrical men as the home of the largest copper mine in the world, the Anaconda. It is also of interest as being one of the best markets for electric power in the Rocky Mountain district on account of the large number of copper, silver and lead mines and reduction mills, and the good demand for light that comes from a live and prosperous mining town. There is at present only one water-power plant, supplying the town, the balance of the electric power being supplied from steam plants at Butte. The Montana Power Transmission Company owns a water-power plant, on the Big Hole River, over 20 miles from Butte, and sells power to the Butte Lighting & Power Company. The transmission is at 16,000 volts. The sub-station in Butte also contains a steam plant, which supplies what power cannot be furnished by the water-power plant. Max Hebgen is in charge of the operation of both companies.

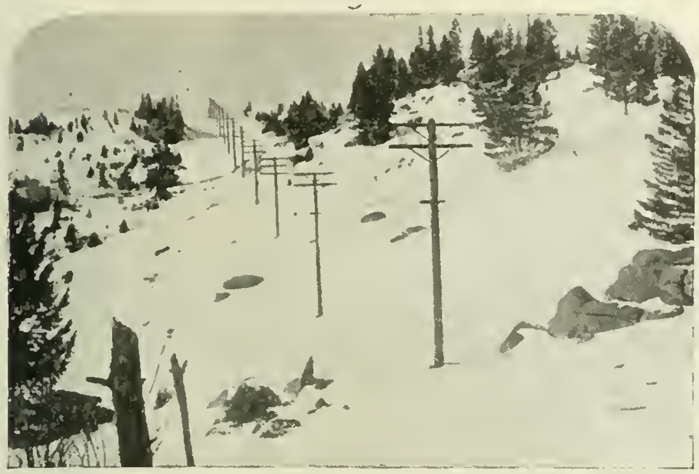
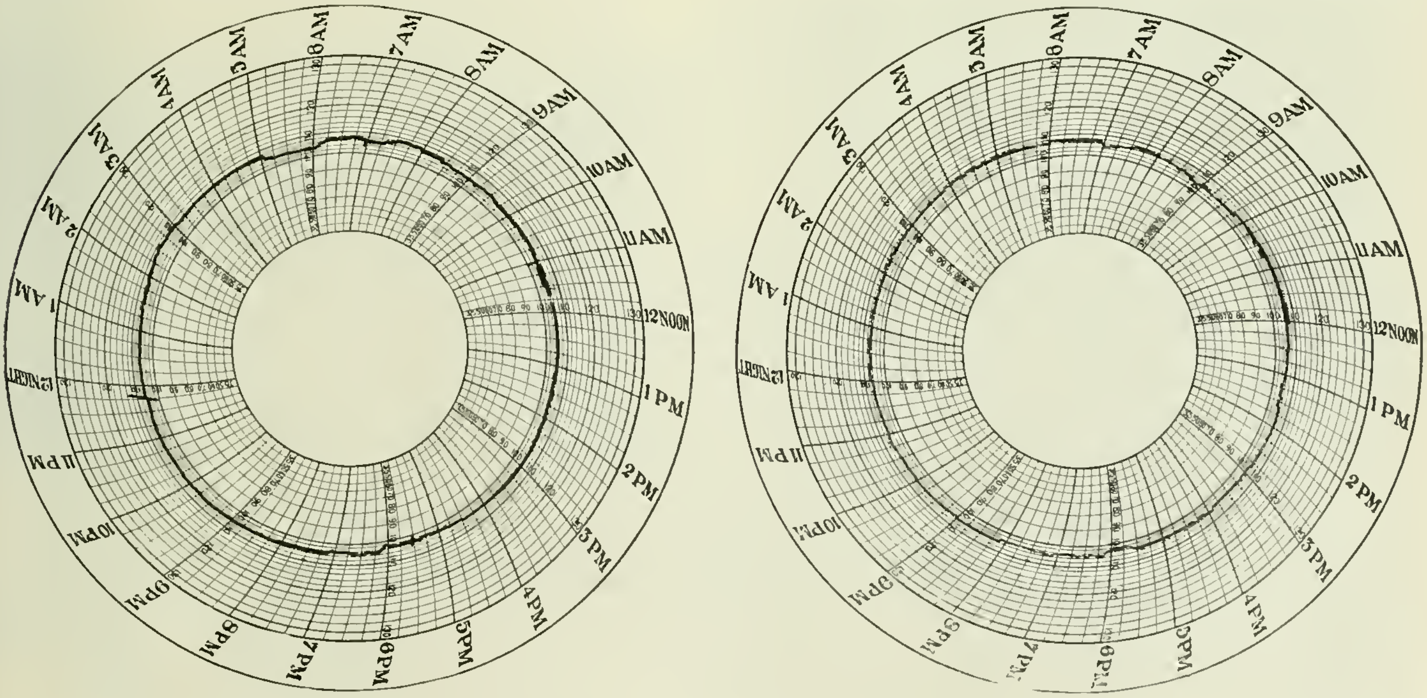


FIG. I.—LINE CROSSING CONTINENTAL DIVIDE.

The 16,000-volt transmission line has been remarkably free from interruption. In the first year of operation, which ended Dec. 15, 1900, there was only one break in the service, and that was due to a very unusual occurrence. In blasting for a sewer in Butte, under the line, some rocks were blown up through the line and broke it down. The trouble experienced elsewhere from the shooting at insulators and throwing things across the lines by boys, has not been felt at Butte. This is no doubt because the line runs across an unpopulated district over low mountains. The line (see Fig. 1) has the distinction of crossing the great continental divide. The power is generated on the Atlantic slope, and used on the Pacific. The line consists of two three-phase circuits on porcelain insulators, on a six-pin cross arm, as shown in Fig. 1. Above the cross arm carrying the high-tension lines is a cross-arm carrying two barbed wires for lightning protection. A third barbed wire is put on a pin on the pole top. These are not fastened with staples, as is the common practice, but are on glass insulators just as any line wire. They are grounded every fifth pole and at streams. The object of putting the barbed wire on insulators is to prevent corrosion and breakage of the wire. The barbed wire has so far proved a very efficient protection against lightning, although in the country through which the line passes many trees are splintered from that cause. Although in service only one year, current was on the line two years preceding that to prevent wire being stolen and furnish light at the water-power plant from Butte during construction. There has been so little trouble on the transmission line that regular patroling has been abandoned. Leakages are made apparent from the sound of the telephone, and when the telephone indicates a leak men are sent out to fix it. The telephone line is on the same poles as the transmission line, as seen. There are no fuses in the 16,000-volt circuit or on the generators.



Figs. 2 and 3.—Voltage Records.

At the sub-station is also a steam-generating plant. The light and power distribution in Butte is made at 2200 volts, three-phase, and 500 volts direct-current. The lighting circuits were formerly on a single phase system, and when the change was made to three-phase the balancing of circuits was done by plugging various feeders onto the three-phase mains at the central station switchboard in such a way as to maintain the balance of the load on the circuits. The distribution of feeders to secure a more perfect balance can be changed at any time.

For power purposes, both induction and synchronous motors are used, and circuits separate from the lighting are run for this purpose. Most of these large three-phase motors are 2000-volt machines, run direct from the primary circuit. A large amount of power is also furnished by a 500-volt rotary converter. Synchronous motors have been intelligently placed on lines having induction motors, so that the power factor averages 87 per cent. The strength of the field excitation on these synchronous motors is adjusted by the company at the time the motors are installed, so as to give a leading current on the line whenever the capacity of the motor is large enough to permit this. These synchronous motors are mostly old, 125-cycle single-phase alternators, rewound for 2000 volts three-phase, and are giving excellent service. In rewinding the armatures (which were all single-phase surface wound of various makes and sizes), they were slotted in a planer. For this cast core heads firmly clamped were, of course, necessary. The winding was done with formed coils, two coils per slot and two slots per phase per pole, or six slots per pole. The two adjacent coils of each phase were connected in series, and the three phases of the armature connected on the Y method. The frequency being 60, these motors run about half their former speed as dynamos, which is more suitable for a motor than the former high speeds. The cost of this rewinding was only from $150 to $200 to a motor, and it seems to be an excellent way of making use of old material. Two of these synchronous motors are belted to old 500-volt generators for carrying the power load when the rotary needs to be stopped, so saving investment in one new rotary.

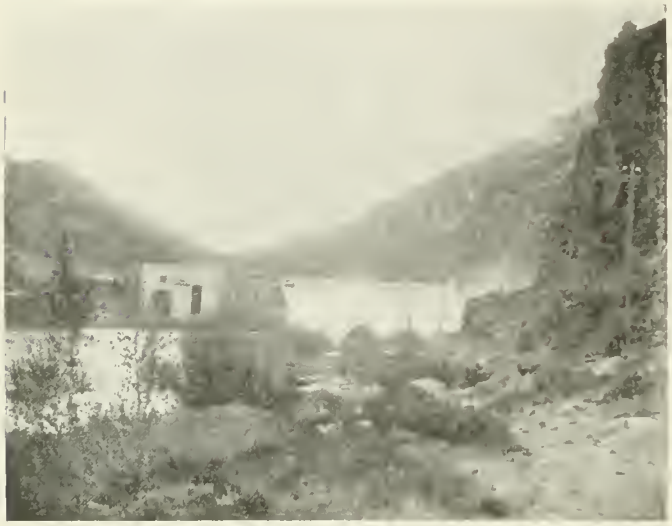


FIG. 4.—DAM AND POWER HOUSE.

As mentioned before, the lighting feeders are balanced between the legs of the three-phase mains by a plug switchboard at the station. This includes constant-current alternating arcs. Each incandescent lighting feeder supplies one district. Each district is numbered, and where there is more than one transformer in a district they are run in parallel on the same secondary network. The secondaries are three-wire 105-210 volt.

The regulation on the system is remarkably good, as can be seen by the accompanying Bristol recording voltmeter charts, Figs. 2 and 3, from an instrument connected on the mains in the business part of town. Considering that a water-power plant is furnishing part of the power, and that during daylight hours, 75 per cent of the load is power which is fluctuating greatly, such a record may to some look like an impossibility. Mr. Hebgen lays much of the credit for the good regulation to heavy flywheel action. Lombard water-wheel governors are used, and their performance is excellent, but Mr. Hubgen considers good heavy flywheels in the shape of revolving field alternators as essential in damping the small pumping action of a governor, which pumping with a fluctuating load knocks out all attempts at close regulation. The water-wheel regulation is as good now as that on a first-class steam engine.

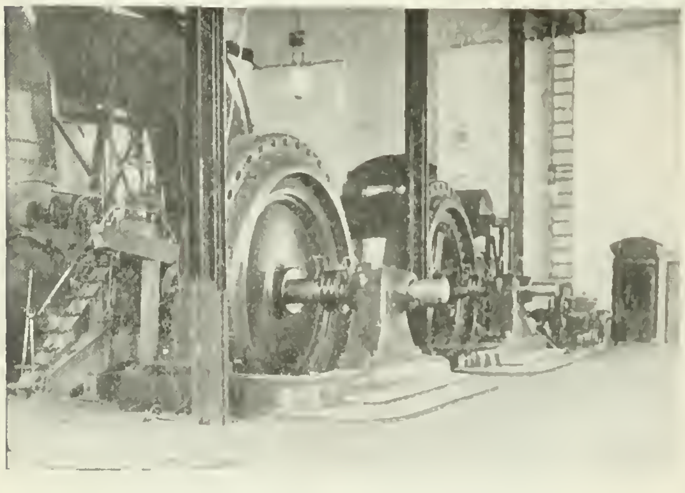


FIG. 5.—TWO GENERATORS AND TURBINES.

FIG. 6.—STORAGE RESERVOIR.

As mentioned before, there are no fuses either on the generators or high-tension lines. Oil switches are being put on the generators. This omission of all automatic-circuit opening devices is partly on account of the danger of temporarily shutting down the whole system by the blowing of fuses, and partly because it is not thought desirable or safe for the apparatus to suddenly open the main circuit. It is believed that as between a short circuit on one of these large alternators and a sudden open circuit that the short circuit is the least harmful. In case of short circuit these generators will give a little less than 50 per cent of their full-load current. In connection with this the question naturally arises, what about the strain on an alternator when it is being cut off the bus-bars and put out of service? In this company's plants this is being provided for by an attachment to the main circuit oil switch, whereby the alternator field current is cut down the instant the main armature circuit is opened.

The water-power plant on the Big Hole River, 21 miles from Butte, has four 750-kw, 60-cycle, 800-volt, revolving field three-phase alternators, driven by horizontal Niagara type Leffel turbines, running 180 r. p. m. The working head of water is 58 ft. The transformers, which step up from 800 to 16,000 volts, are General Electric air blast. Fig. 4 is a view of the dam and power house, Fig. 5 shows two of the generators and turbines, while Fig. 6 shows the storage reservoir above the dam.

As said before, the average power factor on the system for 24 hours is 87 per cent. Few plants of this kind have an accurate record of what their power factor is, and as this figure is not a guess, but is the result of actual tests by an interesting method, it is of value. The method of determining the power factor is this: The plant is operated in the ordinary way, and the ammeter and voltmeter readings are taken to give the apparent watts. Then one of the generators at the power house is started up and run as a synchonous motor. The field of this motor is over-excited so as to give a leading current. The effect of this is to overcome induction and bring the power factor up toward unity. The excitation is increased until the power factor is unity, which is indicated by the ammeter reaching its lowest position, on a given load. The observed watts will then be the true watts, and can be compared with the previous reading. At present writing, when the load is not too heavy to spare one generator, one generator is run as a synchronous motor with heavily excited field on purpose to bring the power factor near to unity. In this way the one idle generator at the power house takes care of part of the idle current on the system, and the other generators are run fully loaded on useful current.

A systematic overhauling of all the meters on the line is being made with a view to cutting down the loss of revenue through meters running slow.

Canadian Water Power Development.

The Great Dog Falls, over which the drainage of 1200 square miles of territory passes, are to be developed into electrical power and the power transmitted to Port Arthur, Ont. The company which will develop the power has been quietly investigating the possibilities of these immense falls. The Ontario government will be interviewed with the object of securing control of the falls at once. The Great Dog Falls are, in an air line, about 25 miles from Port Arthur, and according to estimates, are capable of giving 5000 horsepower the year round.

The Washington, D. C., Electric Automobile Service.

WASHINGTON CITY, with a large influx of visitors who come to spend money seeing the sights, a population largely made up of wealthy people and high Government officials, and with streets of asphalt everywhere, offered exceptional inducements for just such an enterprise as the Washington Electric Vehicle Transportation Company, and the managers are to be congratulated upon the result and the outlook.

The work of securing a strong foothold was not an easy task, however. The investment in costly vehicles and apparatus was continued at a pace just ahead of the returns from the services rendered to the public, so that to-day the parent company acknowledges this branch to be one of the finest and most thrifty that it has established. There are many reasons why this plant should be successfully and economically operated, and in brief they are as follows: The streets and avenues are paved with asphalt, the street railways use grooved rails flush with the roadbed, the climatic conditions are favorable, there being little snowfall, and what does fall as a rule melts quickly. The central station is in point of fact nearly centrally located with respect to the business portion of the city, the prominent hotels, theatres, public buildings and attractions for sight-seers. The grades in Washington are exceptionally easy, and in most cases the roads to points of interest near the city are under Government control and always kept in perfect condition.

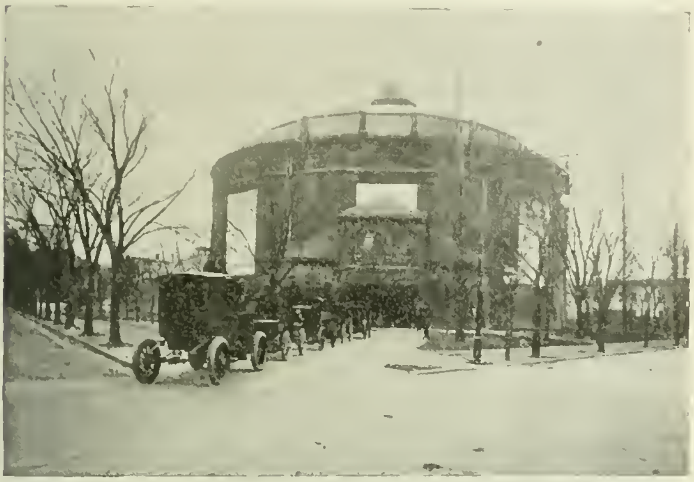


FIG. 1.—EXTERIOR OF AUTOMOBILE STATION.

The central station and offices of the company are located in the edifice known as the Panorama Building on Fifteenth Street and Ohio Avenue, three blocks south of the United States Treasury Building. (Fig. 1.)

At present, only the ground floor of the building is used, with the exception of a gallery for the drivers' lockers, shown in the right of Fig. 2. The 16-sided brick building is 100 ft. in diameter. The roof is about 80 ft from the floor. The walls of the building are sufficiently strong to easily sustain the weight of additional floors when loaded with vehicles. These floors will be built when the business has so increased that more storage room is required.

The offices of the several departments and waiting rooms for patrons are located at the street entrance. In the wings that have been added to the building since it was acquired by this company are the extensive machine shops, battery rooms, booster crushers and boilers for heating the building. The whole floor of the main building is paved with granolithic, sloped to drains at the centre. Around the sides the vehicles are arranged according to styles and service conditions.

Located near the centre is the apparatus for putting in and taking out of vehicles the trays of batteries. For vehicles having underslung batteries there is a specially constructed device located alongside of the other apparatus just mentioned. Batteries can be changed in three vehicles at one time. At present there are 120 vehicles in the livery service, consisting of hansoms, broughams, golf traps, surreys, four styles of victorias, runabouts, hotel busses, theatre busses. and 15 broughams in the service of the Baltimore & Ohio Railroad.

A number of the diplomatic corps and society people have been carefully taught by experienced men to drive runabouts and victorias, and are permitted to hire these vehicles and use them at will, without the attendance of the company's drivers. The instructions given this highly privileged class of patrons, besides covering fully the handling of the vehicle, include information as to distances that can be traveled on a single charge of batteries, and at what readings of the measuring instruments it is wise to return to the central station for freshly charged batteries, which can be had at all hours, with a delay of a very few minutes.

A large number of vehicles are rented by the month and are delivered to and returned by drivers in livery. This service is subject to call at all hours of the day or night, and to as many calls as may be made. To facilitate the conduct of business there have been established several separate departments, all under the management of the general superintendent, Mr. Wm. T. Headley, formerly of the New York system, who is assisted by the chief electrician, the master mechanic, and Mr. Alfred M. Welch, manager of the selling and renting department.

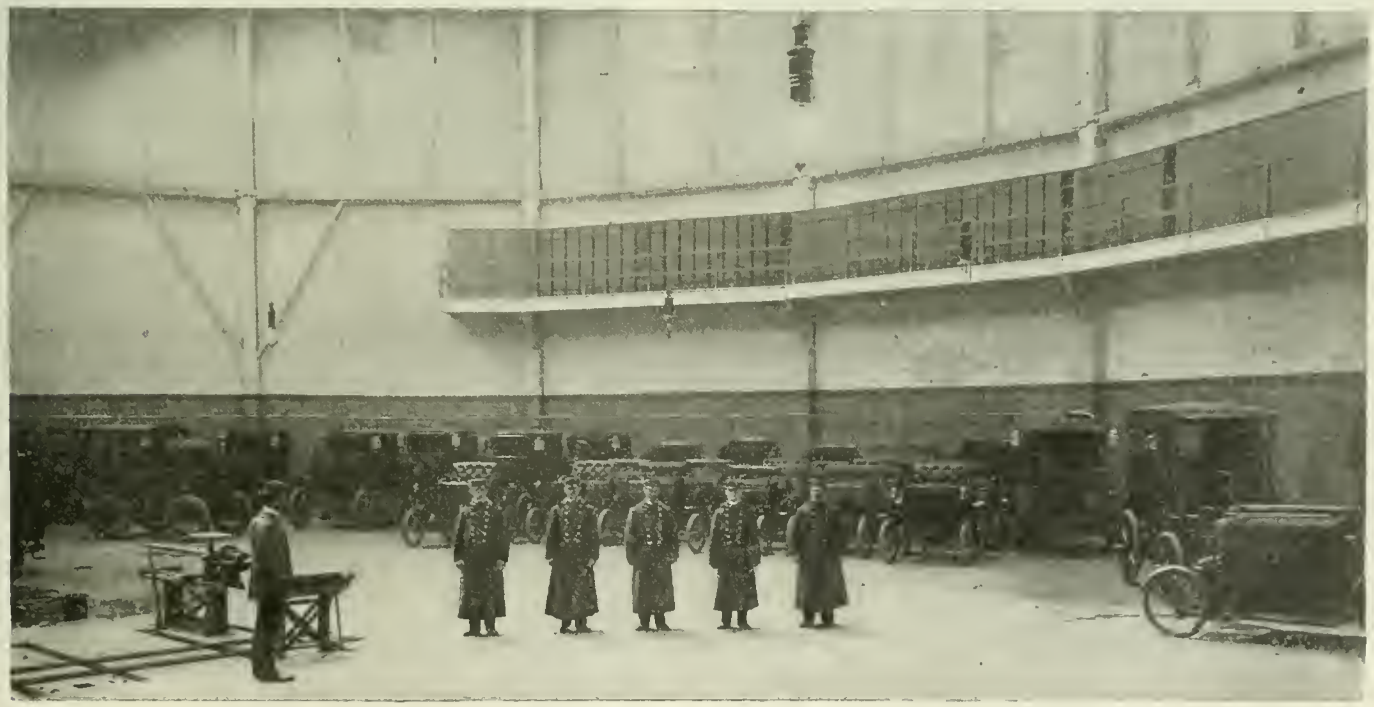


FIG. 2.—INTERIOR OF AUTOMOBILE STATION.

The chief electrician has charge of the electric installation, and under him are the switchboard men and the battery men. This department is the most important branch of the business and demands more than passing mention. Unusual conditions were encountered in the installation of the electrical service for charging the batteries, and it was found necessary to devise special electrical apparatus to insure a constant potential. The charging station being located within 1500 ft. of the local lighting and power station, two sets of cables were laid, one of 1,000,000 cir. mil. capacity and a reserve cable of 500,000 cir. mil. capacity, both running directly to the bus-bars of the main switchboard at the power house. This arrangement gave the full fluctuation in voltage at power house at the charging station also, and means for taking care of it were provided as follows: For transforming this very variable current to a constant potential a booster-crusher set was installed. This consists of a 50-hp motor directly connected to two generators each of a capacity of 450 amperes and 33 volts, with Belknap regulators of special design, connected in series with the fields of the two generators. With this apparatus a constant potential of 122 volts is maintained at the bus-bars of the charging switchboard and fluctuations in the primary potential of 33 volts above or below the normal can be taken care of automatically. When the initial voltage is above the normal, the motor acts as a generator, and the two generators act as motors, the outside wires of the three-wire system being led through their armatures. When the initial voltage is below the normal, the reverse action takes place. When the initial voltage is normal the regulators stand at the neutral point, and not over one volt is generated. The current is then taken from the booster-crusher switchboard by cables to the charging switchboard, consisting of 18 panels, each with a capacity of 8 circuits. Each panel is equipped with 8 enclosed rheostats set edgewise at the lower part of the panel. Above, mounted on slate, are one Weston round-pattern 150-volt voltmeter, one Weston round-pattern 150-ampere ammeter, one 8-circuit voltmeter switch, one 8-circuit ammeter switch and eight 75-ampere single-pole double-throw knife switches set horizontally and having enclosed fuses at the two extremities. The double-throw switches are connected to two sets of bus-bars for high and low voltage, the four upper switches being on the positive side of the system and the four lower ones on the negative side. The high voltage bus-bars are connected to one booster-crusher set, and the low voltage bus-bars will be connected to another booster-crusher set (now being built), and which will be set at a lower voltage to be used in beginning the charging. The main cables are connected to double-throw switches, so that they can be connected through the booster-crushers, or direct to the street mains, and the charging rheostats are of a sufficient capacity to take care of a large range in the initial voltage, if the booster-crushers should ever break down. (Fig. 3.)

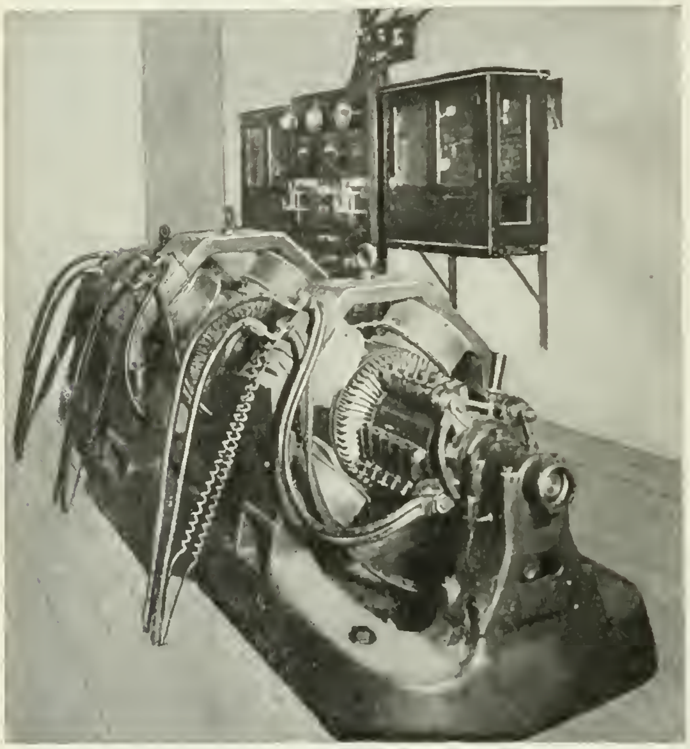


FIG. 3.—THE BOOSTER-CRUSHER AND SWITCHBOARD.

Individual circuits are carried overhead from the charging switchboard to the various parts of the battery room, the other side of the circuit being supplied from the neutral cable, which does not go through the switchboard. The current comes down through the twin cables into the charging plugs, receptacles being supplied on the various battery trucks. The switches on the switchboard are numbered correspondingly with the plugs, so that the switchboard men can at any time determine the exact condition of the battery attached to any plug in the charging room, of which there are 144. There are, in addition to these plugs, 16 plugs in the main building arranged for charging batteries without removing them from the vehicles containing them. The battery men test and repair batteries, see that they are properly placed in or taken from vehicles, and make up all the new batteries that are required. (Fig. 4.)

The machine shop is completely equipped in every particular for the thorough repairing of automobiles. A staff of machinists who are experts in automobile construction carefully examine at night every vehicle after its day's work, and make all the needed repairs or adjustments, thus insuring perfect condition of the vehicles whenever they are called into service.

The company has a considerable number of elegant vehicles that are rented to private parties for their own use. These vehicles are quartered at the station, where the drivers remain in charge of them, ready to respond with them at any hour. These drivers are in the special livery of the lessees of the vehicles.

The favorite vehicles for the monthly service are the victorias, broughams and runabouts. All of the prominent hotels have electric busses running to and from the depots on regular schedules. It is the truthful boast of the manager that these vehicles have never failed in meeting punctually the trains running through the city. In addition to this service, the leading hotels maintain electric cab service for the convenience of guests. All of these vehicles are operated by this company. The drivers are all carefully picked men and are put through a thorough course of training before they are finally accepted. They are uniformed and daily inspected for general appearance before they take a vehicle from the building. When the drivers meet with accidents to their vehicles, they report at once to the central station by telephone. Should nothing out of the ordinary occur, a report is made and posted for the future guidance of drivers, explaining the proper remedy for the trouble, enabling them to make minor repairs without calling for assistance from the central station. One trouble, rarely met with in Washington, is the stalling of vehicles in the snowbanks at street curbs. The trouble is now easily remedied by wrapping the tires of the drive wheels with a small rope. The rope gives the wheels a grip and prevents slipping and churning in one spot.

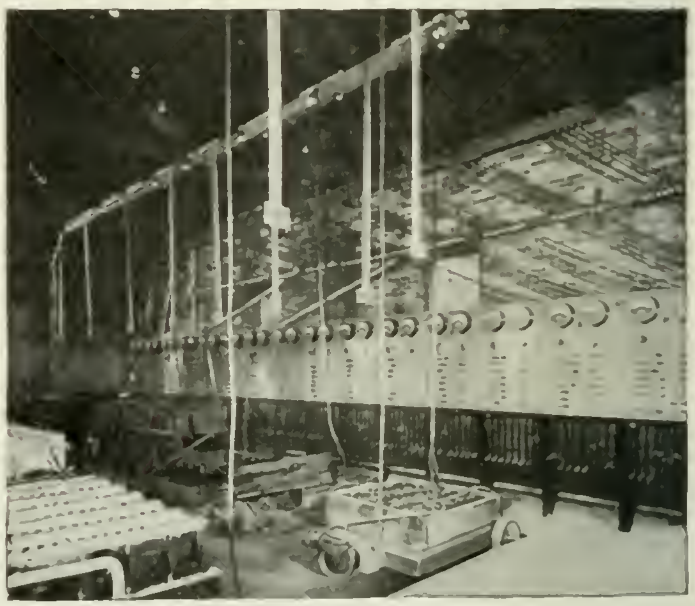


FIG. 4.—THE CHARGING SWITCHBOARD.

In the station office are a number of starters who keep the register in which all calls for vehicles are recorded, the kind of vehicle desired, the time it is wanted and the name and address of the person asking for service. The starters see that prompt service is rendered. There are two shifts of drivers, working 12 hours each. The day men report on at 7 a. m. and off at 7 p. m.; the night men report on at 7 p. m. and off at 7 a. m.

In Washington the vehicles are allowed to run at a maximum speed of 12 miles per hour, but this is not always strictly obeyed. Accidents are rare to either vehicles or pedestrians. The service rendered the public is excellent, and the public appreciation is abundantly proven by its great popularity.

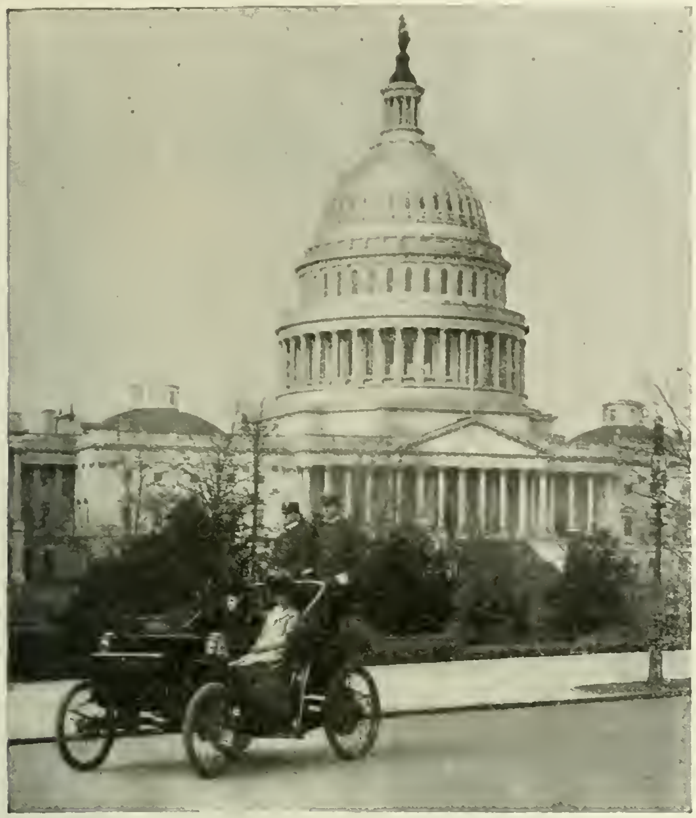


FIG 5.—FAVORITE AUTOMOBILE ROAD IN FRONT OF CAPITOL.

The work on this station was designed and supervised by Mr. A. W. Gilbert, superintendent of construction for the Electric Vehicle Company of New York. The electrical part was carried out by the Electro-Dynamic Company of Philadelphia and the General Incandescent Arc Light Company of New York.

Niagara and the Pan-American

By Orrin E. Dunlap.

Henry Rustin, chief of the mechanical and electrical bureau of the Pan-American Exposition, reports that he is confident that all of the electrical work will be completed in ample time for the opening of the Exposition on May 1. It will be recalled that the Pan-American Exposition is to receive 5000 electrical horse-power from Niagara Falls, a contract for that amount of force having been made with the Cataract Power & Conduit Company. This power will be generated in the central station of the Niagara Falls Power Company at a voltage of 2200, two-phase, and it will pass from the power station to the transformer station, where its voltage will be raised to 22,000, three-phase, for transmission to Buffalo. In the terminal station of the company on Niagara Street in Buffalo, the voltage will be reduced to 11,000, and at this potential it will be conducted over a special transmission line, for a distance of 13,000 ft., to the Exposition grounds. This transmission line leading from the terminal station to the grounds is an overhead line, and has six bare copper cables of 00 wire. The line enters the Exposition plot near Groat Street and Elmwood Avenue, and drops into the rheostat for dimming effects. Converging into three cables, copper, lead covered, 300,000 cm., it passes under ground to the Electricity Building, connection being made with the transformer-service station in the General Electric Company's exhibit in the Electricity Building. At this point the current is stepped-down to 1800 volts, and at this pressure it is sent about the grounds to the many distributing transformers, which again reduce it to 104 volts for use at the lamps.

The transformer plant of the Pan-American Exposition will consist of 18 air-blast transformers, General Electric, form I. It will be equipped with blowers operated by electric motors, and a complete set of oil switches operated pneumatically. Distribution will be effected by an exceedingly handsome line of switchboard panels, of blue Vermont marble, having silver trimmings. This plant will control the entire decorative lighting system throughout the Exposition grounds, and the plant will itself be one of the exhibits of the Exposition. Its location will be adjacent to the exhibit of the General Electric Company, which, those in charge of the Exposition state, will be the largest ever attempted by that company.

In addition to the above, there will be an auxiliary plant for patrol and other lighting purposes. The object of this plant will be to supply 500-volt and 110-volt service without resorting to the use of rotary transformers. It will care for the necessary all-night lighting for police purposes. The apparatus in it will be part of the exhibit of the Westinghouse Electric & Manufacturing Company, and will consist of one 60-cycle alternator, having a capacity of 180-kw; four power generators, 500-volt, d. c., capacity 225-kw each; two 110-kw, 110-volt, d. c. generators, and 15 Brush arc machines. the circuits from which, except the all-night lighting circuit, will run direct from the power plant to the Electricity Building, which is to be the principal point of distribution. In addition to this a 600-kw, 60-cycle alternator, located in the exhibit of the Westinghouse Electric & Manufacturing Company, will be devoted to the service of the midway concessionaires' and exhibitors' lights.

The Pan-American Exposition is destined to be memorable for Mr. Luther Stieringer's charming water and light effects. For this reason the pumping plant of the fountains is closely connected in its usefulness with the electrical installation. The pumping plant will be located in the court of the Machinery and Transportation Building. It will consist of 12 pumps, made by the P. H. & F. M. Roots Company, of Connersville, Ind. These pumps will have a capacity of 35,000 gallons of water per minute, and will be run by exhibit engines of the following makes: American Engine Company, Bound Brook, N. J.; Murray Iron Works, Burlington, Iowa; Lane & Bodley, Cincinnati, Ohio; Ames Iron Works, Oswego, N. Y.; Harrisburg Engine Company, Harrisburg, Pa.; Fitchburg Steam Engine Company, Fitchburg, Mass.; Watertown Engine Company, Watertown, N. Y., and by gas engines of these makes: Struthers, Wells & Co., Warren, Pa.; National Meter Company, New York; Bessemer Gas Engine Company, Grove City, Pa.; Marinette Iron Works Manufacturing Company, Marinette, Wis.; J. L. Alberger & Son, Buffalo, N. Y.

These engines will be belted to their respective pump units, and will be required to be in service each day during the Exposition from 10 a. m. to 11.15 p. m. They will serve the fountain displays at the Electric Tower basin, and also in the Court of Fountains basin, including the Fountain of Abundance. Water is to be taken from an intake located at the north end of the Court of Fountains basin, through a 48-in. rivetted suction pipe, and delivered by pumps through 16-in. and 20-in. pipes at a pressure of 110 lbs. per square inch to the various fountain orifices.

In the court of the Machinery and Transportation Building there will also be located four engine-generator units. Two of these will be supplied by the D'Olier Engine Company, of Erie, Pa., and will be used for serving the projector display that lights up the spectacular fountain in the Electric Tower basin. Another of these units, furnished by the Erie Ball Engine Company, a direct-connected unit, will furnish 110-volt, d. c. service for arc lights in the plant itself, and also for decorative incandescent lighting around the arcade which surrounds the court of the Machinery and Transportation Building. The other unit will also be a direct connected one, and will be supplied by the American Engine Company, of Bound Brook, N. J. It will be used for furnishing arc light for the Horticulture group, as well as providing current for a storage battery station near the Streets of Venice concession, the boats on which will all be operated electrically. These launches will probably have motors of from five to seven horse-power capacity, and will be an attractive feature of the Exposition.

Dominion Cable Inquiry.

It is learned in Ottawa that the Imperial Government will appoint a committee to inquire into the question of cable communication. The investigation will be a very comprehensive one, and will not only deal with the present cable services in British territory. and the rates charged, but also will ascertain if it is possible to establish new lines with advantage. The inquiry will begin in February.

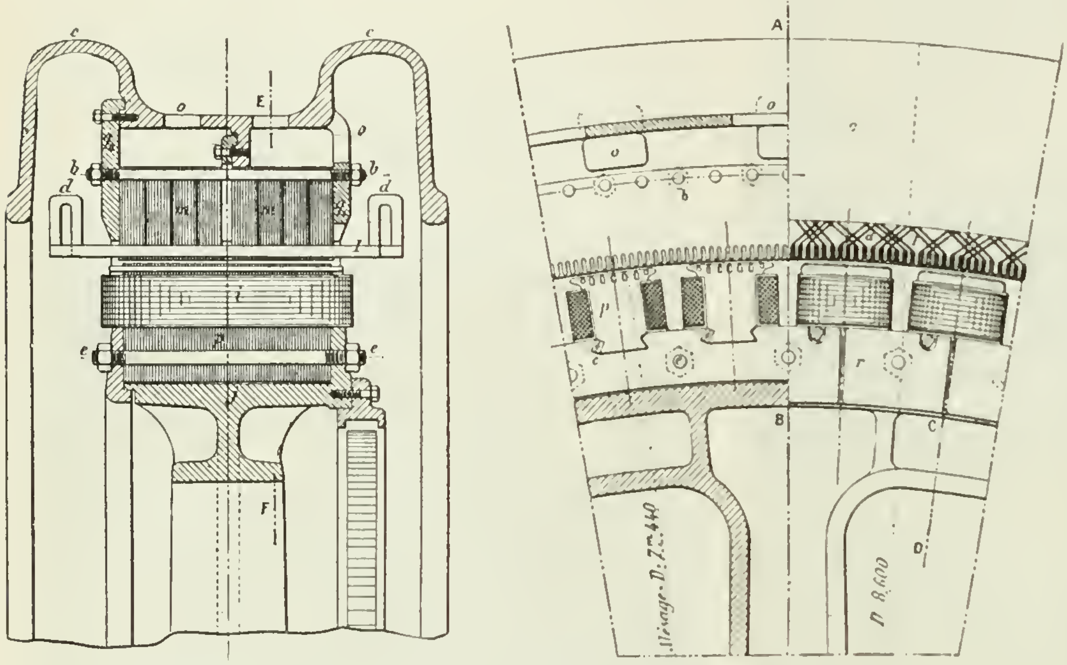
European Types of High-Tension Alternators—II.

By C. F. Guilbert.

In the descriptions which follow the order in which the various alternators are taken up will not be according to merit, but by countries, and in each country the machines will be classed by output, that of largest capacity coming first. The writer has not considered it advisable to follow order of merit, for his judgment has not in every case been in accord on this point with the report of the Exposition Jury, which, as may be easily understood, was not in every instance able to base judgment on technical considerataions solely.

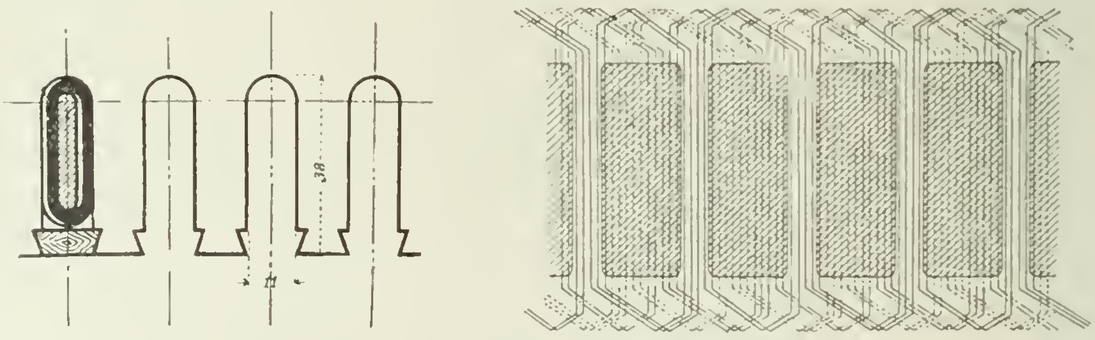
THREE-PHASE ALTERNATOR OF THE ALLGEMEINE ELEKTRICITATS GESELLSCHAFT.

The alternator exhibited in Paris by the Société Generale, of Berlin (Figs. 1 and 2), was the most powerful of the three-phase generators there shown. But one other machine was shown having the same rating, or 3000 kilovolt-amperes, that of the Helios Company. The latter machine, however, judging from the type of armature, appears to have been designed with a view to its eventual employment as a single-phase machine. It was built for one of the stations of the Berlin Electricity Works. The Oberspree and Moabit stations of this company will contain 22 machines of this type, of which 8 are now being installed, and 13 are under construction.



Figs. 1 and 2.—Allgemeine Elektricitats Gesellschaft Alternator.

From the electrical standpoint, the Allgemeine alternator presents two principal features. One is the employment of Hutin and Leblanc amortisseur circuits, the patent for Germany on that device as well as all other patents of the inventors mentioned, being owned by the company manufacturing the machines. These circuits are for each pole formed of five bars of rectangular section and two of circular section placed at the horns of the poles. The seven bars are riveted to two copper segments placed on each side of the pole. The object of the amortisseur circuits is in this case to facilitate operation in parallel, and also to suppress harmonics in the armature flux, which otherwise would give rise to a rotary field having a speed of rotation with respect to the poles which would be greater the higher the order of the harmonics.



Figs. 3 and 4.—Section of Armature and Scheme of Winding.

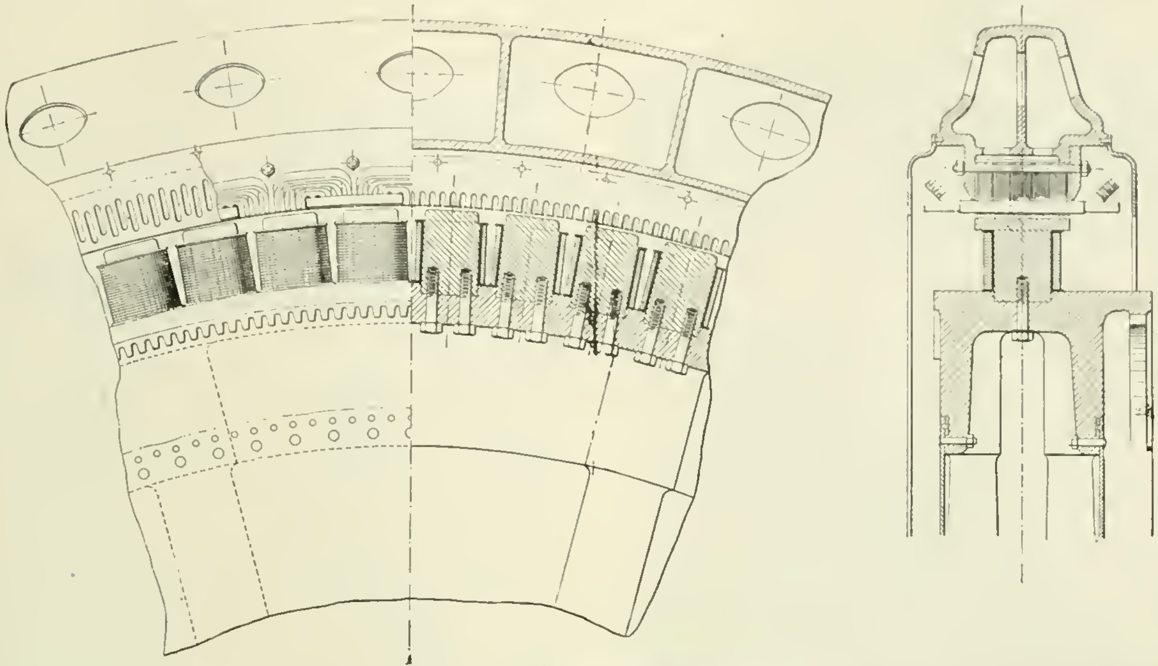
The second feature is the employment of bars with end connectors instead of coils, and with a number of slots per pole and per phase much greater than has been considered allowable in the case of alternators with fixed armatures. These bars (Fig. 3) are connected by means of end pieces having a V-section somewhat smaller than that of the bar, and placed in micanite tubes—the tubes being shown black in the engraving and the bars hatched—$\frac{1}{8}$-in. thickness. There are three different types of connectors with respect to length, as may be seen from the diagram of Fig. 4.

This diagram indicates that for each pair of poles, each of the phases of the armature winding includes a coil of three turns and one of two. The potential at the extremity of each conductor does not exceed nine to ten volts, and that between neighboring connectors never exceeds 20 volts, which explains why the latter are simply covered with a layer of insulating varnish, and why no attention has been given to insulating them with respect to the core. The generator terminals are mounted on porcelain insulators on the lower part of the dynamo frame.

HELIOS ALTERNATOR.

The alternator shown at Paris by the Société d'Electricite Helios (Figs. 5 and 6), had the highest normal output among the single and polyphase alternators in service at the Exposition, and it also had the largest diameter. The machine was operated by a direct connected horizontal triple-expansion engine. In point of fact, the machine was a single-phase alternator of 200 kilovolt-amperes, to which had been added, in order that it could furnish three-phase currents, an auxiliary winding mounted with respect to the main winding in a similar manner to the auxiliary winding of the Steinmetz monocyclic machine, but differing from the latter with respect to the ratio of the potentials of the auxiliary and principal windings. This ratio in the present case was that indicated by Scott—that is to say, $\sqrt{3}:2$ instead of $1:4$. The capacity of the auxiliary winding was 1500 kilovolt-amperes, or 1910 volts and 788 amperes. The capacity of the machine as a three-phase generator for the same density of current in the armature as that in the auxiliary winding, should correspond to the same output of 788 amperes per phase; the single-phase potential being then 1270 volts, the apparent output is $3 \times 1270 \times 788 = 3000$ kilovolt-amperes. On the other hand, retaining the normal density of current in the two windings it can very simply be shown that the alternator would furnish at the same time an apparent output of 1200 kilovolt-amperes of single-phase current and an apparent output of 1500 kilovolt-amperes of three-phase current, the power factor being the same in each case.

The winding is disposed in 672 slots, or eight per pole. Of these eight slots, six carry the principal winding divided in three sections. The auxiliary winding consists of but a single coil per pair of poles, each of which consists of two sections. The 42 coils of this circuit are also grouped in three sections mounted in parallel. On account of the smaller current density in the auxiliary circuit, and consequently of the smaller inductive drop in this circuit, the auxiliary winding consists of a cable having a section much smaller than that of the principal circuit. The difference of the inductive drop in the two circuits is due to the fact that in case of non-inductive loads, for example, equally distributed over the three legs of the line, the auxiliary circuit has a power factor of unity, while the two parts of the principal load have a power factor of .866 (cos. 30 degs.), as may be seen by laying down a voltage diagram.



Figs. 5 and 6.—Helios Alternator.

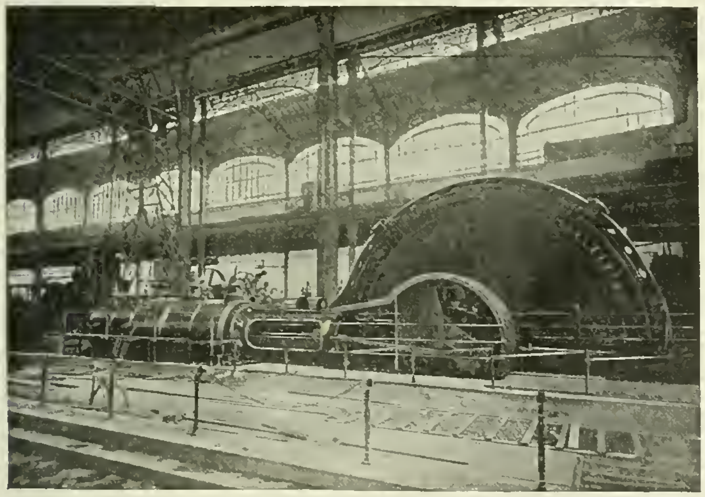


Fig. 6a.—Helios alternator.

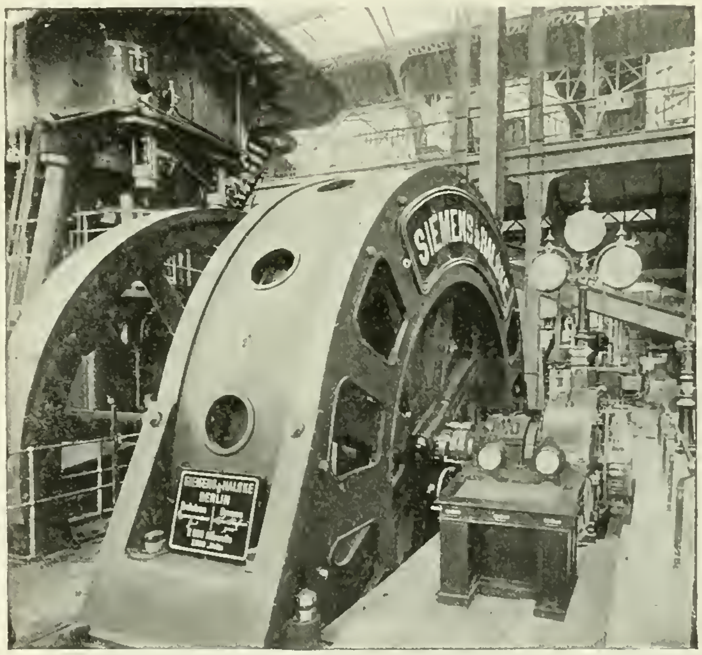
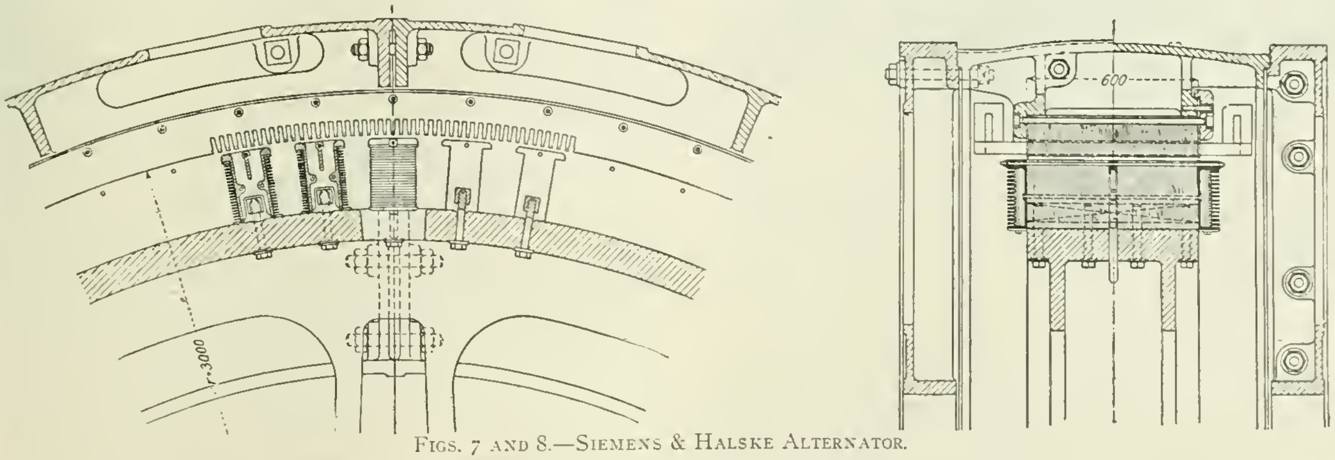


Fig. 8a.—Siemens & Halske alternator.

For inductive loads the case is similar. The largest ohmic drop permissible in the auxiliary winding permits of an equalization more or less exact of the drop in the two parts of the principal circuit. The dissymetry introduced by the simultaneous generation of simple and three-phase currents has for effect to replace the equilateral voltage triangle with an isosceles triangle, of which the base becomes smaller as the output of single-phase current becomes larger, the output of three-phase current remaining constant. It may be added that the dissymetry introduced by this system of winding is of the same order as that existing when three-phase alternators



Figs. 7 and 8.—Siemens & Halske Alternator.

operate on loads not equally distributed on the three phases of the line.

SIEMENS & HALSKE ALTERNATOR.

The alternator of this firm (Figs. 7, 8 and 9A), was operated at the Exposition by a Borsig four-cylinder triple-expansion engine, and provided with a flywheel. As in the case of the Allgemeine alternator, the armature winding consisted of bars united by connectors; the winding, however, was of the wave form, such as is employed with alternators of low tension. The measuring instruments—voltmeter, ammeter and wattmeter—were connected to small transformers; that for the voltmeter and for the fine wire coil of the alternator being on two legs of the circuit, and those for the ammeter and for the large wire coil of the wattmeter in series in one of the legs. Fig. 9 illustrates the arrangement.

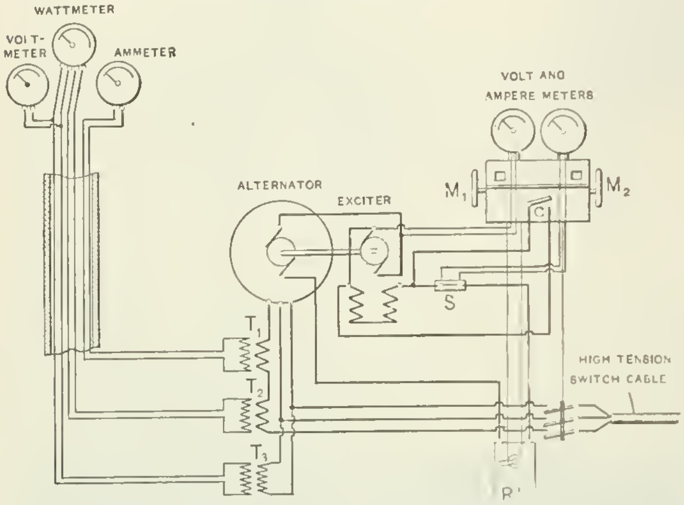
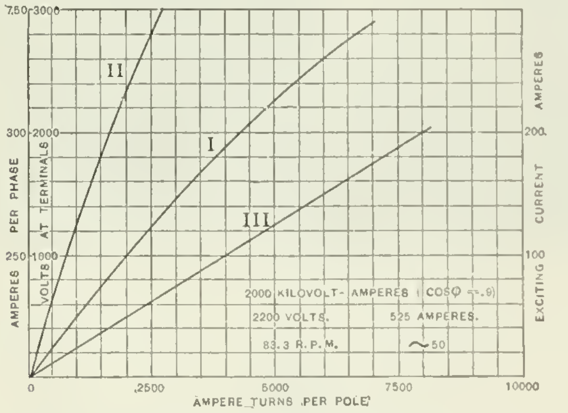


FIG. 9.—SIEMENS & HALSKE ARRANGEMENT OF INSTRUMENTS.

In order to adjust the air-gap in case of its change through wearing of the bearings or other cause, the armature or stator was made perfectly cylindrical in a lathe, and bore on two rollers placed symmetrically with respect to a vertical plane passing through the shaft of the dynamo. These rollers may be adjusted vertically by means of a screw turned by a lever. If the two rollers are raised simultaneously, the frame will be raised vertically; and by turning one screw in one sense and the other in the opposite sense, a horizontal adjustment may be obtained. In order to prevent any displacement on the rollers after adjustment, the frame is rigidly bolted after the air-gap has been regulated to castings on each side serving as the support for the frame.



I.—No-load Characteristic. II.—Short-circuit Characteristic. III.—Excitation line.

FIG. 9A.—CHARACTERISTICS OF SIEMENS & HALSKE ALTERNATOR.

Gong Crusade in Chicago.

A beginning has been made in Chicago to supplant the clanging gongs of public vehicles by more mellow chimes, a down-town firm which operates several automobiles being the first to make the change. The Municipal Art Association and the Anti-Noise League are interested in the matter, and it has been suggested that a crusade against gongs be inaugurated.

Elements of Illumination—XIX.

By Dr. Louis Bell.

The variation of resistance with temperature in such substances as the rare earths as used by Nernst is truly prodigious. They seem really to pass from insulators to conductors. Even glass, in fact, conducts fairly well at high temperatures, although in all such cases conduction is probably electrolytic in its character, a fact which is of considerable practical moment. As developed by Nernst his filaments when cold have several hundred times the resistance which they have when hot. Fig. 1 shows graphically from Nernst's tests the way in which the specific resistance falls off as the temperature rises. From the somewhat meagre data it is of necessity only approximate, but it gives a vivid idea of the extraordinary nature of the phenomenon. Of course, carbon shows a great decrease of resistance when hot, but it is a pretty good conductor when cold, while the Nernst filament is practically an insulator in that condition. But the oxides of the Nernst filament are enormously more refractory than carbon, and can not only be carried to far higher incandescence without breaking down, but probably have, at least in some of the combinations used a rather more efficient distribution of energy in the spectrum than is the case with carbon.

But being an insulator at ordinary temperatures some means has to be taken to get current through the filament. It has long been known in a general way that magnesia and similar materials conduct at a high temperature, and both Le Roux and Jablochkoff had dabbled with the idea years ago. But Nernst took up the matter anew and in earnest. The lamp which he has produced consists essentially of a thin pencil of mixed oxides, forming the incandescent body. This pencil is much thicker and shorter than a carbon filament as used in incandescent lamps, being, say, from 1-64 to 1-16 in. in diameter, and ¾ to 1½ in. long. If heated by a match or spirit lamp the filament becomes a conductor, and goes to vivid incandescence. Such artificial heating being somewhat of a nuisance, much of the work spent in developing the Nernst lamp has been in the direction of providing means for artificial lighting. As developed abroad the self-lighting Nernst lamp has taken the form shown in Fig. 2. Rising from the base of the lamp *G* are two stiff wires, *DD*, spaced near the ends by a porcelain disk *C*. Across the platinum tips of these rods is fastened the filament *A*, secured at its terminals by conducting cement similar to that used in fastening incandescent lamp filaments. Coiled in loose turns about the filament is a porcelain spiral *B*, into the surface of which has been baked a fine platinum wire closely coiled around it. The office of this resistance spiral is to bring the filament to a temperature at which it begins to conduct. At the start *A* and *B* are in shunt, but when current gets fairly started through the former it energizes a tiny electro-magnet, *F*, situated in the base of the lamp, its armature *L* is attracted and the circuit through *B* broken, turning the whole current through *A*.

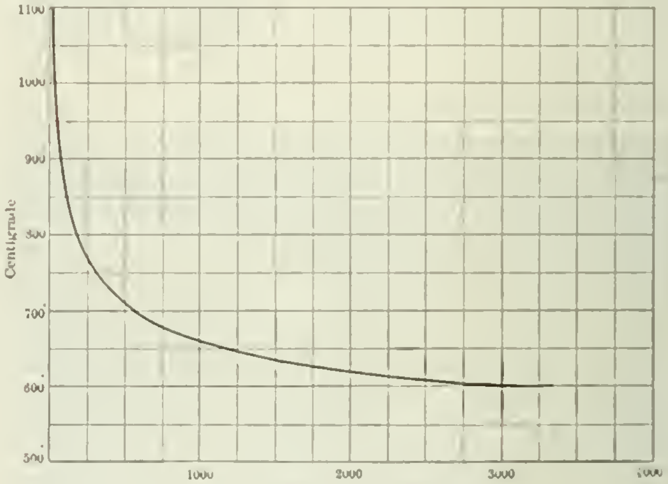
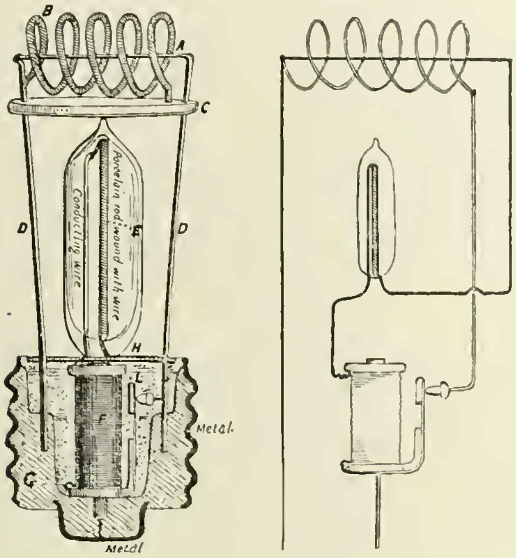


FIG. 1.—CURVE OF RESISTANCE VARIATION.

At *E* is a very interesting and important feature of the lamp. It is a resistance of fine iron wire wound upon a porcelain rod and sealed into a little bulb to prevent oxidation. It is connected in series with the filament. Now iron has a resistance that increases rapidly with the temperature, and this increase is particularly rapid at about 450 degs. to 500 degs. C. This resistance coil is designed so that with normal current in the lamp the temperature will rise to the point noted, and its office is to steady the lamp. Without it the Nernst lamp would be terribly sensitive to variations in voltage, but if the voltage rises with this resistance in circuit, its increasing resistance chokes the current. Even with this steadying element the Nernst lamp is still hyper-sensitive to changes of voltage. The filament does not function properly in an exhausted globe, and must be worked in the free air, although a glass shade is provided to protect it from draughts, dust, etc. In point of fact, protection from draughts is at present rather necessary, since the filament is so sensitive to changes in temperature that it can readily be blown out by the breath. Fig. 3 gives a clear idea of the connections of the lamp of Fig. 2, while Fig. 4 shows complete, on the left, one of the earlier Nernst lamps without the automatic lighting device.



FIGS. 2 AND 3.—CONNECTIONS OF NERNST LAMP.

The foreign manufacturers of these lamps are producing them of 25, 50 and 100 cp, for 110 and 220-volt circuits. It lends itself more readily to powerful high-voltage lamps than to small ones at low voltage, and is said to work better on alternating than on continuous-current circuits, apparently for reasons depending on the electrolytic nature of the conduction. Like other incandescent lamps, it works the more efficiently as the temperature rises, but owing to its refractory composition the Nernst filament can be pushed to very high efficiency. As the lamps are produced at the present time, their initial efficiency is about 1.50 to 1.75 watts per candle, including the energy lost in the steadying resistance (about 10 per cent), and the useful life is said to be about 300 hours. The filament at the end of this time rises in resistance and falls in efficiency, much like an ordinary incandescent filament.

The real life of a Nernst lamp, when defined as it should be in terms of, say a 20-per cent drop in candle power, is not at the present time known. It has only been put upon the market abroad within the present month, and the owners of the American rights have not yet put lamps on sale, so that really accurate data are entirely lacking as yet. It seems, however, certain that the Nernst lamp is an important addition to the art within at least a limited sphere. It gives a very powerful and steady white light at about double the efficiency of ordinary incandescents.

The present lighting arrangements seem altogether crude and imperfect, but it is probable that they will be displaced by something more simple and practical, as the art assumes definite shape. The filament can certainly be replaced at a trivial cost, far below the cost of replacement of an ordinary incandescent lamp, so that even with a rather short life of the filament, the lamp would still be economical in use. While less efficient than the best arc lamps it compares favorably with enclosed arcs of moderate amperage, and it is just now to be regarded rather as a competitor of the arc than of the glow lamp. However, it would take no great advance to change this condition, and the ease with which Nernst lamps may be made for high voltage is a rather important matter. If one institutes a comparison on the basis of 250-volt lamps the result is very greatly in favor of the Nernst filament at any reasonable estimate of its life. As in ordinary lamps so with Nernst lamps, filaments for small candle power involve unusual difficulties, but at present one may regard the 16-cp lamp as the normal glow lamp, while with the Nernst filament perhaps 50 cp may be regarded as the normal.

At present one must regard the Nernst lamp as in a tentative condition, and various problems regarding it must be threshed out—in particular there must be very radical improvement in the automatic lighting device or such evolution of a filament of some initial conductivity as will obviate further necessity for special lighting devices. But a higher efficient and very easily replaced incandescent body is in itself a material advantage over the delicate filament and exhausted globe of the ordinary incandescent lamp, and unless the former shall develop some unexpected limitation, it must be looked upon as a competitor that, although not now serious, may become so at any time, and to almost any extent.

Following up the question of higher luminous efficiency than that given by the incandescent lamp one naturally turns to the vacuum tube, in which the illuminant is not a heated solid, but an incandescent gas. It has long been well known that an electric discharge passed through a tube of very rarefied gas causes the tube to become the seat of very brilliant luminous phenomena. The light produced, however, does not form a continuous spectrum as does an incandescent solid, but gives a spectrum of bright bands or lines. This fact of itself gives some hope of efficiency, for it is the plentiful production of useless wave lengths that renders an ordinary incandescent body so inefficient a source of light. If a gas could be found giving a brilliant spectrum of bands, all of useful wave lengths, one might expect that a considerable proportion of the energy applied to the tube would turn up as illumination. Or if not a single gas, then a combination of gases might be found such as would answer the purpose. During the past ten years much work has been put in along this line by Mr. Tesla and others, but as yet without the production of a commercial lamp, although very magnificent effects have been produced experimentally.

The difficulties which have been met are first the need under ordinary conditions of rather high voltage in the discharge, the difficulty of obtaining a steady light of good color, and, most of all, the production of anything like a practicable intrinsic brilliancy. The brightness of an ordinary vacuum tube is apt to be greatly overrated, seen as it is with the room otherwise in darkness, and a tallow candle will make a pretty bright vacuum tube look like a wisp of fog.

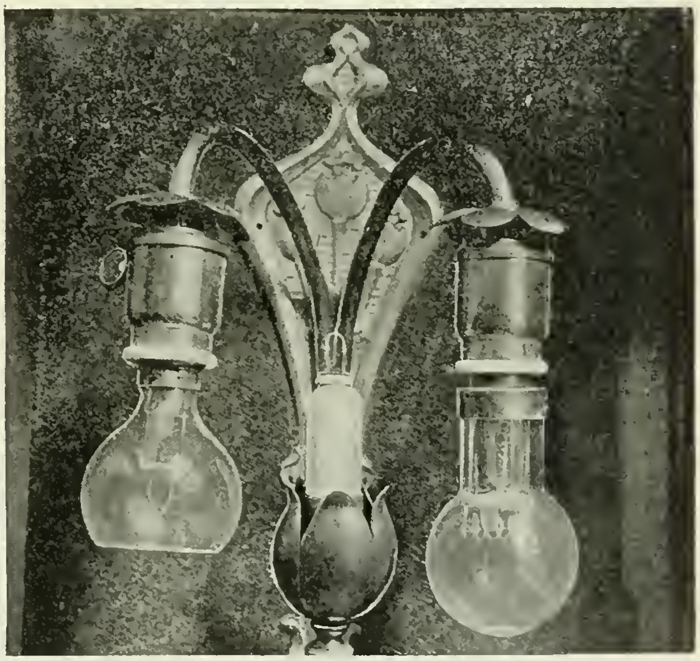


FIG. 4.—NERNST LAMPS.

Now, low intrinsic brilliancy is not in itself at all objectionable, but in the matter under discussion it connotes a radiant of large dimensions. This means that either there must be an enormous multiplicity of small tubes or else a few tubes so large as to involve pretty high electromotive force in driving the discharge through them. In either case, the condition is troublesome. In large tubes the light is generally very unsteady, and the best effects seem to be gotten from long-coiled tubes of small diameter, which are not easy to excite. As to color, there is a tendency toward a bluish hue, which will have to be removed before a practical lamp is produced. It is easy to find gaseous mixtures free from this objection, but perhaps at a considerable loss of efficiency.

The efficiency of the light produced by vacuum tubes has been several times measured, with fairly concordant results. It appears that the luminous efficiency, that is, the proportion of the whole radiant energy from the tube which is of luminous wave lengths, is something like 25 or 30 per cent, 5 or 6 times better than in case of the incandescent lamp.

If the tubes are forced to anything like the intrinsic brilliancy of even the dullest flames, secondary phenomena involving heating seem to arise, considerably decreasing the efficiency, so that it seems to be still a long step from our present vacuum tubes to "light without heat." This "light without heat" implies radiant energy that is nearly or quite all luminous. But this condition might be fulfilled and the light yet be most impractical, as, for example, in a sodium flame which gives an effect altogether ghastly. Any monochromatic light is utterly destructive of color, but it might be possible so to combine nearly monochromatic lights of the primary red, blue and green as to obviate this difficulty. Or, it may be eventually possible to excite luminous radiation in gases or even in solids so as to get results quite different from the ordinary spectra of the bodies. The vacuum tube lamp is certainly capable of development into a commercial method of illumination assuredly for some purposes, but in any form in which it has yet been suggested it must be regarded rather as a stepping stone on the way toward light without heat than as the thing itself. It is given this place in a discussion of practical illuminants not on account of its present position, but because the author is very strongly of the opinion that it may advance to some degree of importance at almost any moment, and gives promise of an efficiency considerably beyond anything which has hitherto been reached in artificial illuminants.

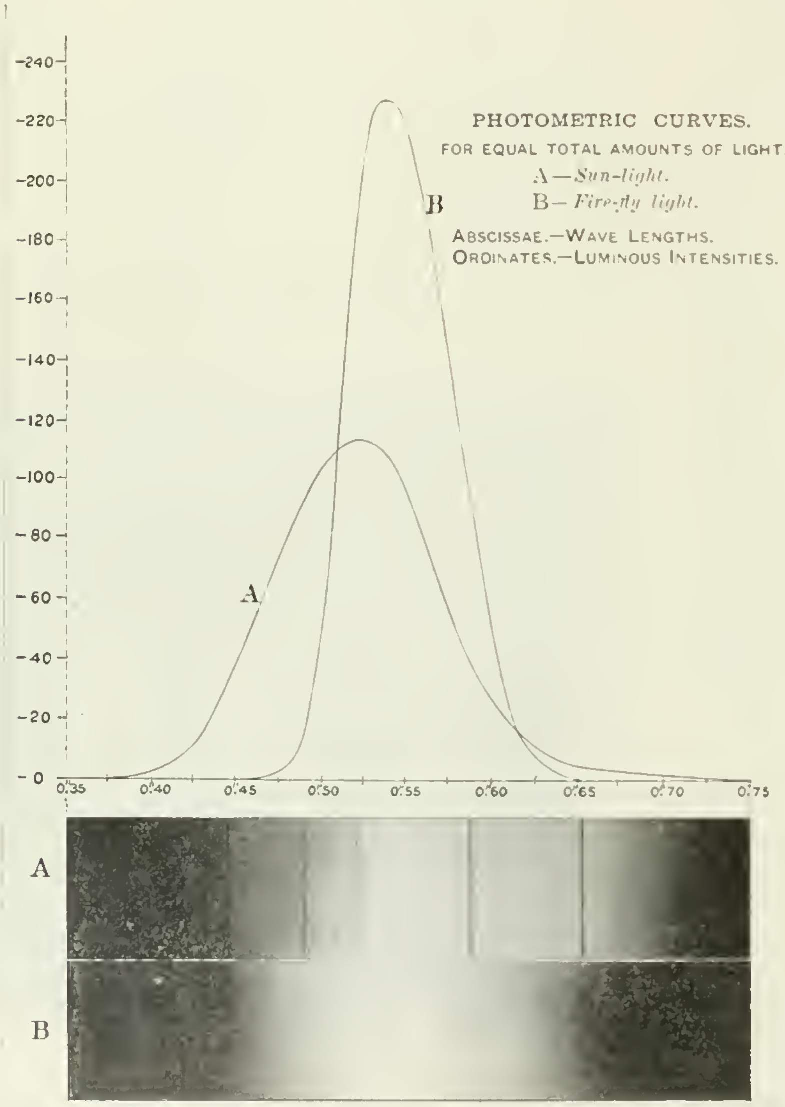


Fig. 5.—Curves of Firefly Light and Solar Light.

But it may be that we must look to the chemist rather than the electrician for the final word as to illumination. It is well within the bounds of possibility that some exaggerated phosphorescence may be found which will enable us to store solar energy directly for use at night. Or the firefly may give up his secret and teach us how to get light by chemical changes at low temperatures. And the firefly knows. The light emitted by such light-giving insects is unique and most extraordinary in its properties. For so far as can be ascertained the total radiant energy lies within the limits of the visible spectrum, and not only this but in the most brilliant part thereof. No similar distribution of radiant energy is elsewhere known. The ordinary firefly of this country is typical of the whole class, giving a greenish white light that when examined in the spectroscope shows a brilliant band extending over the yellow and green and fading rapidly as the red and blue are approached.

Prof. S. P. Langley has carefully investigated the radiation from *Pyrophorus noctilucus,* a West Indian species which attains a length of 1½ in., and of which a half dozen specimens in a bottle give light enough for reading. These insects gave spectra bright enough to permit careful investigation, and by comparison with solar light reduced to the same intensity, Langley found the curves shown in Fig. 5. Here *B* is the light radiated by the insect and *A* solar light. The curves show by the ordinates at each point the relative intensities of the various parts of the spectra. It at once appears that the light of *Pyrophorus* includes much the less range of color, and is much the richer in yellow and green. The maximum intensity is very near the beginning of the clear green (at about wave length 5500), and the light extends only a little way into the red and the blue. Fig. 5, which shows the apparent distribution of light indicated by the two curves exhibits the narrow limits of the radiation from *Pyrophorus* very clearly. The spectrum is practically limited by the solar lines *C* and *F*, and Langley's most careful experiments showed nothing perceptible outside of these limits, a most remarkable state of affairs, quite standing alone in our knowledge of radiation. For equal light Langley found that *Pyrophorus* expends only about 1-400 of the energy required by a candle or gas flame. This fact gives us a clue to the efficiency of *Pyrophorus* as a light producer. It appears to be about 0.20 watts per candle, perhaps even a little better—15 or 20 times the efficiency of an incandescent lamp, about five times the efficiency of an arc lamp at its very best. It is a startling lesson. The light-giving process of *Pyrophorus* is apparently the slow oxidation of some substance produced by it. Even if this substance could be reproduced in the laboratory the light would be too nearly monochromatic to be satisfactory as an illuminant, but it certainly is within the range of possibility to obtain a combination of phosphorescent substance that would give light of better color at very high efficiency. Certainly the problem is a most fascinating one, and whether the ultimate solution lies in vacuum-tube lighting or in some form of phosphorescence, one may say with an approach to certainty that all forms of incandescence of highly heated solids are too inefficient in giving light to approach the economy desirable in an artificial illuminant. Indeed, a solid substance of great light-giving efficiency when heated to incandescence would be somewhat of an anomaly, since it would have to possess an enormous specific heat at moderate temperatures. What is really needed is some method, chemical or electrical, passing by the slow vibrations that characterize radiant heat and stirring up directly vibrations of the frequency corresponding to light. The vacuum tube gives the nearest approach to a solution of this problem yet devised, but it still leaves much to be desired, and there is plenty of work for the investigator.

Convention of the Northwestern Electrical Association.

THE sixth annual convention of the Northwestern Electrical Association was held at Milwaukee, Wis., on Wednesday and Thursday, Jan. 16 and 17. Five papers were presented before the meeting, and while the discussions were not as complete as usual, this is partly to be ascribed to the large amount of time consumed in the consideration of legislation in Wisconsin affecting the electric lighting interests of that State, and in a lengthy discussion on competition from gasoline lighting, which latter is abstracted below.

After considerable discussion as to whether the summer meeting of the association should be held in Madison or Sheboygan, the latter place was named, the time of meeting to be the last week in June, unless changed by the committee having power in the matter.

The following officers were elected for the ensuing year:

E. L. Debell, president; S. B. Livermore, first vice-president; W. Worth Bean, second vice-president; Thomas R. Mercein, secretary and treasurer. Directors: L. E. Kerns, J. H. Harding and Charles Cuno.

The address of the president, Mr. Pliny Norcross, was devoted to municipal ownership, and formed an able presentation of the subject from the central station point of view. The address is reprinted in another column.

Mr. P. D. Wagoner read a paper entitled "The Series Incandescent Lighting System of the Future," a considerable portion of which was devoted to a consideration of the Welsbach light. The result of tests were given on 14 80-cp (rated) Welsbach street mantles, made with a view of determining their photometric value and life. The average life of the mantles was 388 hours, and the illuminating power for that time averaged from 66.3 to 54 cp; 1.85 chimneys were required per mantle, so that 18 mantles would be required per year of 4000 hours. While the average of the candle-power when the mantles broke was 54, the useful life on the basis of the time in which the light falls to 80 per cent of the rated candle-power, was only 72.1 hours. It should be added that the tests on these mantles were made under laboratory conditions and were, therefore, more favorable than if made under actual working conditions. Tests of the useful illuminating power were also made in comparison with 50-cp incandescent lamps. A given size of type could be read 150 ft. from the 50-cp incandescent lamp, and only 122 ft. from the 60-cp Welsbach lamp.

A list is given of companies, located chiefly in New England, which have replied to inquiries regarding series incandescent systems. The candle-power of lamps used averages about 25, and the price varies from $15 to $20 per lamp per year, with an average of $16 for lights burning on moonlight schedule until 1 o'clock, and between $20 and $30 per lamp per year, with an average of $24 for lamps burning all night every night. The stations in general reported good satisfaction obtained from this class of illumination and a reasonable amount of profit.

Several systems of series incandescent lighting were described, and preference given to that employing an automatic constant-current transformer similar to that used for series arc lighting. As an example of the efficiency of this device, it is stated that one giving 100 per cent regulation on a 3000-volt, 3.5-ampere, 60-cycle circuit, has only 131 watts copper loss and no core loss when the circuit is fully loaded. When all the lamps on the circuit are cut out the total loss is 133 watts copper and 130 watts core loss. The power factor at full load is 98.5 per cent. The apparatus weighs approximately 400 lbs., occupies a floor space of 20 × 44 ft., and is 46 ft. high. The coils can be wound for any current, and when purchasing, if allowance is made for increased capacity for the future, practically nothing is lost by so doing, the regulator taking care of the load as it increases. If at any time it is desirable to install a number of lamps greater than the number which the line voltage will accommodate, this can be done with the same regulator by putting in a compensator to boost the voltage. A list accompanying the paper shows that this system is now in use, or has been ordered, for 26 towns and cities. It is stated that a further development of this type of apparatus will soon be placed on the market, in which both the boosting and regulating will be accomplished in one piece of apparatus.

In the discussion of Mr. Wagoner's paper, Mr. C. F. Hewitt said that the plant of which he has charge operates about 50 60-cp series incandescent lamps on the system described by Mr. Wagoner, which enabled his company to enter into fierce competition with Welsbach, gasoline and acetylene lights, including a new form of naphtha lamp, all of which were beaten out; the income of the station was increased $9,000 or $10,000 a year, and a load placed on the plant during the whole night. In reply to a question, Mr. Wagoner said: "It is practicable to operate the series incandescent lamps on the same circuit with enclosed alternating current arc lamps, using a constant-current transformer, which is being done at Woburn, Mass., and more or less on a number of other plants." In reply to a question asking if it could not be arranged to have taps added to the regulator, thus keeping the power factor up, Mr. Wagoner said that if the disadvantage of the power factor is considered greater than the extra cost of purchasing a constant potential compensator with taps, the reactive coil should by all means be run in conjunction with the compensator.

In a paper entitled "Synchronous Converters," Prof. W. E. Goldsborough gave a description of the rotary converter in simple language, enabling those not having an extensive knowledge of alternating currents to easily understand. The explanation of the apparatus was largely made with reference to the dynamotor, or direct-current converter, having two independent armature windings, whereby one direct-current voltage may be converted into another. A table was given, showing the different comparative capacity ratios of different types of single-current converters, as follows:

	Direct. Current.	Single. Phase.	Three Phase.	Four (Two) Phase.
Volts between adjacent collector rings.	1	.707	.612	.5
Amperes per line	1	1.414	.944	.707
Ratio of copper loss in rotary converter to copper loss of same machine operated as a direct-current generator at same output	1	1.37	.555	.37
Relative capacity of rotary converter, and same machine operated as a direct-current generator at same temperature	1	.85	1.34	1.64

The above consonants were derived mathematically, and assume a harmonic variation of voltage and current, and including no allowance in the voltage ratio for the copper losses in the winding. In practice, a variation of as much as 15 per cent may be found in these values, owing to departures from the sine waves, though the difference is not often more than 5 per cent. Rotary converters constructed for low efficiencies differ in but slight details from lines followed in the construction of standard direct-current machinery. For successful working it is necessary that the synchronous converter be equipped with an armature having high inductance. This means that the coils are placed in deep slots and the teeth with projecting heads are not objectionable. Machines with small armature self-induction do not compound so readily, and are prone to "hunt." The starting current of a rotary converter often exceeds by 50 and even 100 per cent the full load running current of the machine, which is likely to produce serious voltage fluctuations in the distributing system. Auto-transformers are consequently often used in starting, reducing the line voltage and consequently the starting current, and can be cut out when the speed of the machine has risen an appreciable amount.

In the discussion of Prof. Goldsborough's paper, Mr. Gill said that he had found trouble in the cables of his rotary converter, which ran very hot with 800 amperes, and that he could not account for the trouble. Prof. Goldsborough said that he could only account for the heating in a measure. The alternating currents themselves developed a magnetic field around the current which tends to repel the current to the outside layers of the wire, which increases the density in the copper at that point, and, therefore, increases the heating of the cable. Again, if the wave form of the generator were different from the wave form of the converter there would be idle currents circulating between the two machines to fill in the gaps of the wave forms, and thus cause heating of the cables. Prof. Jackson called attention to the fact that the power factor of the rotary converter in practice can never reach unity.

A paper on "Practical Line Construction," by Mr. Loren W. Burch, gave specific instructions for constructing electric-light lines. Throughout the paper Mr. Burch insisted upon the importance of good line construction, and the greater expense in the end of cheap lines. He believes that instead of trimming trees and thus causing annoyance to both property owners and the station managers, it is preferable to use high poles and carry the line above the trees. He also considers that stringing wires on buildings is bad practice.

In the discussion of Mr. Burch's paper, Mr. George Cutter referred to a recommendation that all guy wires should be fitted with circuit breakers placed at a distance of 6 to 8 ft. from the pole end, and the grounding of all live guy wires. He said that two instances had come under his own observation where men had been killed by contact with guy wires, and he thought that every guy wire that is within the reach of the public should be perfectly grounded and insulated at the top.

Among the letters received was one from ex-President H. L. Doherty, who was unable to attend the convention. Mr. Doherty expressed the hope that the Association would give the question of Correspondence Instruction serious consideration, and stated the belief that the average central station could make enormous savings in boiler results alone by proper attempt to educate their station employees. He suggested that the Association can at the present time advantageously consider three-phase distribution for light and power, which is fast coming into public favor. Its use permits of many advantages which do not always appear on the surface, and this is especially so where there are immediate prospects of being forced underground, a fate which Mr. Doherty considers will have to be met by all sooner or later.

A letter of inquiry from an electrical company led to a lengthy discussion, which brought out the fact that in certain Western localities a gasoline street lighting system is being brought into competition with the electric light. One of the members described the system as consisting of a single Welsbach burner or a group of Welsbach burners fed from a gasoline holder, and others referred to a system in which the gasoline is conducted to the lamps in small tubes having the appearance of wires. The lamps are suspended much the same way as are arc lamps. A blow torch or alcohol lamp is needed to start up the lamps. One of the members stated that the burner referred to is known as the "Kern" burner, and that it is being pushed very hard.

Mr. Debell said that according to experiences had with the gasoline burner in Sheboygan, and judging from inquiries made in other places, it does not seem to promise to be much of a factor as a competitor with electric light. One of the strong objections to the light is the strong odor of gasoline which it gives forth, and unless some very radical improvement is made in this respect, the electric light need have little fear of the lamp for interior illumination. Mr. Livermore called attention to the fact that while the insurance laws require the merchant who deals in gasoline to keep his bulk gasoline outside of the building, the gasoline lamp is permitted to be used indoors, although in some of these lamps one-half gallon of gasoline is used, and the fluid is also distributed through thin tubing. Mr. Lord said that several years ago a gasoline-lighting plant was installed in his town, but on the third night after it had been running it exploded, and there had been no gasoline plant in Waupaca since. Mr. Kountz gave his experience with competition from the gasoline lamp, and said that as a result he is not afraid of any gasoline lamp that has been put on the market. Mr. Cutter said that in Chicago he found that gasoline lamps were being manufactured by the thousand, and he considers that they present a matter of danger for electric light people. Mr. Thayer said that gasoline made from Wyoming, California and Texas oils is not satisfactory, for the reason that in burning a black gum forms, which will, in the course of time, gum up the passage way. If the increase in the use of gasoline grows to any great extent, the price of gasoline will also increase. As Eastern oils contains but 10 per cent gasoline, it is thus practically a byproduct, and its supply thus is limited. Mr. Grover said that recently in his town three fires were caused by gasoline lamps. Mr. Strong stated that an ordinary 62-cp gasoline lamp will run 125 hours on a quart of oil. Mr. Kountz said that he had had experience in competition with both gasoline and acetylene gas, and expressed the opinion that an electric-light plant properly operated and giving reasonably good service that cannot run in opposition to acetylene or the gasoline lamp, ought to go out of business.

Prof. D. C. Jackson read a report of the committee of the association on "The Trade Education of Central Station Employees." The report gives results of an investigation of the committee into four of the leading correspondence schools of the United States, to each of which a series of questions was submitted and an examination made of the financial status and administration of the schools correspondence instruction as being an excellent one in its place. It believes that good is coming from the correspondence schools, and is satisfied that the administrative methods are reasonably well planned. It considers, however, that the courses in electric lighting and central station practice of the schools must be greatly altered before they will be of the greatest use to central station employees, and through them to their employers, and the committee outlined a course which it believes would meet the requirements of the average central employee, and which would result in great advantage to central stations if the employees followed it. The course suggested is to be submitted to the central correspondence schools with the request that they change their courses as far as possible in order to conform with that suggested.

After reading his paper, Prof. Jackson added that after fully investigating the several correspondence schools mentioned he finds that each is financially responsible. Mr. Livermore said that the general tendency of correspondence schools was to elevate the men. and that he knows of several cases where men have moved rapidly up from lower to higher positions by the aid of these schools. Mr. Ahlmert stated that he took the lesson leaves of the correspondence schools and gave them to his employees, and once a week all through the winter gave a little lecture and went over the leaves with the men. The result was that he got very much better work from his men, but he has only one of them left, and he has been advanced in his position. The others have all found better positions elsewhere. He stated, however, that the results he obtained while he had the men with him amply repaid him for the trouble he took, and that he will continue along the same lines. A motion was finally adopted that the four leading correspondence schools of the country be individually requested to reorganize their course for central station employees to conform as nearly as possible with the requirements set forth in the report of the Northwestern Electrical Association.

A paper by Past-President Henry L. Doherty was read on "A Method of Charging," in which he gave further information concerning a system which was the subject of a paper read by him before the last meeting of the National Electric Light Association. In the system described there is a fixed charge for each consumer regardless of his consumption or the size of his installation, to cover certain costs, such as bill making and meter reading, meter testing and maintenance, office rent, superintendence and inspection, complaints and gratuitous work. There is also a fixed charge for each lamp the consumer's connection will permit him to demand, without regard to the number of lamps installed or amount of current used; this covering costs which are fixed by the capacity demanded, such as interest on the investment, transformer losses, maintenance, depreciation, etc. There is also a fixed and uniform rate per kw-hour consumed which is fixed by the direct cost of the current generated, in which enter boiler fuel, lamp renewals, etc. The total charge thus consists of one for "Readiness to Serve" and a low kw-hour rate. It is not advised, however, to suddenly change the tate, but to proceed by a gradual process. It is suggested to adopt the system first as a substitute for all special rate consumers and also for new consumers. Instead of dividing expenses as they exist to-day, and proportioning them among their consumers on the basis above outlined, it is well at starting to make such changes as will benefit long-hour, and, therefore, profitable consumers to such an extent as can be readily compensated for by the additional business which can be secured by a low rate per kw-hour. Mr. Doherty advised that all contracts be made for a year or more, the capacity to be increased whenever the consumer desires, but not to be decreased except at the expiration of the period contracted for; the capacity to be limited by a suitable maximum demand cut-out to prevent the consumer from demanding more capacity than he contracts and pays for. One-twelfth of the fixed charge should be included in each monthly bill. In conclusion, Mr. Doherty said the system is already in use in one central station with which he is connected, and that he is about to put it in use in two others. The system has also been partially adopted by other central stations with which he has no connection.

Municipal Ownership.

Following is an abstract of the presidential address of Mr Pliny Norcross, delivered before the recent meeting of the Northwestern Electrical Association:

The fourteenth annual report of the Commissioners of Labor includes data from 952 plants in the United States, of which 320 are owned by municipalities, while 632 are operated under private or corporate ownership. Neither the names nor locations of these plants are given, but each plant is reported by a certain number. The report itself includes about 1000 pages of carefully prepared matter, and was suggested by a committee of the National Association of Officials of

Bureaus of Labor Statistics in the United States, consisting of Mr. Lee Merriweather, Commissioner of Labor of Missouri; Mr. Horace G. Wadlin Chief of the Bureau of Statistics of Labor of Massachusetts, and the president of the Convention—the United States Commissioner of Labor.

A study of this report develops many interesting facts. In one municipal plant, No. 151, there were 8 private arc lamps, 1200 cp, and 10 public street lamps. The users of the 8 private arc lamps were obliged to pay the city 12 cents a kilowatt hour, while the city paid nothing for its 10 street lamps. In other words, a few enterprising citizens paid for their own light 5 or 6 times as much as they would have paid to a private company, and they alone, thereby, carried the burden of lighting the streets, which should have been borne by all of the taxpayers.

In No. 152 the private user was compelled to pay 6 cents per kw-hour for 8 arc lamps, and $1 apiece for 2 other lamps, while the city reports that for its 26 arc lamps it pays but 2⅓ cents a kw-hour. In No. 156 it costs the city 5¾ cents a kw-hour for 42 street arc lamps. In this town or city there seems to be no private user willing to bear the burden of lighting the city.

In No. 160 it costs the city over 12½ cents a kw-hour to light 75 street lamps. In No. 161 a private company furnishes the city and private users light at the uniform and moderate price of 2½ cents a kw-hour. In No. 163, 15 private arc lamp users pay the city plant a little over 9 cents a kw-hour, and thus enjoy the honor of supplying the city with 14 street lamps free of cost to all other residents. In No. 165 there seems to be no public-spirited citizens who take arc lamps, and thus the cost to the city is over 3 cents a kw-hour. In No. 167 the city owns and operates the plant and furnishes arc lamps to 17 private users at 4½ cents, and admits a cost to itself for 50 arc lamps of over 11 6-10 cents per kw-hour. It is barely possible that the private users are public officers.

In No. 168 a private company gets between 8 cents and 12 cents from private users and receives from the city about 8½ cents. In No. 174 a municipal plant furnishes incandescent lamps for 8 cents a kw-hour, and thereby gets its own lamps for nothing. In No. 175 the same policy is pursued by a municipality, the private users alone paying for city lighting. In No. 179 the city furnishes 1050 incandescent lamps for 10 cents a kw-hour, and thereby gets its 24 arc lamps for a trifle less than 1 cent a kw-hour.

In Nos. 187 and 188 it costs the city $.0461 and $.0347, respectively. No private users. These samples are taken from one or two pages as they run.

The book, or report, is very interesting, and it establishes the fact that a city is not as well equipped to perform the intricate work of making and selling electric current as a private company which makes this class of work a close, careful study, for the sole purpose of furnishing to all customers reliable light, or power, or both, at a fair price, and at a very small profit to itself.

In cases of municipal ownership the city pays no direct tax on its plant, but indirectly it does pay a tax, because it does not receive the tax which a private company would pay into the treasury.

Ordinarily, a municipal plant makes no allowance for depreciation or for the exchange of improved appliances for the old system.

A city cannot buy material any cheaper than a private company, and usually not so cheaply; generally it pays more wages for inferior service. It is handicapped in the matter of adopting improvements.

In the matter of personal damage suits, a city occupies an unfortunate position. A city is not so well situated for speedy recovery from damage by freshets, cyclones or fire, as a private company.

Not long ago a Texas city gave bonds for over $1,500,000 for the construction of an immense dam and power plant, in the belief and hope that it could not only light its streets and public buildings for nothing by selling current to private consumers, but could secure a large profit thereby. It is a matter of record that the dam when built would not hold water, and utterly failed to furnish power for the use of the city alone. The enormous burden thus placed upon the city has reduced the price of real estate and discouraged investment.

Numerous instances can be readily cited to sustain the proposition that although the theory of municipal ownership is very bright and full of promise, yet the actual practice as shown by the majority of cases is not encouraging. Aside from figures and details, there is, to my mind, one insurmountable obstacle to city ownership and continued successful operation of electric plants:

All city officers must be elected by the people at large; as a rule, they never have been, and probably never will be elected for their fitness to discharge the various duties which they so willingly assume.

I readily concede that in many instances they are intelligent, honest, public-spirited men, and if they could remain in office long enough, and could afford to give up their own business and would devote their energy and time to the city business, they would soon become competent to perform the duties incident to their positions.

The whole matter of streets, sidewalks, gutters, sewers, parks, bridges, pavements, schools, courts, police, sanitary regulations, water and light supply, etc., is in most instances entirely new to them.

They are nominated and elected by their friends, and when elected they must take care of their friends, and that fact alone prevents such a discharge of their duties as they themselves would desire; but outside of those who are honest and intelligent, a great many are nominated for the sole reason that they can be elected when nominated. The same clique or "pull" which nominated them, also elects them. There is no pretense that they are capable, and there is no thought or care as to their honesty. If their record is a little shaky on that score, all the better for the purpose of those who secured their election.

When elected they must help their friends; but whether honest or dishonest, capable or incapable, most of them have had no experience in the work which comes to them when once in office. Their terms of office are short and uncertain; they generally receive no pay for their work; they are blamed and abused by the press or a part of it, and by a good part of those who elected them, and by all who opposed them. No sensible business man would for one week trust his business to such control or management.

The "fad" of municipal ownership of electric plants may sweep over the country as other socialistic, communistic, impracticable schemes have done, but it will in the end be a ruinous experience, and I firmly believe that there is not now so strong a sentiment in its favor as there was a year ago.

As the matter of municipal ownership is more fully understood the desire for it will diminish. One reason for its adoption by many towns is the fact that unpleasant relations have grown up between the local plant and the munipicality. The citizens are possessed with the idea that the local company is making too much money out of the business, while the company is confronted with the fact that the original outlay was not always a judicious one, and in all cases was very expensive.

I well remember the time when carbons, dynamos, lamps, etc., cost three times as much as they do now. In every case the original plant was too small, and people who first invested were glad enough to get out of it at any sacrifice. Most of the plants in operation to-day stand upon the ruins of one or two earlier plants.

The competing gas companies at first were somewhat disturbed by the new illuminant, and cut prices in order to hold their plants in operation. New electrical inventions then, as well as now, have compelled the abandonment of the earlier equipment.

Cities are besieged with applications, for apparently better contracts, and too often forced the old companies which had struggled bravely to hold up against the rising tide, into bankruptcy. The city often gave franchises to new companies, or still worse, practically confiscated the existing plant by putting in one of its own. In this way many of the pioneer plants proved to be unfortunate investments. Most of these unfortunate facts could have been prevented by a little mutual concession.

We are now called up in the matter of taxation. Many persons believe that none of the existing corporations are paying their proper proportion of the public expense. We cannot speak for others, but we believe that electric corporations are paying more than their share. The city insists upon getting the very lowest figure for its own service, in streets and public buildings, under the threat of municipal ownership, or, of permitting outside competitors to sweep away the local investment—then after getting the very lowest figure, proceeds deliberately to give the local electric company another twist, by raising the taxes from 50 to 100 per cent.

I sincerely believe that all of this unpleasant condition could be very much improved, if the State and municipality would adopt a new method of procedure. Instead of treating us as enemies to the public welfare, we should be treated as men who are engaged in the laudable effort of endeavoring to promote and enlarge one of the most useful industries known in the history of civilization. Treat us fairly, remember that the road which we have traveled for the last 15 years is literally strewn with the wrecks of hundreds of failures.

Almost all other corporations, such as railroads, telegraphs, telephone companies, water companies, gas companies, have passed through the trying years of experiment and disaster, and are now standing on firm financial grounds. Their bonds are listed in all the market quotations of the world, and their stocks have a definite value; while our stocks and bonds are, in the main, unquoted and unsalable.

I would suggest as one way of reaching a better and fairer understanding between the local companies and the municipalities and States, that we promptly and honestly open our books to the inspection of the new Board of Taxation in this State, or to an inspector of that board, if such an officer should be appointed in that board, as recommended by our present Governor, in his recent address to our Legislature. Such action on our part would certainly give us the right to ask that our taxes should bear a proper relation to the salable value of our plants, and to our net earnings, and would in a large degree settle the question of whether or not the price of our product was reasonable, and would have a tendency to satisfy our own customers, including the cities where we individually operate, that we were treating them fairly. It would further give us the right to insist that the present Board of Tax Commissioners should not name a percentage or license fee at any arbitrary figure, until the Commission has fully examined the facts in each case.

Fifteen years ago an electric plant was considered an experimental, dangerous luxury. To-day it is an established fact that such a plant is one of the most necessary, useful and practical equipments of any city, town or village. It furnishes not only a cheap, safe and healthful light, which, of itself, is a most valuable assistant in preventing crime and securing good order, but it furnishes power at a low price for the local grain elevator, or grist mill, creamery, factory, woodyard or water tank, as well as for the dentist, blacksmith or sewing girl. It will cool the dwelling, office or hotel in summer time, and when connected with the hot water or steam system, it will heat the same in winter.

It puts the town or village in close companionship with the adjacent city by means of the suburban road. It is utilizing every water power on the face of the globe, thereby adding millions of horsepower, which since the creation has remained dormant. Instead of being opposed in its onward march and made the victim of unreasonable competition and of constantly increased taxation, it should be encouraged and sustained.

The practice of confiscating such a plant, or compelling it to produce current at less than cost, and continually and persistently raising its tax, makes it a precarious business and prevents improvement.

The matter of depreciation (which with us is a very serious one), the price of fuel and the freight thereon, vary almost 100 per cent in different parts of the Northwestern States; the price charged for our products, the wages paid, etc., tend to make the gross earnings of an electric plant an unjust standard of assessment. Yet, it may be the only method to adopt.

I would suggest further that the Board of Tax Commissioners recommend a sample of uniform books for our business. Then, after we have fairly done our part, in the matter of furnishing to all our patrons good light and reliable power, we want the State as well as the municipality, to stand by us and not confiscate our property or ruin us by unjust competition. Competition cannot reduce cost; it takes from the poor and weak, and gives to the rich and strong. No city or State should use it as a club to ruin its own citizens or taxpayers.

We must eventually pay our bonds, and our stock ought to be worth par. We must pay interest on our bonds, and we should be able to pay fair dividends on our stock. We must allow more for depreciation than any other of the public industries, and we should be allowed to put aside a reasonable surplus for disaster and for the replacement of present equipment for improved equipment.

If the State and municipality would be fair toward us, we should in a short time possess electric industries which would combine the superior attention, care, economy and experience of the private company, with public inspection and oversight, which, in my judgment, would be an almost perfect system. It would secure fair prices, good products, and would be a bulwark against failure or bankruptcy.

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New Chinese Cable.

The Commercial Cable Company announces that in concert with the Great Northern Telegraph Company, and the Eastern Extension Australasia & China Telegraph Company a cable has been laid for the German Government between Tsingtan and Shanghai. The opening for international service took place on the 1st of January.

A Canadian Rival of Tesla and Marconi.

Prof. E. S. Wiggins, of Ottawa, Canada, has just published a disquisition upon the subject of Tesla's experiments to establish telephonic communication with the planet Mars, in which the former makes a startling assertion in regard to Marconi's discovery, and expresses strong disbelief concerning Tesla's claim of having mechanical and electrical devices by which electrical energy can be forced through space. Prof. Wiggins, however, considered it quite possible for the earth to have electrical communication with Mars, but deprecates the idea of forcing a current of electricity from the earth to Mars. Electricity, he claims, exists only on the surface of bodies. The surface of our own planet's atmosphere is covered by a lake of electrical energy, and no little current, such as Tesla describes, could pass through it without being absorbed.

"Communication with Mars can be established," Prof. Wiggins proceeds, "by Marconi's method, which I discovered and published in 1893, two years before Marconi began his experiments. That is, by elevated points on the same body or planet or different planets. Remove all our mountains but the highest peak. Upon this place an electrical instrument and it will affect a similar one on Mars, especially if the sun, earth and Mars are in conjunction. I am almost certain that, with a proper instrument on the summit of Mount St. Elias we could even now telegraph to the planet Mars. The nick in the edge of that planet, seen by Lowell and Javelle, July 19, 1894, was no doubt an enormous pinnacle, erected to communicate with the planets Jupiter and Saturn."

Speaking upon the question of his claim that Marconi founded his system on the published theory of Prof. Wiggins, and the latter's purpose to demand his right in the honor and emoluments accruing from the new discovery, the professor says: "Surely the philosopher, who by years of study evolves a theory, should be equally rewarded with the man who puts it to the practical test, by having a legal right in all patents. If Marconi does not give me a share of the proceeds from his French patents, I will appeal to Her Majesty, through Sir Wilfrid Laurier and His Excellency, the Governor-General of Canada, as a British subject, and ask for equal right in his patents for the British dominions. I will make the same representations to the President of the United States. My appeal to the latter will be based on the fact that my essay for the Hodgkin's prize of $10,000 was submitted by the Smithsonian Institute at Washington to the French scientists for examination in 1894, and it was from this essay Marconi first learned that the earth's electric energy collects in hills, mountains—in fact, all elevations on her surface. Marconi immediately began to erect towers, and, placing instruments upon their summits, they answered each other.

"But I am now even with him, for I have discovered that the telephone acts on the same wireless principle, and I will ask patents from Canada, Britain and even from France, and my telephone will thus supplant his telegraphy. Then, railway companies will take down their wires, for conversation can be conducted between stations, and even running trains; generals can talk with each other while the battle is raging by merely sticking their swords into the ground; ships will also speak with each other miles away, while we can converse, stretching our limbs upon the grassy lawn here, with the weary traveler trudging his icy way to the northern pole."

Prof. Wiggins further states that volcanoes, like Vesuvius and Ætna, owe their heat entirely to the electric energy that they collect from the adjacent seas, mountains and country. He predicts that before the close of the twentieth century, towers of great height will be built all over the continents and on the sea; and these, burning by the earth's electric energy, will give eternal light to the surface of our planet. With small towers with wire coils, the summits of the Rockies could now, at little expense, become a row of glowing torches from Cape Horn to the Arctic Circle.

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Endurance Tests for Automobiles.

Arrangements for the endurance test to be given by the Automobile Club of America have been planned by the technical and contests committee. It was decided that the test would be of utility only, speed being relegated to the background. Awards will be made on the following grounds:

First—Vehicles making fewest stops en route.

Second—Vehicles carrying greatest weight in passengers in proportion to their own weight.

Third—Vehicles requiring least repairs (if any) and maintaining an average speed of from 12 to 15 miles an hour.

Stops will be made en route for sleep and meals, but no special fuel stations will be provided, competitors relying upon the towns en route for all supplies. An average of 100 miles or more a day is counted on.

The route will be through Tarrytown, Peekskill, Poughkeepsie, Albany, Utica, Syracuse and Rochester to Buffalo and return. Checkers and other officials will be stationed at villages en route at an average distance of about 25 miles. The competition will be open to all motor vehicles carrying two persons side by side on one seat, motor bicycles, motor tricycles and motor quadricycles being barred.

There will be two classes, one for manufacturers and the other for private owners. The entry fee for the former will probably be $100. A prize fund of $2,500 has been established, and awards may be made both in specie and plate, though this has not been definitely decided upon. The date, also, is yet open, though it is thought conditions will be more favorable in the early autumn than at any other time.

In addition to being an endurance test, the run is expected to be made a traveling exhibition, as was the case in England. Efforts will be made to secure a very large entry list, so that the local showings en route may be as effective as possible.

Street Railways in New York State.

The New York State Board of Railroad Commissioners has issued its annual report. The percentage of dividends to capital stock of street surface railroad companies for the year ending June 30, 1900, was 3.77; in 1899 it was 4.67. The number of passengers carried on all the street surface railroads of the State, including the few remaining horse railroads and the elevated roads in Brooklyn, was 1,801,974,097, an increase over 1899 of 122,684,693. The number carried in the boroughs of the Bronx and Manhattan, including transfers, was 567,144,099, an increase over 1899 of 57,829,283. The number carried in the Borough of Brooklyn, including transfers, and including those carried by the elevated railroads in Brooklyn, was 323,229,639, an increase over 1899 of 45,584,744.

The total number of passengers carried by the Manhattan Railway was 184,164,110, an increase of 9,839,535, as compared with 1899. The earnings and operating statistics of the Brooklyn elevated railroads are included in the report to this board made by the Brooklyn Heights Railroad Company.

Fifteen passengers were injured and four employees killed on the Manhattan Elevated Road, while 148 people were killed and 650 injured on the street surface roads.

The average number of persons employed on all of the street surface railroads of the State, including the elevated railroads in Brooklyn, was 28,075, and the aggregate amount of salaries and wages paid them was $16,968,907.05. The companies owned or operated 5,098 electric and cable box cars, 3,666 electric and cable open cars, 23 air motor box cars, 22 electric mail cars, 626 electric and cable freight, express and service cars. There were 2,437 other cars in operation.

Annual Meeting of Contractors.

The annual meeting of the United Electrical Contractors of the State of New York was held in Utica on Jan. 15, the session being held in Arcanum Temple. There were present representatives from all the members of the association, including delegations from New York, Albany, Rochester, Syracuse, Buffalo and Utica. The delegates passed on many matters of importance to the trade. The election of officers resulted as follows: President, Rudolph Schmidt, Rochester; vice-president, Mr. Davis, New York; treasurer, J. C. Stearns, Buffalo; secretary, W. H. Morton, Utica. Directors: Charles Eidlitz, New York; F. L. Frost, Albany; W. H. Morton, Utica; James Hilton, Syracuse; Mr. Olmstead, Rochester, and J. C. Stearns, Buffalo. In addition to the regular business with respect to the trade, E. A. Fitzgerald, inspector of the New York State Board of Underwriters, appeared before the association in regard to insurance inspection. Lunch was served the delegates and visitors in the rooms of the Arcanum Club. In the evening a banquet was served in Watson Hall in the Huron block. About 40 sat down and the occasion was one full of interest and good fellowship. There were several visitors representing different firms of electrical supply dealers.

Electrical Development in England.

According to the statistics of Mr. Emile Garcke, the capital involved in electrical undertakings in the United Kingdom has increased in one year from just under £106,000,000 to £123,636,602, exclusive of the Government telegraphs and telephones, the greatest increases having been in connection with supply, traction and manufacturing works. In five years the total capital has been doubled, while the money involved in electrical manufacturing concerns has increased from £6,500,000 to £21,708,180, and of this increase £5,000,000 is credited to 1900, chiefly light, power and trolleys. Five years ago, less than 14,000,000 sterling were thus involved; now the total is 55,000,000, and schemes projected will swell this total enormously in the next few years. Thus, in Parliament last year 98 provisional orders were granted for the construction of supply works, bringing the total orders still in force to 527; while many also of the 89 stations authorized in 1899 are not included in the capital sum named above. In operation, or under construction, there are 169 municipal and 108 company-owned stations, the sum involved in the former being £13,776,372, and in the latter £12,434,827. Under the former head there has been a very much greater advance than in the case of companies. Thus, five years ago, the capital of company supply stations was three times that of municipal loans; now the latter excels. In other words, the company capital has only doubled in five years, the municipal loans have increased sevenfold. In traction schemes there has been an increase in the five years from 6 to 28.89 millions sterling; but here private enterprise still holds the field, for of the total only £2,748,873 is held by 18 municipalities, while over £26,000,000 has been found by 75 companies. It would be easy to prove, also, that there has been great progress towards the reduction of costs of production. The average cost of generation has been decreased in five years from 2.45d. to 1.79d., with the corresponding reduction in other items, and the total cost is now 2.67d. against 4.07d. per Board of Trade unit. In five years the number of 8-cp lamps connected has increased from 2 to 7.66 millions, and the units sold in even greater proportion from 30,000,000 to over 125,000,000. The price obtained for current has, in the case of companies, decreased from 6.08d. to 5.26d., and in municipal undertakings 5.32d. to 4.06d. per unit. The percentage of profit on capital expenditure has not increased—being, for municipalities, 4.90, and for companies, 5.45 per cent.

Test of Gasoline Automobiles.

The officials of the Electric Vehicle Company at Hartford, Conn., completed a severe test of the gasoline automobiles on Saturday night, Jan. 19. It was under the direction of H. Percy Maxim, chief engineer of the company. Ten trips to Springfield and back were made without stopping the engines once. There was about 3 in. of snow on the ground, and the temperature varied from 12 degs. above to 2 degs. below zero. The start was made at 6.30 o'clock in the morning, and the finish was at 11 o'clock at night. The fastest time was made by Mr. Maxim on his second trip, when he covered the distance from the company's place to the South End Bridge, in Springfield, in 1 hour and 10 minutes, a distance of 21.37 miles. The average for the entire run, counting the slow rate made by the vehicle when the men were forced to walk by reason of the cold, during the time the tank was being filled, and all other causes taken into consideration, was 13.1 miles per hour. The last three trips, a total of 162 miles, were made at the rate of 20.1 miles an hour. The only serious accident was the cutting of a tire by the sharp ice, and this tire had to be replaced on the vehicle reaching this city. The engine did not stop running while the tire was being replaced.

Missouri River Telephone Association.

The Missouri River Telephone Association was organized at St. Joseph, Jan. 10. About 20 exchanges and toll lines in Northwest Missouri, Southern Iowa and Eastern Kansas are members. The officers are H. E. Ralston, Maryville, Mo., president; G. A. Haynie, Savannah, Mo., vice-president; L. N. Fry, Granite City, Mo., secretary and treasurer. These, with F. S. Travis, of Tarkio, and J. T. Norman, of Stanbarry, constitute the Executive Committee. The object of the association is to establish uniform rules governing exchanges and for mutual protection. The members of the Executive Committee were elected delegates to the Interstate Telephone Association, which met in Kansas City, Jan. 15.

CURRENT NEWS AND NOTES.

EXPOSITION HONORS.—The list of decorations bestowed on Americans by the French Government, in connection with the Paris Exposition, has just been published. J. P. Morgan and F. J. V. Skiff are made officers of the Legion of Honor. Among the chevaliers of the Legion are F. E. Drake, C. A. Moore, C. A. Griscom, C. A. Coolidge, Carl Hering, F. C. Pratt, E. W. Rice, Jr., Ambrose Swasey and George Westinghouse.

COMPOSITION FOR CLEANING METALS.—A patent granted Jan. 15 to J. L. Bach, gives the following formula for a metal-cleaning composition: Pure water, 1 gallon; potassium carbonate, 1 ounce; potassium cyanide, ½ ounce; sodium carbonate, ½ ounce; chloride of sodium, 1-10 ounce. The solution is used at the boiling point, and a strong electric current employed. A formation of gas takes place, which immediately separates all grease or other impurities from the object exposed and renders it chemically clean.

APPARATUS FOR MELTING IRIDIUM.—A patent issued Jan. 8 to G. Armeny and W. C. Marion describes an apparatus for melting iridium in small quantities with or without a small percentage of another metal for attachment to the nibs of gold pens. A carbon plate is provided with a plurality of depressions for receiving iridium in small quantities, and forms one electrode of an electric circuit. The second electrode is a carbon rod secured to a handle, and is placed successively over the iridium in the depressions.

HIGH-TENSION CUT-OUT.—A cut-out for high-potential circuits is the subject of a patent granted Jan. 15 to W. L. R. Emmet. A chamber is formed between two insulating and fireproof bodies, in which a fusible cut-out is inserted, the fuse being held under tension. On one side of the chamber is a contracted opening to the atmosphere, through which the gases formed on rupture of the circuit pass and act expulsively to extinguish the arc. To protect the walls of the chamber it is lined with a removable capsule of paper saturated with a hydro-carbon or other gas-producing material.

PURE HELIUM.—Prof. Dewar, in a lecture last week before the Royal Institution on the advance in the knowledge of gases during the nineteenth century, expressed disappointment that the experiments in the institution's laboratory had failed to produce pure helium. He said he longed to find a rich man generous enough to supply funds for the experiments necessary for the discovery of pure helium, but he was aghast at the possible expenditure. Its discovery would enable the realization of Lord Kelvin's idea that a temperature within 5 degs. of absolute zero can be reached. Prof. Dewar added that he did not know why the reaching of absolute zero should be regarded as hypothetical.

NEW YORK ELECTRICAL SOCIETY.—The 211th meeting of the society, through the courtesy of the New York Gas & Electric Light, Heat & Power Company, will be held at the Edison station, corner of Elm and Duane Streets, on Wednesday, Jan. 30, at 8 p. m. Dr. Louis Bell will deliver a lecture on "Electric Illumination at the Beginning of the Twentieth Century." Unusual preparations have been made for this lecture. Ladies will be welcome, and a collation will be provided with the aid of the company's electric kitchen. It will be remembered that this lecture was postponed on account of Dr. Bell's attack of grip, a circumstance which has happily been availed of, however, to make the proposed experimental demonstrations more complete and interesting.

MOTOR CONTROL.—Two patents were granted to M. Waddell on Jan. 15, on motor control by means of a secondary motor in series, which sets up a counter e. m. f. The application for one patent was filed March 23, 1887, and for the second or method patent, Jan. 13, 1897. Both patents are assigned to the General Electric Company. The method has for its object to dispense with the usual motor-starting resistances, for which is substituted a second motor of smaller size, which having a comparatively inappreciable load to carry will at once attain its full speed and full potential. The speed of the small motor is then diminished by mechanical means or otherwise, thereby lowering its counter e. m. f. and permitting a current to flow through the large motor, the latter beginning to operate when this current reaches a certain point. The speed of the small motor being still further decreased, the potential of the large one will increase until, when the small motor is stopped, the large one is running on full potential, at which time the small motor may be cut out of circuit.

"BUSY."—In speaking to a *Mail and Express* reporter, Mr Herbert Laws Webb, of the New York Telephone Company, gives some interesting data as to the daily work in this city. The line of the load curve described by Mr. Webb rose to two peaks, one showing the business at 10 o'clock, the other about 1 o'clock in the afternoon. Between these is a considerable depression on both sides, steep and low declines. During the day in all the 13 central stations there are 400,000 cells, of which about 325,000 make connections. Fully 90 per cent of all the calls are made between the hours of 9 a. m. and 5 p. m. Only 10 per cent are made between the hours of 5 in the afternoon and 9 in the morning. This, said Mr. Webb, is one of the difficulties of the telephone business. There are two or three rush hours, when the business done is tremendous in comparison. But a force must be employed and a plant used to meet the greatest demands, while at other hours a far smaller force and a much smaller equipment would do. At the Cortlandt central station, the largest in the city, there are 75,000 calls daily, but less than 1,500 of these come between 6 in the evening and 8 in the morning. All the other stations maintain nearly the same proportion.

NEW ELECTROLYTIC PROCESSES.—Among the patents of Jan. 15 are two on new electrolytic processes, the subjects being the electrolytic production of nickel and allied metals, and the electrolyzation of soluable salts. The latter—granted to A. J. O. Chalandre and L. J. B. Colas, of Paris, France—applies to salts, the electrolyzation of which causes detrimental secondary reactions in the electrolyte. The process consists in combining outside the apparatus part of the gases from the anode and cathode compartments to form an acid, then introducing this acid in the anode compartment, where it annuls detrimental secondary reactions. The specifications describe the application of the process to the electrolyzation of sodium chloride to procure sodium hydro-oxide on the one hand, and pure chlorine on the other, in the proportions they are combined in salt. The other patent was granted to Moritz Kugel, of Berlin, Germany, and relates to the production of electrolytic nickel and allied metals in layers of desired thickness in such manner that the product is equal to rolled nickel as regards its mechanical properties. The process consists in keeping the electrolyte at a temperature over 30 degs. C., maintaining the electrolyte acid by the addition of a strong mineral acid not changeable by the current, and adding a highly-concentrated solution of a light metal salt, also not changeable by the current. Nickel sulphate and magnesium sulphate are named as the two constituents of the electrolyte.

ELECTRIC WELDING.—Three patents were issued Jan. 15 on electric welding apparatus, two being granted to Elihu Thomson and the third to A. F. Rietzel. Both of the former relate to means for operating electric welding apparatus from a direct-current supply by the use of the Wehnelt interrupter. In one case the transformer has a straight magnetic core, around which is a primary coil in close inductive relation to the welding secondary, to which clamps for holding the work are attached. In the primary is an interrupter of the Wehnelt type. The second patent describes a transformer with a closed magnetic circuit, which contains a third or auxiliary coil termed a "depolarizing coil." The object of the third coil is to maintain a continuous magnetic polarization of one sign or direction. A closed iron core tends to maintain its magnetism even if the magnetizing current is broken or cut off. The polarizing coil is wound in opposition to the primary, having in its circuit a Wehnelt interrupter, which latter produces a rapidly interrupted direct current of a power sufficient to overcome the effects of the depolarizing coil and reverse the magnetism of the transformer. The Rietzel patent relates to details of electric welding apparatus, which fit it more particularly for use in electric welding of tubes, cylinders and other forms of work which are made from sheet metal pressed or formed into their respective shapes, and welded along the seams. The apparatus is so constructed that the work to be welded is practicably out of the field or magnetic circuit of the conductors, this not being true of similar apparatus heretofore constructed. The welding current passes from one terminal of the secondary to a disk or roller bearing on the welding edge of the tube, thence across the seam and through the adjacent welding edge of the tube into the other secondary terminal.

THE NEW YORK ZOOLOGICAL SOCIETY, in reporting a very successful year, states that it is building a motor road in Bronx Park and that the society will operate on it automobiles of its own for the convenience of the public.

WIRELESS TELEGRAPHY IN THE FRENCH NAVY.—A dispatch from Toulon states that the recent experiments with wireless telegraphy in connection with the French fleet have been so satisfactory that it has been decided to provide the Mediterranean squadron with wireless apparatus, which will be subjected to decisive tests. The recent experiments showed that dispatches can be exchanged reliably at distances of from 18 to 20 miles by the new system.

LONDON UNDERGROUND.—A cable dispatch from London, of Jan. 16, says: "It is understood here that Tom L. Johnson, the American street railroad capitalist, has bought the Baker Street & Waterloo Underground Railroad from the London & Globe Finance Corporation, Limited. The officials of the company, however, decline to give the name of the purchaser. It is understood that the price, £500,000, carries a concession to extend the surface lines to Brighton, which Mr. Johnson tried to secure a year ago." This purchase is denied by the Johnsons.

THE NERNST LAMP.—At a recent meeting of the Frankfort-on-the-Main Association of Electrical Engineers, Herr Wolff, manager of the local branch of the Allgemeine Elektricitäts-Gesellschaft, showed a new form of Nernst lamp. The necessary initial heating of this lamp is effected by a spiral of platinum embedded in fireproof composition. By means of a switch neatly concealed within the base of the lamp, this spiral is automatically cut out of circuit after the lamp has been rendered sufficiently conductive by the imparted heat. The lamp exhibited was of 25 cp.

VISITING ENGINEERS.—The American Society of Civil Engineers held its annual meeting in this city last week. On Thursday, by invitation of Thomas E. Murray, general manager of the New York Gas & Electric Light, Heat & Power Company, J. W. Leib, Jr., general manager of the Edison Electric Illuminating Company, and John Van Vleck, constructing engineer of both companies, the party inspected the new waterside power station, in course of construction, at Thirty-eighth Street, East River. A stop was also made at the new power station of the Manhattan Railway Company at Seventy-fourth Street, East River, recently illustrated and described in these pages.

LONG ISLAND AUTOMOBILISTS.—Theodore Roosevelt, Vice-President-elect of the United States; Lieut.-Gov. Timothy L. Woodruff and Richard Dudgeon, of Locust Valley, have been elected as the first honorary members of the Automobile Club of Long Island. The honor was conferred upon Mr. Dudgeon in view of the fact that he is acknowledged to be the first automobilist on Long Island, some fifty years ago. The club took up the subject of placing sign posts on highways, and will at once begin the erection of forty iron sign posts at prominent points on Long Island roads. This is one of the steps toward carrying out a general placing of such road marks throughout the country, as determined upon by the Automobile Club of America.

A JERSEY MUNICIPAL GAS PLANT.—The new Hudson County Board of Freeholders has made a contract with the Hudson County Gas Company to supply gas to the county institutions for less than half of what it has cost the county for many years to run its own gas plant for this purpose. In seeking for plans to enforce economies, in accordance with the mandate of over-burdened taxpayers, the new Freeholders saw in the gas extravagance a shining mark. The county has had to pay about $2.50 per 1000 ft. for gas to suppy the county institutions, and at the same time the local gas company offered a better gas at less than half the rate, the contract agreement being at slightly lower figures than the $1.10 rate now charged to private consumers. "That will be about the last of the municipal gas-plant idea in Hudson County," said a taxpayer there. "Those fellows pretended to run it in the interest of taxpayers, but I guess about all they did was to make a political machine out of it and gather in money."

MORE SUBMARINE CABLES.—A cable dispatch from Berlin of Jan. 19 says that the project of a net of cables to cover the world is being diligently pursued by Germany, and is most actively furthered by the Emperor, who made some significant utterances on the subject to Privy Postal Councillor Strecker recently. The latest shape of the project, so far as the Far East is concerned, is as follows: Germany and the Netherlands to jointly lay a cable, which will go through the Dutch Indies, touching at the Natuna Islands, Billiton, Palembang, Batavia, Macassar, Amboina, German New Guinea and the Carolines, with a central point at Shanghai, thence branching from Kiao-Chou easterly to Japan and America. The Dutch Government will lay the cable through its own colonies, and Germany will do the rest. The financing of this project is about concluded in principle. The plan of General von Podbielski, the Imperial Postmaster-General, for gradually raising the annual appropriations to a maximum of 6,000,000 marks in 1920 has been approved by Emperor William. But if private companies, with a State subvention, will undertake the work, General von Podbielski will not object.

CATHEDRAL CHIME RINGING.—The bells and chimes of St. Patrick's Cathedral, New York City, are now rung by compressed air and electricity. The big bell weighs 6000 lbs. The 19 chime bells weigh from 270 lbs. upward. The installation was made by H. C. Champ, of Brooklyn. William F. Wynn, consulting engineer to the trustees, in describing the plant, says: "It is an adaptation of the compressed air cylinder adopted by the Union Switch & Signal Company. Mr. Champ, in following their idea, constructed 19 bell engines, corresponding to the number of bells. These bell engines are bolted to wooden seats, which in turn are bolted on a system of steel beams inserted in the walls of the north tower. These engines consist in their working parts of a fine grade of bronze composition metal, so as not to rust or corrode. The engines practically consist of three main parts, two cylinders and a piston, which is fitted to a clip hung on the clapper of the bell above it. On the engine there is an adjustable clevis, so that the stroke can be arranged to a nicety, and, once so adjusted, it cannot change its position. The engines are operated from the sacristy by means of a keyboard. A key being depressed, a current of electricity is sent along its wire to the belfry, where, by means of an air valve operated through an electromagnet, the compressed air is admitted to the bell engine, and the air pressure delivers the blow, which acts upon the clapper, and rings the bell."

LETTER TO THE EDITORS.

Wireless Telegraphy Over Frozen Ground.

To the Editors of Electrical World and Engineer:

Sirs:—I should like to make a correction in your columns of a statement made by me in the discussion on Wireless Telegraphy at the Am. I. E. E. meeting of last year. I there stated that according to my experiments frozen ground made little difference in the transmission of signals, the waves apparently going down to the moisture under the frozen surface.

Whilst this statement was correct for the case tested, it does not hold always. The experiments on which I based this conclusion were made on a gravelly soil, with cinders overlying a clay bottom. Consequently, the frozen moisture was probably highly charged with salts, and was a fair conductor.

I have, within the past few months, had an opportunity of testing the effect over a stretch of land of a different nature. Two stations between which I have been working—one at Cob Point, Md., the other at Arlington, Va.—are 47 miles apart, the line between them passing entirely over open land, with the exception of half a mile of water, and through the City of Alexandria, a few miles from Arlington. The land is practically all well wooded, and the trees of considerable height.

Several sets of measurements were made in fine weather, and fairly accurate results obtained. A severe frost then set in, and the ground was frozen to a depth of several inches. It was found that under these conditions the signals received had only one-seventh the power of those received in warm weather; that is, for equally good transmission, we had to use seven times the power that we used in warm weather. It is evident therefore that in some places, possibly in most places, frost will form a very serious obstacle. I may say that the ratio will not always be one-seventh, but will be still larger for longer distances.

In this connection I would point out that the usual formulæ for the capacity of a vertical wire or cylinder are not correct, being from 500 to 1000 per cent out. After considerable labor, I have succeeded in getting approximately correct formulæ, which I will give later. The usually given formula for the self-inductance is also incorrect, but the correction has been given by Heaviside. As an example of the approximate accuracy of the new formulæ, the calculated wave length was 254 ft. and the actual length as measured was 250 ft.

The design of stations for wireless telegraphy is now on exactly the same footing as the design of telegraph lines, and the laws are now fully understood. It is perhaps unnecessary to add that the various wild hypotheses of equipotential surfaces in the air or in the ground, of "wobbling" earth charges, etc., have been definitely disproven, the matter being a plain, simple case of ordinary electrodynamics.

With regard to the so-called Martian signals, these external disturbances have long been known, and only the crassest ignorance could attribute any such origin. They formed at one time a serious obstacle to multiplex systems, but are now eliminated. The different kinds are easily distinguishable, i. e., those due to lightning flashes anywhere within 100 miles or more, those due to street cars, etc., and those due to the gradual electrification of the vertical conductor by the air currents. This last gives, unless eliminated, signals at regular intervals, and by those ignorant of the subject, might be mistaken for intelligent signals.

Some work was done with the coherer, for the purpose of making comparative tests. Lodge's theory was confirmed. After long use the particles are found strung together in groups by thin ligaments of metal. Decohering can be obtained with all metals yet tried. The action observed is as follows: With small discharges the microscopic points of contact are fused off and the circuit opened. This gives decoherence. With greater discharges, the points are fused, but the fusion extends over a greater extent, and the electrostatic attraction draws out a thin tongue of melted metal till the gap is bridged. This gives coherence. Arsenic and other metals which do not fuse (except under great pressure) do not cohere, except when oxidized slightly on the surface. Then a discharge sufficient to reduce the oxide causes coherence, but a larger current burns away the contact points and causes decoherence; and as the metal does not fuse, larger currents do not cause coherence. The action of such materials as silver bromide is due to the fact that, after reduction and coherence, the now active bromide combines again with the silver. I gave a description of a coherer worked on this principle about a year and a half ago, in a review I wrote on Lodge's book, for this journal. All of Bose's experiments are therefore quite in accordance with Lodge's theory.

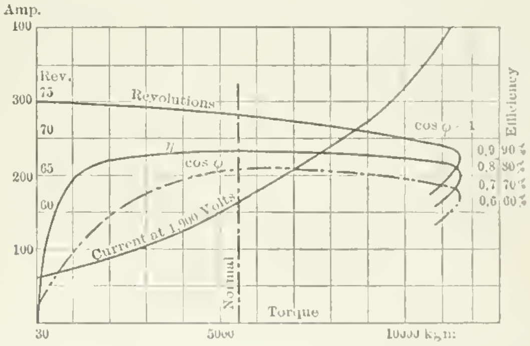
The amount of senseless and sensational stuff which has been written about wireless telegraphy suggests that the little knowledge, which the poet assures us is a dangerous thing, may have a certain function. That is, a very small amount of knowledge gone bad, of no particular use even to the owner, may yet, when spread in a thin film over the columns of the newspaper, give rise, by its very superficialty and tenuity, to a pleasing and striking iridescence. But, after all, it is only scum, and an evidence of the drink underneath. The fount of truth has another appearance.

Washington, D. C. R. A. Fessenden.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Induction Motor.—An illustrated description of a 600-hp three-phase induction motor, running at 75 r. p. m., made by the Oerlikon Company for pumping water in a mine in Germany. A special condition was that the motor had to be transported through a shaft of 2 x 2 meter cross-section, and that the maximum weight that could be hauled was 1000 kg. The main difficulty for the designer was to prevent excessive magnetic leakage. A three-phase generator of 840 hp was also to be furnished, direct connected to a steam engine running at 90 r. p. m. A frequency of 22.5 was chosen; the generator has 30 poles, the motor 36 poles; the voltage at the terminals is 1900. The diameter of the rotor is slightly less than 3 meters; the air gap between rotor and stator is 2 mm. The three ends of the windings of the rotor are connected with three short-circuit contacts and also with three slip rings, upon which three brushes are sliding, which make connection with a large starting rheostat. The external diameter of the case is 4 meters, the breadth 0.9 meter, the total weight 28,000 kg., the weight of the rotor 11,000 kg. The results of tests are as follows: Resistance of the winding of a phase of the stator, 0.4 ohm, the stator being delta or ring connected; resistance of a phase of the rotor, 0.016 ohm; for the motor running with no load at 75 revolutions, 1900 volts, 62 amperes, 22.5 periods, 16 kw; for the motor at rest, with short circuited rotor circuits, 390 volts, 110 amperes, 22.5 periods, or 600 volts, 200 amperes, 22.5 periods. The leakage co-efficient for a load of 190 amperes is 0.1. The losses for friction and ventilation are 3.5 kw. The heating of the iron, when the motor runs with no load, is 18 deg. above the surrounding temperature. In the adjoining diagram the current, the number of revolutions, the power factor, and the efficiency, are given for varying torque under the assumption of a decreasing leakage co-efficient. The maximum torque is 11,500 kg. m., equal to double the normal.—*Elek. Zeit.*, Dec. 27.



INDUCTION MOTOR CURVES.

Lights and Lighting.

Train Lighting.—An article on the Vicarino system of train lighting. He "uses an axle-driven dynamo fitted with in ingenious arrangement of brush holder, whereby the direction of motion of the carriage is rendered immaterial. This dynamo supplies light to the carriage lamps in connection with a small battery of accumulators. An auxiliary apparatus cuts the accumulator in and out at the proper moment, and is also arranged to equalize the voltage, so that the pressure at the lamps does not vary very much. The dynamo is compound wound, the series winding being arranged to oppose the effect produced by the shunt winding. The general principle upon which the whole arrangement is based, is that at the normal speed of the train the dynamo is driving the lamps direct; at lower speeds the accumulators supply the lamps, and at higher speeds the surplus current generted by the dynamo over and above that necessary for the lamps, goes to charge the battery. The system is in use in Nancy. The first cost of installation per car for different systems is given as follows: Oil $40, gas $160, a storage battery of 120 ampere hours for eight 10-cp lamps $190, the Vicarino system for eight 10-cp lamps with a battery of 40 ampere-hours' capacity $250. The cost per year, assuming the car to be lighted on the average 4 hours per day, is given as follows: Oil, four 5-cp lamps, $53; gas, four 10-cp lamps, $41; accumulators, eight 10-cp lamps, $58; Vicarino system, eight 10-cp lamps, $14.—Lond. *Elec. Rev.*, Jan. 4.

The Trouble with High-Voltage Arc Lamps.—Griffin.—An illustrated article on the troubles experienced in Burnley and other British towns with the new high-voltage arc lamps, after the supply voltage at the consumers' terminals had been raised from 105 to 220. "The principal faults of the 220-volt arcs, in comparison with the low-voltage lamps were as follows: The carbons lasted less than half the time, far more heat was given off, the light was not nearly as steady, and lastly, but chiefly, the arc gave scarcely one-fifth of the light, and that fifth of such a quality that it was utterly impossible for any shopkeeper to distinguish the different shades of his colored materials. Various other makes of lamps were tried without success, and it was finally decided to return to the old 105-volt lamps and to supply them from a 5-wire system, as follows: The main generator gives 440 volts, this voltage is divided into 2 x 220 volts for the 3-wire system by means of a balancer, consisting of two machines. Two small balancers have now been connected across both sides of the 3-wire system, and from the middle wires of these small balancers cables are run through the afflicted arc lamp district. He says that the customers are now again satisfied and recommends this system wherever the arcs are not distributed over a wide area.—Lond. *Elec. Rev.*, Jan. 4.

Power.

Electric Distribution of Power in Workshops.—An interesting discussion at the Franklin Institute, which was opened by Crocker, who discussed the subject under the following headings: Saving in Power; Cost of Buildings; Cost of Equipment; Arrangement of Machinery; Clear Head-Room; Cleanliness; Health of Employees; Convenience for Detached Buildings; Freedom for Growth; Shut-Downs Less Frequent and Less Serious; Speed Control; Increase of Output. Vauclain made some very interesting remarks on the highly successful adaptation of independent electric motors to machine tools in the Baldwin Locomotive Works: "If we should abandon electric driving our manufactured product would now cost us from 20 to 25 per cent more for labor"; "were it not for electric driving, the Baldwin Locomotive Works would have to cover 40 per cent more floor space than they now do, to maintain their present output." Dunn discussed the methods of obtaining adjustability and controllability of speeds, which he considered to be one of the greatest advantages accompanying electric power, either control by armature resistance, or by field resistance, or by variation of voltage of the circuit. Tapley gave an account of the results obtained in the Government Printing Office. The cost of the whole electric plant was $150,000. The benefits derived during the five years they have used electric power, have equaled the cost of and maintained the entire electric equipment, and the saving in coal and gas has been paying 10 per cent on the investment after making an allowance of 6.6 per cent for insurance, taxes and interest. Elgin spoke about the installation of motors, and expressed the wish that all the auxiliaries necessary for the operation of the motor should be arranged in a compact form and enclosed firmly in an iron box, the operations of starting and stopping being controlled by a single lever which should be provided with stops, so that the motor could not be accidentally started or stopped. Dougherty spoke in favor of a certain flexible conduit for portable connections, and wished that the tool maker and the motor maker should consult each other in regard to just what they want. Kennelly said that in order to develop the best capabilities of modern machinery, makers of machinery are gradually leaning to the constructions which involve individual direct connection with electric motors. Hering said that the induction motor appears to be an important step toward the ideal motor for use in workshops, as it has no commutator, is extremely simple in construction, and requires no attention, except oiling. It runs at nearly constant speed. He referred to the great progress that has been made in Germany and Switzerland in the introduction of induction motors. Dunn criticized the induction motor unfavorably, and said that for factory distribution the direct-current motor possesses many advantages over the alternating, especially on account of the adjustability of speed and because the starting torques of induction motors are much less than those of direct-current machines. He acknowledged that in Europe induction motors are more widely used, because the direct-current motor was not so well developed there as in this country. Here commutators are made now that run with but 1-64 of an inch wear per year, served by carbon brushes that operate with a wear of from 1-32 to ⅜ of an inch per year. Hering replied to the adverse criticisms of Dunn, and defended the induction motor. He admitted that their constancy of speed is sometimes a drawback, but that such cases are the exception. It is one of the reasons why it is not so well suited for traction in cities.—*Jour. Frank. Inst.*, Jan.

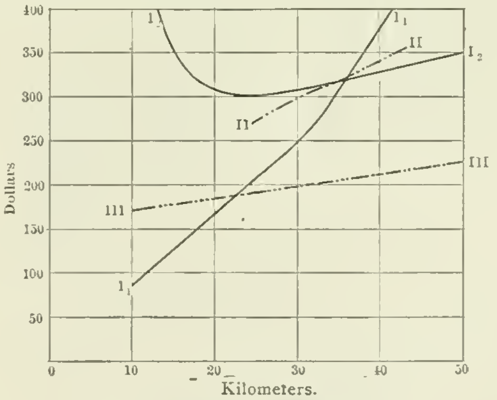
Electricity in Coal Mining.—Jackson.—A Franklin Institute paper on electric apparatus in coal mining. He starts with general remarks about mines, the effect of number of openings and rapidity of working upon the efficiency, the location of the station and character of power, and the systems for the application of power. The most suitable insulation of wires is a triple braiding of cotton or linen thoroughly impregnated with an insulating waterproof pitchy compound. After the wires are put up, it is also desirable to paint them with two or three coats of this compound. Voltage of not over 250 should be used wherever the mines are not of so great extent as to make the cost of copper excessive, and that where the extent of mines requires 500 volts, special precaution should be taken to protect the workmen. Wiring should be done very carefully. The return circuit should be made just as substantially, by means of a proper bonding of the track, as would be done in a well-equipped passenger railway system. Where pipes run near the tracks they should be carefully connected at short intervals to this return circuit by means of substantial copper wire taps; failure to do this has caused the destruction of much piping, due to electrolytic action. He then describes forms of electric locomotives, cutters, longwall machines, shearing machine, electric drills, pumps, hoisters and fans.—*Jour. Frank Inst.*, Jan.

REFERENCE.

Handling Coal in Power Stations.—The first of a series of illustrated articles on "Coal and ash handling, and storage plants for electric light and power stations." In this installment a plant is described which is working at the electric tramway power station in Leeds, for unloading barges, each containing about 80 tons of small boiler coal.—Lond. *Elec. Rev.*, Jan. 4.

Traction.

Current Supply to Long Railway Lines.—Rasch.—A long paper, illustrated by diagrams and giving a comparison of the following three systems, which may be used when, on account of the extension of the road, the amount of copper would be too great with a direct-current supply at about 600 volts from a single station. First, direct-current supply from several independent stations. Second, direct-current supply from one generating station and one or more sub-stations, the transmission to the sub-stations being by high-tension alternating currents. Third, three-phase traction, with one generating station and step-down transformers along the road. In the comparison of these systems the following suppositions are made: A straight road is assumed, the transmission line following along the road. A uniform load is assumed, i. e., *a* kw are consumed per kilometer, where *a* is a constant along the road; in practice *a* is between 5 and 15, in the diagram below it is assumed as 10. It is also assumed that for the choice of the site of the station, only the most favorable distribution of current is to be considered. For the comparison of the three systems he calculates the cost per kilometer and year for transmission and distribution of current, and also for the generation, so far as this cost is greater in one system than in the others. The result is given in the adjoining diagram in which the abscissas represent the length of the road and the ordinates the comparative cost of each system. From the diagram it can therefore be seen which system is the cheapest for a given length of road. The curve I_1 is for the direct-current supply system from one station, the curve I_2 for the direct-current supply system from two stations, the voltage being 600 in both cases. It will be seen that one station is cheapest as long as the length of the road is below 36 kilometers, this one station being in the center of the road. When the length of the road is greater, two stations are cheaper. The curve *II* is for the system in which three-phase current is generated in a station at 5000 volts and transmitted to a sub-station, where it is changed by transformers and synchronous converters into direct current at 600 volts. In the generating station direct current is also



CURRENTS FOR LONG RAILWAYS.

generated for the supply of the parts of the road in the neighborhood of this station. It is somewhat surprising to see that this system is always more expensive than the other; it should therefore be used only in exceptional cases. The author thinks that it can be used to advantage near where the lines for a direct-current supply from one and from two stations intersect, that is, where they are about equal. The conditions under which it is advantageous to this system, are a small total load and relatively great length. A system with more then one sub-station is still less advantageous. The curve *III* is for three-phase traction, with one station and step-down transformers along the line. It will be seen that this system is superior to all other systems, whenever the length of the road is above 22 kilometers. Below this limit direct-current supply from one station is cheaper. As mentioned above, this limit is calculated for $a = 10$, and in practice a may be between 5 and 15. For higher loads than 10 kw per kilometer this limit decreases to 20 kilometers, for smaller loads it increases to 30 kilometers. It will be seen that for greater lengths, three-phase traction is decidedly the cheapest.—*Elek. Zeit.*, Dec, 20, 27.

Electric Automobiles.—Joel.—A long article in which he first briefly criticizes the earlier attempts to produce electric carriages, in which the weight of the carriage was out of all proportion to the weight of the battery carried on it. He then discusses the improvements made in recent years, especially in the motors, controllers and batteries. Among other things he points out that the use of zinc with peroxide of lead gives a higher e. m. f., given as 2.45 volts by Wheatstone, than lead and peroxide of lead, but necessitates the use of porous pots. This battery has the advantage in common with other types of porous cell storage batteries that it can be quickly charged; a battery of 120 cells is charged in two hours with 90 amperes, and can be discharged at 20 to 60 amperes, whereas the best form of pasted type must be charged at 20 to 40 amperes, but is more efficient, gives a greater output for the same weight, and is more durable. The following system of control is recommended: Starting on the basis that the greatest power is required for hill climbing, the motors are then in parallel, and are working at their normal speed and highest possible efficiency; the limit battery discharge is not exceeded while the carriage is geared to ascend the hills at half speed. For running on level roads at higher speed the motors are overrun, and for slow speed the motors are coupled in series.—Lond. *Elec. Rev.*, Jan. 4.

REFERENCE.

Electric Traction.—Dawson.—An article on the development of electric traction. Statistical data are given especially on the development in England and Germany.—Lond. *Elec. Rev.*, Jan. 4.

Installations, Systems and Appliances.

Central Station Costs in Great Britain.—A long and very full, statistical article on the costs of British central stations in 1898 and 1899. Several large tables and quite a number of diagrams are given. The adjoining two diagrams are reproduced as samples, both give the average costs for the four years 1896 to 1899, one for 52 municipal plants, the other for 33 plants owned by private companies. Municipal plants are discussed first. In the matter of total costs, Bradford heads the list as the best, with 2.36 cents total cost per unit sold. In works cost Leeds is the best, with 1.48 cents per unit. All the items of cost per unit sold have fallen except that of fuel, which has increased by 6.42 per cent, in spite of the fact that the 1899 average is in conjunction with a mean output 44.2 per cent, and with a load factor 5.5 per cent above those respectively of 1898. Another interesting point is the gradual approach of the average total costs, plus 6 per cent on the mean capital, to the total revenue; in 1899 the average total revenue was 8.12 cents per unit, while the value of the total costs plus capital charges is 8.16 cents per unit. The lowest value of the latter quantity is 5.18 cents for 1898 for Edinburgh and 4.56 cents for 1899 for Halifax. It is of significance that the two stations which are best in this respect have a traction load. From other diagrams it appears that high-load factors are generally associated with high outputs; furthermore, the greater the output, the smaller the wages at the station, the generating costs, etc.; the output does not rise continuously with the load factor. Among the plants owned by private companies the Charing Cross station has the lowest total costs, namely, 2.36 cents per unit. The lowest works cost are at Preston, namely, 2.04 cents per unit. The averages indicate increased economy in all the items of cost, and, rather surprisingly, a diminution of the load factor and the ratio of the output to the plant capacity. The lowest value of total costs plus 7 per cent of mean capital expended per unit, is 6.28 cents for the St. James station in London.—Lond. *Elec.*, Jan. 4.

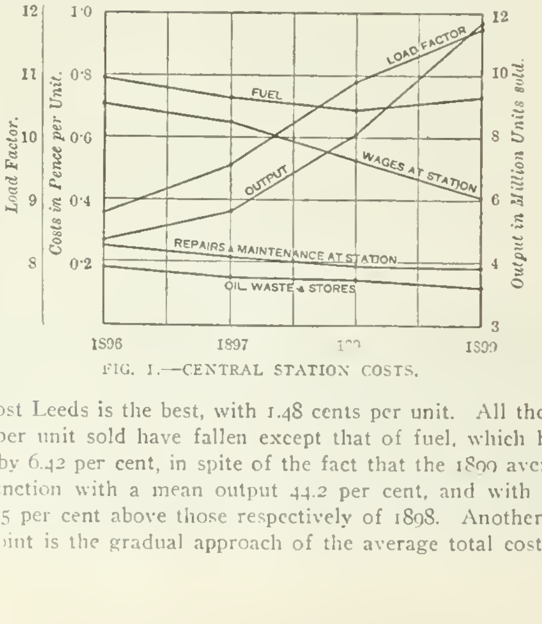


FIG. 1.—CENTRAL STATION COSTS.

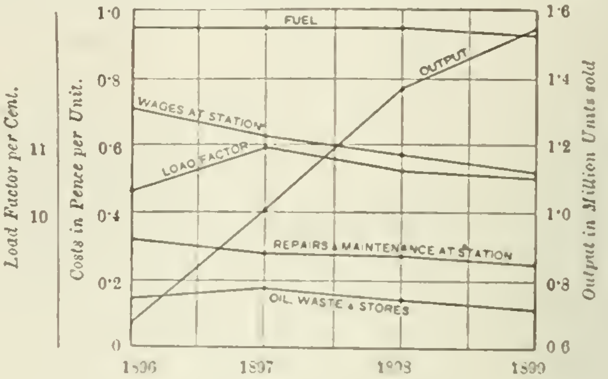


FIG. 2.—CENTRAL STATION COSTS.

Electro-Physics and Magnetism.

Point Discharge from a Tesla Pole.—Knoblauch.—An investigation of the following phenomenon: The discharge from a Tesla pole charges an insulated metallic plate positively at a certain distance and negatively at a greater distance. This is due to the greater speed and penetrative power of the negative ions. He has studied the distribution of the ions by means of perforated plates, and found that the positive charges are due to visible brush-discharges. When these brush discharges are prevented from impinging upon the plate by cutting out a central portion, no positive charge is obtained. The positive ions are strongest in the axial portion of the discharge.—*Phys. Zeit.*, Dec. 15; abstracted in Lond. *Elec.*, Jan. 4.

Spectra of Radium and Polonium.—Berndt.—By means of Runge's method of fusing the salt into a platinum coil and then using it as an anode for a spark-gap, he has discovered no less than 15 lines of the polonium spectrum. He has also studied the radium spectrum. The spark was in all cases furnished by two Leyden jars charged by a large induction coil, and the platinum coil was kept in a state of incandescence. Under these circumstances the space between the electrodes was filled with the vapor of the salt, and the platinum and air lines were quite faint.—*Phys. Zeit.*, Dec. 23; abstracted in Lond. *Elec.*, Jan. 4.

REFERENCES.

Crookes Tubes.—Westbury.—An article on the use of the Crookes tube for the production of Röntgen rays, and on the best form of the tube.—*West. Elec.*, Jan. 5.

Thermo-Magnetic Phenomena.—Moreau.—A theoretical paper in which he shows that the thermomagnetic effect, discovered by Nernst and Ettinghausen, is a Hall effect of special kind.—*L'Eclairage Elec.*, Dec. 22.

Electro-Chemistry and Batteries.

Electro-Chemistry and Electro-Metallurgy in 1900.—J. B. C. Kershaw.—The first part of his annual review. The last year has not been marked by any striking discoveries or developments in the electro-chemical and electro-metallurgical industries. The process for the manufacture of alkalies and bleach, of chlorates, and of hypochlorites, and for the refining of copper and bullion, all show progress during 1900. The development of the ozone and the aluminum industries is retarded by the limited field of application for these products. The process for the extraction of zinc and copper directly from their ores are still in the experimental stage of their development. The number of factories engaged in the electrolytic production of alkalies and bleach has increased to 27, with a capacity of 52,370 hp, three more factories being in course of erection; some of the processes used are briefly described. The Pittsburg Reduction Company is still the largest porducer of aluminum, the 1899 output being 2990 tons, while the 1900 output is expected to exceed this total by some hundreds of tons. The fall in the price of calcium carbide which has occurred during 1900 will not be without its effects upon the aluminum industry, for all the European aluminium works have taken up carbide manufacture, and now that this has ceased to yield any profit, a larger proportion of their power will be devoted to the production of aluminum. The total power now available for alumium production is 56,000 hp, but not more than one-half of this is at present utilized in the manufacture of the metal. All the factories use either the Herault or the Hall process. While many solders have been invented, none, with the exception of that of Richards, have given strong and durable joints; Heraeus has succeeded in joining the metal by a new method of autogenous soldering. He makes use of the fact that at a certain temperature, far below its melting point, aluminum becomes plastic and can be kneaded. The edges of the plate or ends of the wires to be joined, are raised to and maintained at this temperature, and are kneaded together until a homogenous mass of metal has been produced at the point of contact. The interest in the various alloys of aluminum increases. In France "partinium" and "albradium" are expected to have a wide field of usefulness. Partinium is an alloy of aluminum and tungsten, and it is used in the motor car industry for portions of the structural work of the carriages. Albradium is an alloy containing copper, nickel, zinc, phosphorus and aluminum, and takes a polish equal to that of silver. Another series of alloys of the light metal made in France, contain tin, copper, zinc and aluminum. The specific gravities of these alloys vary between 2.8 and 7.1. The chief event in the calcium carbide industry has been the heavy fall in the selling price; the carbide factories cannot, in most cases, make any profit at this low price. This fall in price is, however, an undoubted gain to those interested in the acetylene lighting business, as it reduces by 30 to 50 per cent the cost of their raw material. There are already 34 central supply stations for acetylene gas in operation in Europe, and five in the United States. The use of the new illuminant for railway car lighting is rapidly extending in continental Europe. The consumption of carbide by the Prussian State Railway in 1900 for this purpose is estimated at 8000 tons. The number of the factories producing chlorates of potash and soda is 11, with a capacity of 40,000 hp. Two new improvements seem to be of importance. The addition of a small quantity of potassium chromate to the electrolytic cell greatly increases the yield of chlorate per horse-power-hour. By the use of a small quantity of alumina in the cell, in order to combine with the sodium hydrate as it forms at the cathode, the losses resulting from secondary electrolysis are reduced. The past year has been marked by a continuance of the high prices, first obtained in 1899, for all classes and brands of copper. The world's output of copper for 1900 will be greatly in excess of that for 1899, when 470,000 tons were produced. Of this total it is now estimated that 44 per cent is refined by electrolysis in the 42 refineries of the world. Only one—that at Papenburg in Germany—starts with the ore as raw material, the Hoepfner process being used. Some information is given regarding the electrolytic methods of producing hypochlorite of soda solutions for bleaching wood pulp and textile goods, which are making progress. —Lond. *Elec.*, Jan. 4.

Electrolytic Effects of Secondary Currents.—Johnson.—An investigation of the evolution of explosive gas at the submerged electrodes of the secondary circuit of an induction coil which is often assumed to be due to the alternate formation of hydrogen and oxygen at both electrodes, in accordance with the charge in the direction of the reduced current. He proves that while gas is evolved at both electrodes by the current induced at breaking, no gas is evolved by the current induced at making. He further found that the gas evolved at both electrodes is explosive, and that therefore both oxygen and hydrogen were evolved at both electrodes. The electrodes were platinum wires fused into thin glass tubes, and the electrolyte was either acidulated water or a solution of sugar and calcium nitrate. The fact is proved that the secondary current at break is alternating. The amount of gas evolved, as well as the maximum spark length in air, are inversely proportional to the square root of the capacity of the primary condenser, provided that the capacity is considerably above the capacity required for supressing the primary break-spark.—*Ann. der Physik*, Nov. 12, 1900; abstracted in Lond. *Elec.*, Jan. 4.

REFERENCE.

Pastes for Storage Battery Plates.—Peters.—A very long abstract, with the tables of the German paper abstracted in the Digest, Sept. 1. —Lond. *Elec.*, Jan. 4.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Phasemeters.—Armagnat.—An abstract of a paper read before the Internat. Soc'y of Elec. in Paris on the phasemeters exhibited at the Exposition. He calls attention to the fact that the instruments thus called really measure different quantities. If pure sine waves are assumed, for the phase difference between two currents of the same period, or between e. m. f. and current of the same period, an exact and simple mathematical definition can be given by means of the time at which both waves have the maximum value. As is well known, the phase difference is of importance as the power is equal to the product of the effective e. m. f., the effective current and the cosine of phase difference. In this case the utility of a phasemeter giving direct the phase difference is evident. In practice, however, pure sine waves are scarce, and the wave form is often of a very complex form. The e. m. f. and the current also have different wave forms. In this case the phase difference can no longer be defined as before. If, then, the power is equal to the product of effective e. m. f., effective current, and a co-efficient which may be called power-factor, the phase difference can be defined as that angle, the cosine of which is the power-factor. Finally, a third definition is possible: If the current is decomposed into its two components, the current in phase with the e. m. f. and the wattless current, the phase difference is that angle, the sine of which is equal to the wattless current divided by the whole current. There are actually no apparatus giving the power-factor by a simple reading, but it can be found sufficiently accurately by three readings with a voltmeter, ammeter and wattmeter. All apparatus which have been proposed and which are exact for sine waves, must be used with caution for industrial currents, for the same current they may give correct readings for one value of the power-factor and wrong readings for other values. The phasemeters, properly so-called, at the exposition were those of Siemens & Halske, of Ricardo Arno, and of Hartmann and Braun. The apparatus of the General Electric Company, of Berlin, was an ammeter giving the wattless current. The Siemens' phasemeter for measuring phase differences of some seconds to 10 deg. is briefly described.—*L'Eclairage Elec.*, Dec. 22.

Fault-Finding on Tramway System.—Johnston.—An illustrated description of a quick method for finding a fault on a tramway line. Fig. 1 shows a short tramway 2½ miles in length, with the feeder, trolley wire and pilot wires for testing, which go from the supply station to the bus-bars in the feeder pillars. In the supply station they go to a small double-pole multiple-way switch, to which is also connected a low-reading voltmeter, as shown in Fig. 2. The test is as follows: "Suppose a short circuit has developed. Change the throwover switch to down position, which will allow a limited amount of current to flow through the feeder, this current being controlled by the resistance that has been put in series with it. Then put the testing switch *D* in the position marked 1. By so doing you connect up the low-reading voltmeter between the pilot wires 1 and 2, in other words, you take the drop in volts between the feeder pillars. If you get the correct drop, which can be found by calculation or experiment (a record of which should be kept always at hand), the fault is at or further away from the supply station than feeder pillar No. 2. A similar test can be made between the other feeder pillars, and by that means the fault located, but another position should be shown on the switch *D* to enable the voltmeter to be put across between the positive bus-bar and feeder pillar No. 1, in case the feeder should break down between those two points. If this should occur, the position of the fault can be found as the total drop on this length is known, which we will call v_1; then if the drop found by the test when the fault is on it v_2, the distance of the fault

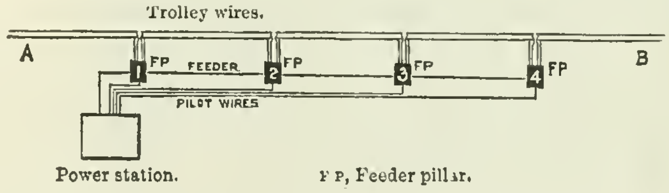


FIG. 1.—LOCATING FAULTS ON TRAMWAY SYSTEMS.

from the supply station will clearly be v_2L/v_1, where L is the total length of the cable under test. A fault often occurs which is not a "dead" short circuit, that is, it has in itself a certain amount of resistance to earth which may cut down the current below the standard amount allowed by the auxiliary resistance, and from which amount the calculations have been made. This, however, will introduce no error, for, suppose the fault was on the feeder between the supply station and feeder pillar No. 1, as in the last case, the position of the fault will be $(C_1v_2L)\div(C_2V_1)$ where C_1 is the standard current and C_2 the current going through the cable during test." — Lond. *Elec. Rev.*, Jan. 4.

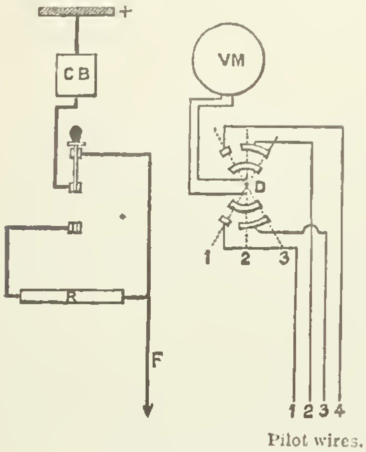


FIG. 2.—LOCATING FAULTS ON TRAMWAY SYSTEMS.

REFERENCE.

Phase-Turning Apparatus.—CAMPBELL.—Hist. Brit. Phys. Soc'y paper in full on a phase-"turning" apparatus for use with electro-static voltmeters, an abstract of which was noticed in the Digest, Dec. 15.—Lond. *Elec.*, Jan. 4.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephony.—The first part of a serial referring to Pupin's system. In discussing the transmission of electrical disturbances over telegraph and telephone lines, the disturbance at the sending end is resolved into a group of harmonics of different periods, the problem is treated as if each of these harmonics was transmitted quite independently. This assumption that harmonics of different periods do not interfere with one another, is said to lead to correct results in the case of copper wires suspended in air, "but where solid dielectrics or iron form part of the system, as in the case of a submarine cable, it appears to be very doubtful"; the results obtained by Squier and Crehore on the Commercial cable "do not seem capable of explanation if harmonics are transmitted quite independently." The case of a twin line is analytically treated, and three special cases are briefly considered: First, there is no leakage, and induction coils are inserted in the line, according to Pupin; second, there is non-inductive leakage to give Heaviside's distortionless circuit; third, inductive leakage is applied to a line whose inductance is small, this is the basis of S. P. Thompson's proposal.—Lond. *Elec. Rev.*, Jan. 4.

REFERENCE.

Statistical.—The conclusion of the long statistical article on telegraphy and telephony in France, also statistical articles on telegraphy and telephony in British India in 1898-99, and on telegraphy in New Zealand in 1899.—*Jour. Teleg.*, Dec. 25.

MISCELLANEOUS.

REFERENCES.

New Century Reviews.—Quite a number of illustrated reviews, among which there are the following: Child, The First Century of Electricity; Maver: The Telegraph in the Ninteenth Century; Sprague: Historical Notes on Electric Traction; Maxwell: Electromobile Evolution; Maynard: Development of the Telephone; an interview with Edison on the starting of the Pearl Street station in New York, and on his inventions; Trowbridge: Wireless Telegraphy and the Earth; Weeks: A Review of the History of Electric Lighting; Caldwell: History of the X-Rays; Stillwell: Electric Power Transmission.—*Elec. Rev.*, Jan. 12.

Metal Market.—Diagrams showing the fluctuations of the price of zinc, lead, iron, tin and copper for December. Such diagrams are published in that journal in the first number of every month, and will not again be noticed here.—Lond. *Elec. Rev.*, Jan. 4.

New Books.

THEORIE UND PRAXIS DER ANALYTISCHEN ELEKTROLYSE DER METALLE. Von Dr. Bernhard Neumann. Halle: Wilhelm Knapp. 224 pages, 65 illustrations. Price, 7 marks.

This book is intended to be a practical book explaining the application of electrolysis to analytical purposes, and describing the electrolytic methods which have been found useful in practice for the estimation of metals. The author has taken great care to give a very exact description of the special conditions of the tests, such as voltage, current density, temperature, concentration, etc. He deals first with the electrolysis of a pure metallic salt solution, then with the electrolysis of a solution of several salts, and gives finally practical applications of electrolytic methods for tests of alloys, ores, etc. Although the book is thus a practical book for the engineer, it is pleasing to see that the theoretical parts are all fully up-to-date, and based entirely upon modern views of electrolysis. A rather long and well-written introductory chapter is devoted to a summary of these views.

BOOKS RECEIVED.

AN INTRODUCTION TO MODERN SCIENTIFIC CHEMISTRY. By Dr. Lassar-Cohn. Translated by M. M. Patteson-Muir, M. A. New York: D. Van Nostrand Company. 348 pages, 58 illustrations. Price, $2.00.

THE COAL AND METAL MINERS' POCKETBOOK. Principles, Rules and Tables. Sixth edition, revised and enlarged. Scranton: The Colliery Engineer Company. 637 pages. Illustrated.

Exhibits at the Milwaukee Convention.

A report of the proceedings at the Milwaukee Convention of the Northwestern Electrical Association appears elsewhere in this issue. There was a good display of exhibits and gathering of commercial interests, as will be seen from the subjoined notes:

THE ILLINOIS ELECTRIC COMPANY, Chicago, was represented by Mr. C. W. Bacon.

MACOMBER-WHYTE ROPE COMPANY, Chicago, was represented by Mr. George Whyte.

EVANS, ALMIRA & CO., Chicago, Ills., were represented by F. N. Jewett, Western agent.

THE ELECTRIC VEHICLE COMPANY, of New York, was represented by Mr. Joseph M. Hill.

TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, was represented by Mr. J. Holt Gates.

JOHN A. ROEBLING'S SONS COMPANY, of Trenton, N. J., was represented by Mr. M. B. Kitt.

THE STANDARD CARBON COMPANY, of Cleveland, Ohio, was represented by Mr. William O'Connor.

MUNSELL & CO., of New York, were represented by their Chicago manager, Mr. Charles E. Coleman.

WARREN ELECTRIC MANUFACTURING COMPANY, of Sandusky, Ohio, was represented by Mr. J. Holt Gates.

CHICAGO EDISON COMPANY had its interest well taken care of by its purchasing agent, Mr. Charles Holmes.

O. C. LITTLE PULLEY COATING COMPANY, of Menasha, Wis., was in charge of its president, Mr. O. C. Little.

THE HART & HEGEMAN COMPANY and PERU ELECTRIC COMPANY were well represented by Mr. George B. Searing.

THE EDWARD P. ALLIS COMPANY, of Milwaukee, Wis., was represented by its traffic manager, Mr. David Harlowe.

THE CHICAGO BELTING COMPANY, of Chicago, was represented by Mr. Ed. H. Ball, treasurer, and Mr. E. T. Toogood.

THE AMERICAN ELECTRIC WORKS, of Providence, R. I., were represented by their Western manager, Mr. F. E. Donohoe.

AMERICAN STEEL & WIRE COMPANY, Chicago, was represented by the manager of its electrical department, Mr. E. J. Pietzeker.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, had its popular Chicago salesman, Mr. Richard O'Connor, in charge.

CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., was charmingly represented by its officials, Messrs. Bacon and Hickcox.

ELECTRIC APPLIANCE COMPANY, Chicago, was represented by its president, Mr. W. W. Lowe, assisted by Mr. W. P. Upham, S. A. Rall and B. B. Downs.

THE NEW YORK INSULATED WIRE COMPANY, New York, had its interests taken care of by its well-known and popular convention favorite, Mr. James Wolff.

THE BUCKEYE ELECTRIC COMPANY and the Jandus Electric Company, of Cleveland, Ohio, were represented by their Western manager, Mr. Joseph H. Cook.

THE AMERICAN CIRCULAR LOOM COMPANY was represented by Mr. H. B. Kirkland, the general sales manager, and Mr. Thomas G. Grier, Western manager.

ILLINOIS MAINTENANCE COMPANY, Chicago, was effectively represented by its president, Mr. E. H. Cheney, who was most thoroughly welcomed by his many friends.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, was represented by the manager of its Northwestern office, at Minneapolis, Minn., Mr. James B. Coale.

DEARBORN DRUG & CHEMICAL WORKS, Chicago, were represented by its Milwaukee manager, Mr. J. W. Harkins, who presented some very attractive and useful souvenirs to all callers.

CHICAGO MICA & INSULATION COMPANY, of Valparaiso, Ind., was represented by its vice-president, Mr. Charles W. Cobb. Mr. Cobb closed one of the largest deals during the convention.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, was well represented by its Chicago Western sales manager, Mr. J. G. Pomeroy, one of the most popular gentlemen attending the convention.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, exhibited a new style of transformer, which attracted a great deal of attention. The exhibit was in charge of its Western manager, Mr. George B. Foster, assisted by Mr. J. F. Begole.

GEORGE CUTTER COMPANY, Chicago, was represented by its president, Mr. George Cutter, whose watchword was "Why Don't That Lamp Drop?" His many friends can receive an answer to this by enclosing a 2-cent stamp when writing to the above.

WESTERN ELECTRIC COMPANY, Chicago, exhibited an interesting display of arc and incandescent lamps, also ceiling and desk fan-motors. The company was represented by Messrs. A. L. Tucker, Irving Jackson, E. P. Warner and Fred Basedow.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, was most effectively represented by its sales manager, Mr. George J. Cadwell. As Mr. Cadwell had just been appointed to this position, he was receiving congratulations from his many friends during the meeting.

THE NORTHERN ELECTRIC MANUFACTURING COMPANY, Madison, Wis., was well looked after by Mr. D. E. Goe. This gentleman has been a familiar figure amongst the electrical fraternity for a number of years, and his many friends were delighted to see him on the warpath once again.

GENERAL INCANDESCENT ARC LIGHT COMPANY, of New York, was ably taken care of by its popular Western sales manager, Mr. Francis Raymond, who was well assisted by its Milwaukee representative, Mr. Thomas James. It had an exhibit of many lines, which were attractive and interesting.

THE GREGORY ELECTRIC COMPANY, Chicago, was represented by its general manager, Mr. Louis A. Kuehmsted, assisted by Mr. R. H. Watson. The "Bargain House" of America was referred to by all present. They entertained sumptuously, and their very handsome and attractive souvenirs were in great demand.

THE MILWAUKEE ELECTRIC COMPANY, of Milwaukee, Wis., was represented by its vice-president, Mr. Walter Cary, assisted by Mr. I. B. Cary and Mr. W. H. Perry. They exhibited a very handsome line of motors, which attracted much attention, particularly a special 6-pole S. P. motor for direct-current fans and printing machines.

M. B. AUSTIN & CO., Chicago, were represented by their president, Mr. M. B. Austin, and vice-president, Mr. W. A. Brown, assisted by Mr. A. H. Friend, C. N. Jackson, C. A. Robinson, A. Meinuna. Mr. Edward Belden also assisted in the arc lamp department. Their exhibits consisted of Belden arc lamps, Dayton fans, Safety wires and cables, and other electrical specialties.

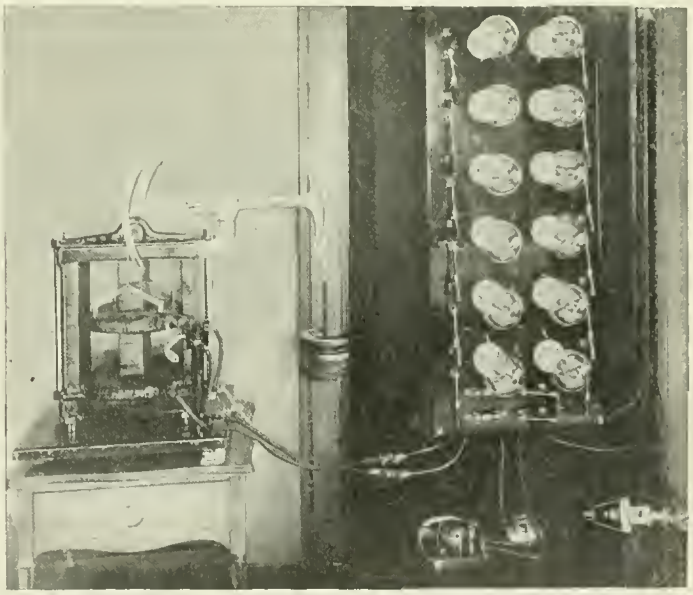
THE SAWYER-MAN ELECTRIC COMPANY had an attractive exhibit of incandescent lamps. It also had a complete photometer outfit, by which it was able to give convincing proof of the efficiency of these lamps. The Westinghouse Electric sign was equipped with Sawyer-Man lamps. The gentlemen in charge of this exihibt were Mr. C. A. Ross, manager of the Chicago office, and Mr. R. S. Mueller.

THE RICHMONDT CONDUIT COMPANY, Milwaukee, attractively exhibited a sample of its electro-galvanized interior and exterior reamed conduit, especially designed for interior work in fireproof buildings. This company is building a large factory 85 ft. wide, 400 ft. long and 35 ft. high, and will install a 150-hp engine. It has booked orders for about 2,000,000 ft. of conduit, and the new factory will give it a very large capacity. This company will also erect a plant in Canada for the Canadian trade, which will be in operation in about two months. Mr. Richmondt was in charge of this exhibit.

McROY CLAY WORKS, of New York, were represented by Mr. E. F. Kirkpatrick, or "Kirk," as he is familiarly known, in charge of the exhibit. "Kirk" had a surprise in store for his electrical friends. The sign on his door read, "McRoy Clay Works, vitrified conduits, E. F. Kirkpatrick, Western manager." This necessitated many explanations, as Mr. Kirkpatrick has only just been appointed to this position. Mr. Kirkpatrick has been identified for the past 15 years with the Westinghouse, Fort Wayne and General Electric Companies, and his many friends congratulate the McRoy Clay Works in securing his services.

THE BROWNING MANUFACTURING COMPANY, of Milwaukee, had an unusually attractive exhibit of motors, ranging in size from 1-12 hp to 3½ hp. This concern is rapidly coming to the front as a manufacturer of strictly high-grade direct-current motors, and also makes a specialty of slow-speed motors, for special purposes, and its output is in general demand. The finish of its product is very artistic, and nothing but the best of material and workmanship enter into its construction. The exhibit was in charge of its president, Mr. Howard L. Browning, assisted by its secretary and treasurer, Mr. William Stark Smith.

THE GENERAL ELECTRIC COMPANY was to be found at the old stand. This company was represented by the following gentlemen, who attended to the wants of their many customers: Mr. B. E. Sunney, general Western manager; Mr. F. N. Boyer, manager supply department, Chicago office; Messrs. L. G. Crawford, J. Scribner, S. F. Dibble and Thomas Ferris, of Milwuakee; F. G. Vaughn and P. D. Wagner, of Schenectady. The General Electric Company's exhibit was unusually interesting to the electrical fraternity, and comprised many new and interesting pieces of apparatus. Probably the most interesting new device exhibited at the convention was a new method of controlling series incandescent lamps for street lighting. This system is similar in principle to the well-known constant-current transformer system for arc lighting, but slightly different in practical application. The regulator for the system is placed in series with the line, and one point in which this method of control is superior to all others is that the regulation is automatic. This is a most important consideration on such a system. The efficiency is remarkably high, there being only 131 watts copper loss, and no core loss on a coil at full load for 3000 volts at 3½-ampere circuit. At position of no-load the losses would be core loss 130 watts, and copper loss 131 watts. At full load, the power factor is approximately 98 per cent.



METHOD OF CONTROL OF SERIES INCANDESCENT STREET LAMPS.

These coils have been in use for about a year, but have not been pushed, as it was the desire of the General Electric Company to obtain results of practical operation before pushing the sale of these coils. About 50 coils are now in use or on order.

The Westinghouse Electric & Manufacturing Company, presented a detail exhibit of apparatus, consisting of a Westinghouse wattmeter, which was shown in operation in connection with suitable switchboard instruments, particular attention being called to the company's new line of long-scale indicating instruments. It also exhibited its types of lightning arresters, fan motors, cut-outs, etc. A prominent feature of the exhibit was the new "O.D." type transformer, which represents the most modern practice in its details of construction. A large electric sign, suspended across the west end of the hall, bore the name of Westinghouse. The officials representing the company during the convention were W. R. Pinckard, C. C. Burton, T. P. Gaylord, W. S. Rugg and Ervin Dryer. Mr. Arthur Hartwell, manager of the Chicago office, was expected to be present, but was detained by matters of greater importance.

The Fort Wayne Electric Works, of Fort Wayne, Ind., were, as usual, represented by their well-known salesmen, Messrs. Willard Knight and Frank McMaster. Mr. King, head of the meter department, was also on hand to explain the details of the type "K" meter, which attracted a great deal of attention, owing to its many novel but practical features, such as absolute interchangeability of all parts. The entirely new features of adjustment in this meter caused a great deal of interest, and Mr. King received a great deal of praise. Mr. Edward A. Wagner was also on hand to show up the leading features of the new type "A" transformers, which also have some entirely new and useful features. They also exhibited a 5-hp Wood automatic starting box, with over-load and under-load release. The simplicity and ingenuity of the little device made it particularly attractive to those operating motors, as it is practically impossible to burn out a motor, when using this device.

Double Wound Armature Motors.

The use of motors having an armature with two independent windings is not new in European practice, particularly for automobile work. The great advantage of this system for variable speeds is evident, since it permits variations in speed to be obtained without the waste of energy involved in the rheostatic method of control. The C & C Electric Company has adopted a double-wound armature system in the manufacture of motors for certain classes of work, in connection with a very complete system of control which its engineers have devised and which formed the subject of a patent granted last year.

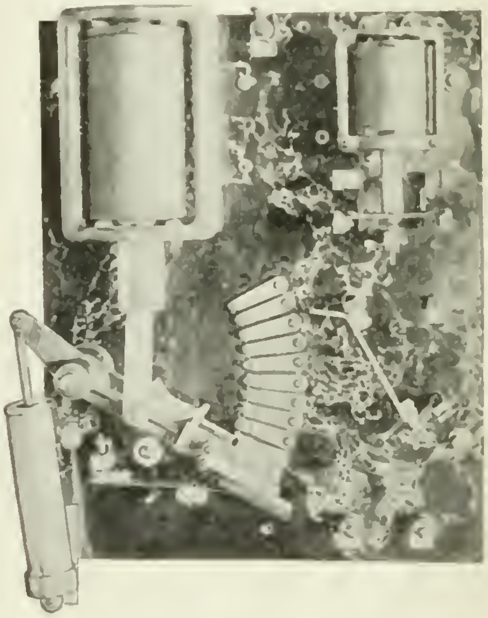
The controlling apparatus is arranged in two sections. One of these is operated by the motorman in starting, stopping and changing plates and buttons, a hand lever centrally pivoted with respect to these is operated by the motorman in starting, stopping and changing speed. The second portion of the controlling apparatus consists of an arrangement of solenoids whereby the motor is started or stopped, and the armature windings thrown into series or parallel. The contacts of the controller panel connect with the motor series and shunt fields, with resistances to be thrown in and out of the armature and field circuits and with the solenoidal switches. As the hand lever is moved along, a contact is made which causes the solenoids to throw the armature windings in series and into circuit. Further motion of the lever cuts resistance out of the armature circuit. Part of the series windings of the field are short-circuited at ensuing contacts, and further movement short-circuits the remainder of the series windings, the motor then running as a plain shunt machine with the armature windings in series and without external resistance. The next motion of the lever makes a contact which causes the solenoids to throw the two independent winding armatures in parallel with resistance inserted, and still further motion cuts out all the resistance. By means of the final contacts resistance is thrown into the shunt field, thereby increasing the speed. By means of the various combinations described, the speed of a motor may be gradually increased from, say, 20 r. p. m., to a final speed of 400 r. p. m. One of the incidental advantages of this system is that by means of push-buttons located at any desired number of points, a motor may be cut out of circuit, the push-button not being in the main circuit but acting on the stopping solenoid.

The most obvious application of this type of motor is to printing presses, where a considerable range of low speeds and quick control are absolutely essential. Still other applications are in paper making rolls, certain machine tools, grinding and polishing tables—in fact, wherever large starting torque, considerable speed variation and quick control are requisites. It is customary to lay stress upon the word "flexibility" in speaking of the advantages of the alternating current, but the present system is an illustration of the great capabilities of the direct-current in flexibility of motor speed which will always retain for it supremacy in that field.

C. & H. Self-Starter.

The device illustrated herewith is designed to start and stop an electric motor automatically. It is made in two styles, one being adapted for the control of motor-driven pumps, which can be automatically started and stopped by means of either a float switch or a pressure regulator. The same style is also adapted for operating what are known as double-belt elevators, which are driven by a non-reversing starter. The other style is designed for use with reversing motors. Arcing on the main switch is taken care of by powerful blow-out magnets behind an independent solenoid-controlled switch.

This starter consists of a pivoted lever which holds renewable carbon brushes moved over renewable copper segments by means of a powerful solenoid. An oil dash-pot retards the movement of the lever, the speed of which can be regulated by varying the consistency of the liquid in the dash-pot. The smaller solenoid located in the upper right-hand corner carries a carbon-tipped switch, whose purpose is to close the main-line circuit and start the motor. The circuit which includes the winding of this solenoid is closed and opened by means of a float switch, pressure regulator, reversing switch or other device, according to the use to which the starter is applied. The closing of this solenoid controlled switch not only closes the circuit of the motor through the resistance of the starter, but also closes the circuit which includes the winding of the large solenoid. The lever of the main rheostat slowly moves over the segments, thereby gradually cutting out all of the external resistance in series with the armature, and also strikes the smaller lever shown at the right of the middle of the cut. The latter lever is moved so as to introduce an incandescent lamp in series with the winding of the main solenoid. The resistance of this lamp prevents the winding from overheating, and also serves as a pilot lamp, indicating whether or not the main solenoid is receiving the proper amount of current.



AUTOMATIC MOTOR-STARTER.

The small carbon-tipped switch in the lower left-hand corner is so arranged that when the main lever is at its lowest position as shown, the two small carbons will be pressed together. The moment the rheostat lever starts to lift, these carbons separate and insert the resistance of another incandescent lamp in series with the winding of the smaller solenoid, thereby preventing the latter from overheating, and also providing other safeguards in the operation of the device.

This starter is manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

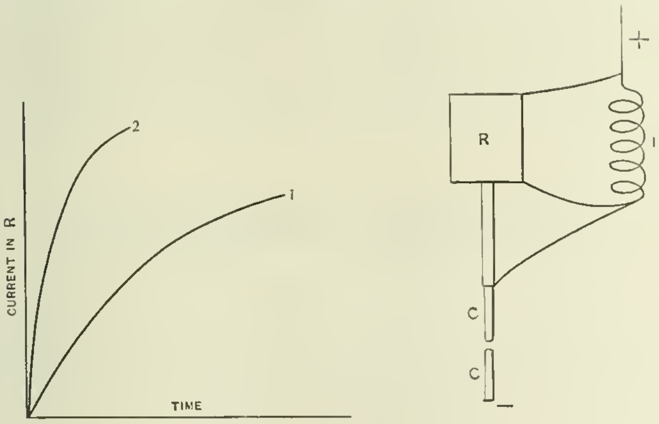
The Helios-Upton Continental Arc Lamp.

Central station managers who have arc lamps on constant potential continuous-current circuits will be interested in an improvement in enclosed lamps, which is claimed to accomplish by remarkably simple means, some greatly desired results; among others, making the arc "strong" and "tough," to use the language of arc lamp makers; enabling the resistance in series with the arc to be greatly reduced, thereby reducing the usual dead losses, and at the same time enabling arc lamps to be run with greatly reduced currents, as small even as 1½ amperes. This latter improvement has been very greatly desired for a long time, but the fact that few if any of such small current lamps have been in use, shows that this problem had not before been solved in a satisfactory way. Moreover, the addition of this new and simple improvement enables the amount of light given out for the same current to be increased, or what is the same thing, the same amount of light can be obtained with less current—a very important matter for central station managers.

Claims are often made by inventors for their devices which frequently are not substantiated by practical tests. In this case, however, the lamp has passed through this trying test, it being stated that several thousand are already in practical use, and thus any one can satisfy himself about the claims made. Not the least interesting feature is the great simplicity of the device, which consists simply in connecting in parallel to part of the series regulating coil, a self-induction coil, which, as is described below, tends to regulate the arc before instead of after a change of current in the arc takes place, thus anticipating, as it were, any change of current. This prevents the very objectionable pumping or surging which is often seen when one tries to accomplish the same result by other means. This improvement is claimed to be for arc lamps what the Nernst lamp is for incandescent lamps.

This new lamp, which is now being put into the market by the Helios-Upton Company, of Philadelphia, and is called the Continental arc lamp, is of the enclosed type, and is for use on direct-current constant potential circuits. The higher economy is obtained by a regulating mechanism which dispenses with the use of "dead resistance" in series with the arc when the lamps are connected across constant potential circuits.

It is well known that the e. m. f. required to sustain an electric arc of a given length is smaller the greater the current. This is the reason why it is impossible to supply an arc of given length directly from constant-potential mains. It would, however, be possible to do so if by a regulating mechanism the potential of the arc could be made to rise with increase of current and fall with decrease of current, by lengthening and shortening the arc. The practical difficulty which has so far prevented the use of this method is that the regulating mechanism lags behind in time in its action, so that stability is lacking. It is well known that in practice a stable condition is obtained by using a dead resistance in series with one or more arc lamps across the line, which is open to the objection that the resistance consumes energy.



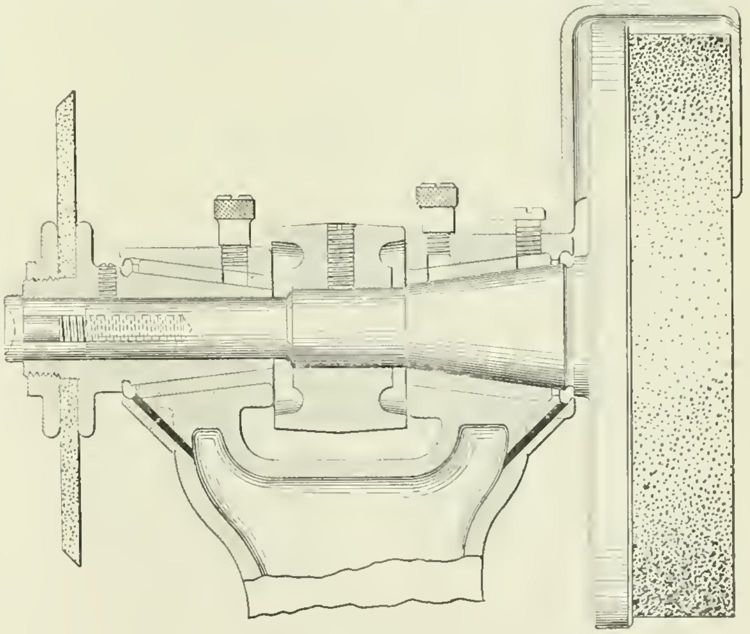
CURVES AND DIAGRAM OF LAMP CONNECTIONS.

In the Continental lamp of the Helios-Upton Company, no dead resistance is employed, but use is made of a regulating mechanism of the kind mentioned above, and the practical difficulty noted above is overcome in an interesting and ingenious way, which is roughly illustrated herewith. *C* and *C* are the carbons. *R* is the electromagnetic device controlling the motion of the upper carbon. *I* is a self-induction coil. *R* and *I* are in parallel with each other, but in series with the arc. *I* has a high self-induction, while *R* has not. Then if, for instance, there is a tendency to an increase of current, it will rise more rapidly in the resistance *R* than it would without the reactance. If the current in *R* varies like curve 1 when no reactance coil is used, it will vary like curve 2 when the reactance coil is added in parallel. This means that the regulating mechanism shortens or lengthens the arc in time to prevent any pumping. In a lamp connected across 110-volt mains the current was 4½ amperes, the e. m. f. at the terminals of the arc itself was 95 volts and the arc burned very steadily. It will thus be seen that of the 495 watts supplied from the mains, as much as 428 watts are consumed in the arc itself.

There is claimed to be a gain of light with this lamp for two reasons: More watts are consumed in the arc itself than with the use of a dead resistance, and the arc is longer, so that less light is hidden by the tip of the lower carbon. The same amount of light is thus obtained with less current. Moreover, the lamp burns steadier, and well-regulating lamps are made for currents as small as 1½ amperes.

Improved Twist Drill Grinder.

The accompanying illustration shows the improved form of bearings adopted for the American twist drill grinder built by L. S. Heald & Son, Barre, Mass. The machine was formerly constructed with a long, straight taper bearing, having the pulley at the small end, and to adjust for wear the arbor was drawn into the bearing by the adjusting screw outside the pulley. In the new construction, as will be seen in the cut, the arbor is turned with a sufficiently steep taper at the end, which carries the principal wheel, this taper journal running in a babbitted bearing. The arbor is then turned straight for the fit of the driving pulley, and then smaller for the other end, on which is a snugly fitted sleeve with the outside made of a similar taper to the one forming the other journal of the arbor, and this carries on its outer end a thin and light emery wheel when desired, as shown.



TWIST DRILL GRINDER.

The sleeve is adjusted by the central screw tapped into the end of the arbor, and is secured by a small headless screw at the side. This adjustment, it will be seen, provides for the fit of both journals, and for the end thrust. The bearings are provided at the outer ends with oil channels, and at the inner ends with suitable self-closing dust-proof oil covers, so that the lubrication of the entire journal surface is assured.

This arrangement of two bearings adjustable toward each other makes a superior construction to the old style single taper. The emery wheel consists of a ring of emery 8½ in. in diameter, with a 6-in. hole, and is threaded into the wheel chuck by the use of a ring of soft metal. A safety chuck is thus provided, and the entire wheel may be used up in service. The thin emery wheel on the other end is furnished when desired, and is found very convenient for thinning the points of drills when they are worn back and the center becomes thicker.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed 2½ per cent, nominally. Time money was easier, the supply exceeding the demand. Rates are 3½ per cent for thirty days, 3¾@4 for sixty days to six months. Mercantile paper was active, the demand, especially that from out of town, having broadened. The closing rates were 3½@4 per cent for sixty to ninety days' endorsements, 3¾@4¼ for choice 4 to 6 months single names, and 5@5½ for others. In the stock market reactionary influences were in evidence, and there was a general decline in prices under both heavy liquidation and selling for short account. The downward movement extended to the tractions and electrics, the heaviest declines in these being 11⅜ points in Brooklyn Rapid Transit; 4 in General Electric; 11⅛ in Metropolitan Street Railway, and 5½ in Western Union. Manhattan had a sharp advance early in the week, accompanied by the perennial report connecting it with Metropolitan's interests, but the customary denial knocked the price down again and the stock closed at 112—a net loss of 9¾ points. The market for outside securities was characterized by sharp declines and generally lower bids of security values. Among the principal declines were Electric Vehicle pfd. 5 points and General Carriage 1 point. Electric Vehicle on Thursday broke to 3 per share, accompanied by a rumor of another assessment on the stock. Following are the closing quotations at the four centres named:

NEW YORK.

	Jan. 12.	Jan. 19.		Jan. 12.	Jan. 19.
Gen. Elec.	190	186	Elec. Veh.	16	15
Bklyn. Rap. Tran.	86¾	75⅜	Elec. Veh., pfd.	35	35
Met. St. Ry.	170⅞	159¾	Gen. Car.	3¼	2¼
Am. Tel. & C.	93	—	Ill. Elec. Veh. Tran.	¼	¼
West. Un. Tel.	86¾	81¼	N. E. Elec. Veh. Tran.	3¼	3
Am. Dist. Tel.	30	—	N. Y. Elec. Veh. Tran.	4¼	4¾
Com. Cable	165	—	Tel. & Tel. Co. of Am.	4¼	4½
Elec. Boat.	27	28	Hud. Riv. Tel.	116	116
Elec. Boat, pfd.	49	50	N. Y. & N. J. Tel.	174	174

BOSTON.

	Jan. 12.	Jan. 19.		Jan. 12.	Jan. 19.
New Eng. Tel.	129¾	—	Erie Tel.	53	65
Mex. Tel.	2¾	—	Gen. Elec., pfd.	—	—
Westing. Elec.	56	—	Am. Tel. & Tel.	163	157
Westing. Elec., pfd.	67	—	Boston Elec. Light	—	205

PHILADELPHIA.

	Jan. 12	Jan. 19.		Jan. 12.	Jan. 19.
Elec. Stor. Bat.	78	78	Phil. Elec.	5⅞	6
Elec. Stor. Bat., pfd.	80	80	Pa. Elec. Veh.	2	2
Elec. Co. of Am.	9⅝	9	Pa. Elec. Veh., pfd.	1	1
Gen. Elec. Auto.	—	—	Am. Rys.	32½	33¼

CHICAGO.

	Jan. 12.	Jan. 19.		Jan. 12.	Jan. 19.
Chicago Edison	150	151	Chicago Telep. Co.	245	253
Chic. City Ry.	255	253	Union Traction	12	12
Nat'l Carbon	16	15¾	Union Traction, pfd.	48½	49
Nat'l Carbon, pfd.	83	83	Northwest Elev. Com.	28¾	27

ERIE TELEPHONE CHANGES.—At a special meeting of the directors of the Erie Telegraph & Telephone Company, held in Boston on Jan. 17, the new management, representing the bankers' syndicate, took charge of the company's offices. Charles J. Glidden resigned the office of president, but will remain a director. Charles A. Grant resigned as treasurer. Mr. Glidden's position was not filled, and will not be for the present, but Walter Abbott was chosen treasurer, and Mr. Grant was made auditor. An executive committee, consisting of the following named gentlemen, who will, for the present at least, direct the affairs of the company, was appointed: Philip Dexter, chairman; William Endicott, Jr., Reginald Foster, Francis R. Hart and W. J. Latta. These changes are acknowledged to be in accord with the plans that the new management of the corporation has arranged, and are a part of a broad scheme which will, it is believed, ultimately result in the absorption of this great property by the American Telephone & Telegraph (Bell) Company. Under agreement with the Old Colony Trust Company, the officers of the Erie Company agree to keep the Cleveland, Northwestern, and Southwestern companies absolutely free from debt, and that they will do nothing in the management of the subsidiary companies to in any way impair the value of their stocks, which are collateral to the Erie bond issues. Mr. Glidden asserts that the decline in Erie was aided by a powerful bear clique in New York which sold large blocks of stock short. He says the Erie Telephone Company will earn $5,000,000 gross in 1900, an increase of $1,200,000 over 1899, and he looks for an increase of $500,000 to $750,000 in 1901.

AMERICAN BELL TELEPHONE.—The opinion seems to be general in Boston, says the *Boston News Bureau*, that the Erie Telephone Company will ultimately lodge within the control of the American Telephone Company, and that the failure of the Telephone, Telegraph & Cable Company to finance the company's expanding business, means the utter collapse of the independent telephone movement. A prominent Erie Telephone man says that in any absorption of the Erie Telephone Company by the Bell people, the trade would probably be made on the basis of two shares of Erie for one of the American Telephone Company. A gentleman at the head of one of the large telephone corporations operated by the Bell people said in discussing the Erie Telephone situation: "The trouble with the telephone business throughout the country is that the demand for services exceeds the supply of capital. The question is a vital one and must be met on a broad and elaborate plan if the position of the Bell companies is to be maintained. The development of telephone exchanges must continue and new business be obtained; otherwise the death of subscribers, failures, removal of, and discontinuance of instruments would soon impair the service and reduce its value greatly."

NEW YORK ELECTRIC VEHICLE TRANSPORTATION.—Reports have been current lately that on account of the extensive new work described in these pages an assessment would be called on the stock of the New York Transportation Company. The rumor has been denied, but within the last few days has been revived, and been followed by marked weakness in the company's stock. A member of the executive committee of the company states that such a thing as calling for a further payment had not been considered. The company, he said, has in bank $480,000 which will not be needed for a long time to come, and has in operation 300 vehicles which are now being run at a slight profit, so that the company is no longer losing money on operation, which was the case during the time it was engaged in the preliminary establishment of its business. In addition to these assets the company owns unincumbered the Fifth Avenue stage line, which is deemed a valuable property, and for which the New York Transportation Company has received and refused large cash offers.

NATIONAL LEAD.—The sharp decline in National Lead stock is said to be largely due to the competition of the Electrical Lead Reduction Company, whose new factory has recently started at Niagara Falls, and whose quick electrical processes of converting lead ore into the various lead compounds threaten to revolutionize the old and present methods of manufacture. Note of the new process, etc., was made recently in these pages.

GENERAL ELECTRIC.—The recent advance in General Electric to 200 has naturally resulted in the exchange of stock for the 5 per cent debenture bonds. To date about $3,600,000 bonds have been surrendered, leaving $1,700,000 outstanding.

NATIONAL CARBON.—The directors of the National Carbon Co. have declared the regular quarterly dividend of 1¾ per cent on the preferred stock.

Commercial Intelligence.

THE WEEK IN TRADE.—The general condition of trade, as indicated by reports to the mercantile agencies, has a satisfactory and hopeful aspect, although nothing of a startling or extraordinary nature transpired in any line. The chief interest just now is in iron and steel, arising from the reports of the past few days regarding probable aggressive competition. *Bradstreet's* says that trade on Spring account has, on the whole, improved. The great speculative staples are lower and transactions are smaller, but there is more doing in Spring business by Eastern jobbers. Southern and Southwestern trade is opening up satisfactorily and the Northwest reports a better outlook for Spring business. Conditions as to retail distribution are not quite so favorable. The open season, however, has helped the distribution of hardware: lumber is more active in the West, and in the East wholesalers have done more business, but export trade in this line lags. December gross railroad earnings gained 9 per cent over December, 1899, and closed a year which has certainly been the best in the history of American railroads. The earnings of 109 roads for the full calendar year 1900 aggregate $759,291,615, a gain of about 10 per cent over 1899. Copper was extremely dull and inactive. The official quotations of the New York Metal Exchange are 17c. for Lake and 16⅝c. for electroyltic. As regards steel rails the *Iron Trade Review* says: "The rail mills have booked a fair amount of business since the year opened, electric lines in the Central West contributing some good orders. In the Chicago district a 20,000-ton contract for export was booked in the week. The announcement that prices on rails would be withdrawn on Jan. 15, may have hastened some buying, but there is still skepticism concerning the reported purpose of the pool to make a $2 advance with Feb. 1. Mills in all districts are fully occupied, and none are pushing for business."

THE JAPANESE GOVERNMENT ARSENALS at Tokio and Osaka are about to be equipped with American electrical machinery, etc., the placing of the contracts for which have just been determined upon. It is a matter of congratulation to manufacturers in the United States that, despite the severest competition which was presented by English, German and other European concerns, contracts for everything foreign which the specifications requisitioned for, are being placed in this country. As regards the Tokio Arsenal, the most important contract has been secured by the Westinghouse Electric & Manufacturing Company, of Pittsburg. This concern will furnish three direct connected 250-kw generators, two 100-hp motors, one 75-hp motor, two 50-hp motors, two 30-hp motors, and one 15-hp motor; large switchboard for central plant and a number of transformers, etc. The engines, of which there will be three vertical cross compound ones of 350-hp each, will be built by McIntosh & Seymour, of Auburn, N. Y. The Westinghouse people are to furnish two 200-kw generators and a number of motors which will be installed in the Osaka Arsenal. The Morgan Engineering Company, of Alliance, Ohio, will undertake the building of six electric cranes which are to be erected in the new machine shops and foundry of the same arsenal. These equipments will vary in capacity from 10 tons to 25 tons. The following firms are among the successful bidders for the supplying of machine tools, which are to be driven by the Westinghouse motors: Pratt & Whitney, of Hartford, Ct.; Prentice Bros., of Worcester, and the Becker-Brainard Milling Machine Company, of Hyde Park, Mass.; Wm. Sellers & Co., of Philadelphia, Pa.; also the American Tool Works, J. A. Fay & Egan Company, and the Cincinnati Milling Machine Company, of Cincinnati, Ohio. All the above mentioned contracts were secured through the New York office of the Japanese house of Takata & Co.

THE I. P. MORRIS COMPANY, of Philadelphia, Pa., has been awarded a contract for six new 5000 horse-power turbines by the Niagara Falls Power Company. The new turbines are to be built after designs prepared by Escher, Wyss & Co., of Zurich, Switzerland, and will differ from the turbines now in use, principally by the guides and buckets being enclosed in the wheel case and having draft tubes which will allow the utilization of the full head of water available. The turbines now in use in the present wheel-pit were designed by Picard, Pictet & Co., of Geneva, Switzerland. About a year ago Dr. Coleman Sellers and William A. Brackenridge, of the Niagara Falls Power Company, visited Geneva, Switzerland, and on their return last Spring, the Niagara Falls Power Company invited competitive plans from Escher, Wyss & Co., of Zurich, which have now been accepted. When the new turbines are installed they will be placed in the new wheel-pit to drive the six 5000 generators ordered last November from the General Electric Company, of Schenectady. It is expected that the I. P. Morris Company will deliver the new turbines in August of the present year. Clemens Herschel is the consulting hydraulic engineer of the Niagara Falls Power Company.

SPRAGUE COMPANY IN THE SOUTH.—With the beginning of the new century, the Sprague Electric Company opened another branch office to facilitate the handling of its constantly increasing business in the South. The new office is located in Baltimore in the Guardian Trust Building, corner of Calvert and German streets. The Baltimore office will enable the company to keep in closer touch with the large amount of Government work constantly being done and also to handle more conveniently the increasing demand for its various products throughout the South. The manager of the new office is Mr. W. H. A. Davidson, who goes there from the New York office, where he has been for many years. He has sold Lundell motors ever since they have been on the market, and is thoroughly familiar with their characteristics.

THE MORRIS ELECTRIC COMPANY, of New York City, has just made shipment of what is claimed to be the largest number of iron poles ever shipped from this country in one lot. The contract called for no less than 8,000 poles intended to be utilized for the transmission line of the water power plant, which is being erected by the General Electric Company, at an estimated cost of three-quarters of a million dollars, for the purpose of operating the far-famed Mysore Gold Fields in India. The power house is to be installed at Cauvery Falls, ninety-three miles distant from the gold fields. The poles, which were manufactured by the Electric Railway Supply & Equipment Company, of Cincinnati, aggregated a weight of nearly 1500 tons. The contract was valued at $16,500.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has secured a contract for the installation of its special system of newspaper motor control in the printing plant of *El Diario*, one of the most prominent newspapers published in Buenos Ayres, Argentine Republic. The contract, which is valued at $12,500, calls for twenty motors, varying from 1-hp to 40-hp each. Current to run these machines will be derived from the central generating station of the Buenos Ayres Tramway Company. The Cincinnati concern has also been awarded a contract for the equipment of a generating plant in Tasmania. The value of the order is said to exceed $11,000.

PLANS FOR BELLOWS FALLS, VT.—The Fall Mountain Electric Light & Power Company has succeeded to the Bellows Falls Electric Light Company and makes the following announcement: "The aim of this company will be to establish a modern plant for the generation and supply of electricity, as speedily as possible, and with that end in view, we are perfecting plans for the building of a steam auxiliary plant, where a complete duplicate generating plant will be held as a reserve in case of interruption to the service of the main plant; the latest modern apparatus will be installed and in general everything will be done to make the service modern in all respects."

THE ELECTRIC STORAGE BATTERY COMPANY has recently closed a contract with the Camden & Suburban Railway, N. J., for the installation of an additional battery of chloride accumulators, making the third order received from this company. The new battery sub-station is necessitated by the extension of the railway company's lines to Moorestown, a distance of ten miles from their power house at Camden, and will be located at Pensauken Creek, near Moorestown. The battery will consist of two hundred and forty cells, having a capacity of two hundred kilo-watt hours.

THE AMERICAN BRIDGE COMPANY has grouped all its Eastern plants in one section, and has appointed Mr. A. J. Major, formerly manager of the Bridge and Construction Department of the A. & P. Roberts Company, as manager of all of these plants, which include the following: The Pencoyd plant, the East Berlin plant, the Buffalo plant, the Edge Moor plant, the Elmira plant, the Groton plant, the Hilton plant, the Horseheads plant, the Trenton plant, the Post & McCord plant, the Rochester plant and the Union plant.

THE AMERICAN STOKER COMPANY, of New York City, is reported to have recently closed contracts for the shipment of over sixty underfed mechanical stokers for various parts of the world. The Halifax Electric Tramways Company, of Halifax, Nova Scotia, is to be equipped with eight machines. Six stokers are to be shipped to the Brisbane Tramways Company, of Brisbane, Queensland, while other Australian contracts include four equipments, which will be installed in the principal generating station of the Sydney Tramways Company.

TROLLEY WORK IN NEW ENGLAND.—A considerable amount of electric railway is in process of construction up in New England, under General Electric engineers: The Boston & Worcester, with J. Shaw in charge; Rockingham County (Portsmouth, Dexter, etc.), W. D. Lovell; Nashua, Lawrence & Haverhill, C. E. Barnes. Then there is the work on the Boston Elevated, with Mr. A. Anthon in charge, with headquarters at 10 Milk street, Boston.

CLAY CONDUITS.—The clay working and coal mining interests of John T. McRoy, maker of the well known "McRoy conduits," situated at Brazil, Ind., which he has conducted for the past five years, have been incorporated as the McRoy Clay Works. "McRoy conduits" will continue to be the principal product manufactured. Hereafter, the headquarters of the company will be Brazil, Ind., with branch offices in Chicago and New York.

PRINTING TELEGRAPH.—A series of tests of the Murray page-printing telegraph system recently made between Boston and New York, extending over a fortnight, were remarkably successful, a column of the New York *Herald* being repeatedly transmitted without any error at speeds varying from 60 to 96 words a minute. A number of ordinary commercial messages were also transmitted with equally satisfactory results.

THE KEHIN ELECTRIC RAILWAY COMPANY, Japan, has placed an order with the Westinghouse Electric & Manufacturing Company, through Takata & Co., for the supply of one 150-kw generator, a number of small motors, switchboard, instruments and other accessories required for an extension of its power plant.

Ahearn & Soper, of Ottawa, Canada, who have long been actively connected with Canadian electrical development and the representation of American electrical manufactures in the Dominion, announce that their busineses has now been incorporated as Ahearn & Soper, Limited.

CATALOGUES AND PRICE LISTS WANTED.—La Compania Electrica de Regla & Guanabacoa, of which H. H. Rivera de Gray, Regla, Cuba, is electrical engineer, desires to receive catalogues and price lists of electrical machinery and supplies, engines, etc.

General News.

THE TELEPHONE.

PERU, IND.—Jerome B. Herff has secured a telephone franchise at this place.

TEMPLE, GA.—J. B. Earle and J. E. Boynton have obtained a telephone franchise here.

WEST UNITY, OHIO.—The Citizens' Telephone Company has been organized to install a local exchange. Capital stock, $15,000.

ALLIANCE, OHIO.—The Columbiana County Telephone Company is building a line connecting the exchanges at Salem, Sebring and Alliance.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has opened its two branch exchanges, one in Newburgh and the other in East Cleveland.

SHERIDAN, IND.—The Central Indiana Telephone Company has made plans to build a toll line to Arcadia and establish an exchange at that place at once.

SALEM, OHIO.—The Columbiana County Telephone Company has completed details for the establishing of 27 toll stations with automatic toll boxes in this county.

BRAZIL, IND.—Rural telephone service is rapidly increasing in Clay County. The plan in vogue for making extensions is for each farmer-subscriber to build one mile of line.

ALBANY, N. Y.—The Cuba Telephone Company of Cuba has been incorporated. Capital, $12,000. Directors: Charles Richer, Clarence Richer and G. H. Richer, Cuba.

MACON, GA.—The St. Petersburg Telephone Company has been incorporated by T. C. Parker, John W. Markham, Charles L. Goodrum and William B. Birch. Capital stock, $10,000.

GUTHRIE, OKLA.—The Osage Telephone Company was granted a charter Jan. 12. Its capital stock is $10,000. The incorporators are Elijah N. Yates, W. Brideville and Elliott B. Gravet.

BELLEVUE, OHIO.—The Bellevue Telephone Company is enjoying a healthy natural growth. It now has 340 subscribers, 40 of which were obtained last year. It has a switchboard capacity of 400 drops.

GALLATIN, MO.—Articles of incorporation have been granted the Davies County Telephone Company. The capital stock is $5000. The incorporators are C. J. Bain, J. W. P. Lane, M. L. Bain and others.

XENIA, OHIO.—C. D. Juvenall of Upper Sandusky, A. A. Dye of New Philadelphia, Elias Haiman, J. M. Blatt and I. N. Dufan of Cleveland are organizing a local independent company and have applied for a franchise.

COLDWATER, OHIO.—The Co-operative Telephone Company of this place now has 38 subscribers and a switchboard capacity of 250 drops. The company reports a steady growth in the number of subscribers. Mr. Anthony Rathweg is secretary.

METROPOLIS, ILL.—The franchise granted to the Cumberland Telephone & Telegraph Company recently was repealed by the City Council Jan. 14. The company's attorney stated that suit for damages will be instituted at once against the city.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has elected the following directors: E. M. Waller, E. R. Taylor, W. W. Stevens, J. F. Babcock, C. F. Pitkin, H. L. Beatty. The capital stock has been increased from $10,000 to $20,000.

AKRON, OHIO.—The People's Telephone Company has just completed traffic arrangements with the United States Telephone Company for New York and Chicago service. The United States Company is putting up a line from Akron and Cuyahoga Falls to Medina.

CARROLLTON, OHIO.—The Stark County Telephone Company has applied for a franchise for an exchange in this place, and has been assured that it will be granted. A toll line will be built from Carrollton to Steubenville, via Harlem, New Amsterdam and Richmond.

EAST LIVERPOOL, OHIO.—The Columbiana County Telephone Company has settled the differences with striking linemen and the men have returned to work at $2.50 per day for such days only as outdoor work can be done. The company offered $55 per month for winter months.

LEWISBURG, PA.—The Home Telephone Company of this place now has 340 subscribers, of which 140 were acquired during the last year. Proposed extensions include 50 new subscribers and a Williamsport trunk line connection. Mr. John P. Ruhl is the manager of the company.

CINCINNATI, OHIO.—The Cincinnati Telephone Company shows a gain of over 2000 subscribers during the fiscal year just ended. This company, the City & Suburban Telegraph Association, as it is called, has successfully combatted all efforts of outsiders to secure a competitive franchise.

BRITT, IA.—The Western Telephone Company has purchased the entire stock of the Iowa & Nebraska Telephone Company, valued at $100,000. This includes the exchanges at Sheldon, Sibley, Estherville, Spirit Lake and Cherokee. The Western Company operates 2700 miles of line in Iowa, Minnesota and the Dakotas.

NASHVILLE, ILL.—An extension of the long-distance line of the Union Telephone Company, between this city and Okawville, will soon be commenced. During the year the Union Company acquired several minor lines in this part of the State and now has an excellent system. A line between this city and Irvington will also be erected.

CLEVELAND, OHIO.—The talk of consolidation of the Cleveland Telephone Company (Bell) and the Cuyahoga Telephone Company has again been revived. The Cleveland Telephone Company's offices have recently experienced a thorough shaking up. A large number of employees in the construction and contracting departments have been discharged.

TOLEDO, OHIO.—The long-talked-of Toledo independent company has materialized by the organization, a few days ago, of the Toledo Telephone, Telegraph & Messenger Company, with a capital stock of $25,000. The incorporators are J. H. Bellows, L. P. Harris, C. F. Watts, H. A. Merrill and A. M Hough. It is proposed to conduct a telephone, telegraph and messenger service in Toledo and in Lucas, Williams, Fulton, Ottawa, Erie, Ashland, Sandusky, Lorain and Cuyahoga counties. The company is backed by Toledo capital and a franchise will be applied for at once.

CLEVELAND, OHIO.—The Federal Telephone Company, which is the controlling organization of the United States Telephone Company and other allied independent companies, has completed arrangements whereby it takes over the organization of the Interstate Telephone Company, the Galion Telephone Company and the People's Telephone Company of Shelby. It is now making preparations, getting out bills of material, etc., for the coming year's work, which indicates that the year 1901 will be equally as active with this company as any previous year.

THE NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY issues a special notice to its subscribers that, owing to the rapid increase in the number of subscribers in the present Haymarket Exchange district, Boston, it becomes necessary to divide the district, making two exchanges in place of one On April 1, a new exchange will be opened under the name of "Richmond." In consequence of the establishment of numerous exchanges within the city, the designation "Boston," which has heretofore been employed for the Milk Street Exchange, has ceased to be distinctive, and on Jan. 1 the use of this name was discontinued and the name "Main" substituted.

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ELECTRIC LIGHT AND POWER.

MT. STERLING, KY.—The electric light plant here is to be enlarged.

NEWCASTLE, DEL.—A municipal electric light plant may be erected here

GAINESVILLE, GA.—A company proposes to build an electric light plant here.

PORTSMOUTH, N. H.—The Portsmouth Gas, Electric Light & Power Company will, it is reported, erect a new plant.

BUFFALO, N. Y.—The Buffalo & Niagara Falls Electric Light & Power Company has increased its capital stock from $250,000 to $500,000.

ROCKINGHAM, N. C.—This city will petition the Legislature for permission to issue bonds for erecting an electric light plant and water works.

DARTMOUTH, N. S.—The Council for the town will apply to the local Legislature for authority to borrow $40,000 for electric lighting purposes.

ANNAPOLIS, N. S.—The rate payers of the town of Annapolis have decided to take over the O'Dell electric light plant of the town and operate it under municipal ownership and control.

TAMPA, FLA.—The city has voted affirmatively on the queation of issuing the $250,000 of bonds for acquiring the city waterworks and an electric light plant if there is enough money left.

TRENTON, N. J.—The Freehold Electric Light, Heat & Power Company, with a capital of $10,000, has been incorporated by Ruhef P. Smock, Freehold, N. J.; Joseph McDermott, Freehold, N. J.

ELLICOTT CITY, MD.—Jacob Shaw, of Ellicott City; George L. Mone and Edw. L. Ward, of Baltimore, have bought the light plant of the Ellicott City Electric Company, and will operate it.

COLUMBUS, OHIO.—W. H. Sharp and John J. Chester, who are building a number of apartment houses and dwellings on the North Side, have applied for a franchiae to install and operate an independent lighting system.

RAVENNA, OHIO.—The Ravenna Gas & Electric Light Company has elected officers as follows: Charles Merts, president, W. H. Hayes, vice-president; W. H. Beebe, treasurer; E. P. Merts, secretary; E. C. Lindsey, superintendent.

WINSTON-SALEM, N. C.—The North Carolina Electrical Power Company will increase its capital stock of $100,000 and arrange for an immediate continuance of the work for developing its water power and transmitting electrical energy for factories, etc.

GREENVILLE, ILL.—Local capitalists are considering the proposition of erecting and maintaining an electric light plant. The company operating the present city plant has raised its prices, and a meeting of the patrons will be held to consider the new plant proposition.

KENDALLVILLE, IND.—The City Council of this city has taken steps toward securing an incandescent electric-light plant. It is the purpose of making the new municipal plant auxiliary to the arc light plant, which has been operated very sucessfully by the city for several years.

OTTAWA, ONT.—Messrs. Robertson & Robertson, of Victoria, B. C., will apply to the Dominion Parliament for the incorporation of a company for the transmission of electric power and the construction and operation of telephone lines within the districts of Esquimalt, Victoria City and North and South Victoria.

SAN FRANCISCO, CALIF.—The Truckee River General Electric Company, which operates the transmission system, supplying the mines on the Comstock lode with electric power, recently declared its first dividend of 10 cents a share, payable Jan. 20. It is expected that a similar dividend will be paid each month in future.

RICHMOND, IND.—The citizens of this city are much aroused over the proposition of the City Council to expend over $144,000 for a municipal electric light plant. All of the bids recently opened exceed that figure, and a decided sentiment against awarding the contract has developed. It is probable that a suit will be brought to enjoin the Council from making the appropriation.

MINNEAPOLIS, MINN.—Mr. P. F. Crafts, representing the Eastern capitalists who are said to have purchased the plant of the International Electric Company recently, has been appointed receiver for the concern. This action was precipitated by a suit of the Minneapolis Loan & Trust Co., as trustee of the bondholders, to foreclose the trust deed to secure the outstanding bonds, amounting to $140,000.

ST. LOUIS, MO.—At the annual election of the Missouri Edison Electric Company last week the following officers were elected: S. M. Dodd, president; James Campbell, vice-president; Sherman B. Pike, secretary; C. L. Horton, assistant secretary; Jas. J. Kelly, treasurer. Directors: S. M. Dodd, James Campbell, J. C. Van Blarcom, Thomas H. West, James W. Bell, R. C. Kerens and Edwards Whitaker.

MINNEAPOLIS, MINN.—Mr. Thos. Lowry states that he, with other capitalists, will build a dam and electric power house at Coon Creek Rapids on the Mississippi River. Flowage rights have been obtained and surveys and plans are being made. The dam will be erected about nine miles from Minneapolis. The plant will supply the electric needs of Anoka and Columbia Heights. It is estimated that 10,000 horse-power are available at the falls.

CINCINNATI, OHIO.—It is now practically certain that the North American Company has secured control of the Covington Gas Company, the Covington Electric Light Company and the Newport Gas Company. The North American Company is also the owner of the Cincinnati Edison Electric Company, and those on the inside believe that the latest move is one calculated to assist the Cincinnati Edison Company in securing control of the Cincinnati Gas Company, a bitter competitor.

OTTAWA, ONT.—The movement in favor of municipal ownership and operation of electric light plants is gaining in popularity throughout the Province of Ontario. The town of Blenheim has just carried a by-law for the town to take over its electric light system; Parry Sound has also carried a by-law for $29,500 to purchase the electric light plant of the town and improve water works, and the electors of the town of Lindsay have voted in favor of municipal ownership of the electric light plant.

NEW YORK, N. Y.—Contracts have been awarded for the lighting of buildings and streets in the Boroughs of Brooklyn and Queens, as follows: Arc lights in Brooklyn to the Edison Company, of Brooklyn, at 34 cents per lamp per night for 1200-cp lamps and 17 cents per night for 600-cp lamps, providing 4000 or more are used. If less than 4000 are used the rate is to be 35 cents per 1200-cp and 18 cents per 600 cp. The contract for Queens electric lighting goes to the New York & Queens Electric Power Company for incandescent lamps at $25 per year each.

SANDUSKY, OHIO.—Bids have been opened by the city for electric lighting. The Sandusky Gas & Electric Light Company, which now has the contract, made a bid of $82.50 per lamp for five-year contract, and $80 for ten-year contract; its present rate is $87.50 for 166 arc lamps. The Citizens' Electric Light & Power Company offered a bid of $71 per lamp for five-year contract and $70 per lamp for ten-year contract. The Citizens' Electric Light & Power Company is an adjunct of the Sandusky & Interurban Electric Railway Company, and it has no franchise.

NEW YORK CITY.—The Park Commissioners have denied the application of a number of wealthy residents of Morningside Heights for permission to build an electric elevator in Morningside Park, between 116th and 117th Streets, the board considering that the proposed structure would mar the beauty of the scenery in that part of the park. Some time ago residents of Morningside Heights formed a company to construct an elevator, subject to the approval of the Park Commission. The heights at the point mentioned are very steep, and the summit can only be reached by a stiff climb up winding stone stairs and inclined pathways. Nobody has explained why the elevator shaft could not be run up through the face of the cliff, out of sight, instead of in the open.

NIAGARA FALLS, N. Y.—For several months the Common Council of the City of Niagara Falls held up the amount of the lighting bills of the Buffalo & Niagara Falls Electric Light & Power Company, the object being to force the company to work its employees in shifts of eight hours. At a recent meeting of the Council the city attorney called the attention of the mayor and aldermen to a decision of the Court of Appeals covering a similar case, and pointed out that the course adopted by the Council would not be sustained by the courts, but, on the contrary, that if the bills were not paid, costly suits for the city might result. The bills were immediately ordered paid. By the decision referred to it was shown that the city had no right or pretext to arbitrarily hold up the bills of the company for moneys due under the terms of a contract, for the purpose of enforcing the company to observe the eight-hour law.

THE ELECTRIC RAILWAY.

HAMILTON, OHIO.—Local capitalists are forming a new company for an electric railway from Hamilton to Eaton.

UNION, S. C.—A franchise has been granted to Col. T. C. Duncan and associates to build an electric railway in this city.

LEICESTER, ENG., has reported in favor of a trolley system of electric roads, and proposes to put in eighteen miles of double track.

NEW ALBANY, IND.—Louis Schneck and others have obtained a franchise for an electric railway between this city and Jeffersonville.

CANTON, OHIO.—James M. Ferguson, of Steubenville, is the promoter of an electric railway which will extend from Canton to Steubenville.

SHELBY, OHIO.—A. J. Kern and associates have been granted a 25-year franchise through this place for the proposed road from Bucyrus to Ashland.

ITALY.—An electric railway is proposed to run from San Niccolo to Agozzano, Italy. It is stated that London capitalists are interested in the scheme.

CHILLICOTHE, OHIO.—The Ross County Commissioners have withdrawn the franchise granted on Dec. 17 to the Columbus & Southern Electric Railway.

LIMA, OHIO.—The promoters of the Lima & Findlay Electric Railway have decided to change the route originally planned so that the road will pass through Blanchard and Benton Ridge.

LANSING, MICH.—Articles of incorporation of the Detroit & Charlevoix Railway Company have been filed. The company is capitalized at $525,000 and is wholly owned by the estate of David Ward.

CINCINNATI, OHIO.—The Cincinnati Street Railway Company is now building its own cars. Practically all departments are now in running order and every style of car is built entirely at this plant.

EAST LIVERPOOL, OHIO.—The stockholders of the East Liverpool & Wellsville Street Railway Company have decided to make a number of improvements to the road and to purchase a number of cars.

THE JERSEY CENTRAL will establish an electric automatic block signal system on its entire line between Bound Brook and White Haven. Many grade crossings will be eliminated in Bayonne and Newark.

READING, PA.—The differences between the employees and the United Traction Company of this city, noted last week, were finally adjusted by a board of arbitrators, nearly every demand of the strikers being granted.

AKRON, OHIO.—Thomas L. Childs, who has secured franchises in Stark and Summit counties for the Canton & Akron Electric Railway, has announced that he will build a new line from Akron to Cleveland, and franchises will be applied for.

SACRAMENTO, CALIF.—The Auburn Electric Railway Company was recently incorporated, with Auburn, Calif., as the place of business. Directors: A S. Moore, B. F. Hartley, J. H. Wills, P. C. Moore and F. G. Flanagan. Capital stock, $50,000.

TAMPA, FLA.—A company has been incorporated here under the name of the Florida Sub-Peninsular Transportation Company, with a capital of $1,000,000. This company proposes to construct electric railways to a number of towns situated along the gulf coast.

INDIANAPOLIS, IND.—The Connersville Traction Company, capital $25,000, board of directors headed by J. C. McFarlan, and the Greensburg & Versailles Electric Railway Company, capital $100,000, board of directors headed by G. S. Littel, have been incorporated.

CINCINNATI, OHIO.—It is reported that formalities have been practically concluded whereby the Whitney-Elkins-Widener syndicate will secure control of the Cincinnati Street Railway Company. Mr. John Kilgour, president of the company, denies the truth of the report.

ASHLAND, OHIO.—At the meeting of the stockholders of the Norwalk, Ashland & Southern Railway Company Judge C. P. Wickham was elected president and C. F. Jackson treasurer. The road will extend from Norwalk to Ashland over a private right of way 36 miles in length.

BUFFALO, N. Y.—An effort is being made to organize a new company, capitalized at $800,000, out of the Buffalo, Hamburg & Aurora Railway Company. Those interested include George H. Blanchard, William Miller, Edward Henry and Luther Cary, all of Erie County.

BUCYRUS, OHIO.—The Buckeye Traction Company, of this city, has been incorporated by H. V. Flickinger, R. V. Sears, W. A. Blicke, S. J. Kibler, A. J. Scott and C. Feiring. It is the intention to build an electric railway from Bucyrus to Norwalk. The temporary capital stock is $10,000.

CINCINNATI, OHIO.—Application has been made for a franchise to build a new traction line from the present terminus of the Norwood (Cincinnati) Railway lines through the towns of Montgomery, Silvertown, Pleasant Ridge, Kenedv Lebanon, Kings Mills, Warren and into Dayton, Ohio.

OTTAWA, ONT.—Information has been received that the Alaska Exploration Company, a syndicate capitalized in Great Britain, has laid plans before the Council for the Yukon District for the building of a $1,000,000 line of street railways through the main streets of Dawson City and out to the creeks.

SPRINGFIELD, OHIO.—A new company, soon to be organized, has made application to the Clarke County Commissioners for a franchise for an electric railway to extend from Springfield to South Charleston. The promotors are L. H. Houston, Edward Houston, J. F. Rankin and S. B. Rankin, of South Charleston.

DEFIANCE, OHIO.—The Northern Ohio Electric Railway Company has been incorporated by W. D. Sherwood, Elias Bartholomew, Charles H. Adkins, Gilbert Bartholomew, E. W. Fink, J. U. Merwin and C. H. Hubbard for the purpose of constructing an electric railway from Defiance to Bryan. The capital stock is $25,000.

ANDERSON, IND.—A train-dispatching system is being inaugurated by the Union Traction Company between this city and Indianapolis by means of the telephone. There are switches every two and a half miles. The conductors carry receivers that can be attached to wires suspended every half mile from the wires overhead.

SANDUSKY, OHIO.—The Sandusky & Interurban Electric Railway has submitted a bid for municipal electric lighting under the name of the Citizens' Light & Power Company. In case it secures the contract it will be necessary to string new wires over the whole city, as the Sandusky Electric Company has always enjoyed a monopoly of the business.

CHATTANOOGA, TENN.—Application has been made here for a charter for the Chattanooga & Lookout Mountain Railroad Company by the recent purchasers of the Chattanooga Rapid Transit Company, Clarence P. King and others of Philadelphia, to enable the company to do a general freight business in connection with passenger service.

OTTAWA, ONT.—Letters of incorporation and a charter have been granted by the Ontario Government to the Queenston, Niagara & Port Dalhousie Electric Railway. The share capital of the road is $40,000, and it proposes to connect Queenston with Niagara-on-the-Lake, the latter place with Port Dalhousie, and the latter town with the city of St. Catherines.

CLEVELAND, OHIO.—The gross earnings of the Cleveland Electric Railway Company for 1900 were $2,061,434. In 1898 the gross earnings were $1,739,331, and in 1899, through the influence of the strike, they dropped to $1,509,003. The operating expenses and taxes for the year were $1,119,986, as compared with $1,046,592 for 1898 and $967,949 for 1899.

COLUMBUS, OHIO.—The new blanket franchise, granted the Columbus Street Railway Company, provides for the double trolley system as a safeguard against electrolysis. The company is to pay the city $10,000 a year and 2 per cents of its gross receipts in excess of $1,000,000, with an extra 1 per cent for each additional $250,000. These cash payments are to cease whenever the company sells eight tickets for 25 cents. The franchise is for 25 years.

BRAZIL, IND.—The Stone & Webster syndicate has arranged to locate a $200,000 rolling mill at this place. The company announces that it will build one or more electric railroads out of Brazil into the populous districts touching Carbon, Diamond, Cardinia, Benwood Perth, and Bridgeton. This company owns the Brazil street car system and electric light plant, also the Terre Haute street railway system and electric light works, besides the interurban line between these two cities.

NEWARK, N. J.—The report is confirmed that the Raritan Traction Company has secured from the Freeholders of Middlesex County, N. J., the right to extend its lines to New Brunswick and to Woodbridge, thereby giving it connections with the Consolidated Traction Company of New Jersey and enabling the company to run from Perth Amboy to Jersey City by trolley. The Raritan Traction Company is a consolidation of the Perth Amboy Railroad and the Raritan Trolley Company, and is owned by New York capitalists.

CINCINNATI, OHIO.—The Westinghouse Electric Company has a contract to furnish the electrical equipment for the Columbus & Buckeye Electric Traction Company, the cost being in the neighborhood of $160,000. The main power house will be at Hebron, midway between Columbus and Newark. Sub-stations will be located between Hebron and Columbus and between Hebron and Newark. Alternating current at 1500 volts will be transmitted to the rotary substations and there transformed to 550 volts direct, which will be used to operate the cars.

THE TOLEDO, FOSTORIA & FINDLAY ELECTRIC RAILWAY COMPANY, and the Dover Construction Company, which is building the road, have closed contracts for the equipment of the power house now building near Fostoria, Ohio. The Westinghouse Electric & Manufacturing Company will furnish two 250-kw engine type railway generators, 640- volt, 150 r. p. m.; one 75-kw 200-volt motor-driven booster, and an eight-panel switchboard. The Arbuckle-Ryan Company, Toledo, will furnish a 400-hp Russell engine. Contracts have also been closed for six Jewett Car Company's cars, to be equipped with 55-hp Westinghouse motors and Peckham trucks.

THE AUTOMOBILE.

AUTOMOBILE CLUB OF AMERICA has before it as candidates for active members, A. C. Harmsworth, of the *London Daily Mail;* H. Ward Leonard, the electrical engineer, and W. K. Vanderbilt.

COLLECTING MAIL BY AUTOMOBILE.—The Post Office authorities in Boston have made arrangements to use three steam automobiles for the purpose of collecting mails in the Back Bay district.

NEW YORK CYCLE SHOW last week was quite a success, but only a few automobiles were shown, chiefly by the American Bicycle Company, including six Waverley electrics. The Boston Motor Carriage Company showed a new electric runabout with a single motor. Chas. E. Miller had a good exhibit of automobile supplies.

LOUISVILLE, KY.—The first and only electric delivery wagon in the State of Kentucky was sold to the John C. Lewis Company (large department store) by G. W. Hubley, agent for the American Electric Vehicle Company of New York. The vehicle has proven most successful in this class of work and has been in daily working service without interruption during the past three months and averages 35 to 40 miles per day.

THE BOSTON AUTOMOBILE SHOW.—The automobile show to be held in Mechanics' Building, Boston, during the week of March 4 to 9, inclusive, will, according to indications, be a success. It is proposed to have daily exhibitions of automobiles in operation, under the supervision of a committee selected from the local automobile clubs. Manufacturers in every section of the country, it is stated, are taking an interest in the exhibition.

NEW INDUSTRIAL COMPANIES.

NEWARK, N. J.—The Newark Electro-Galvanizing & Plating Company has been incorporated; capital, $25,000. Incorporators: Edward Lyman, New York; Charles L. Kingsley, attorney, New York.

ALBANY, N. Y.—The United States Electric Contracting Company, of Syracuse, has been incorporated; capital, $40,000. Directors: David Cronin, F. S. Rogers and E. R. Caldwell, Syracuse.

THE MISSOURI ELECTRICAL COMPANY, with a capital stock of $20,000 all paid up, has been incorporated at St. Louis, Mo. Robert W. Moore, Fred B. Little, Wm. F. Little, W. F. Little and stockholders.

ST. LOUIS, MO.—Articles of incorporation have been filed by the Imperial Electric Plating & Manufacturing Company. The capital stock is $5,000. John S. McKinley, Frank R. Harris and Frank L. Horton are the incorporators.

LEGAL.

COMPLAINT DISMISSED.—Justice W. M. Smith, of the Supreme Court in Brooklyn, dismissed the complaint of Mark Farrell against Noah L. Cocheu. Mr. Farrell is a stockholder in the State Electric Light & Power Company, and brought suit against Mr. Cocheu, charging him with conspiracy and violation of his office as president, director and general manager of the State Company in selling the plant to the Amsterdam Electric Light, Heat & Power Company. In dismissing the complaint Justice Smith says that the company was heavily in debt and the only asset it had was its franchise, and that in order to save this a mile of conduit had to be laid. The company did not possess enough money to lay the conduit, and therefore Mr. Cocheu, after giving notice to the stockholders, sold the franchise to the Amsterdam Company. The proceedings were regular, Justice Smith states, and Mr. Cocheu's action was ratified by the stockholders.

OBITUARY.

THE LATE F. A. GILBERT.

MR. F. A. GILBERT, president of the Boston Electric Light Company, died quite suddenly while in New York City last week. He was dining at the New York Club with Mr. J. P. McQuaide and was seized with a choking, apoplectic fit. He appears to have died almost instantly, the doctors being able to afford him no relief. He was only fifty-four years of age and was a man of very corpulent habit of body, so that he suffered from shortness of breath. He was one of the pioneers in the development of electric lighting in New England, and at the time of his death was an officer or stockholder in such companies as the Boston, New Haven, Newport, Bridgeport, Portland, etc. He became interested in the Boston field in 1888 through the foreclosure purchase of the Merchants' Electric Light Company; and soon after he consolidated all the interests, except the Edison, in the Boston Electric Light Company. As these columns have recorded, a deal with the Boston Edison Company was on foot, and it is understood that he was in New York in connection with the difficulties that had arisen in the matter. His estate is estimated at from $500,000 to $1,000,000; he held 1[illegible]0 shares of Boston Electric Light selling at over 200. He was a director in the New England Electric Vehicle Company and the Copper Range Railroad, and was heavily interested in copper mining. For some years he had been president of the Massachusetts Electric Light Association, but had steadfastly declined the frequent requests to serve as president of the National Electric Light Association. Aside from his great executive ability, he was of genial disposition, enjoying society and taking a keen interest in life's affairs generally. The funeral services took place at New Haven on Jan. 21.

EDWIN HOLMES. Edwin Holmes, president of the Holmes Electric Protective Company, died on Thursday, Jan. 17, in New York City, from a complication of diseases. He was born in West Boylston, Mass., eighty-one years ago, and was educated at the Leicester Academy. At the age of twenty he was engaged in Boston in what was then known as the "Yankee notions" business. He began the study of electricity in 1857 and two years later got a patent for an electrical appliance called the "Home Protector." This apparatus was a system of stringing wires connected with a bell which would announce the opening of a door or window in the house once the alarm had been set. He then came to this city and became interested in the development of the telephone. He was president of the first telephone company in this city, which afterward became the Metropolitan Telephone Company, and which is now part of the Bell system. In 1873 he conceived the idea of furnishing protection to the banking houses, and the jewelry houses in the Maiden Lane district, with his burglar alarm system and he located a station in Pine street. The Holmes Electric Protective Company was formed in 1883. Mr. Holmes married Elizabeth A. Richardson of his native town. She and three children survive him. The children are Edwin T. Holmes, who was associated with his father in business, Mrs. J. Stewart White and Mrs. A. S. March, of Orange, N. J.

PERSONAL.

DR. A. E. KENNELLY is to lecture before the Franklin Institute and the Y. M. C. A., Philadelphia, on Feb. 1, on solar eclipses and what they teach us.

PROF. E. P. ROBERTS, of Cleveland, Ohio, at the January meeting of the Cleveland Electric Club, read a paper on "The Design of Electric Railway Power Stations."

MR. J. J. OOLGARDT, who had charge of the General Electric exhibit at the Paris Exposition, has closed up all his work there, and has just returned home. He went up to Schenectady last week.

MR. OZRO N. WISWELL, formerly of Lynn, Mass, and for the past eighteen months the city electrician of the Municipal Electric Light plant of the city of Tacoma, has severed his connection with the city.

MR. C. W. RICE, on the evening of Jan. 18, gave a lecture before the Electrical Section of the American Institute of the City of New York, on the subject, "High Potential Distribution About New York City."

MR. W. J. CLARK, European manager for the General Electric Company, arrived in this city last week from London, but was confined to his hotel by illness, much to the regret of a host of friends anxious to see him.

MR. JAMES R. CHAPMAN, electrical engineer for the Union Traction Company, Chicago, has been employed by Charles T. Yerkes to superintend the construction and equipment of his underground railway system in London.

GEN. A. W. GREELY, chief signal officer, has disclaimed an intention on the part of the Government to use the Pupin method on its lines. He thinks it might be tried between Key West and Cuba by some company, but not on any Pacific cable.

MR. J. W. RENO, the engineer, who has lately been engaged in the development of electric stairways and whose system is in quite general use, was married on Jan. 15 in New York City, to Miss Marie H. Snowman, daughter of Mr. W. Hagenah.

LORD KELVIN, Master of the Clothworkers' Company, has accepted an invitation to dine with the governors of the Yorkshire College on Feb. 1, on the occasion of their annual gathering at Leeds. He is expected to deliver an address on textile industries.

GENERAL MANAGER McLEAN, of the Toledo Traction Company, will, it is reported, shortly resign to accept the position of general manager of the South Side lines in Chicago. Mr. McLean is at present recuperating his health in the West Indies. He will return to Toledo about Jan. 30.

MR. T. M. MESTON, the energetic secretary of the Emerson Electric Manufacturing Company, of St. Louis, Mo., is a visitor in the East and was at the company's New York headquarters last week. He reports very hopefully on the present situation, and is about to introduce some admirable novelties in the general line of power work.

MR. ROBT. T. LOZIER, of the Bullock Electric Company, of New York City, which concern acts as Eastern sales representative of the Bullock Electric Manufacturing Company, of Cincinnati, has been appointed a general sales agent of the Ohio concern. Mr. Frank G. Bolles, the advertising manager, has returned to headquarters at the factory.

MR. MARTIN O'BRIEN, late of the American Telephone & Telegraph Company's Chicago office, has removed to Providence, R. I., where he enters the employ of the Clark Automatic Telephone Switchboard Company. He has had an extensive experience in the telephone business, and will considerably augment the effective force of the latter company in its interesting new field of work.

MR. E. H. WISE, foreman of the Cambria Steel Company's electrical department at Johnstown, Pa., and John W. Carter, the company's superintendent of supplies, have jointly patented a design for a steel hopper-bottom freight car. The design is especially adapted for coke haulage. A crank manipulates the mechanism for emptying the car. It is believed that the Cambria Company may build the car as a new branch of business.

MR. PAUL H. BRANGS, for the past eleven years electrical engineer for the Lackawanna Railroad and during the past year sales agent for the Safety Car Heating & Lighting Company, has accepted a position as general Eastern agent for the Heine Boiler Company. He will assume his new duties Feb. 1, and will have his headquarters at the Bowling Green Building. Dating back to the early Edison and Maxim days in electric lighting, Mr. Brangs had a large experience and wide acquaintance, and brings boundless energy to his new work.

MR. CHAS. J. GLIDDEN, who has just resigned the presidency of the Erie Telegraph & Telephone Company, and may soon, it is rumored, retire from the telephone business on his handsome fortune, has been connected with the Erie company nearly eighteen years, being one of the organizers of the company in 1883. He has held the position of secretary, treasurer, vice-president and president. He has been connected with the telephone business over twenty-four years, starting the canvass for subscribers at Lowell in 1877 and serving a number of years as treasurer of several companies making up the New England Telegraph & Telephone Company and later being secretary of that company, which position he resigned in 1884.

Trade Notes.

THE DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, has increased its capital stock from $20,000 to $50,000.

THE WESTERN ELECTRIC CO., Chicago, in Bulletin No. 7009, describes and illustrates its series enclosed alternating arc lighting system.

AIR HOISTS.—The Northern Engineering Works, Detroit, Mich., in a pamphlet describes and illustrates its air hoists and pneumatic lifting appliances.

NEW ELECTRICAL COMPANY.—Mr. David Cronin, of Syracuse, N. Y., dealer in electrical supplies, has been succeeded in his business by the United States Electrical Contracting Company of the same city.

THE OTITO ELECTRIC COMPANY is the name of a new concern at 464 State Street, Schenectady, N. Y. The company will conduct a business of wiring for electric light, bells, burglar alarms, etc., and will also install private telephones and repair the same.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING & EQUIPMENT COMPANY, New York, has distributed a very convenient telephone call book, which no doubt will prove a great convenience in any office which may be fortunate enough to receive one.

WAGNER OFFICERS.—The following directors and officers were elected at the meeting of the Wagner Electric Company, St. Louis, Mo., on Jan. 14. Directors—S. M. Dodd, S. B. Pike, James Campbell, James W. Bell, J. C. Van Blarcom, Ferd Schwerdtmann and H. A. Wagner. Officers—S. M. Dodd, president; James Campbell, vice-president; S. B. Pike, secretary; W. A. Layman, treasurer.

THE PELTON ENGINEERING COMPANY, Cleveland, Ohio, announces the removal of its office and factory to the corner of Merwin and James Streets, that city, at which location the company will have every facility for better serving its patrons. The company conducts a business as contracting engineers, and installs steam apparatus, dynamos, motors, switchboards and machine tools, and carries full lines of supplies.

INTERIOR TELEPHONE.—The Simplex Interior Telephone Company, Cincinnati, Ohio, is making a line of high grade intercommunicating interior telephones for factories, warehouses, etc. The system is operated from a central battery. The transmitters are of granular carbon mounted in a hard-rubber cell, and the receivers are of the bipolar type. All parts of the instruments are made and finished in the best manner.

THE ANNESS-FREEMAN MANUFACTURING COMPANY, Hamilton, Ohio, has been incorporated, with $25,000 capital stock, to manufacture motors, generators and other electrical appliances under the patents owned by W. P. Freeman. The incorporators of the company are W. H. Anness, Louis F. Utz, W. D. Campbell, Aaron Wescoe and W. P. Freeman. A factory is being built in Hamilton which will be completed early next spring.

FRANKLIN'S BIRTHDAY.—The Franklin Electric Manufacturing Company, of Hartford, Conn., mailed to its friends on Jan. 17, Franklin's birthday, a steel engraved portrait in miniature of the good old scientist, diplomat and author, superscribed with a facsimile of his famous autograph. The attractive little gift was accompanied by a note calling attention to the fact that it commemorated the natal day of the company's grand old "godfather."

FIRE IN ST. LOUIS.—The factory of the Central Telephone & Electric Company, at 909 Market Street, St. Louis, Mo., was damaged by fire on the morning of Jan. 12. The loss falls somewhere between $6,000 and $10,000. The office and factory, together with goods of the St. Louis Electrical Supply Company, at 911 Market Street, were considerably damaged by water and smoke. The losses are covered by insurance. It is the opinion that the fire started spontaneously.

THE AMERICAN BRIDGE COMPANY will furnish the steel work for the new 10-story office building to be erected by the Mutual Savings Bank, San Francisco, Calif., and the Gillette-Herzog Manufacturing Company will supply the steel work for the office building to be erected by the Surety Investment Company at East Denver, Colo. The American Bridge Company announces that its New York contracting office will hereafter be in charge of Mr. S. Fischer Miller, formerly with Milliken Bros.

RUSSIAN STUDENTS.—Mr. Charles A. Olson, of the Crane Company, Chicago, formerly superintendent for the Westinghouse Company, at St. Petersburg, Russia, was a recent visitor at the International Correspondence Schools, Scranton, Pa. Mr. Olson stated that a number of men in his employ in Russia were students of the Schools. As instruction is carried on by mail, no difficulty is experienced in teaching students at a distance, and in fact the schools have students in over one hundred foreign countries.

THE ELECTRIC EQUIPMENT COMPANY.—Mr. Chas. J. Klein, formerly general superintendent of the New York Electric Equipment Company, has organized the Electric Equipment Company and become its president. The company's headquarters are at 101 West Thirty-ninth Street, New York, and it will conduct an electric equipment business, for which Mr. Klein is certainly eminently fitted, after an experience of eighteen years. Mr. Klein will give personal attention to all contracts entrusted to the new company.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has closed a contract with the Cleveland Twist Drill Company, Cleveland, Ohio, for equipment to increase the capacity of its power house, which was completed some months ago. The installation will consists of one 200-kw two-phase 240-volt alternating current generator, 7200 alternations, with exciter and switchboard. The Cleveland office of the Westinghouse Company reports that the use of alternating current apparatus for factory drive is rapidly growing in favor in its district.

A NEW MAGAZINE IDEA.—*Cassier's Magazine*, beginning with the new year, has put into practical shape a novel idea in magazine make-up—a "Library Edition," as it has been called. Instead of having the usual paper covers, this "Library" copy each month hereafter will be available in handsome cloth covers, with gilt lettering, printed on extra heavy paper—constituting in fact a copy *de luxe*. In this form, each separate copy of *Cassier's* will be a substantial volume, likely to have a much more enduring life than that of simply one single month.

SOME FORGE SHOP PLANTS have of late been provided with only a single fan blower designed to produce the blast for the fires and at the same time by means of a special piping arrangement to exhaust the resulting smoke from the hoods. In a recent paper read before the American Society of Mechanical Engineers Mr. William Sangster shows that "such an arrangement is not economical, since a much larger volume of air must be raised to a high pressure than if a separate fan had been used for the exhaust system. In the case given above we should have to handle five times 140 cubic ft. of air at 4 oz. pressure, requiring 1.25 hp., instead of .44 hp. for each forge. Even in a small system the power saved by the extra fan will pay for its cost in less than a year's time."

MINIATURE LAMPS.—The American Endoscopic Company, Providence, R. I., announces a new line of novelties. Among the latest productions of this company is the portable electric display sign which is designed for window display. It consists of a circular frame around the edge of which is a row of lamps. The space in the interior admits a card 20 ins. in diameter, upon which any advertisement may be placed. Eighteen and 20 lamps are placed on these signs. Another novelty is the electric hat pin for ladies, which is a perfect imitation of a miniature electric light. It is made in the following colors: Ruby, green and frosted. The Endoscopic Company makes a full line of electric novelties, such as night lamps, scarf pins, etc., its standard products being surgical lamps, dental lamps, series lamps, candelabra lamps, etc.

NEW ENGINEERING FIRM.—Messrs. George Weston and Charles V. Weston have formed a copartnership as consulting and contracting engineers under the firm name of Weston Brothers, with offices at 711 Merchants' Loan & Trust Building, Chicago, Ill. The firm will give attention to steam and electric railways, bridges, buildings, foundations, tunnels, plans, specifications and supervision of work. It has had long experience in the construction and development of railway properties, and it is especially fitted to carry on the business in the various lines above mentioned. The firm will make a special feature of the examination of street railway properties for the purpose of making full and trustworthy reports for the guidance of the investors.

THE ELECTRIC STORAGE BATTERY COMPANY has placed on the market a new type of chloride accumulator especially adapted to the requirements of telegraph, fire and police alarm, laboratory and other service where voltage rather than amperage is desired. This "BT" type, although of identical plate construction to the other sizes of accumulators manufactured by this company, is peculiar in having the positive and negative plates, together with the lugs or connectors cast in one section, forming "couplets," in this way obviating entirely the necessity for bolt connectors or burning, to set up the battery. The plates are simply lowered in the receiving jars and the only connections to be made are at the terminals, thus effecting a very considerable saving of labor in installation. The "BT" cell is made in one size only, the plates being 4" x 3 1-16", the discharge in amperes for eight hours being ¾ of an ampere, for five hours 1 ampere and for three hours 1½ amperes. A circular describing these cells will be forwarded upon application to any of the company's offices.

THE STUART-HOWLAND COMPANY, of Boston, is making a name for itself and building up a large business. Its growth has been exceptionally rapid. It started in the electrical supply business April 2, 1900, in a modest way. It has had to move into larger quarters since then, and now has seven salesmen on the road. As an example of the kind of supply business it is doing, two orders which it has on its books at the present time for lighting supplies amount to over $20,000. On August 6 it added street railway supplies to its line, and has already furnished the overhead material for 12 new roads, having orders on its books for 175 miles of street railway equipment. Mr. H. W. Smith, who has charge of the street railway department, is a good "live" man, with an extensive acquaintance, and is building up its business in this department in a substantial manner by making customers of some of the best roads in New England. The line which the Stuart-Howland Company carries is a very complete one, not only in street railway material, but also in lighting supplies, telephones, etc.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 15, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

665,864. COMPOSITION FOR CLEANING METALS; J. L. Bach, Buffalo, N. Y. App. filed Oct. 19, 1900. (See Current News and Notes.)

665,882. ELECTRIC ARC LAMP; J. A. Delzell, Lynn, Mass. App. filed Dec. 7, 1898. Details of a clutch carrier for the Brush-type of arc lamps.

665,888. CUT-OUT; W. L. R. Emmet, Schenectady, N. Y. App. filed July 27, 1899. (See Current News and Notes).

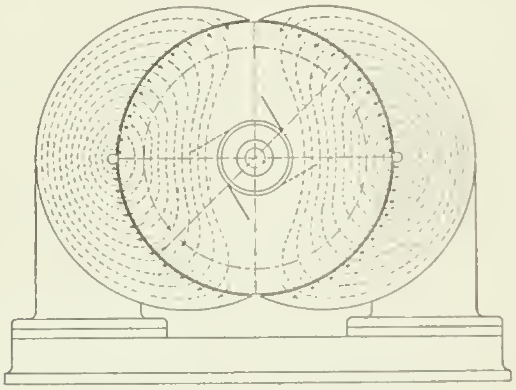
665,902. DYNAMO ELECTRIC MACHINE; H. E. Heath, Windsor, Conn. App. filed June 7, 1900. A dynamo electric machine having unwound pole pieces and a wound armature, with the planes of commutation of the armature circuits so arranged that the armature currents create magnetic flux through the armature and each pole-piece, the centre of which magnetic flux is approximately midway of the length of the pole-piece.

665,903. RHEOSTAT; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 13, 1900. A power driven rheostat comprising a motor and a limit device for cutting out the motor, automatically operated when the rheostat contact nears its limit of movement.

665,915. PROCESS OF ELECTROLYTIC PRODUCTION OF NICKEL OR ALLIED METALS; M. Kugel, Berlin, Germany. App. filed March 24, 1900. (See Current News and Notes.)

665,917. APPARATUS FOR OBTAINING RECIPROCATING MOTION; L. J. Le Pontois, Pittsburg, Pa. App. filed April 12, 1898. The invention consists, generally stated, in causing a conductor or conductors carrying current to be reciprocated in a unipolar magnetic field by the action exerted on the flux surrounding the conductor by the flux of the stationary field, the reciprocating motion of the conductor being obtained by reversing the current passing through the conductor.

665,921. COMBINED CIGAR LIGHTING AND CLIPPING DEVICE; C. A. Miller, Kansas City, Mo. App. filed Aug. 31, 1900. The device automatically restores the clipping mechanism to its original position and incidentally extinguishes the flame after the cigar has been clipped and lighted.


665,902.—Dynamo Electric Machine.

665,923. TELEPHONIC APPLIANCE; F. R. McBerty, Downer's Grove, Ill. App. filed Aug. 12, 1897. To avoid troubles arising from leakage of magnetism from one magnet to others closely adjacent, the magnets are provided with a mass of magnetic material forming a return circuit for the lines of force emanating from the core and an electrically conducting circuit encircling the core and the said return circuit.

665,928. ELECTRICAL CUT-OUT; C. G. Perkins, Hartford, Conn. App. filed Jan. 17, 1900. Details.

665,943. ELECTRIC CUT-OUT; J. H. Trumbull, Plainville, Conn. App. filed April 2, 1900. Details.

665,953. PROCESS OF ELECTROLYZING SOLUBLE SALTS; A. J. O. Chalandre and L. J. B. A. Colas, Paris France. App. filed March 21, 1899. (See Current News and Notes.)

665,957. RECEIVER FOR HERTZIAN ELECTRIC WAVES; E. Ducretet, Paris, France. App. filed May 22, 1899. (See Current News and Notes.)

665,986. LIGHTNING ARRESTER; W. D. Wood, Paris, Texas. App. filed June 5, 1900. The device serves the function of a lightning rod and consists of a strip of metallic cresting, having a conducting strand running through it and connected with the earth.

665,998. ACCELERATION LIMITING AND RECORDING DEVICE; A. G. Davis, Schenectady, N. Y. App. filed Sept. 29, 1900. A device mounted on a car and acting to record the number of times a predetermined acceleration or retardation is exceeded.

666,000. CIGAR LIGHTER; F. T. Dickerson, Chicago, Ill. App. filed May 5, 1900. The lighter is in the form of a cannon and contains a wick which projects from the mouth of the cannon, and is ignited by an electric spark when the cannon it tilted on its trunnions.

666,003. INSULATED ELECTRIC CONDUCTOR; W. L. R. Emmet, Schenectady, N. Y. App. filed Aug. 19, 1899. An electric conductor or cable provided with a helical winding of paper coated with a plurality of adherent layers of a vegetable oil, each layer being separately oxidized and hardened.

666,004. INSULATING ELECTRIC CONDUCTOR; W. L. R. Emmet, Schenectady, N. Y. App. filed Aug. 19, 1900. Relates to the preceding.

666,008. EDGEWISE WINDING APPARATUS; H. Geisenhoner, Schenectady, N. Y. App. filed Sept. 29, 1900. An apparatus for winding a flat metallic strip or ribbon edgewise, which comprises means for preventing the strip from buckling at the portion where it is being bent, and a non-circular former which is capable of movements of revolution and reciprocation.

666,067. ALARM SIGNAL; J. J. Ross, Detroit, Mich. App. filed March 26, 1900. Details.

666,080. ELECTRICALLY CONTROLLED AND OPERATED RAILWAY SWITCH; P. B. Williams, Washington, D. C. App. filed Oct. 11, 1900. In addition to the switch moving devices a pan is provided to catch dirt and the same is tilted to empty the dirt by electrical means.

666,121. MEANS FOR CONTROLLING ELECTRIC MOTORS; M. Waddell, New York, N. Y. App. filed March 23, 1887, renewed Jan. 18, 1897. (See Current News and Notes.)

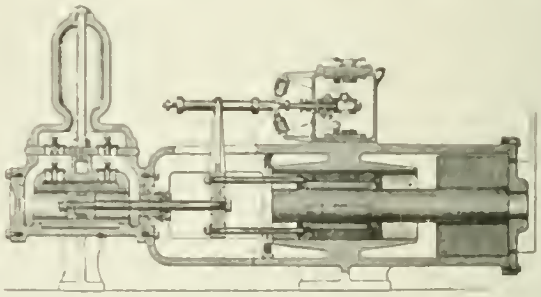
666,122. METHOD OF CONTROLLING ELECTRIC MOTORS; M. Waddell, New York, N. Y. App. filed Dec. 13, 1900. (See Current News and Notes.)

666,157. ELECTRIC WELDING APPARATUS; A. F. Rietzel, Lynn, Mass. App. filed Sept. 28, 1900. (See Current News and Notes.)

666,157. ELECTRIC WELDING APPARATUS; A. F. Rietzel, Lynn, Mass. Swampscott, Mass. App. filed July 3, 1899. (See Current News and Notes.)

666,162. TRANSFORMING APPARATUS FOR ELECTRIC METAL-WORKING; E. Thomson, Swampscott, Mass. App. filed July 3, 1899. (See Current News and Notes.)

666,177. TROLLEY FINDER FOR ELECTRIC CARS; E. S. Booth, Waterville, Maine. App. filed Sept. 19, 1900. Two curved arms are pivoted near the wheel and adapted to be thrown into a position above the wheel where they will form a V-shaped guide to direct the wire into the wheel.


665,917.—Apparatus for Obtaining Reciprocating Motion.

666,183. ELECTRO MAGNETIC BRAKE; F. L. Clarke, Pittsburg, Pa. App. filed May 14, 1900. An improvement on the preceding, by which the shoes throughout a double truck are applied by the movement of other shoes against the rail.

666,184. ELECTRO MAGNETIC BRAKE; F. L. Clarke, Pittsburg, Pa. App. filed May 14, 1900. Brake shoes, when acting upon the rail, react to throw other shoes against the wheels.

666,189. GONG TRIPPING MECHANISM; F. M. Dunn, Baltimore, Md. App. filed Jan. 31, 1900. Details.

666,199. GERMICIDE DEVICE FOR TELEPHONE TRANSMITTERS; A. B. Larsen, Minneapolis, Minn. App. filed April 27, 1900. A receptacle containing a disinfectant is attached to the transmitter.

666,213. TELEPHONE EXCHANGE CIRCUIT AND APPLIANCE; G. K. Thompson, Malden, Mass. App. filed Feb. 9, 1900. The first claim defines the invention as follows: The combination in a telephone-circuit, of two main conductors extending between a substation and a central station, and respectively forming portions of two associated sub-circuits; a third main conductor constituting a complementary and common portion of both of said sub-circuits; a condenser at the central station included in one of said sub-circuits; a source of transmitter-current supply at the central station connected in the other sub-circuit; a transmitter at the sub-station connected in the said complementary main conductor; and an induction-coil for said transmitter at the central station, having its two windings included in the said two sub-circuits respectively; substantially as set forth.

666,221. APPARATUS FOR DECOMPOSING SOLUTIONS; D. N. Hathorne and H. E. Hobson, Rumford Falls, Maine. App. filed Jan. 11, 1900. In an apparatus for the decomposition of solutions, a tank, a perforated chamber constituting the cathode, a diaphragm therefor, an outlet opening through the bottom of the diaphragm and the cathode, a chamber constituting the anode located in said cathode, and electrical connections between said cathode and anode and the source of electrical supply.

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OUR EXPORT TRADE.

The United States Bureau of Statistics has just published the figures of export trade for December and for the calendar year. The showing for manufactures can only be characterized as extraordinary. It appears that during 1900 the export of manufactures reached $441,406,942, or not less than $66,619.05 over 1899, and more than twice as much as in 1895. Another fact, equally striking, is that this country is already exporting half as much in manufactured goods as in agricultural produce, the total of the latter in 1899 being $904,658,958. There is a deep significance to these figures. The total of American export trade was, in 1900, not less than $1,453,000,000, of which manufactured and mining products were 35 per cent. And yet the development is far from complete, for American manufacturers are still looking for new agents and new customers throughout the world.

ELECTRIC HAULAGE ON CANALS.

In view of the immense amount of money that has been expended throughout the world on the development of canals, it is not to be wondered at that there should be great anxiety for the further utilization of that system of transportation upon an economical basis. The success of electric traction long since suggested the possibility of supplanting old methods of haulage on canals and the work of experimentation has been assiduously followed up for years. There is every reason to believe that in the near future electricity will have supplanted all antecedent methods wherever there is sufficient traffic to justify the resort to mechanical power. We present elsewhere in this issue an interesting summary of the work which has been done up to date in this country, including also a glance at the recent work in Europe. While we should hardly care to pronounce on the superior availability of any one of these methods to the exclusion of the others, it seems evident that electricity in some form is rapidly attaining the point at which it may be described as wholly practical and commercial. There are virtually three methods now competing among themselves for adoption, and each of these has peculiar merits of its own. There is the trolley system with wires along the bank and the motor on the boat. There is the trolley system with the motor traveling along the bank, either on the plain towpath or on a special narrow-gauge track. There is the automobile system in which a tractor carrying its own batteries or aided by batteries on one of the boats does the work independent of any live current from a line wire. Perhaps we ought to include the method in which the boat driven by electric motors picks up a chain lying along the bed of the canal, but this system appears to have no vogue, and seems hardly likely to be adopted on an extensive scale in the future. The data which we give in this issue as to the work done by electric automobiles would justify considerable confidence in the economical successes of that method, especially if cheap current be available for charging the batteries; while, on the other hand, the present rapid extension of long-distance polyphase circuits would warrant the belief that many canals may soon be operated in that fashion from stations widely apart.

As our article shows, the interest in this very important question is not confined to this country, but is now felt also in Holland, Belgium, Germany and France. As we go to press, we learn that a deputation from the Associated Chambers of Commerce in England has laid before the Board of Trade a plan for the appointment of a

Royal Commission to inquire into the canal system in the United Kingdom. The deputation which waited on the authorities pointed out how much work was being done on the Continent in the improvement of communication by internal waterways, and Mr. Gerald Balfour in his reply recommended that the Chambers themselves should appoint a committee to draw up a scheme. Three points have been urged for consideration in this connection, namely, the enlargement of the locks, uniformity of gauge and electric haulage, and it is upon the last of these points that emphasis is now being laid in England. So far as we have been able to study the situation, it appears to us that electric haulage by means of a bank tractor has so many advantages that its general adoption cannot long be delayed even though after a time electricity in this respect should be rivaled by gasoline and steam tractors, for which, under certain conditions, we can imagine advantageous opportunities. As matters are to-day, the canals represent often a sunken investment, and sometimes, alas! one that has been utterly abandoned. It rests with electricity to cure all that.

OSCILLOGRAPHS.

One of the most beautiful applications of dynamics to the illustration and elucidation of electrical engineering problems is represented in the oscillograph. Here a minute galvanometer needle is mounted in a powerful magnetic field in such a manner as to have a natural period of vibration far shorter than that of the periodic current which is to be measured and indicated. Consequently its own inertia and swing has an entirely negligible influence upon the oscillations it performs under the influence of the varying or alternating current. A tiny mirror mounted on the needle and powerfully illumined enables the swing of the needle either to be recorded on a rapidly moving photographic plate, or upon a ground glass screen, so that the resulting picture is to the alternating-current engineer what the engine diagram is to the steam engineer, an index and examplar of all the essential properties of the cyclic motion. The oscillograph is an apparatus which has gradually developed, and in its most recent form has become a very useful instrument in the hands of electrical engineers. A letter from Prof. Blondel in our correspondence columns bears upon his own contributions to the development of the oscillograph, which contributions appear to have been almost entirely inclusive in their scope.

We regret that Prof. Blondel should have considered significant the absence of notice in our columns of his paper read before the Paris International Electrical Congress of last year. So numerous were the papers read before the Congress that the notice in any case was necessarily limited, and the paper by Prof. Blondel was not of a kind to admit of brief abstract. We did, however, refer to the exhibition of the oscillograph in action, which, from the interest it excited, was easily the "clou" of the Congress. To those acquainted with the laborious, time-consuming and relatively inaccurate methods formerly employed for obtaining alternating curves, and who had never seen an oscillograph at work, the ocular demonstration of its operation, was simply startling. When the machine to which the instrument was connected was started, there flashed on a ground glass plate a luminous curve on a large scale corresponding to a cycle of e. m. f. variation—a physical representation of what, in most minds, has existed only as a mathematical abstraction. As changes were made in the field excitation or output of the armature, the curve simultaneously assumed new forms, in some instances the presence of harmonics being plainly portrayed by peaks disturbing the smoothness of curvature. As the originator of this beautiful instrument, Prof. Blondel has reason for showing irritation at denial of credit and apparent lack of recognition of its value to alternating-current science.

RANGE AND POSITION FINDERS.

We note that the current Fortifications Bill contains an item of $150,000 for range and position finders, which have certainly been needed badly and long enough to justify any reasonable expenditure. But we wonder what the army is going to get for its money. For, to tell the truth, there seems to be sad need of something better than it has as yet seemed anxious to adopt. The Spanish war tried out some of the naval range finders with anything but satisfactory results, and, if we remember correctly, the actual fighting was done by the aid of depression angles taken with sextants or by the crude but effective method of "trying it on the dog" with small rapid-fire guns. The electrical range finders came to grief from the tremendous shock of gun fire. As to the land service, the army has a very good depression instrument, but its method of operation leaves much to be desired at the ranges of modern artillery practice, while for field service nothing convenient is available. In fact, no range and position finder appears to have been tried anywhere in actual war. Each year makes the problem of producing a thoroughly satisfactory instrument tougher and tougher, for each year makes the ranges longer and the counter-fire more deadly. As the range increases the trajectory gets more and more curved, and small errors in range grow more serious. And when, as in the Boer war, heavy field artillery is frequently used for firing high explosive shells at a range of 6000 or 8000 yards, the need of a good portable range finder is badly felt.

Here is work for the electrician—work which may be fruitful both to the inventor and to the country. Uncle Sam has been notoriously short tempered with inventors in the past, and for years it has been a tradition that no civilian need apply except for a kicking. But times have changed somewhat; the immensely rapid progress of the art of war has tended to break down the extreme conservatism of the bureaus and to convince them that real help from whatever quarter is desirable. To-day the officials of both services are ready enough to give an inventor who does not know it all, and who does not come sneaking around the back door with a pull, a fair show. Pulls have often worked in such matters, and will perhaps continue to work, but the better class of officers—and these are a vast majority—are inwardly inclined to give the man with a pull a particularly long and difficult row to hoe. The last few years have seen the growth of a more progressive spirit. The question of the range finder matter is one which needs attention very badly, and we earnestly hope both that the instruments already produced will be thoroughly threshed out, and that the keenest wits of the electrical profession will take a shy at the problem. There are already several promising range finders before the authorities in one way and another. The Ruckman-Crosby instrument described in these columns nearly a decade ago, is certainly capable of development into great usefulness, and Capts. Lewis and Zalinski have also done a vast amount of useful work in this direction. Others there doubtless are, too, well worthy of thorough trial, and we hope that the War Department will go over the whole field thoroughly until there has been evolved the best apparatus of its class that American ingenuity can produce. The electrical inventor had better bestir himself and help along the good work.

To any one who tackles the problem we can give some suggestions that he will not find amiss. First, he had better acquaint himself as thoroughly as possible with the nature and capabilities of modern ordnance. If he has never seen a big gun fired he had better try for an opportunity to see a little target practice, and get some full realization of the tremendous shocks with which he has to deal, and the rapidity and precision which has to be attained in the operation of a range finder under these trying circumstances. After he has put in some careful study of these things and ascertained thoroughly the limits of precision which must be reached, he may venture to begin work. Then the first thing to be borne in mind is that a range finder must not only work with perfect promptness and accuracy nine hundred and ninety-nine times out of a thousand, but the thousandth time as well, even when the ground under it is shaking from the concussion of heavy firing. If position finding is also to be attempted, all the rest of the mechanism must be equally reliable, and no amount of jarring must be able to get it out of step or impede its action.

Many past failures with range finders have been due to the application of quite insufficient power to overcome unfavorable conditions, and to the use of too delicate parts. For use in fortifications such apparatus does not have to be light or particularly compact, but it must work correctly, and all the time. If a horse-power or two will obviate one failure in 10,000 times on the part of a dry battery, then throw away the battery and put on the power. It makes little difference whether the power required costs much or little, but it makes a great deal of difference whether a 12-inch shell, directed by that range finder, rips through the enemy's hull or tosses up the spray a hundred feet short. Such apparatus should be made brutally strong in the first place, and cut down in weight and power only when it has been thoroughly demonstrated that part of the weight and power is unnecessary. This advice may be needless, but now in time of peace is the time to prepare for future emergencies, so that when Uncle Sam again takes off his coat and rolls up his sleeves he shall not find his big guns without sights or proper ammunition and a couple of hundred mortars pointing skywards without even an official guesser to direct their fire. If the American people get caught in such wise again it will take more than a Beef Commission to prevent their calling the guilty to account, be they in the service or out of it.

MAGNETIC FLUX DISTRIBUTION OVER DYNAMO ARMATURES.

At the last meeting of the American Institute of Electrical Engineers, a paper was read by Prof. Goldsborough upon the general distribution of magnetic flux over the surface of an armature, as distinguished from the more simple and rough determination of the magnetic distribution underneath the polar surfaces of the field magnets. The subject is in the last analysis extremely complicated, partly on account of the complexity of the law of magnetization in iron, and partly on account of the complex geometrical form of polar surfaces and armature surfaces with beveled edges on the one and slots in the other. Moreover, there is the additional complication introduced into the matter by reason of the magnetizing coils on the field frame being usually in fairly close proximity to the armature surface, and exerting thereon an appreciable magnetic influence directly, without the intermediary of the iron pole-pieces. It would be safe to say that if a very accurate predetermination of the magnetic flux distribution over the armature surface were required it would be a hopelessly insoluble problem.

The simple ordinary dynamo formula ingenuously assumes that all the magnetic flux passes from the field pole into the armature underneath the shadow of the pole, and the magnetic density and distribution corresponding to such an assumption is readily computed. Occasionally a designer takes into account the magnetic flux fringing the polar face, having recourse for that purpose to approximate or empirical formulas. The rest of the magnetic flux which enters the armature by the unbidden pathway of air-space between adjacent poles is only treated as stray flux and regarded as a perturbation that good fortune may enable him safely to ignore.

If, however, certain assumptions are made—not very violent in their nature—the problem of general flux distribution becomes simplified to a degree that admits of the application of arithmetic. The assumptions are first, that a dynamo armature has so great a length as to reduce the computation to that of two dimensions, or corresponding to an indefinitely long cylinder; second, that the armature surface in the two-dimensional problem, instead of being circular, embraced by polar segments of concentric circles, is virtually equivalent to that of a plane at one magnetic potential, with rectangular poles supported over it, so as to include a straight strip of air gap, and that the entire polar surface so supported over the flat armature has also one and the same magnetic potential, differing by a known amount from that of the armature. The corresponding problem in electricity may be represented by a very deep electroplating vat, in which one electrode is a large plane vertical plate, and the opposite electrode a rectangular mass of relatively small width, but approached parallel to the flat plate so as to include a narrow uniform gap of electrolyte. The distribution of current in this imaginary vat, when the two plates are connected to a fixed difference of potential, would be entirely analogous to the magnetic problem of the dynamo simplified in the above ideal fashion, and it is evident that the electric current would not be entirely confined to the narrow gap, but that a feeble current density would exist throughout the electrolyte.

The Institute paper attacks this simplified problem by what might be called the synthetic method, assuming that the flux density at any point on the armature is due to a contribution from every elementary area of the polar surface, and that each elementary surface polar area contributes in proportion to its inverse distance from the point on the armature considered. The results, therefore, are examples of the use of the integral calculus. They are continued not merely to the nearest pole, but the summation is carried to the next adjacent pole of opposite polarity. These computations are embodied in a general formula involving the dimensions of the air-gap and the dimensions of the poles. The results of this formula are compared with the results of experimental observation in one or two instances, and a satisfactory agreement is indicated between the calculation and the observations. As a rough generalization of the result it seems that if we plot the flux density under the pole as uniform, in accordance with the ordinary simple formula, as ordinates, and distance along the armature surface as abscissas, then do the same negatively for the adjacent pole, and join, by a straight line on the diagram, the edge of the density line over the opposite pole with the edge of the density line under the negative pole, the saw-tooth diagram with filed off points will roughly represent the practical flux density distribution.

The same problem was recently attacked by Mr. F. W. Carter as an original communication to the Transactions of the British Institution of Electrical Engineers, May, 1900. His mathematical analysis is a much more powerful one, and involves transformation from one set of conjugate co-ordinates to another. The resulting formulæ are somewhat simpler than those of the American Institute paper, and are more rigidly demonstrable, while permitting of extension to the determination of the flux paths and equipotential surfaces. It is very interesting to compare the numerical results obtained by the two different mathematical methods. It is, of course, important physically, as well as in the abstract, to possess the key to this problem, but it is rarely that the extrapolar magnetic distribution over the armature is of sufficient importance to the designer to require exact predetermination.

The Employment of Women in the Telegraph and Telephone Services Outside the United States.

By H. L. Geissel.

The International Telegraph Bureau of Berne, Switzerland, has issued an interesting report on the employment of women in the telegraph and telephone services of those countries belonging to the International Union, from which we abstract the following:

The admission of women to the telegraph service dates back about 30 years. The admission of females was chiefly caused by the steady reduction of the rates of the telegrams and the resulting necessity of cheaper labor, but also on account of the fact that women were better fitted for the telephone service than men. Of the countries now belonging to the International Telegraph Union 32 employ to a greater or smaller extent women in the telegraph and telephone service, while only 10 administrations so far do not admit women, namely: Bosnia-Herzegovina, Egypt, Greece, Luxemburg, Montenegro, Natal, New Caledonia, Tunis, Turkey and Siam In Belgium and Spain women are still employed in the telegraph service, but new appointments are not made any longer.

The regulations for the admission of women to the service in the different countries have only the one common point, that the appointees must be citizens of the respective country. Though not specially mentioned, yet it is generally understood that all persons to be admitted must have a clean record and good health. In some countries, such as Germany, Austria-Hungary, Switzerland and others, only persons without any bodily defect are admitted, while in France the authorities demand further that the applicants have a minimum height of 1.50 meters (5 ft.), the same minimum height being required in England for positions in provincial cities, towns and villages. German and French regulations also demand that the applicants be never fined or punished by any public court, and another additional prime condition to admission in Germany is that the applicants must be absolutely free of debts. One single country, Victoria, demands that the applicants be life-insured. The admissible minimum age varies in the different countries between 14 and 18 years, and the maximum age, wherever stipulated, 45 years; Germany makes in so far an exception as it fixes the maximum age for admission at 30 years. In Germany, Bulgaria, Holland, Roumania, Japan, New South Wales, New Zealand and Victoria the applicants must either be unmarried or childless widows. Other countries, like Russia and England, only demand that the candidates be unmarried or widows, which was also the case in Spain as long as women were admitted. The French regulations do not contain special paragraphs relating to civil life, and married women, girls, widows, as well as divorced women are admitted to the service. As a rule, however, women have to quit the service after they get married. In Sweden, the employee may remain in the service after marriage, if the husband is also employed in the telegraph service, and the same is the case in Russia, Roumania, Bulgaria and New South Wales. Only in Belgium the female employees are allowed to marry. In Italy, only those female employees who have been appointed superintendents are allowed to stay in the service after marriage, while in England those employees who marry receive on retiring an indemnification in the form of a month's salary for each year of active service. In some countries widows and orphans, as well as daughters, sisters and wives of employees are given preference to any other applicants.

As far as educational questions are concerned, the regulations of almost all countries demand in the first place a perfect knowledge of the mother language, in reading and writing, and a good general knowledge acquired at school. Some countries demand besides a certain geographical knowledge, while in Italy the candidates must speak and write Italian and French; the same is the case in Holland, where furthermore a certain elementary knowledge of the German and English languages is required. Swedish regulations, too, prescribe a certain knowledge of French, English and German.

The average working time in the different countries varies between 7 and 8 hours. In many countries women are employed during day hours, while at night time men take their place.

Accidents From Berlin Street Cars.

Considerable discussion has been caused in Berlin by the manner of the death of Lieut-Gen. Pochhammer, who was killed by a street car. There have been numerous fatal accidents of a similar nature of late in Berlin, and astonishment is expressed that the authorities have not compelled the use of the American fender.

The Figures of Americn Foreign Trade.

The record made by the manufacturers of the United States forms the most striking feature of the history of our foreign commerce during the period 1890-1900. The Treasury Bureau of Statistics has just completed its analysis of the record for the calendar year 1900, and a comparison of the figures thus presented with those of 1890 and the intervening years discloses some interesting facts. It shows a remarkable increase in the importation of manufacturers' materials and an even greater increase in the exportation of manufactured goods, while in the importation of manufactures there is a decided decrease.

Dividing the importations into three great classes—first, foodstuffs and live animals; second, manufactures and luxuries, and third, manufacturers' materials, it is found that foodstuffs and live animals, which in 1890 formed 31.5 per cent of the total imports, were only 26.4 per cent of the imports of 1900; manufactures and luxuries, which formed 34.6 per cent of the imports of 1890, formed but 29.5 per cent in 1900, while manufacturers' materials, which formed but 34.3 per cent of the total imports of 1890, formed 44 per cent of the total imports of 1900. On the export side agricultural products, which formed 74.3 per cent of the total domestic exportations of 1890, formed only 62.2 per cent of the total in 1900, while manufactures which formed but 18.5 per cent of the total domestic exports in 1890, formed 30.4 per cent in 1900.

The following table shows the importation of foodstuffs and live animals, manufactures and luxuries, and manufacturers' materials in each year from 1890 to 1900:

Calendar Year.	Food and Live Animals.	Manufactures and Luxuries.	Manufacturers' Materials.
1890	$259,820,704	$280,730,040	$282,839,094
1891	300,013,872	231,202,368	297,097 650
1892	287,388,397	251,427,254	302,115,304
1893	275,106,340	230,447,210	270,694,720
1894	263,542,858	182,740,855	230,028,391
1895	231,548,775	248,110,586	233,009,986
1896	234,183,741	198,980,754	248,411,644
1897	220,494,113	202,163,357	319,937,759
1898	187,829,802	188,751,323	258,353,323
1899	229,977,787	226,034,075	342,955,548
1900	219,329,205	244,545,532	365,144,600

The following table shows the exportation of agricultural products, manufactures and miscellaneous products, in each year from 1890 to 1900, domestic products only being included:

	Agricultural Products.	Manu-faactures.	Miscellaneous Products.
1890	$628,779,597	$157,126,803	$60,093,203
1891	730,085,335	168,600,912	58,653,458
1892	712,539,832	152,397,392	58,300,091
1893	619,050,547	177,419,288	58,267,936
1894	573,687,474	177,786,069	55,839,410
1895	545,715,881	201,153,663	60,872,871
1896	664,962,505	253,688,527	68,193,161
1897	730,294,792	279,616,898	69,922,606
1898	851,915,762	307,924,994	73,717,384
1899	782,133,405	380,787,891	90,011,048
1900	904,658,958	441,406,942	106,947,759

Telephone Rates.

Prof. Parsons, president of the National League for Promoting the Public Ownership of Monopolies, testified recently before the Industrial Commission on the telephone service of the country generally, and that of the District of Columbia in particular. He said from $30 to $35 a year for an unlimited service with only one instrument on a line would be a fair rate in any of the large cities. He cited the experience of the French Government, which, on taking the telephone service of that country under its control, reduced the rate from $116 to $78 in Paris and $39 outside. He said telephone rates are higher in this country than anywhere in Europe. Mr. Parsons does not seem to be aware that the whole tendency of telephone work is away from a flat rate and towards a scientific measured rate per message. Moreover, telephone rates are not intrinsically higher here than in Europe.

Inner Circle London Underground Railway.

AMONG the proposals for the electrical equipment of the Inner Circle London Underground Railway, now operated by steam, is one submitted by Messrs. Dick, Kerr & Co., London, of which Prof. Sydney H. Short is technical director. The principal points of the scheme upon which the proposal is based are given below.

At present the trains on the Inner Circle line (Fig. 1) require 70 minutes to run 13 miles, including 27 stops. A large percentage of this time is consumed at the stations, an average of 34.8 seconds for stops now being the rule, though 20 seconds would give ample time for passengers to enter and leave the train. The acceleration of the steam trains is extremely slow, 30 seconds being required to obtain a speed of 10 miles, while electric trains would reach the same speed in 11 seconds.

The curves of Fig. 2 show the accelerations that are obtained on various steam and electric railways, and that which this scheme proposes for the Inner Circle trains. These trains would be run up to a maximum speed of 30 miles per hour, and the braking accomplished within 20 seconds. Under such conditions the trains could complete the trip in 50 minutes with reasonable consumption of power, which will reduce the number of trains and the braking expenses for a given traffic, nearly 30 per cent. A further saving would be made in the reduced fuel consumption, as stationary condensing engines would deliver to trains upon the line a horse-power for every 3 lbs. of coal, while locomotives burn about twice that amount.

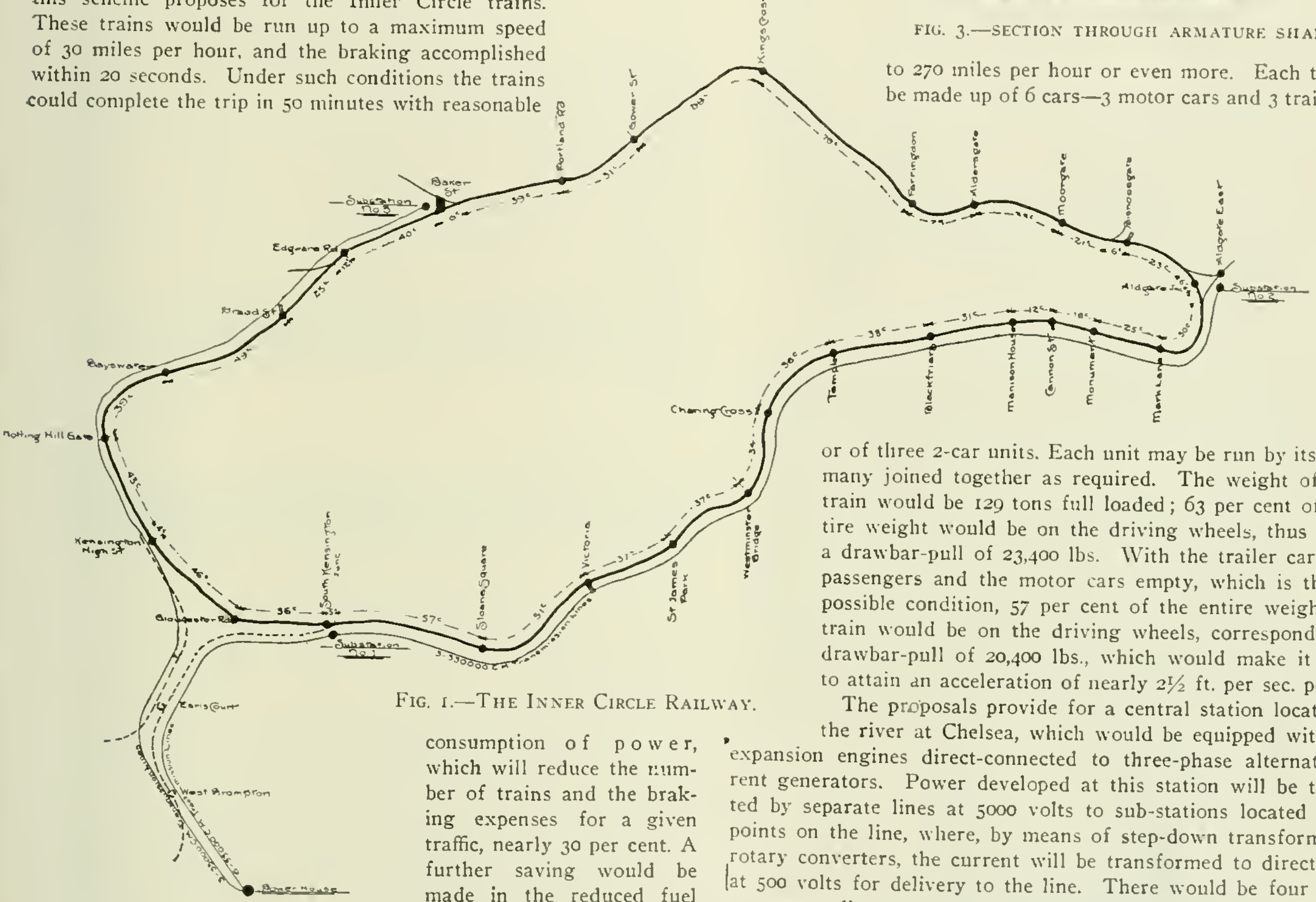


FIG. 1.—THE INNER CIRCLE RAILWAY.

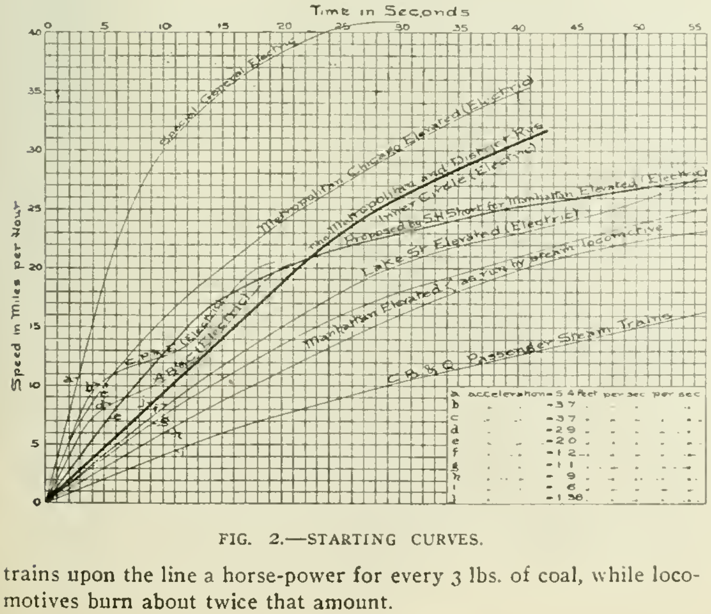


FIG. 2.—STARTING CURVES.

The proposals provide for 18 trains in all, which allows for three extra ones, or, when necessary, an increase of train mileage to 270 miles per hour or even more. Each train will be made up of 6 cars—3 motor cars and 3 trailer cars; or of three 2-car units. Each unit may be run by itself or as many joined together as required. The weight of a 6-car train would be 129 tons full loaded; 63 per cent of the entire weight would be on the driving wheels, thus assuring a drawbar-pull of 23,400 lbs. With the trailer cars full of passengers and the motor cars empty, which is the worst possible condition, 57 per cent of the entire weight of the train would be on the driving wheels, corresponding to a drawbar-pull of 20,400 lbs., which would make it possible to attain an acceleration of nearly 2½ ft. per sec. per sec.

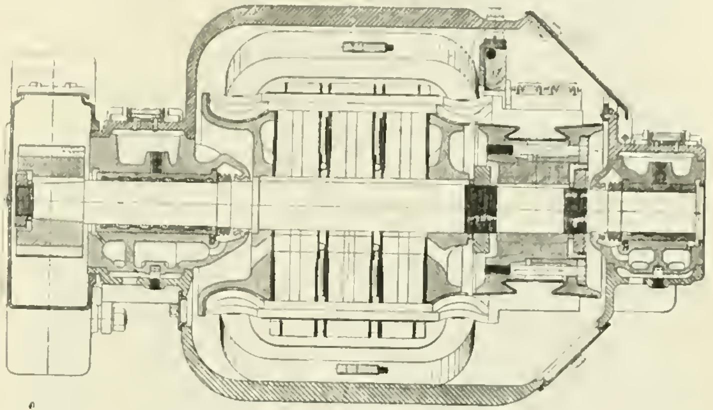


FIG. 3.—SECTION THROUGH ARMATURE SHAFT.

The proposals provide for a central station located upon the river at Chelsea, which would be equipped with triple-expansion engines direct-connected to three-phase alternating-current generators. Power developed at this station will be transmitted by separate lines at 5000 volts to sub-stations located at three points on the line, where, by means of step-down transformers and rotary converters, the current will be transformed to direct current at 500 volts for delivery to the line. There would be four 1500-kw generators direct-connected to the same number of engines, each running at a speed of 187 r. p. m., and capable of taking an overload of 50 per cent for short periods of time without difficulty. The generators will be capable of delivering 2200 kw for 5 hours, with a temperature rise of not over 80 degs. F. above the surrounding air. The frequency is 25 cycles per second. During the busiest hours of the day three of the units would be run in parallel, the fourth being kept in reserve.

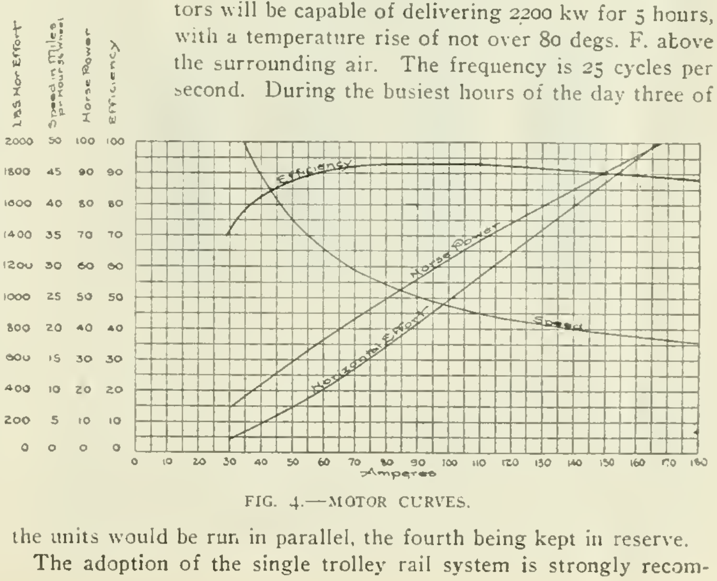


FIG. 4.—MOTOR CURVES.

The adoption of the single trolley rail system is strongly recommended in the proposals, but owing to regulations for the protection of the Magnetic Observatory, it may be necessary to use a double trolley rail system, thereby introducing many complications and considerably increasing the cost. The disposition of the trolley rails of this system is shown in Figs. 5 and 7. As the rails would be supported in a vertical position with insulating protecting strips protecting them on the faces, the arrangement would be perfectly harmless to workmen.

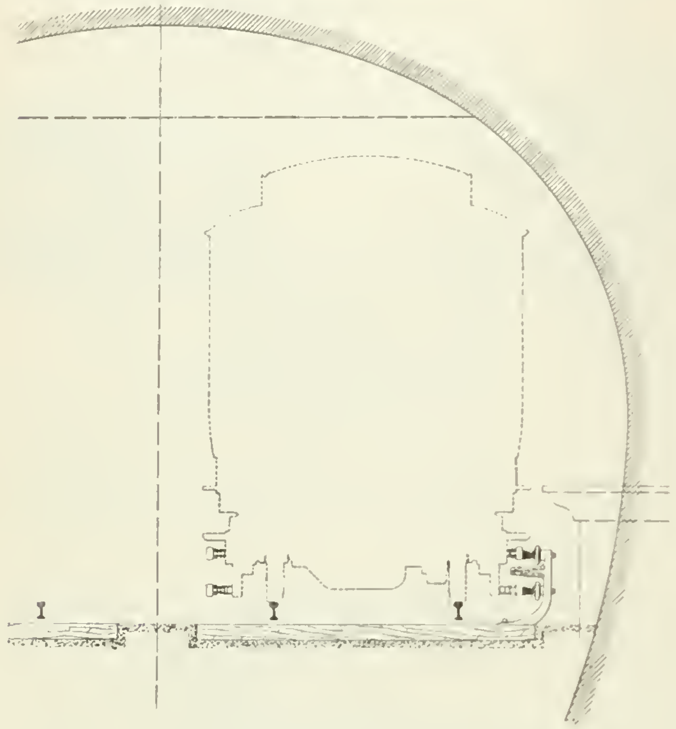


FIG. 5.—SECTION OF TUNNEL.

A section through the armature shaft of the motor proposed is shown in Fig. 3. The armature and fields would both be wound with rectangular copper bars. The weight would be 3800 lbs., one-half spring suspended from the truck and the other half supported on the car axle. Fig. 4 shows the frequency speed and horizontal effort curves of the motor. It will deliver 75 hp at the armature shaft for one hour, with a maximum rise in temperature of 63 degs. C. in the field coils; or 100 hp with a maximum rise in the field coils of 100 degs. C. With an intermittent load of 100 amperes at 500 volts applied at 80-second intervals, the load being kept on for 25 per cent of 80 seconds, the temperature rise at the end of one hour would be 18.3 degs. in the field coils.

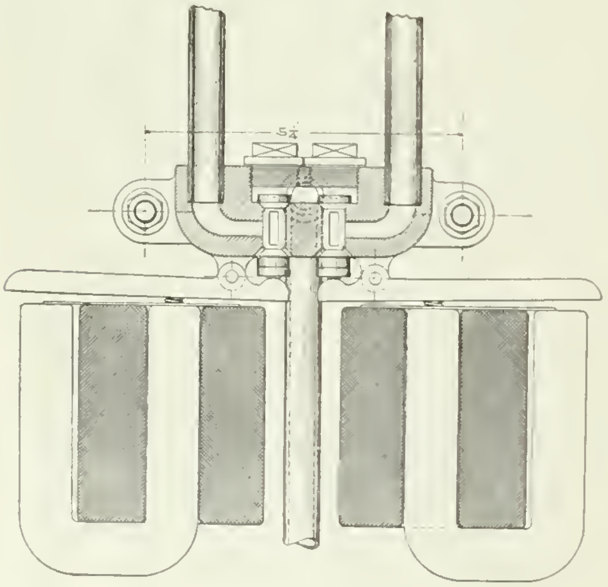


FIG. 6.—RELEASING VALVE.

For train control each motor car will be equipped with an electrically driven air compressor having sufficient capacity to supply air for the airbrakes and the controlling mechanism for at least four cars. The main air reservoirs for all the motor cars of a train will be connected to an equalizing train pipe. An automatic system of air brakes will form a part of the equipment of each car. The motors will be controlled by a combination cylinder actuated by air pressure from the main reservoir, the position of the cylinders being regulated by releasing valves excited by a small current delivered to them successively by the movement of the lever of the master controller from the off position, through the various lengths, to full speed. By moving the lever of the master controller back to the off position the air compression is automatically released from the combination cylinders, which are brought back to the original position by means of springs. The train would be controlled from any motorman's cab. No matter how long the train the work of each controller and pair of motors will be the same. Fig. 6 illustrates the releasing valve

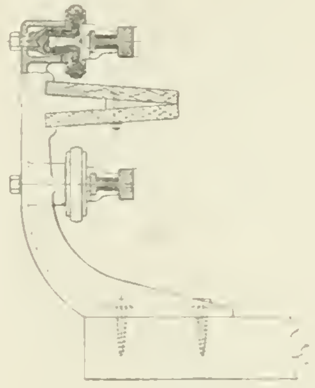


FIG. 7.—TROLLEY RAILS.

The average accelerating current for a fully loaded 6-car train will be 1440 amperes, and the average current per train 450 amperes at 500 volts. This corresponds to 15-kw hours per train-mile or about 2½ kw-hours per car mile for the fully loaded train. In actual practice, however, with average all-day loads, the power consumption would be about 2 kw-hours per car mile, or about 3 kw-hours at the engines. If the stops at the stations be reduced to 20 seconds, the average current will be reduced to 340 amperes, which will be equivalent to about 2 kw-hours for the fully loaded train.

Electrolytic Plant at Anaconda, Mont.

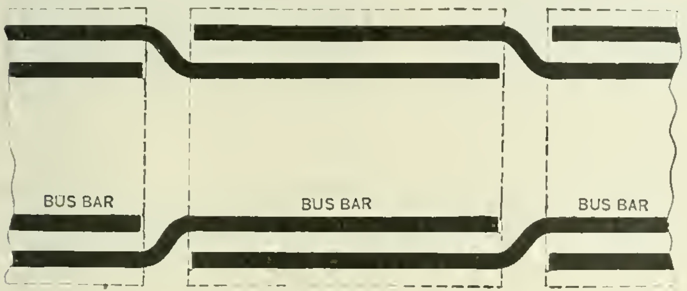
ALTHOUGH the electrolytic process of copper purification is simple and the principles involved are so old and well known, copper electrolytic works where the operations are carried out on a large commercial scale have in the past been so jealously guarded against all outsiders that the industry has perhaps been surrounded by an artificial halo of mystery. The management of the Anaconda Copper Mining Company recently gave a representative of the ELECTRICAL WORLD AND ENGINEER the freedom of the electrolytic works at Anaconda, Mont., and an account of the plant and methods employed will doubtless be of interest. This company is the largest single producer of copper in the world. Its mines are at Butte, Mont., and the smelter and electrolytic plant is at Anaconda, 28 miles distant.

Before describing the Anaconda plant a few words as to the principles and objects of electrolytic copper refining will not be amiss. When electrolytic refining is to be done the copper before it leaves the smelter is cast into plates of a suitable size for anodes in the electrolytic bath. The electrolyte is copper sulphate. The anodes are put in the bath opposite cathodes of thin copper, and current is passed until most of the copper on the anodes has been deposited on the cathodes. The cathodes, of course, constitute the refined product, which is copper almost chemically pure. Now the object of this electrolytic refinement is not entirely to obtain purer copper, at least as far as the Anaconda plant is concerned. The gold and silver found in the bottom of the electrolytic tanks much more than justifies the expense of the process. At Anaconda the purity of the anodes as they come from the smelter is given as 99.6 per cent. The electrolytic process therefore has only .4 of 1 per cent impurities to deal with. However, all electrolytic plants do not work with anodes as pure as those at Anaconda.

The Anaconda plant has about 1400 cells, or vats, as they are more commonly called, housed in a number of plain one-story buildings, opening into each other and onto railroad tracks. Overhead cranes are provided in the buildings for picking up and carrying out cathode plates when finished and putting in new anodes. There are aisles between each row of vats. The vats are, roughly, about 8 by 5 ft., and 3½ ft. deep. The current used is 4000 amperes, and 200 vats are placed in series. The voltage required per vat is 3-10 volt, so that including line losses the total voltage is about 65 volts at the generators. The vats are lead-lined wooden tanks. The bus bars which carry the current are round copper rods, 2 in. in diameter, run along the top edges of the vats as indicated in the accompanying illustration, which is the arrangement as it would appear looking down from the top. The outer bars are in each case considerably higher than the inner, and are both, of course, of the same polarity.

The electrodes are hooked onto cross rods, which rest across the upper or lower bus bars, as the case may be. To lift out an electrode the tackle is simply hooked onto the cross rod carrying that electrode. About 4000 litres of copper sulphate solution are required per vat. In one vat there are 19 sets of anode plates and 20 sets of cathode plates. The weight of the new anode plates from the smelter when first put in is 8200 lbs. Of course these cannot be used entirely up, but have to be sent back to the smelter for remelting when eaten down so that they begin to fall apart.

The current density employed at the present time is 13 amperes per square foot of anode plate. This is much lower than was formerly used when the plant was more crowded than now. The matter of the best current density at which to run a copper deposition plant is largely a question of the cost of power and of the output desired from a plant, provided precious metals are not present—in this case large densities resulting in their deposit with the copper. Lower densities are more economical in copper reduced per kilowatt hour, but if power is cheap, and it is desired to increase the output, it is sometimes justifiable to run the current density very high and deposit a large amount of copper per day per vat. Electrolytic copper refining has been run with current density as high as 40 amperes per square foot and with entire success. In the Anaconda plant this current density of 13 amperes per square foot deposits about 210 lbs. of copper per 24 hours per vat. At the end of 34 days the plates are taken out and the vat started afresh. A man tests each vat with a voltmeter every day, and if there is a short circuit indicated by low or zero reading of the voltmeter he proceeds to remove it. During the first week the plates may bend so as to cause a short circuit. The latter part of the time dropping off of pieces of the anodes onto the tank bottom have to be looked out for. The plates are about 2 inches apart from one surface to the other.



Arrangement of Bus-Bars.

The gold and silver which were contained in the anode plates fall to the bottom of the vat during the process, and are found as a very fine brownish black powder, technically termed "slime."

During the process the solution must be kept warm and circulated. To do this it is pumped from warming vats up into pipes, entering the center of the bottom of each vat. At the top of each vat are overflow pipes, which return the overflow to the warming vats. This circulation is kept up as long as the vats are in operation.

The maintenance of the solution at its proper strength and purity is where the great work of the expert electrochemist in this line comes in. In some cases, though not to any extent at Anaconda, impurities exist in the anodes as they come from the smelter, which injure the electrolyte and must be intelligently battled with. The maintenance of a solution of the proper strength and proportion of free acid is no small part of the management of a plant of this kind. At Anaconda Mr. Johnson, the chemist who supervises operations at this plant, has chemical analysis and specific gravity tests made on the solution every day. When the amount of copper in a solution becomes too great the solution is run for a time in a vat in which are certain anodes of lead, in which case, of course, all the copper deposited on the cathodes must come from the solution.

The manufacture of copper sheet onto which to form the cathodes is an interesting process, and opens one's eyes as to the toughness and density of electrolytic copper. To make these forming sheets a sheet of copper is painted over with a mixture of graphite and hot paraffine, and hung as the cathode in a vat for 24 hours. It is then taken out and is covered with an envelope of thin copper sheet, non-adherent on account of the graphite, and practically as tough as rolled sheet. This sheet, or envelope, is cut around the edges, stripped off the plate on which it was formed, and when attached to a terminal hook is ready to be hung up in a vat as a cathode-forming plate to receive the copper.

The Development of Electric Traction on Canals.

THE announcement that the Erie Canal Electric Traction Company is about to enter into contracts for the construction of a number of electric tractors for use upon canals, both in this country and Europe, recalls to public attention a most vital question which will be under consideration at Albany in a few days. Governor Odell, in his message, intimated his intention of sending a special message to the Legislature, based upon the report of a commission, appointed by Governor Roosevelt, to consider the future of the Erie Canal. The commission recommends the expenditure of $62,000,000 for canal improvement. The Erie Canal Electric Traction Company is a corporation which has been in the public eye for a number of years because of the prominent politicians and capitalists connected with it. Its directors include Baron von Hoffmann, Hon. Thomas C. Platt, Hon. John G. Carlisle, William H. Baker, Henry R. Ickleheimer, Albert S. Heidelbach, Frank W. Hawley, William Mertens and James Verden. Its experiments in connection with the introduction of electricity for the propulsion of canalboats have been spread over many years, and a fortune has been expended in demonstrating what it is thought possible to accomplish through the medium of electricity. Through subsidiary organizations, which it controls, the traction company will distribute the power generated at Niagara, which is transmitted beyond the limits of the counties of Niagara and Erie, along the line of the Erie Canal, under a contract with the State of New York, authorizing such occupancy of State lands.

During the session of the Legislature of 1892, a grant was made to the Niagara Falls Power Company authorizing that corporation to construct a great system for the generation of electricity. Governor Flower, in his annual message to the Legislature of that year, foreseeing that this power could be made available, sought to inspire legislation facilitating the introduction of electricity upon the canals of the State. In obedience to his suggestions, the necessary legislation was had, and an organization, which was subsequently formed, undertook the problem to apply electricity to the propulsion of canal traffic. This legislation authorized the Superintendent of Public Works to expend $10,000 in experimental work, but this experimental work was undertaken by the Erie Canal Traction Company, with whom a contract was made for the installation of a system upon the canals of New York. The engineers of the Traction Company suggested many methods of applying power, and many were tried by that company in its efforts to demonstrate that from the standpoint of commercial economy, traffic could be transported through the medium of electricity. The first system suggested was that of the overhead trolley, and the first canalboat in the world propelled by electricity, the "Frank W. Hawley," ploughed through the waters of the Erie Canal at Pittsford, on Nov. 18, 1893. That test was witnessed by Gov. Flower, who himself discharged the duties of motorman. From a pole line, running along either bank of the canal for nearly two miles, were suspended span wires sustaining copper trolley wires. Upon the trolley wire was a traveler connected with the motor on board the canalboat by a flexible cord. The motor on board the boat was attached to the propeller which exerted the motive power. The experiment made upon that occasion, described in these pages at the time, was reported as entirely satisfactory; but to the engineers of the Traction Company there were so many difficulties that it was decided to further pursue the investigation, in the hope of accomplishing better results.

In his address delivered upon that occasion, Gov. Flower said: "In 1829, when De Witt Clinton started from Buffalo for Albany on a canalboat, he had a military company as an escort, but there was no electricity to move his boat, or transmit the news. They sent the fact of his starting from Buffalo to Albany by successive discharges of cannon along the bank, and the time occupied in transmitting the news was an hour and 50 minutes. The introduction of electricity may yet work as wonderful changes in transportation as it has in news transmission. The first year only 40 tons of merchandise were sent from Buffalo to Albany. Last year more than 3,000,000 tons were transported, and in a single year more than 6,000,000 tons have found there way through this channel of commerce, from the lakes to the ocean. I believe when this electric system is perfected the traffic will be quadrupled. Some of our people noting improvements in means and methods of transportation everywhere, save on the canals, have been misled into the belief that the canal is an antiquated and useless piece of furniture to be abandoned. Others seeing improvements on lake and ocean have desired to create a great ship canal in order to permit the introduction of machinery and appliances, such as have been found economical operating under conditions very different from those surrounding canal traffic. In my judgment neither course would be well advised. Neither improvident destruction nor extravagant taxation is necessary. Ingenuity has not been exhausted. The best inventive genius of the world is to-day engaged in solving the problem of how to most economically operate canals under the conditions which actually surround them. The tests which we have witnessed prove that its solution is at hand. I am confident that electricity will yet work changes in canal traffic as it has in other departments of industry; that it will be more effective than enlargement; that it will quadruple the capacity of this waterway, and that we will yet see this line of transportation carrying 20,000,000 tons of freight per annum, and contributing even in a greater degree than in the past to the prosperity and commercial supremacy of our people. I regard it as a great privilege, as Governor of this State, to witness this experiment which marks the change from horse-power to electricity, and inaugurates a new era of usefulness for our canals."

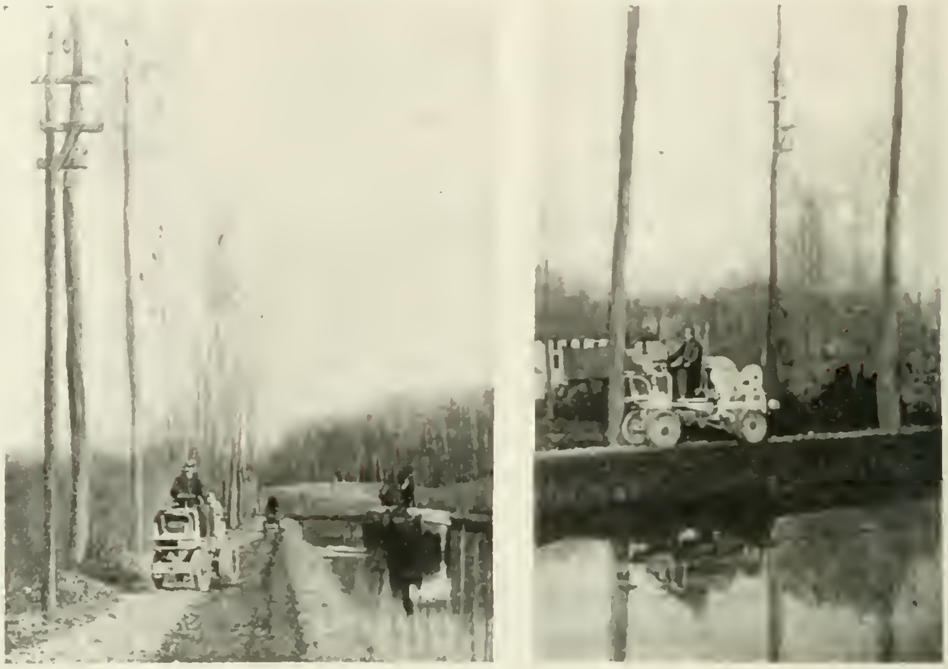


FIG. 1.—ELECTRIC HAULAGE ON BELGIAN CANAL.

The change, however, did not come then. On Oct. 26, 1895, there was again subjected to a test the cable-way system of electrical canalboat propulsion, which was witnessed by Gov. Levi P. Morton, ex-Gov. Roswell P. Flower and others. The cable-way system consisted of a motor not traveling along the towpath, but suspended over it from a cable, through which a current of electricity passed to the motor. The propelling power was furnished by a second cable, making three turns around a drive wheel, which was revolved by the motor. This equipment furnished an economical method of canal-boat propulsion, as subsequent tests, under the direction of the State Electrician clearly established. The enormous cost of installation, however, discouraged the use of this system, and further experiments were authorized. Upon that occasion Gov. Morton said: "The achievement of success in so important a scheme as the application of electricity as a motor for canal traffic is an event fraught with such deep interest to the commercial community and therefore to the whole people, that I cannot let pass this opportunity of saying how deeply I am concerned in this enterprise and its ultimate success. It promises in larger measure than any other factor, a present solution of the great problem of canal transportation for the Empire State, which is the key to the geographical position of a water route from the Great Lakes system to the Atlantic Ocean. Various projects are on foot, in more or less advanced conditions of scientific and physical development, for the enlargement of the traffic capacity of the canals of this State, but the simplest and least costly of them must involve the expenditure of millions of money and occupy many years of time for their accomplishment. This project promises, through the medium of scientific, intelligent and praiseworthy private enterprise, to so multiply the immediate present scope of the canal service as to furnish with present conditions all the actual carrying capacity that may be required for years to come."

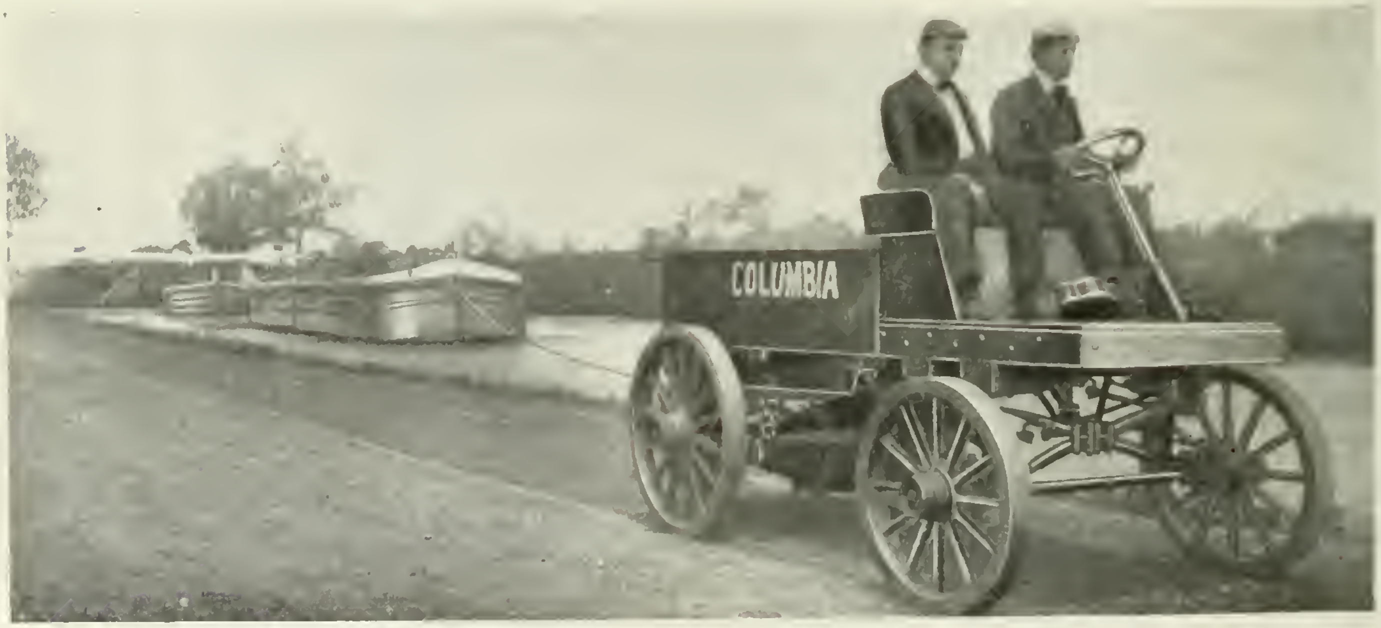


Fig. 2.—Hauling Barges with Electric Automobile on Raritan Canal.

At the conclusion of Gov. Morton's remarks, ex-Gov. Flower, always conspicuous for his interest in electrical matters, said: "This occasion is a gratifying one to me because the introduction of electricity as a motive power on the canals was a favorite project of my administration as Governor. I believed it would remove many of the obstacles which are diminishing the usefulness of the canals, and would restore them to their old-time importance as carriers of freight and regulators of freight rates. It was my privilege to recommend to the Legislature experiments on the canal with a view to the introduction of electricity as a motor power, and I attended in my official capacity the first experiments at Pittsford two years ago, which demonstrated completely the practibility of the innovation. Later on I signed an act which authorized the Superintendent of Public Works to contract for the supply of electricity on the canals, and subsequently a contract was prepared under my direction and executed on behalf of the State. The event which we have come to witness to-day may mean much to the commercial interests of New York. I have some figures, furnished by the State's Electrician, showing that it costs $43.24 to propel a 240-ton boat from Buffalo to Albany by horse-power, and $17.80 by steam power, and by electricity $7.97. These figures, suggestive as they are, do not tell the entire story. Horses draw boats along, at the slow pace of two miles an hour, steam at three miles per hour, while electric propulsion would give a speed of four or five miles per hour. New York cannot afford to neglect this opportunity to utilize to the best advantage this great highway of commerce, if she wishes to maintain her supremacy among the States."

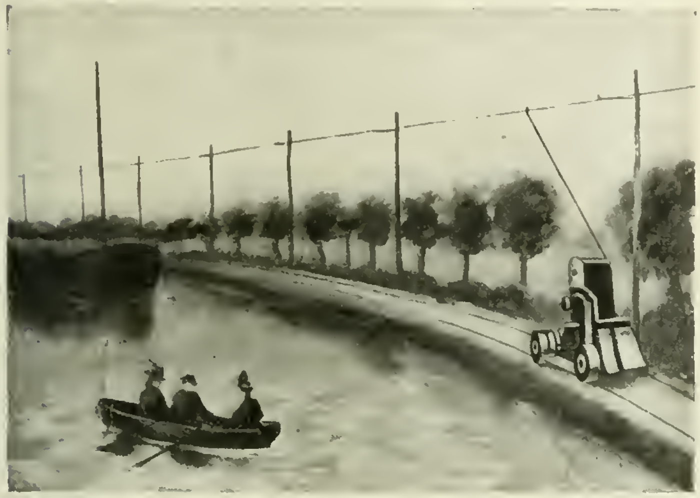


FIG. 3.—ELECTRIC HAULAGE ON FINOW CANAL, GERMANY.

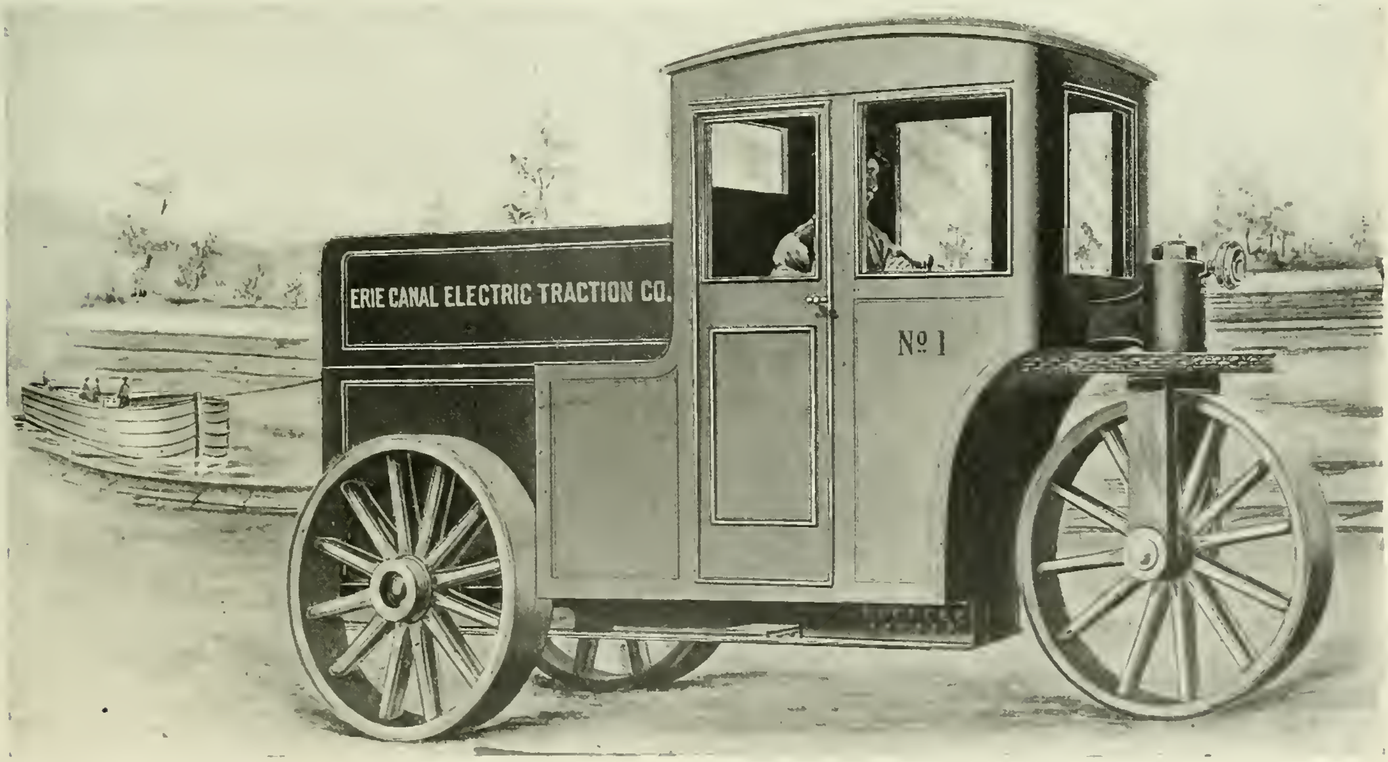
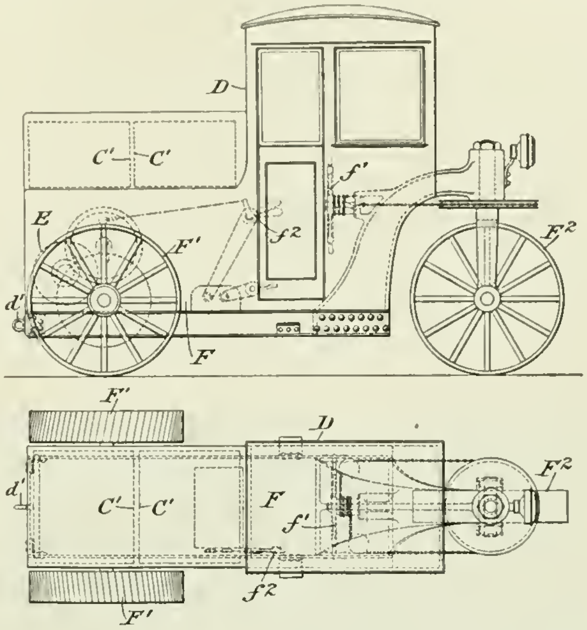


FIG. 4.—THREE-WHEEL ELECTRIC TRACTOR FOR CANALBOAT HAULAGE.

On April 26, 1900, there was tried upon the Delaware & Raritan Canal, in the presence of the officers of the Pennsylvania Railroad, engineers of the Traction Company, and a party of New York capitalists, a tractor of recent invention, which, to the satisfaction of the Traction Company, fully demonstrated its ability to move traffic at a minimum cost. This tractor consisted of an automobile, mounted upon four steel wheels, traveling upon the towpath. This vehicle, shown in Fig. 2, was furnished with storage batteries, and its interesting performance is referred to in detail at the end of this article, the data being published for the first time. This tractor was operated a large part of last season, and the engineers of the Traction Company reported its ability to move freight at less than 1 mill per ton per mile, about one-fourth of the cost of the movement of the same traffic, by the Pennsylvania Railroad, which owns and directs the Raritan Canal. The successful operation of this tractor has prompted the construction of an improved tractor mounted upon three wheels, which is also referred to later.



FIGS. 6 AND 7.—DETAILS OF NEW AUTOMOBILE TRACTOR FOR CANAL HAULAGE.

The interest in the application of electricity to canalboat propulsion has by no means been confined to this country. The Canal Electric Propulsion Company, Limited, of London, has expended large sums in experimenting upon one of the canals of Great Britain with a motor operated upon a rigid steel structure built along the towpath. In France an experimental line under the direction of Monsieur Galliot is now being tested on the canals of the Aire.

This system is operated through a traction motor running upon the towpath and operated from an overhead trolley by direct current.

In Germany, the system controlled by Messrs. Siemens & Halske, which requires a narrow-gauge railway upon the bank of the canal, is being successfully operated on the Finow Canal (Fig. 3); while still another system under the directions of the Kaiser is being experimented with upon the Dortmund-Ems Canal. There was never keener interest in the canal situation in Germany than at the present moment. The speech from the Throne to the Diet at its opening on Jan. 8, was largely occupied by the discussion of canal improvements and extensions, and the application of electricity to their operation.

Under a concession from the King of Belgium, a system known as "the electric horse," has been in operation for nearly two years, moving all the traffic upon one branch of the great Belgian canal system running out of Brussels. The system illustrated in Fig. 1 has shown great commercial economy in the handling of small crafts. Three-phase current is supplied from three overhead wires connected with the motor by a flexible cord, as noted already in these pages.

Returning to the Raritan Canal experiments, it may be stated that an extemporized tow-car built by the Columbia & Electric Vehicle Company, of Hartford, was placed upon the towpath just west of Trenton, N. J., for a series of tests to determine the drawbar-pull per ton and the ease or difficulty of manipulation of the system. This car was made up very hurriedly from such standard material as the company had at hand, and was in no sense of the word designed for the service for which it was used. The running gear was that of a standard delivery wagon, except that the wheels were 40 in. in diameter instead of 42 in., and it had 5-in. steel tires instead of 2½-in. solid rubber tires. The motor was built for 40 amperes, but was constantly overloaded during the test to from 150 to 200 amperes. The gearing reduction was 15.08 to 1. The vehicle was equipped with two sets of Electric Storage Battery Company's standard inverted 7-M.-V. batteries, making a total weight of 5500 lbs., of which 2700 lbs. was battery. The two batteries were placed in multiple. Their normal discharge rate at a three-hour rate was 33, but they were constantly worked at from 75 to 100 amperes per set. Thus it is evident that the equipment was worked at a point far in excess of its rated capacity. In spite of this, however, it underwent the severe service very satisfactorily.

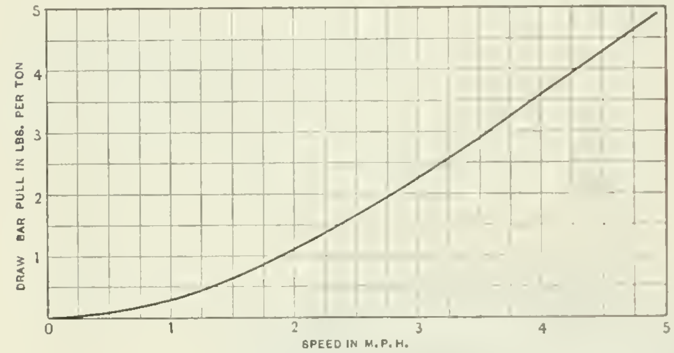


FIG. 5.—DRAWBAR-PULL, CANAL HAULAGE.

The tests made were of two kinds. First, to determine the general behavior of the vehicle in starting the towboats, hauling them back and forth through locks and manœuvering in general. Second, to determine the drawbar-pull per ton and its operation with the speed and number of boats in the tow, and also the maximum safe speed of haulage without damage to the canal banks. During the test the two sand boats known as the Admiral Dewey and Samuel Weller, the sand scow and a loaded coal boat were used. The Admiral Dewey weighed 100 tons, and Samuel Weller 125 tons, the coal boat 247 tons and the sand scow 100 tons. These were towed sometime singly and sometimes in twos.

1st. General Behavior Tests.—It can be briefly stated that no difficulty whatever was experienced, the tow-car picking up the boats and getting them up to speed in a very few minutes and maintaining a uniform pull at all times. No tendency was noted toward side slipping of the wheels due to oblique pulling, although quite often pulling out of the locks the angle of draught was at least 20 degs. Upon very sandy portions of the towpath a very noticeable circumferential slip of the wheels was noticed, but on the harder portions of the path this was unappreciable. In passing into and out of the locks no more difficulty was experienced than with an old and well-trained team of mules.

2d. Power Tests.—At first both electrical readings on the tow-car and dynamometer readings on the boat were made. It was found, however, that the uneven nature of the towpath made such fluctuations in the dynamometer readings as to render them quite unreliable. The vibration of the needles of the electrical instruments, however, being very much less marked on account of their being dead beat, it was very easy to get accurate readings. The readings taken were of current only, as it was necessary only to obtain the average current in order to get the drawbar-pull developed, the speed observations being taken with a stop watch between known stations on the bank. Having the average current consumption, it was possible to obtain from the curves of the motor made from actual dynamometer tests just what torque was imparted at the motor shaft. Knowing the reduction between the motor shaft and the rear axle and the efficiency of its gearing, the latter having been obtained from dynamometer tests of the entire vehicle, and knowing the diameter of the wheel, the drawbar-pull was readily calculated.

A summary of the tests is given herewith in a curve (Fig. 5) giving the average of 11 tests. Only the reliable and consistent tests appear in this report. It will be seen that the curve of drawbar-pull at these loads and speeds follows approximately a straight line, the lower end of this line being probably a curve as noted by the dotted lines on the curve. It was expected that the drawbar-pull would decrease with the number of boats in tow, but the distance between successive boats required for convenient hauling was such that each boat had to make its own displacement and consequently the resistance to each boat was approximately the same as that of the one immediately in front.

Within the range of the tests the drawbar-pull seems to follow fairly closely the general formula:

$$y = ax - b,$$

which, after determining the constants, becomes

$$y = 1.2x - 1.3,$$

where y is equal to the drawbar-pull and x the speed in miles per hour. A peculiarity of the results is that the drawbar-pull for light and loaded boats seem to follow the same formula, at least within the range of speed and loads occurring in the test.

The further development of work along this line is shown in Figs. 4, 6 and 7, in which the apparatus illustrated is due to Mr. Herbert W. Alden, an engineer connected with the Electric Vehicle Company, to whom his patent just issued has been assigned, covering the combination of a floating storage battery with a land tractor, also equipped with batteries. Fig. 4 shows the new tractor in perspective. Figs. 6 and 7 show it in detail. Upon the usual tow-path is placed the tractor or electric locomotive *D*, which may be of any suitable character. It is connected with the battery-boat by a suitable tow-rope, *d*, and its motor (indicated at *E* in Fig. 6) is connected with the battery by a suitable conductor, *e*, which may be independent of the tow-rope or combined therewith, as may be found most convenient.

The tractor *D* represented in the drawings comprises a suitable body, *F*, upon which is mounted the motor, *E*, driving-wheels F', operatively connected with the motor, a steering wheel, F^2, and suitable controlling devices, which are indicated at f' and f^2 respectively. A small storage battery, C' is also mounted upon the tractor body and may be connected with the motor *E* for the purpose of enabling the tractor to manœuver around locks, etc., independently of the battery-boat. The towline is suitably connected to the tractor, as at d'.

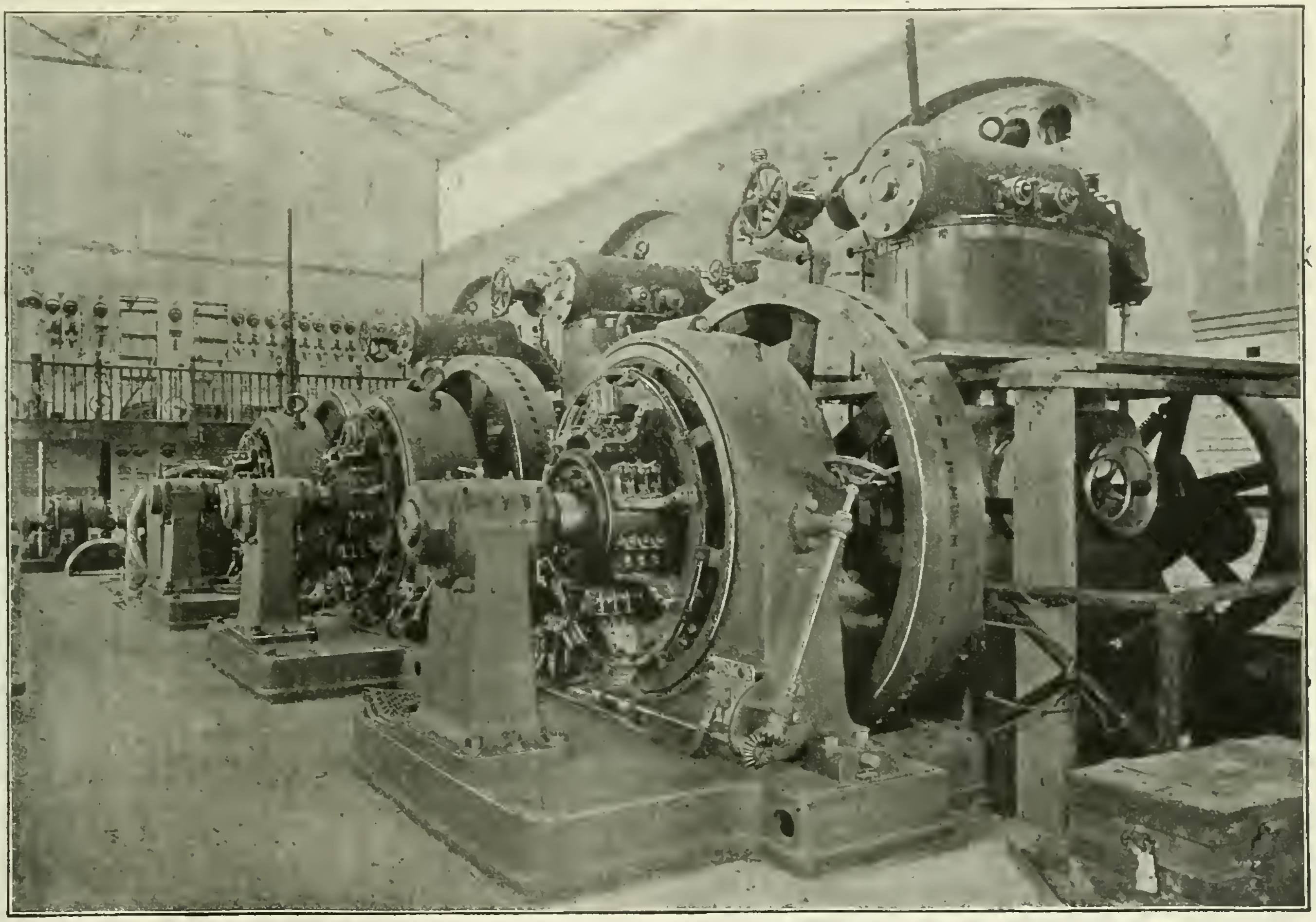
The batteries on the battery-boat are installed as in a central station, there being 200 cells of 1000 lbs. each, in lead-lined tanks. On the tractor itself are 88 cells, as indicated above, with two 50-hp motors, one geared to each driving wheel. The results of the new work will be awaited with much interest.

Dysphoniac.

A new name has been found for the benighted individual who is trying to do business without a telephone. Some years ago such a man could have gone along on the even tenor of his way unnoticed, but in these days of time-economy, it is assumed that he is afflicted with some inexplicable antipathy to modern business methods: and he is now known as a "dysphoniac."

The Dudley (England) Electrical Supply Service.

THE corporation electricity works of Dudley, England, exercises the double function of municipal purveyor of current and vendor of electric power to the Dudley, Stourbridge & District Electric Traction Company, Limited. The line of the latter road was opened to traffic July 25, 1899, with a 15-service of cars, and up to Nov. 3, 1900, was supplied from a temporary municipal plant at Springsmire. A new station recently finished, was built over the temporary one, which is now incorporated in the new building. A Green economizer of 96 tubes is installed. The engine room is shown in the accompanying illustration. At present there is a temporary end, to allow for extensions in the length when the demands for current exceed the safe capacity of the present plant. This temporary end is built on rollers running on girder rails so that as the main walls are extended this end may be easily run out and the engine room enlarged without interfering with the plant at present installed. The engines of the four generating sets are of the Westinghouse compound type. The three largest are 16-in. and 27-in. cylinders by 16-in. stroke, and operate at a normal speed of 250 r. p. m. The small set is driven by one of the engines formerly operating the temporary plant. This engine is 13-in. and 22-in. by 13-in. stroke and operates at a speed of 290 r. p. m. The steam pressure adopted is 150 lbs. per square inch. At the present time the plant, as stated before, is run with a direct atmospheric exhaust, but full condensing plant is in course of erection.



View of Interior of Station of Dudley Electric Plant.

The electrical generators are of the Westinghouse make, and are clearly shown in the illustration. A special modification or addition to the ordinary form of armature winding is provided on these machines, whereby any tendency to want of uniformity in the distribution of the magnetic fields is counteracted, thus preventing brush sparking and large magnetic pulls, even when the armature is considerably out of the normal running center. The three large machines at Dudley are of 200-kw capacity each; the small one is a 100-kw machine. Two motor-generator balancing sets are installed for the purpose of the lighting mains of the town, which are arranged on the three-wire system with 460 volts as the maximum pressure. Each of these sets consists of a pair of 30 kw, 250 volts pressure, shunt-wound Westinghouse generators running at 700 r. p. m., and with the two armatures on the same shaft. Between the two balancing machines and with all three shafts in the same line is a 100-hp, shunt-wound Westinghouse motor. This motor runs at 700 r. p. m. with 500 volts pressure, and can be coupled to either or both balancing sets by clutch couplings. Thus, at times of small lighting loads, this set is used to supply the demand by running the motor on the traction-generator circuit. The three machines are mounted on one bed plate immediately below and in front of the switchboard gallery. The engine room is traversed by a 10-ton overhead traveling crane.

The switchboard gallery is 8 ft. above the engine room floor level, and runs completely across the permanent end of the room. The switching arrangements are set out on fourteen marble panels, thus: Four generator panels, 2 balancing-set panels, 1 motor panel, 1 arc-lighting panel, 1 tramway feeder panel, 4 lighting-feeder panels, and 1 Board of Trade panel. The switchboards are of the usual standard Westinghouse types, and the control of machines and outside circuits is carried out in the manner generally adopted.

The cables used in connection with the lighting and tramways supply are installed throughout on the Callender bitumen solid system, both for feeders and distributing mains, the cables being laid in glazed stoneware troughs filled in with bitumen. The feeders for the traction lines are laid straight across to where the line passes the works about 250 yards distant. There are four single-cored cables, two positive and two negative each of 0.5 in. in area. Laid alongside these mains is a four-core pilot wire, each core of 7-20 S. W. G. Of the private lighting-circuit feeders there is a total length of about 4 miles of triple-concentric cable of the areas 0.3 in., 0.3 in., 0.15 in. The distributing mains, of which about 3840 yards are laid, are also triple-concentric of the areas 0.12 in., 0.12 in., 0.06 in. About one and a quarter miles of a 4-core cable are also installed in connection with the street arc lighting.

There are 18 arc lamps used on the street circuit, arranged in two sets of nine in series on the 460-volt private lighting circuit; 12.5-ampere arcs are used. At midnight the arc lamps are shut off and two 32-cp incandescent lamps are substituted in place of each. The street lamps, both arc and incandescent, are carried by the tubular steel tramway poles, but the isolating switch for each lamp is mounted in a short independent pillar erected alongside the tramway pole. These switch-pillars are ingenious and effective, and were designed by Mr. R. P. Wilson, the consulting engineer of the corporation. A steel tube 7 in. in diameter and about 7 ft. 6 in. long, with 4-ft. length below the ground line and bedded and keyed in a concrete foot, forms the pillar. The inside of the tube is lined with micanite and contains a porcelain frame on which are mounted the fuses and the isolating switch. The latter is on the upper surface of the porcelain block, and is operated in a simple and safe manner. The ornamental cast-iron cap of the tube is fitted with a key, and operates the switch when twisted a quarter of a turn. By a lock operated from outside the pillar the cap may be fixed in either position; that is, the switch may be locked either on or off. Thus the lamp-trimmer does not need to remove the cap or take the slightest risk of electric shock when operating the switch. For the purposes of switch inspection or fuse replacing the cap is removed and then the inner porcelain can be drawn up by a handle and given a half turn, a bayonet joint being arranged so that the porcelain block rests at a point sufficiently high to bring fuses and connections well to hand above the top of the steel tube. It will be seen that this switch is decidedly convenient and not so liable to accident or damage as is the usual underground switch which is always liable to flooding and accumulations of dirt.

The corporation makes a charge to the tramways company of 4 cents per kw-hour, metered, with certain discounts. Private customers have the option of paying on two systems. They may either be charged 10 cents per kw-hour for all loads, times and conditions, or they may prefer to pay at the rate of 12 cents per kw-hour for two certain hours of the day, and 3 cents during the rest of the 24 hours. The two high-priced periods are between 5 p. m. and 7 p. m. in the winter, and between 6 p. m. and 8 p. m. in the summer.

The supply meters used are the improved type of Aron energy meter of the portable, self-winding and automatic reversing type. This meter is used for the two-rate system in conjunction with R. P. Wilson's time-meter switch, the function of which is to introduce at a certain definite time a certain resistance in the meter shunt circuit, whereby its rate of reading is slowed—or to cut out resistance and vice versa. The corporation has adopted the free-wiring system for the consumers.

The general design of the works and the arrangement of the plant have been carried out most effectively. The plant has from the commencement run without any hitch, the tramways are most popular, and demands for electric lighting are coming rapidly forward The work in connection with the contracts already awarded for station plant is, in the case of incompleted parts, such as the condenser plant, being hurried on as quickly as possible, and already it is proposed to increase the capacity of the generating plant by adding a larger set of 500-kw capacity.

Mr. R. P. Wilson is the consulting engineer who designed and has had charge of the scheme right up from the commencement. Mr J. A. T. Marsh is the resident engineer, and has been in charge of the work on the spot, under the consulting engineer. A. H. Lidderdale has had charge of the work of the British Westinghouse Company, Limited, in connection with the equipment of the works with power.

Damage from Lightning.

The United States Weather Bureau in 1898 began to ascertain the amount of damage done by lightning in the United States. The statistics collected for 1899 have just been published in the *Monthly Weather Review*. Though the statistics are only approximate it is believed they include most of the cases where important damage was done. The number of buildings damaged or destroyed by lightning in 1899 was 5527; in addition to these, 729 buildings caught fire as a result of proximity to other structures that were fired by lightning. The approximate loss in 2825 cases was $3,016,000. In 3431 cases the amount of loss was not reported, owing undoubtedly in a majority of instances to the fact that it was very small. The report says that a conservative estimate of the total loss by lightning during the year would be $6,000,000. The great majority of buildings struck by lightning were not provided with lightning rods. This was also the case in 1898. On the other hand, 70 buildings provided with rods were struck and damaged in 1899.

Prof. S. P. Thompson in Berlin.

By Louis J. Magee.

Prof. Silvanus P. Thompson's presence in Berlin the week ending Jan. 12, has excited a good deal of interest among electricians and physicists, socially, as well as in a public way. The Professor's books have a large circulation in Germany and his work is very much appreciated here. A lecture by him in the Urania on Jan. 9 was the cause of his visit, and was of great interest in more ways than one.

First of all, the occasion was of an international character, the lecture being delivered in fluent German, by an Englishman, and the subject matter being outspokenly English in character. Secondly, Prof. Thompson had in his audience a very fine representation from the scientific circles in Berlin. The Patent Office, Post and Telegraph, Technical High School, the University and the large electric manufacturers all were represented. I noticed among others Dr. Hefner von Alteneck and Prof. Reuleaux, sitting side by side; Mr. Gisbert Kapp with his family, Mr. Rathenau, general manager of the Allgemeine Elektricitäts Gesellschaft; Prof. Dr Strecker, chief electrician of the Government Telegraphs; Prof. Roessler, from the Polytechnic; Dr. Görges, chief electrician of Siemens & Halske; Mr. Burke, chief electrician of the firm of Bergmann & Co.; Dr. Niethammer, Dr. Hamburger and Mr. Hobert, of the "Union," etc.

A further element which gave the occasion especial interest, was the fact that the lecturer, instead of describing new inventions, apparatus or phenomena, and running the risk of going over ground familair to some and uninteresting for others, chose a subject which could not fail to interest everybody, and performed experiments not pretending to be new but interesting because they were historical, and performed in many cases with facsimiles of famous original apparatus. The lecture dealt with Faraday's life work and methods of investigation, and his followers of the English school of electricians and their methods. Prof. Thompson would probably have been criticized for saying so much about English electricians if he had not deliberately and outspokenly shown his intention of doing so by the title of his lecture. He laid stress on the fact that the English scientist considers that he understands a phenomenon when he can make a working model which will show the same thing by mechanical analogies, whereas the French school of scientists seek to understand and explain everything by mathematical formulæ.

The latter part of his lecture dealing with such comparisons of methods of research as well as of instruction evidently made a very deep impression on his hearers, and gave them a great deal of food for thought. A great deal of discussion is going on in academical circles in Germany as to the methods of teaching observed in the universities on the one hand and the technical schools on the other. The relation of the technical schools to the industries, for which latter the students are supposed to be prepared, has, with the rapid growth of German industries, brought out interesting phases of technical education and some sharp discussion.

The lecture was given in the "Urania," a most excellent business institution provided with a theatre or lecture room, and a physical laboratory and experimental exhibit, all devoted to the popularization of science, with very low prices of admission. Most of the lectures delivered in this institution are adapted to the general public and are of an elementary nature. On this occasion, however, the general public seemed to have been crowded out by the scientific world of Berlin, which was glad to get this opportunity to see and hear a man who has done so much for our "Fach."

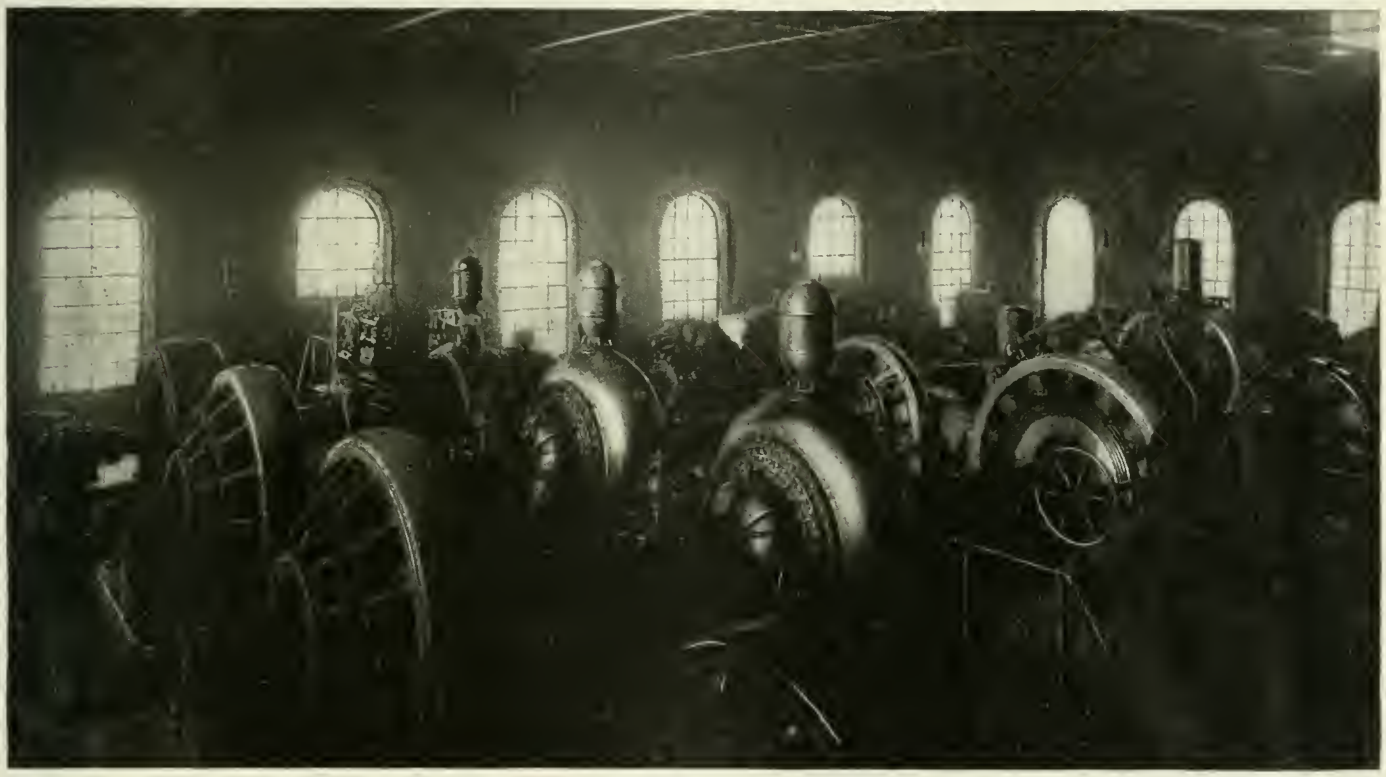
Automobiles on Ferry Boats.

The decision of the authorities to observe a strict construction of the law in relation to the carrying of combustibles on passenger steamers, which has resulted in the exclusion of gasoline automobiles from ferryboats, has been circumvented by Mr. W. K. Vanderbilt, Jr., in a rather expensive manner. Mr. Vanderbilt, according to report, takes his gasoline automobile across the Thirty-fourth Street ferry between New York and Brooklyn on a specially chartered ferryboat, for which he pays $8 a trip. It is stated that he has arranged with the Long Island Railroad Company for a special boat at that figure whenever he wishes to bring his "White Ghost" into New York. Reference was made in these columns recently to the present construction of the law, and the efforts being made to have the restrictions modified so that they shall not apply to automobiles.

Power Development at Niagara.

BY ORRIN E. DUNLAP.

THE past year has witnessed the completion of the third section of the central station of the Niagara Falls Hydraulic Power & Manufacturing Company at the water's edge in the Niagara Gorge, and the installation of the turbines and generators in the second section. The installtion of the third section is yet to be placed. When the Niagara Falls Hydraulic Power & Manufacturing Company broke ground in the Gorge for the original section, the plan was that the building should be completed in three sections of about 60 x 100 ft. This plan has been closely followed, and the dimensions of the structure to-day are 180 x 100 ft. The building is of stone, with a steel truss roof, and it is located north of the pulp mill of the Cliff Paper Company. A penstock 8 ft. in diameter feeds the four turbines installed by James Leffel & Co., of Springfield, Ohio, in the first section, while the wheels in the second section are fed from a penstock having a diameter of 11 ft.


NEW PLANT OF THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY.

All of the five turbines that have been installed in the second section of this station were made in Philadelphia, three of them by R. D. Wood & Co., and two by the I. P. Morris Company. The first wheel in the line is of 3500-hp capacity, of R. D. Wood & Co.'s make, and it is used to operate a 700-kw Walker alternator for the Buffalo & Niagara Falls Electric Light & Power Company, also an 875-kw, 175-volt, General Electric direct-current generator for the National Electrolytic Company. The second wheel in line is one of the I. P. Morris wheels of 2900-hp capacity. On one side it has attached a 1000-kw, 300-volt direct-current machine, made by the General Electric Company, and used to supply the Acker Process Company with current. On the other side, there is a duplicate of the National Electrolytic Company's machine, above described, and which gives service to that company. The third wheel is also of 2900-hp capacity, of I. P. Morris Company's make, and to it are connected two 1000-kw, 300-volt direct-current machines, made by the General Electric Company. Both machines furnish current to the Acker Process Company. The fourth and fifth turbines are of 2900-hp capacity, of R. D. Wood & Co.'s make, and are each connected to two 800-kw, 300-volt direct-current machines of Westinghouse make. These generators supply current to the lower works of the Pittsburg Reduction Company on the high bank over the power station.

The current from this station is transmitted over aluminum bars and cables. In each leg of the Acker Process Company's circuit there are 31,000,000 c. m. The length of the circuit is about 1500 ft. from the power house to the plant, and the circuit carries 9300 amperes, at 300 volts. The Acker Process Company's plant is located on Third Street on lands of the power company. The plant has been very substantially constructed, the buildings being of brick and of handsome general appearance. This company manufactures caustic soda and bleaching powder, the process used, it is claimed being about 15 times more efficient than that used in any other factory of the kind in the world. The operation of the plant was started a few weeks ago. The process is secret.

The installation of the third section of the power house is being prepared for as rapidly as possible. In the tail race beneath the floor the penstock and valves are in place, and the new penstock has been carried to the top of the cliff. This new penstock has a diameter of 11 ft., and was made by Struthers, Wells & Co., of Warren, Pa. It will stand out from the cliff in column form the same as the present 11-ft. penstock, and it will supply water to five new turbines. The contract for these turbines has been placed with the I. P. Morris Company, of Philadelphia, and it is expected they will be ready for very early delivery. To four of these new wheels in the third section there will be connected eight generators of Westinghouse make. These machines will supply current to the Pittsburg Reduction Company's aluminum plant. This additional amount of current will permit the Pittsburg Reduction Company to materially increase its output during the present year, so that the first year of the century will without doubt witness a vast increase in the aluminum output as compared with any past year. To the fifth turbine in the third section of the station there will be connected two 1000-kw, three-phase alternating-current generators for power purposes, the output of which has already been contracted for.

It is understood that the Niagara Falls Hydraulic Power & Manufacturing Company will, in the near future, break ground for a new power house a short distance down stream from the site of the present station. Many will recall the rather pretty spectacle of the downpour of water from the mills on the high bank above. It is highly probable that within a few years this scene will have disappeared, owing to the water having been caught and all utilized to operate turbines. The water is there, and the head is there, two essential features of a successful water development.

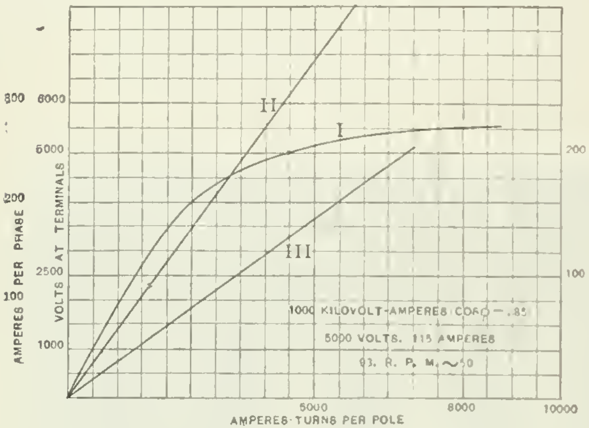
Ever since the Niagara Falls Hydraulic Power & Manufacturing Company has owned this water power, it has been active in its development. Each year the canal leading from the upper river has been enlarged, and now still further developments on the same line are projected. The right of way owned by the company is 100 ft. wide. At points the full width has been opened, while at other points the canal is but 70 ft. wide. A particularly narrow place has been between Second and Third Streets, where the north side of the right of way has been occupied by the train-shed of the Erie Railroad. Under notice from the power company the railroad company has removed its shed, having purchased a new depot site a few hundred feet to the east of the present location, and the power company will at once proceed to widen the canal channel at this point to 100 ft. This will add to the facilities for the flow of water, resulting in an increase of the power.

European Types of High-Tension Alternators—III.

By C. F. Guilbert.

LAHMEYER ALTERNATOR.

The alternator (Figs. 10, 11, 12) exhibited by the Elektricitats Actien Gesellschaft, of Frankfort-on-the-Main, formerly the Lahmeyer Company, was direct connected at the Paris Exposition to a vertical compound engine made by the Augsburg & Nuremberg Engine Company, and the installation was particularly interesting from the ingenious manner in which the measuring apparatus was disposed with respect to the circuits of the alternator. This disposition consists, as shown in Fig. 12*a*, in selecting on each phase at the common point of the three phases, a certain number of armature coils, a single elementary coil (one-sixty-fourth of the winding), for example, and connecting the star circuit thus furnished with the primary of a small three-phase transformer having a transforming ratio of unity, and the power of which, with respect to that of the dynamo is in the same ratio as the number of turns selected on one phase is to the total number of the turns per phase. The measuring instruments are placed on this auxiliary circuit, a voltmeter between two of the conductors, an ammeter on each phase and a wattmeter on one of the phases with its fine wire coil connected with the neutral point. The secondary of the transformer is connected in series with the troncated phases of the alternator with its neutral point grounded It is easily seen that by this means the strength of the current in the primary is practically the same as in the secondary that is to say, as in the alternator winding, and that the voltage is there proportional to the total voltage. This disposition of the measuring instruments has been applied by the Frankfort firm to a large number of machines. Very careful tests have shown that the accuracy of measurements is not lessened by its employment, and that small irregularities in the air-gap have no influence.



I.—No-load Characteristic. II.—Short circuit Characteristic.
III.—Excitation line.

FIG. 12.—CHARACTERISTICS OF LAHMEYER ALTERNATOR.

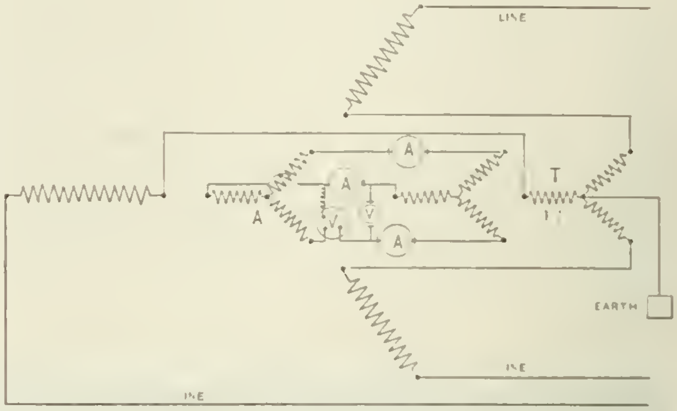
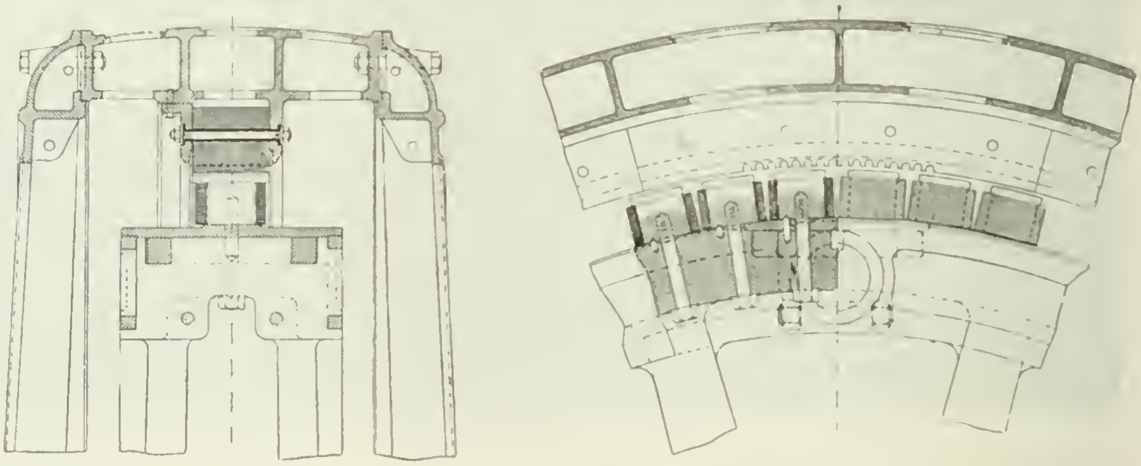
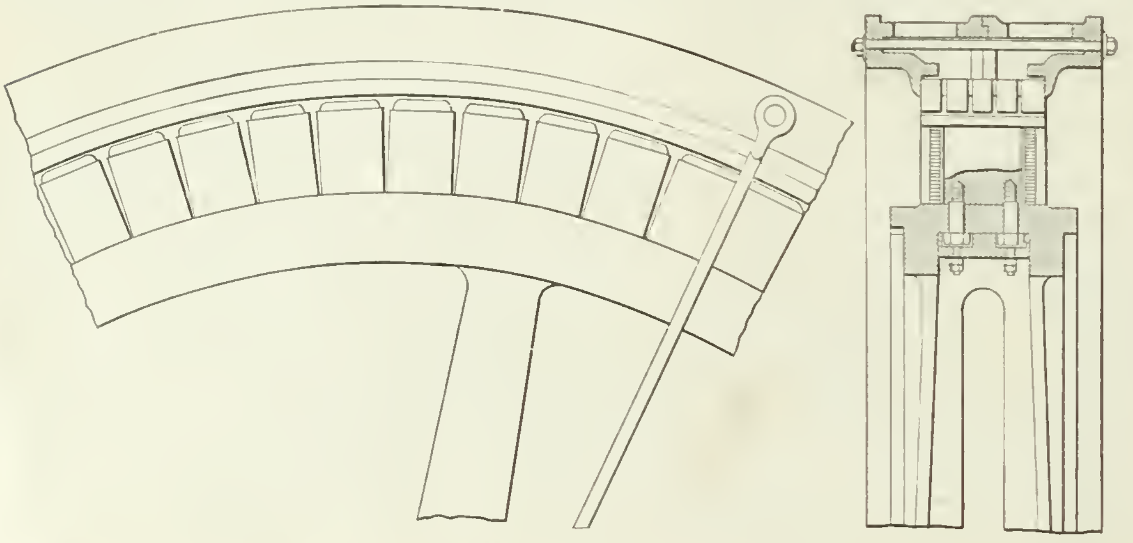


FIG. 12A.—DISPOSITION OF INSTRUMENT CIRCUITS.



Figs. 10 and 11.—Lahmeyer Alternator.



Figs. 13 and 14.—Schuckert Alternator.

SCHUCKERT ALTERNATOR.

The alternator of the Elektricitats Actien Gesellschaft, formerly Schuckert & Co., of Nuremberg (Figs. 13 and 14), presents no notable feature aside from lightness. It was driven at Paris by a 4-cylinder vertical triple-expansion flywheel engine made by the Augsburg & Nuremberg Engine Company.

GANZ ALTERNATOR.

Two Ganz alternators were exhibited at Paris—one in the Hungarian and the other in the Austrian section. The first was driven by a compound engine made at Brunn, and the other by an engine made by L. Lang, of Puda Pest The machines present a

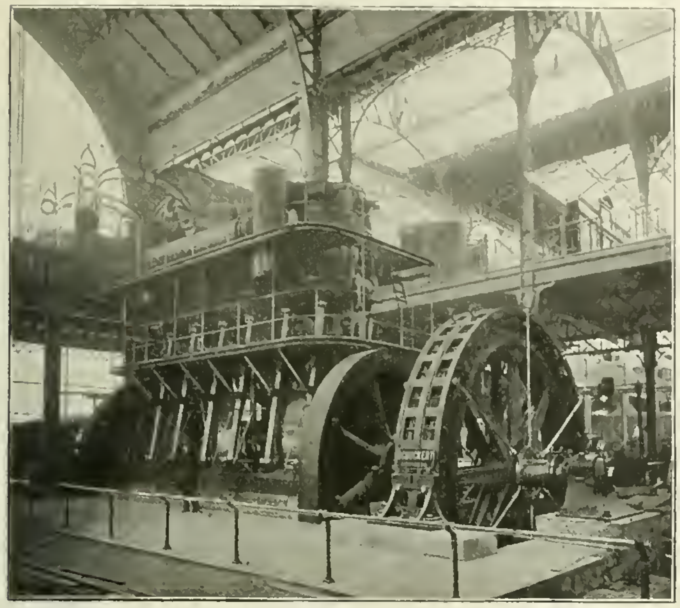
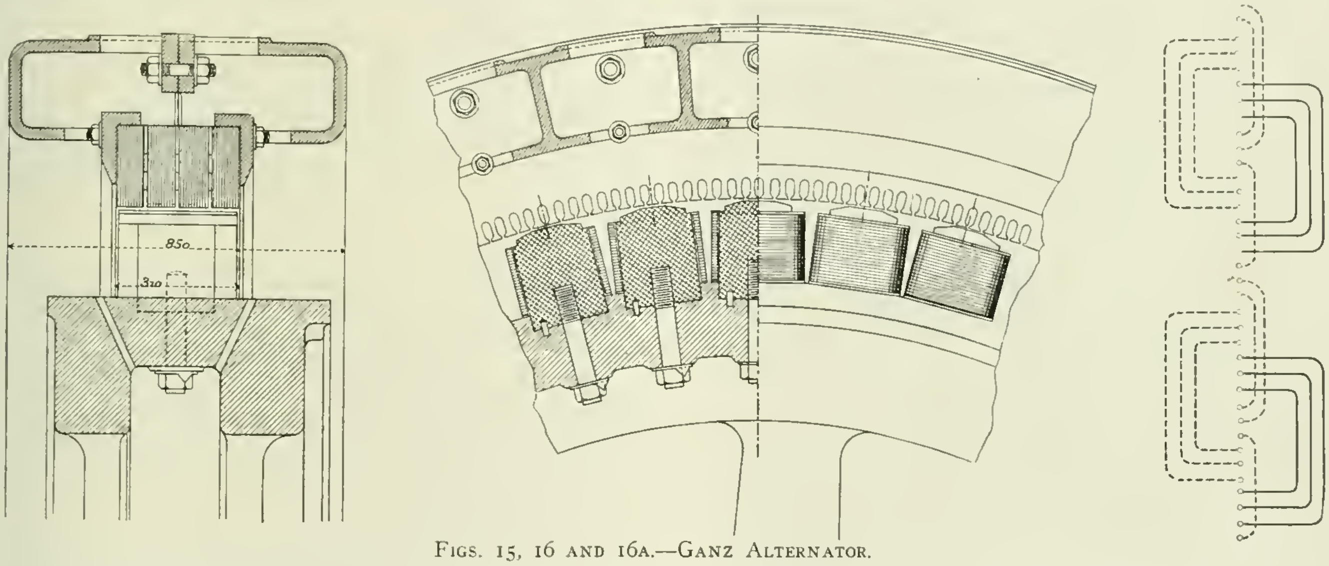
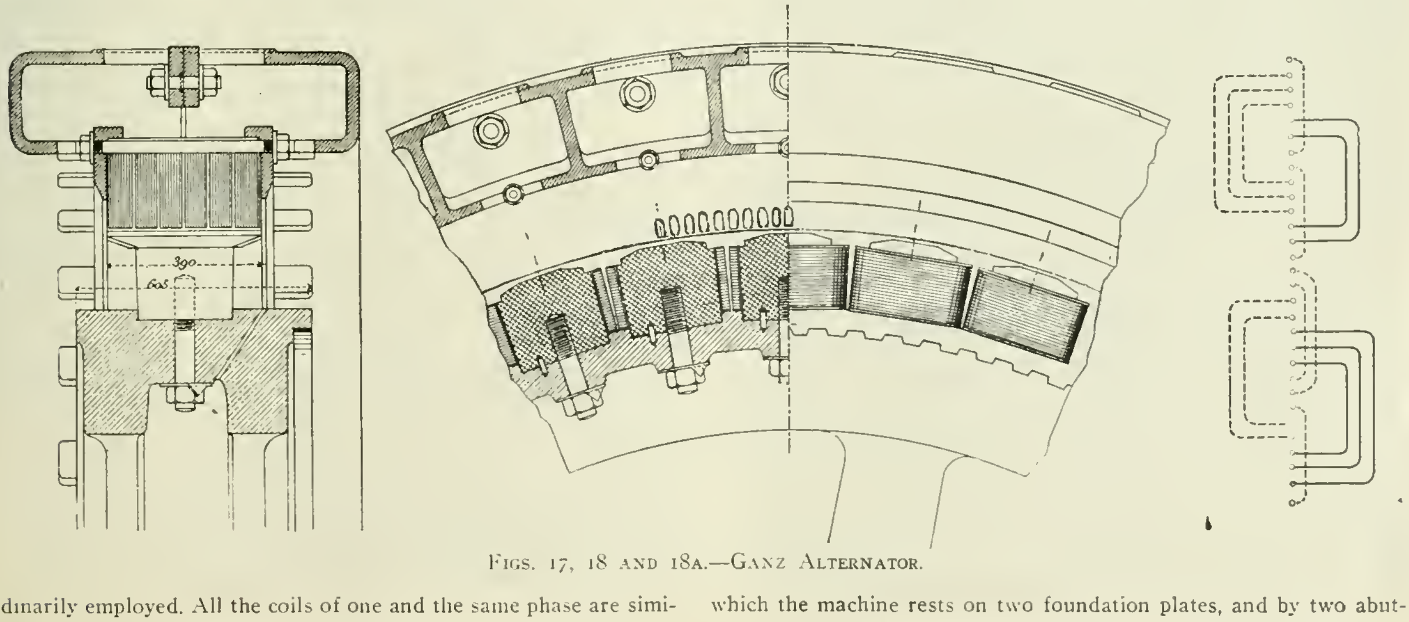


FIG. 14A.—GANZ ALTERNATOR AT PARIS EXPOSITION.

particular interest as they are of a new type originated by the Ganz Company, which is one of the oldest in the European electrical industry. Both machines, aside from the details of construction indicated in Figs. 15 and 16 for one and 17 and 18 for the other, are characterized by a special winding. The winding of the Austrian alternator is disposed in 360 slots, or 9 per pole, but differs from the systems ordinarily employed. All the coils of one and the same phase are similarly placed; but while two of the phases have their coils formed in three elementary sections having the same axis, the third, on the contrary, has its winding formed of two kinds of coils, one occupying four slots and the others two, and the ends are not bent up. Each group of two coils is in series with a simple coil, which together give the same voltage as each coil of the other phases. Fig 16*a* illustrates the scheme of winding. It is well to point out that in this alternator the pole-pieces have a polygonal section and the field cores a troncated section, the larger base being turned toward the air-gap.



Figs. 15, 16 and 16a.—Ganz Alternator.



Figs. 17, 18 and 18a.—Ganz Alternator.

What renders the winding of the Ganz alternator exhibited in the Hungarian group particularly interesting, is the circumstance that there are 2½ slots per pole for each phase. The winding is almost the same as a three-phase winding, in which coils of the same phase are disposed in the same manner, but all the complete coils of the same phase do not occupy the same number of slots. For two of the phases a half of the coils comprise three elements placed in six slots, while the other half comprises only two coils placed in four slots; the two series of different coils are naturally intertwined. The result is that each of the phases comprises five slots per pair of poles, and consequently 2½ slots per pole. The two phases have their ends turned up, one on the exterior circumference, the other toward the air-gap. The third phase, the coils of which are straight, comprises per pair of poles three elements wound in two slots only, and one in four.

The disposition thus consists in completely filling with one of the phases the slot of which the second half belongs theoretically to one of the other phases, and in permitting the phase occupying these slots to be divided. Fig. 18*a* represents the scheme of this winding. The coils shown in least height form the exterior portions and comprise only one or two elementary coils. The others comprise alternately two and three elementary coils, and have their ends turned up toward the top and toward the gap. The adjustment of the gap in these two alternators is made by means of two screws through which the machine rests on two foundation plates, and by two abutting screws engaging in fixed nuts cast in the foundation plates.

The Valuation and Taxation of Telephone Companies in Michigan.

By W. J. Rice.

TELEPHONE and telegraph companies were included in a taxation bill which failed to pass the Senate in December after being favorably acted upon by the lower branch of the Michigan State Legislature, sitting in special session, called Dec. 12, 1900.

The object of the bill was to tax those companies, previously paying a specific tax of 3 per cent on their gross earnings, at the uniform rate paid throughout the State on other properties. While the bill was aimed directly at railroad companies, it included, besides the above named, express, plank road and river improvement companies. The principle involved is one that has been agitated almost continually during the Pingree administration, but a stumbling block always in the way to hinder a definte action being taken was the lack of any accurate record of the actual value of the properties involved.

During the session of 1899 an act called the "Oren Bill" was passed, creating the Board of State Tax Commission and made it a part of its duty to ascertain and report to the Legislature the actual and correct values of these companies. Prof. M. E. Cooley, of the University of Michigan, was employed as appraiser, to have charge and complete the work of affixing values of physical properties. While the force engaged on the entire work during the past three months has numbered nearly 100, there have been actually engaged in telephone work eight or ten inspectors. In determining the appraisal two distinct values have been recognized. First, the tangible value or value of physical properties; second, intangible values, consisting of franchises, rights of way and other elements which enter in to make a large increased earning power. The work of appraising physical properties has been executed along two distinct lines; first, by securing from the various companies their own report of their physical properties, requesting at the same time that they add what they consider for each detailed item a fair price for cost of reproduction, reporting its per cent of new—the product of the two showing its present value. Second, by covering, at the same time, all properties in the State of Michigan by field inspectors connected with the commission.

The intangible values have been made under the direction of Prof. H. C. Adams, of the University of Michigan, and United States Statistician for the Interstate Commerce Commission. This has been arrived at by securing from the companies a statement of their gross earnings, for one year ending with a certain date, from whatever source derived; also their gross expenses for the same period, divided under the headings: Salaries to officers, wages, operating expenses, maintenance expenses, division of tolls, taxes.

From their net earnings is then taken an amount equal to 4 per cent of the value of physical properties as arrived at by this appraisal. This last result, when capitalized at 4 per cent, represents the intangible value of the property. This has not yet been added to the value of physical properties, but is a matter of information still under consideration. At the same time, companies are requested to report the amount of their capital stock, number of shares, par value, market value or actual value of each, their bonded indebtedness, with full details as to the nature and conditions of the bonds, value of real estate, and, finally, all personal property, including moneys and credits. The above statements have been submitted under oath, and, consequently, have been treated confidentially.

At the beginning of this work the State records showed 64 telephone companies in operation, representing a valuation of slightly over $2,000,000. Twenty companies were found to have gone out of existence or consolidated with other companies, while 19 new companies have come into the field, bringing the total appraisal at this time for 63 companies up to $5,500,000, of which $3,000,000 represents increased value on the same property reported in 1899.

The first work done by the Commission was to establish a basis of prices for the different classes of material and labor and ascertain for each an annual rate of depreciation. At the same time a general "description and method to be followed was drawn up and a preliminary draft was submitted to a number of telephone companies throughout the United States asking for criticism and their views upon the plan as submitted. It was expected, and later demonstrated, that from different localities would come a wide range of opinions as to the annual rates of depreciation which should be allowed on the various classes of equipment and construction. In Chicago, for instance, underground and aerial cable is reported as having an annual depreciation of 12½ per cent, while in Boston the same equipment is reported at an annual depreciation of 7½ per cent. Underground conduit in Chicago is reckoned at an annual depreciation of 5 per cent, as against 3½ per cent in Boston. From Boston came the recommendation that an annual depreciation of 7 per cent be allowed on copper wire, while Chicago accepted 75 per cent of new as being a fair estimate of all copper wire in use, regardless of its length of service. In other respects there has not been such a large variety of opinions.

The following is the result which was finally arrived at as being a medium of different criticisms submitted, and upon this as a basis the appraisal of telephone properties has been conducted:

DESCRIPTION.

POLES include chestnut, pine, cedar, tamarack and all other wooden poles; both exchange and toll line poles are considered set in place together with the necessary guys, braces, steps, roofed, gained and bored.

CROSS ARMS for both exchange and toll lines are considered in place on poles, equipped with pins, insulators, bolts, braces, nails and all other necessary apparatus.

WIRE, both exchange and toll line, includes all gauges, whether bare or insulated, and is considered put in place together with all necessary tie wires, sleeves, transpositions, etc. For exchanges it includes all wire used for the purpose of connecting subscribers' stations to the central office, connected at one end to the outside of the building and at the other to outside of fuses in main distributing rack at central office, or cable boxes where taken into a cable. For toll lines it includes connection at the various terminals. No cable conductors are considered under the head of wire.

CONDUITS are figured in lineal duct feet, of various kinds of material and construction, and include all labor in connection with excavating and restoring streets, subsidiaries, manholes, handholes and junction boxes.

CABLE, aerial cable and underground cable are not separated, it being considered that cost of placing each is equal. Aerial cable is considered put in place, including the suspension strand and attachments, cable boxes, cable heads, splicing and connections to cable terminals. Underground is considered pulled in and spliced.

SUBMARINE CABLE is considered as being placed and includes connection at both ends, together with cable houses, boxes, terminal heads, fuses and all other necessary apparatus.

SUBSCRIBERS' STATIONS include total cost of installation. It covers for each station transmitter, receiver, bell, generator and box, battery, fuses, protectors and wire connection to outside of building.

SWITCHBOARDS cover complete central office installation; includes intermediate and main distributing racks, power plant, test tables, toll boards, fuses, heat coils and all apparatus and appurtenances used in connection with the operation of a central office. The total capacity is represented by the number of answering jacks, drops or lines terminating in the board.

METHOD.

COST OF REPRODUCTION, with the exception of copper, current prices have been used for labor and material, it being considered that the current prices are not subject to fluctuations and will not be materially lower in the future. For copper wire, however, which has been subject to and will continue to fluctuate, an average price for the past seven years has been used. Where different prices are noted for similar classes of equipment the same may be interpreted to signify a difference in character and quality of construction.

RATE OF DEPRECIATION, an arbitrary figure of 40 per cent. of cost of reproduction has been taken, below which no depreciation has been allowed, if the equipment is still in use or likely to be continued in use. If not in use or not likely to be used again, its junk value only has been taken. This applies to all the following equipment.

POLES AND CROSS ARMS, accepting about twelve years as the average life of a pole line, a depreciation has been allowed of 8 per cent. per annum.

WIRE, as explained above, the cost of reproduction of copper wire has been taken from the average price for the past seven years. Inasmuch as the cost of copper wire is figured from its weight, its value does not differ materially regardless of its length of service. Eighty per cent having been taken as the junk value of all copper wire in use, no depreciation has been allowed below that figure.

For copper wire in use one year or less its full value will be taken.

For 2 years and less than 3 years, 2½ per cent.
" 3 " " " " 5 " 5 " "
" 5 " " " " 10 " 10 " "
" 10 " " over, 20 " "

UNDERGROUND CONDUIT, a depreciation has been allowed of 2 per cent. per annum.

CABLE, for both aerial and underground (lead covered and rubber) cable a depreciation has been allowed of 10 per cent per annum.

SUBMARINE CABLE, in all cases this material has been treated specially, the same general conditions not being met with in differnt pieces of submarine cable.

SUBSCRIBERS' STATION EQUIPMENT, accepting ten years as the average length of time that this equipment is used, or can be used, a depreciation has been allowed of 10 per cent. per annum.

SWITCHBOARDS, under general conditions, a central office installation does not exceed an average length of life of ten years. A depreciation has, therefore, been allowed of 10 per cent per annum.

Using the detailed reports of field inspectors as a guide, a certain rate per cent has been deducted from or added to this basis to meet unusual conditions, such as inferior construction and equipment or extraordinary difficulties on account of location and other physical characters, for instance, the construction in the Upper Peninsula is made difficult on account of inaccessible rights of way, rocky soil and uneven ground, while in the Lower Peninsula the soil is sandy, with a very level surface, and in most instances a clear right of way along the highways.

As far as a record of actual equipment and construction in use was concerned, it was not expected that the field inspectors would make as complete a report as could be obtained from the companies themselves, who had available records to draw from. When reports were received from companies and an attempt was made to check that report with those received from inspectors, this assumption was found to be a fact, and for that reason where companies made a report of their physical properties, their report was used as a basis and calculations were made on the appraisal prices.

In regard to the question as to whether or not the results secured by field inspectors have warranted the expenses involved, the following summary will demonstrate briefly what aid these field inspections have been.

1. Record and appraisal of 20 companies were obtained representing a value of $200,000, which would not otherwise have been included.

2. They have provided a check upon the reports made by the companies, and had any serious omission been made by them it would at once have been detected.

3. The detailed reports and descriptions of field inspectors have served a very useful purpose in arriving at the rate which should be deducted from or added to a fixed basis of cost to provide for the different conditions and quality of construction met with in different localities.

4. In many instances the depreciation rate has been applied on the strength of these reports, rather than allowing a certain per cent each year for the entire number of years a particular part of a plant has been constructed. In many instances a pole line may have been in existence twenty years, yet the degree of maintenance and reconstruction which has been employed has kept that line practically as good as new. Otherwise, the twenty years' depreciation at 8 per cent would reduce the value of the line far below the 40 per cent limit which has been selected below which no depreciation has been allowed for equipment in use or likely to be used again.

5. Finally, it has assured increased accuracy in all results, as reported.

There has been noted throughout the State a distinctive difference between the construction of the Michigan Telephone Company and the "independent" companies. While reports have been received from independent companies and an estimate submitted of what they consider the value of their physical properties, it has been noted that their estimate was exceedingly low. While reports were undoubtedly made in good faith they could not be accepted in this appraisal, as in figuring on reproducing the plant many advantages would not be counted upon, yet they did actually exist when these plants were built. For instance, the general independent movement has had the one object in view to drive out the American Bell Telephone Company's system and to secure improved telephone service at much cheaper rates. This has been accomplished by a small body of men in a community who have devoted a considerable part of their services to the cause without making any charge. Various classes of equipment, such as poles, particularly, have been secured along the rights of way by being allowed to cut poles within a very short distance of the holes where they were set. There have been no expenses of engineering, supervision, preliminary surveys and plans, legal expenses or interest figured on investment before plant becomes an earning factor, and in various other ways these plants have been constructed at a much lower figure than could possibly have been done independently of these advantages.

The sharp competition which exists in the class of trade which manufactures switchboards and telephone equipment have enabled these companies to secure such equipment at a very low figure, in some instances actually below cost. The general class of construction is not such as would meet with the approval of standard telephone practice. An example of this in particular is that of the Detroit Telephone Company in the city of Detroit, which has recently been purchased by the Michigan Telephone Company. While this board, with a total capacity of about 6000 lines, gave for a year or more excellent service, its original plan was so short sighted that under exceedingly heavy cost of maintenance and operation it actually approached within that short time a condition where it was a hopeless task to produce a satisfactory service. While the outside construction and subscribers' equipment mechanically did not approach the same class of work performed by the Bell Company the results obtained were satisfactory, yet its depreciation was double that of standard construction.

For the Michigan Company in a number of places, such as Detroit, Lansing, Port Huron, Ann Arbor and others, there is an entirely new system installed, though not yet in operation, duplicating the system now being used. Shortly after the first of the year this old plant will be abandoned and the new plant cut into service. The new plant represents the most modern and improved type of construction and equipment. The switchboards are of the latest Western Electric type of multiple relay boards, and the outside construction and distributing poles are made from a superior quality of cedar shipped in from Idaho.

A noticeable feature in Detroit is the relay station which has been established on the outskirts of the city into which terminate or pass through all the principal toll lines of the State. Traffic for the city of Detroit will be handled by local trunks from this relay office to the various central offices throughout the city. A line of 65-ft. Idaho cedar poles, set 44 to the mile, has been erected to carry these trunk lines in open wires around the city. The effect upon cutting out the large mileage of cable will be readily observed on long-haul connections. The general plan of the company has been to erect a system which will stand unsurpassed and outlive any form of construction heretofore erected.

The "independent" telephone movement in this State has been the subject of many articles of late, yet the outcome is not assured and a variety of opinions are expressed. There are about 33,000 telephones connected with the independent companies, as against 40,000 Bell subscribers. The toll business is decidedly to the Bell Company's advantage. It seems to be the policy of the Michigan Company that the sure way of uprooting the independent movement is by establishing a service that cannot be approached. So far as construction and equipment are concerned, this plan is certainly being carried out. While the independent faction is struggling to make a good fight, their plant conditions are not now such as will accomplish it. This together with the tremendous depreciation which is not realized to its full extent or being provided for, will eventually give them a decided setback. While it is their contention that they are satisfied to give only local service and do not care to develop a toll business, yet their connections with the cities of Detroit, Lansing and Kalamazoo having been cut off on account of these companies being purchased by the Michigan Company, is considered as having broken the backbone of the independent movement.

Independent companies are mainly of two kinds: One, purely speculative, having been promoted by men connected with or interested in some concerns manufacturing telephone equipment. These companies are often on a very poor financial basis, carrying in many instances a considerable amount of stock not actually representing money paid in, and further handicapped by possessing an inferior system which was purchased complete at a much higher figure than actually worth, and for the purpose of keeping up the value of the stock dividends have been paid far beyond the amount warranted by net earnings.

Secondly, there are a few instances where "mutual" companies have been organized and operated by business men who would not tolerate what they consider exorbitant rates and inferior service. These concerns are organized and operated on first-class business principles, yet the extent of the service is so restricted that the results obtained are no more than is represented by the amount of rates paid. As regards the future in either of the above cases, there is much honest doubt whether either class of companies will be very long lived. They can, however, be satisfied that they have given the Michigan Telephone Company a severe shock and one from which it will take some time to recover, and in many instances a material reduction in rates has been effected.

In regard to the question of taxation, the new law will include all companies, persons and co-operations doing a business of transmitting telephone messages in or through the State. They will pay the same rate on their actual cash value as is paid by all other properties. This will effect a considerable increased taxation as compared to the previous tax paid of 3 per cent on their gross earnings.

Some of the arguments brought forward in the Governor's message submitting this bill was the objections of having the State dependent upon the companies to report their gross earnings for the purpose of taxation, placing the balance of the power in the company's own hands, leaving the State helpless in the matter. Further, that during the times when business is dull, or hard times prevail, gross earnings are materially lessened, and, consequently, the proportion of taxes paid by these companies are lessened, incurring a proportionately heavy rate on other properties although equally affected by the hard times.

As before explained, this bill was directed principally at railroads, and, of course, that industry represents a much larger interest than telephone or telegraph companies. The latter companies, however, were included on account of the impossibility of affixing a uniform assessment, either locally or by counties. It is well argued that this method will produce a uniform rate of taxation for all companies enjoying franchises and special privileges under the laws of this State and will further be uniform as compared with the rate of taxation paid by property assessed locally. The bill will again be presented at the next session in 1901, when the new Legislature convenes.

Since the above article was prepared, and besides the actual value represented by physical properties of telephone companies, there have been added to the cost of reproduction and present value the following items of expense: 1. Engineering expense. 2. Legal expense. 3. Interest. 4. Miscellaneous expenses. 5. Rights of way. This has been done only in the cases where the property represents an investment of over $50,000.

1. Engineering expense has been arrived at by taking 3 per cent of the amount represented by construction.

2. Legal expense, by taking ½ of 1 per cent of the same amount.

3. Interest, by taking 3 per cent of the total amount of construction plus the amounts of engineering and legal expenses. This item is to cover the interest on money invested during the time that construction has actually begun until it becomes an earning factor. In using 3 per cent it has been assumed that whatever construction is begun will become an earning factor within 6 months.

4. Miscellaneous expenses, being the expense of organization, general office and incidental expenses, is arrived at by figuring 1½ per cent on the cost of construction plus engineering, legal and interest expenses.

5. Rights of way. The independent companies in this State have not acquired any right of way through purchase. They enjoy the privilege merely through the good will of the people, and are likely to be deprived of same at short notice. It is not considered that such rights of way have any tangible value.

The Michigan Telephone Company, however, have permanent rights of way in many instances along or across private property, in some cases on railroad rights of way, and in other cases on private property just outside of the railroad right of way. Including the expense of getting these rights of way, as well as the amount actually expended for same, an average price was arrived at of $20 per mile, or, in round numbers, $100,000 for the Michigan Telephone Company's right of way.

	Michigan Company.	A. T. & T. Co.	Independent.	Total
Total present val..	$5,232,535.66	$73,795.85	$1,033,509.45	$6,339,840.96
" Exchanges ..	165		117	282
" Subscribers..	42,072		25,672	66,744
" No. of poles.	209,449	8,791	117,728	335,968
" Mileage of pole lines..	6,981	293	3,925	11,199
" No. cro'arms.	291,000	9,113	100,880	400,993
" Mile. of wire.	49,686	1,919	20,773	72,378

The foregoing is a brief summary of the final result of this appraisal.

Automobile Competition in Berlin.

In a report to the State Department on the competition of electric vehicles in Berlin, Consul Hughes, at Coburg, says that the battery taking the first honors weighed only 121 lbs. per kilowatt-hour, while the heaviest weighed 286 lbs. per kilowatt-hour. The average weight of the thirteen vehicles participating in the competition was 165 lbs. It is assumed that each of these machines will run 9500 miles a year and at the calculated cost of 1 cent per mile.

The smallest consumption of energy per ton mile at the mean speed amounted to 91 watt-hours for a passenger car, a performance which surpassed all previous records. However, in nearly all the cases the demand did not vary greatly with the speed, which leads to the conclusion that the electrically propelled car should be driven at the highest speed consistent with public safety, in order to obtain the greatest commercial economy of energy. With regard to the motor best adapted for the weight to be propelled, the capacity should amount, approximately, to one kilowatt per ton of the rolling weight.

Are Municipal Plants Profitable?

By M. J. Francisco.

I have read several articles in this journal regarding the success of the municipal plant at South Norwalk, Conn. After an examination of their last report, just published for the year ending Oct. 12, 1900, I am unable to discover where the success of this enterprise is concealed. Perhaps you can give us more light upon the subject. By reference to page 11 of their report you will find the following statement: Repairs, $494.41; running expenses, $7,408.73; salaries, $5,120.51, making a total of $13,023.65 for operating. It is claimed that $209.43 was for operating the fire alarm, leaving $12.814 22 for electric plant. On the sixth page they give the inventory of plant at $62,829.49. Interest upon this at 4 per cent would give $2.513 17. Depreciation at 5 per cent on $57,500, as made by the light committee, is $2,875. Taxes and water rent, at 1 per cent, upon $28,500, one-half of the amount upon which they calculate depreciation, is $285

On page 6 they state that there are $42.500 in 4 per cent bonds outstanding. A sinking fund to pay these bonds would require $2 125 per year, making a total of $20,612.39. Deducting $10,261.98 for all income from commercial and private lights and power, including $521.19 for lighting city buildings, as given on page 13 of report, and we have a balance of $10,350.41 cost to the taxpayers for 100 arc lights of 1400 cp burned from dusk until 1.30 a. m. 312 nights per year, making, as they claim, 1915 hours per year, being $103.50 per lamp, and costing .054 cent per hour, furnishing 259 cp-hour for 1 cent. The candle-power of lamps and hours burned are shown on the 14th page of the report. The average cost of lights when furnished by private companies on contract is .0264 cent per hour, with 750 cp per hour furnished for 1 cent.

With the facts disclosed in this report I am unable to discover where the taxpayers of South Norwalk receive the benefit claimed by municipal ownership. There is one point noticed on page 11 of report where interest for the year is calculated at $1,700. As they say upon the 6th page that the investment is $62,829.40, and that they are paying 4 per cent, I am unable to figure the interest and make it $1,700. The only result I can obtain in calculating 4 per cent on $62,829.40 is $2,513.17.

In their report nothing is allowed for taxes or water rent, neither is any provision made for the payment of outstanding bonds. These bonds will have to be paid and a certain amount should be set aside each year for this purpose. This item is certainly a part of the expense of lights and should be included the same as the wages of employees. Another feature of the business is peculiar. As shown by the lighting committee's report for year ending October, 1899, page 11, repairs, running expenses and salaries were $7,480.30, while the report for year ending October, 1900, page 11, discloses the fact that repairs, running expenses and salaries were $12,023.65, being an increase of $4,543 35 during the year. A statement is made on the 14th page that only one additional light for streets was added during the year. When we add the operating expenses and fixed charges together and deduct the entire income from power, commercial and private lights, the balance is the amount the street lights are costing; and theorizing does not change the fact.

Can you, after an examination of their report, discover any indications showing a profit or any advantages gained by the taxpayers in operating the municipal plant at South Norwalk?

Italian Aluminum Electrical Transmission Lines.

An electrical transmission plant has just been completed in the valley of Pompei near Naples, Italy, in which aluminum is exclusively employed for line wire. The plant has been constructed for G. De Rossi & Company by the Allgemeine Elektricitats Gesellschaft, of Berlin, under the direction of Sig. Silvio Piccoli, engineer and Neapolitan representative of that company.

Three horizontal reaction turbines of 150 horse-power at 190 r. p. m. are each belted to a 100-kw three-phase generator supplying current at 3600 volts and 50 p. p. s. at 600 r. p. m. The current is transmitted at 3000 volts by separate lines to the valley of Pompei, to Sarno and to Torre Annunziata, all three lines being of alminum. The first mentioned line is a little short of two miles in length and ends at a sub-station containing two three-phase transformers of 45 kilowatts each. Current is distributed from the sub-station for supplying 12 arc and 1000 incandescent lamps, a water pumping plant and 10 three-phase motors installed in a printing establishment. The voltage of the distributing circuit is 200.

The second, or Sarno line, is nine miles distant from the power station. The current transmitted operates a 3500-volt three-phase motor, which in turn operates a 36-kw direct current dynamo, supplying a 240-volt three-wire circuit for electric lighting during the evening and night. During the day the circuit supplies power for operating a pumping plant.

The Torre Annunziata line is about two miles long. All the current is used for power purposes. There are 100 horse-power of motors of from 35 to 200 volts, the motors being principally employed in manufactories of macaroni. A third line from the generating plant is projected, which will lead to Castellamare, it being intended to replace the steam engines in the central station of that place by a 100-hp three-phase motor.

Dr. Elisha Gray and the Invention of the Telephone.

An article by Mr. George C. Maynard, which appeared recently in one of our contemporaries, on the early days of the telephone, gave the impression that Dr. Elisha Gray had conceded to Prof. Bell priority in the invention of the telephone, and had consented to the public recognition of such priority. The sudden death of Dr. Gray, noted in these columns last week, has led to the republication of Mr. Maynard's statement, and under the circumstances we feel constrained to publish a letter from Dr. Gray, written to us on Jan 14 from Boston. From this letter it will be seen that whatever may have been his earlier attitude on the subject, Dr. Gray died fighting strenuously against any idea that Prof. Bell was entitled to priority. We feel that, while in no sense committing ourselves to any approval or indorsement of what Dr. Gray asserts, we must, as a matter of duty, let his letter appear as part of the history of the invention of the telephone, as regarded by one of the leading participators. The paragraph from Mr. Maynard's article is as follows:

"Early on the morning of Feb. 14, 1876, Bell's application for a patent on his invention, which had been carefully prepared months before, was filed in the United States Patent Office. On the afternoon of that day the attorney for Elisha Gray sent to the Patent Office the amount of money required as a fee for filing a caveat, which, at that time, had not been written. The document was hastily prepared and rushed to the Patent Office just before the department closed on that day. Gray's caveat did not describe an invention, but gave an indefinite explanation of what he hoped to invent. In the ensuing controversy, growing out of interference proceedings and culminating in bitter legal battles and much newspaper discussion, it has often been stated that Bell's application was granted through some irregular or dishonest action on the part of Major Z. F. Wilbur, the principal examiner, who had charge of the telephone cases. The statement is not true. Wilbur was then, and thereafter continued to be, hostile to Bell, whose patent was issued in March, 1876. It is much to the credit of Mr. Gray that he recognized and publicly declared that Bell, and not himself, was the first inventor of the telephone."

Dr. Gray's letter is as follows:

"I have been reading George C. Maynard's article, that stirs me up a little. 'On the afternoon of that day,' etc., is a fine touch of romance. I was there—had been there for a number of days. The caveat was prepared deliberately, and completed the day before it was filed; and my recollection was that it was filed in the morning of Feb. 14. There was no reason for haste; I did not know or suspect that Bell was working on anything of the kind at that time, so that 'hastily prepared and rushed' is a fairy story and a vile insinuation that I had wind of Bell's application, presumably through the accommodating Wilbur. After some years, the Government instituted an investigation as to the habits of the Patent Office, and found that cases as they came in were thrown into a basket till 3 p. m., when they were taken out and entered on the 'blotter.' My case was near the bottom of the basket and entered near the last. Bell's was near the head of the list. So whatever evidence there is, is in favor of the caveat having been filed first. As to his statement that the caveat was an 'indefinite explanation of what he hoped to invent,' I will say that not only myself, but others—notably Bell himself—constructed apparatus after the drawings and description of my caveat, and it worked. Bell is on record as saying that it was with the liquid variable resistance transmitter that he obtained the first speech transmission. This he swears to in the Dowd suit. Wilbur swears, as you will see by the affidavit I send you, that he showed Bell my caveat a few days before Bell says he obtained his first articulate speech.

"Now, if what Wilbur swears to in this affidavit is true, I showed Bell *how* to make the telephone. He could not mistake it, because the drawings were explicit, as well as the specifications. I am convinced, on testimony independent of the Wilbur affidavit. Wilbur declared, so says a friend of his, on his death bed that his last affidavit was true. This document was given in the suit, and afterward sent to me. After the Centennial Exhibition, I did give the right to Bell, in a letter I wrote him, on the ground that he first constructed a machine and obtained results. Two or three letters passed, and in one of them I told him of the caveat. In his answer he said: '*I do not know about* your caveat, except that it had something to do with a wire vibrating in water,' or words to that effect. 'Vibrating in water' was the whole thing. How should he know that much?

"They published garbled statements all over the world from my letter to him, that would have conveyed a different meaning if the whole correspondence had been published. When I wrote him, I believed that he had done all his work up to the time of the Centennial independent of any knowledge of my work; and because he was first to reduce the invention to practice I conceded it to him. And, notwithstanding there were suspicious circumstances early in the history of the telephone, it was not till eight or ten years—at least, a long time after the telephone was in use—that I became convinced, chiefly through Bell's own testimony in the various suits, that I had shown him *how* to construct the telephone with which he obtained his first results.

"The statement in *Munsey* that I received $100,000, or any amount, for conceding priority to Bell is a *lie*.

"It is not true that Wilbur was hostile to Bell at the time of the filing of our cases. I, on the other hand, was but slightly acquainted with him. Some years after, I met Wilbur on the street in New York. He came up to me and said, 'Gray, you invented the telephone, and if your damned lawyers had done their duty, you would have had it. But at that time I did not know you very well, and you had never given me any cigars or asked me out to take a drink.' Ye gods! A drink and a cigar might have saved me millions!

"I send you a brief marked for your reference. Now, I do not know as all this interests you. You are at liberty to make use of the information contained in these documents if you see fit. You may say that Wilbur's statements are discredited in the fact of his life and character. I answer, that no other kind of a man would do such a dastardly thing. The fact that he was the kind of a man he makes himself out is strong proof that he did what he says he did."

The British Pacific Cable.

Consul-General Bray, of Melbourne, reports to the State Department as follows: The Postmaster-General of Victoria announces that the tender of the Telegraph Construction & Maintenance Company, of London, has been accepted for the laying of the Pacific cable, at a cost of £1,795,000 ($8,735,367), the installation and surveying to cost £204,000 ($992,766), making a total cost of the cable when completed of £1,999,000 ($9,728,133). The cable is to be completed and in working order by the 31st of July, 1902, provided the company is allowed to start laying the Australian section first. The Australian section comprises cables from the New South Wales and New Zealand coasts to Norfolk Island and thence to Fiji. The other section will be from Fiji to Fanning Island, and thence to Vancouver, British Columbia. When completed, it is anticipated this cable will materially reduce the existing charges to the United States.

With a previous report, Mr. Bray inclosed a clipping from the *Age*, of Melbourne, giving the following details, more or less familiar, in regard to the cable: The route decided upon is from Vancouver via Fanning or Palmyra Island, Fiji, and Norfolk Island, with branches from the last-named station to Auckland, New Zealand, and Queensland. The length of the cable over this route would be, allowing 10 per cent for "slack" actually used, 7986 nautical miles, viz., Vancouver to Fanning Island, 3561 miles; Fanning Island to Fiji, 2093 miles; Fiji to Norfolk Island, 961 miles; Norfolk Island to New Zealand, 537 miles; and Norfolk Island to Queensland, 834 miles. Some 1900 soundings over 500 fathoms in depth have been made, which relate directly to the route along the bed of the ocean, the greatest depth being 3200 fathoms, but the general average much less.

It is estimated that with the use of a cable with 650 lbs. of copper and 400 lbs. of gutta-percha per mile, 1,940,000 words might be transmitted in a year. Great Britain and Canada have agreed to defray five-ninths of the total cost; New Zealand, one-eighth; and New South Wales, Queensland and Victoria have pledged themselves to contribute the remainder between them. As to the revenue to be derived from the cable, it is anticipated that the returns for the first year, on a tariff of 2s. (49 cents) a word, will be £109,807 ($534,376), and that by the fourth year of its working the cable will become a paying concern. It has been proposed to charge 3s. (73 cents) a word for messages right through—that is, crossing Canada and the Atlantic, in addition to the Pacific—and 2s. (49 cents) for the Pacific cable section.

England and Foreign Electrical Competition.

Mr. R. Percy Sellon, E. E., a well-known visitor to this country, and managing director of the Brush Electrical Engineering Company of England, writes as follows to the London *Times* on foreign competition:

Having an intimate knowledege of the progress of electrical development on both sides of the Atlantic, I have read with interest the articles of your special commissioner on American engineering methods, commercial and industrial. The impression left on the reader is, I think, that British electrical engineers and manufacturers are behind the times, and that it is mainly owing to their unwillingness to learn of others that we have all to deplore what none can deny—that we are in arrear of America and Germany in workshop practice as well as the practical developments of electrical engineering. It is undoubtedly true that many workshops in this country are maintained on antiquated lines; but it is equally true that many others have been brought to as high a state of efficiency as regards equipment, specialization and standardization of products as any to be found in America or Germany. I know many masters who, like myself, have traveled over the industrial districts of America and the Continent for self-education and are not ashamed to say that they have learned much.

There still remains the problem of the British workman—the third element in the industrial trinity of management, means and men. British managers may imitate foreign methods, or what is good in them, but who shall teach British workmen to imitate what is good in their foreign brethren? Nevertheless, so far as the electrical industry is concerned, backwardness is less due to industrial than financial causes. British electrical engineers and British manufacturers are ready. Apart from established electricity supply undertakings by companies, mostly paying steady and increasing dividends, some 150 electric light railway orders, half a dozen metropolitan deep level electric railways, and vast electric power distribution schemes for the industrial districts of Lancashire, Durham and South Wales have within the last few years been authorized by Parliament. On a conservative estimate the capital required to carry these projects into execution may be taken at £20,000,000 to £25,000,000. But it is not forthcoming.

Recent results of the policy of the legislature in practically handing over the development of electrical enterprise in Great Britain to local authorities have led capitalists and investors at home to view electrical undertakings askance; and they have not yet realized that Parliament, in passing the Light Railways Act and authorizing the deep level electric railways and electric power distribution schemes, has repented of its former mistake, since these are no longer wholly under the heel of local authorities. In America capitalists have a *prima facie* belief in electrical enterprise and come forward readily to support sound undertakings. In Germany there is the highly organized system of industrial banks, existing for the purpose of promoting and assisting sound industrial undertakings, a procedure which appears unknown to the methods and traditions of modern British banking.

There can be little doubt that either in America or Germany the capital required for such projects as those enumerated above would have been promptly forthcoming; and there are not wanting signs that foreign capital is in fact coming here to develop what our financiers and investors are too conservative to grasp the significance of.

If we are to depend on foreign capital to exploit electrical undertakings in Great Britain, two results must follow:

1. British investors will in due time realize that they have let slip an exceptionally valuable field for investment, the profits and control of lighting, locomotion and cheap power in this country passing into foreign hands.
2. Foreign engineers, plants and machinery will be employed, and the electrical manufacturing industry in Great Britain, with all stimulus to invention incidental thereto, will be virtually stamped out.

Electrical Development in Spain.

Some interesting data concerning the electrical industries of Spain have just been published by the Spanish Government. It appears that there are at present 443 electric power stations in Spain, of which 12 are in the city of Madrid. Two of the latter supply power for street railways, 9 furnish power for lighting purposes, while the twelfth plant, which is still under construction, and which will be the largest of all, will supply power for both purposes. Electric light is now to be found all over the city of Madrid, and its application is steadily increasing. Three companies—the Compagnia General Madrilena de Electricidad, the Compania Inglesa de Luz Electrica, and the Sociedad de Electricidad de Chambin—chiefly supply the electric light for the Spanish capital. The first two companies are in the hands of French, German and English capitalists. The Madrilena Company has a capital of 10,000,000 pesetas (about $2,000,000), and in 1899 the dividend paid amounted to 23½ per cent. The third company, which is capitalized at 4,981,000 pesetas ($1,000,000), is entirely Spanish. There are now in Madrid a Tudor accumulator factory, two factories for the manufacture of electrical apparatus and appliances, such as insulating material, fixtures and instruments, etc., and a branch factory of a Paris company, which has a monthly output of 60,000 incandescent lamps. This company imports glass, wire and other material from France and is now enlarging its shops. A few months ago a company was also formed, with headquarters in Madrid, for the purpose of manufacturing electro-mechanical articles and all kinds of electrical appliances. This company is capitalized at 500,000 pesetas ($100,000).

Continuing, the report says that electricity is making steady progress throughout Spain, and that a large number of electric railways are now either under construction or contemplated. All the large German electrical works, such as Siemens & Halske of Berlin, the Allgemeine Company of Berlin, and Schuckert & Company of Nuremberg, have their branches and depots in Madrid. Most of the electrical machinery used so far in Spain has been imported from Germany, and, to some extent, from Switzerland. Copper wire and cables are chiefly supplied by Felten & Guilleaume, of Muhlheim, on the Rhine. The latter article is also imported to some extent from France, Great Britain and Italy. Two thirds of all electrical appliances imported into Spain are of German origin, and one-third of French, British or Swiss origin. A large demand exists throughout the country for incandescent lamps, which are chiefly imported from Germany, France, Great Britain, the Netherlands, Sweden, Austria-Hungary and Italy. There is, however, little doubt that the large increase in the duty rate will largely reduce the imports. Formerly the duty was 5 centimos; it has now been raised to 25 centimos.

The Sault Ste. Marie Power Development.

The company which, under the direction on the spot of Mr. F. H Clergue, is developing the great resources of Sault Ste. Marie has completed already one of the largest water power canals in Canada, giving it 20,000 horse-power, and now on the Michigan side of the boundary it is completing a canal of 50,000 horse-power. This power canal is being cut for two and one-half miles, a channel 25 ft. to 30 ft. deep and 200 ft. wide, for half of its length through walls of solid sandstone, and the rest through heavy clay. At the upper end this canal is about a quarter of a mile wide, and into it the stream flows at a very low velocity. At the lower end it widens at the point of discharge to a great stream 1400 ft. in width, and the water, after passing down through 80 turbines, will move on its way to Lake Huron at the rate of less than a mile an hour. The river into which it flows runs at the same point four times as fast. At the lower end of this immense canal the foundations are now in for a power house, of stone and concrete, to be 1380 ft. long and 100 ft. in height and width. In this power house the water will have a fall of 17 ft., and it will be made to pass through 80 turbines. These wheels will drive Westinghouse generators sufficient to give 50,000 horse-power.

CURRENT NEWS AND NOTES.

THE SOCIETY OF MODEL ENGINEERS will hold a meeting and an exhibit of models at 1200 Madison Avenue on the evening of Feb. 2. The movement is headed by Mr. C. Kehrer at that address.

MR. B. A. BEHREND, formerly assistant chief electrician of the Oerlikon Engineering Works, Switzerland, has taken charge of the alternating-current department of the Bullock Electric Manufacturing Company.

TRAIN LIGHTING.—Consul-General F. H. Mason, at Berlin, reports to the State Department quite extensively on the recent railway accident and fire at Offenbach-on-Main, and the resultant agitation for a general adoption in Germany of electric lighting for trains.

TO RUN EVERYTHING.—The Canadian Independence League of Montreal, declaring for a Republic of Canada, demands that telegraphs, canals, railroads, etc., shall be owned by the State, and that municipalities shall own and operate the electrical plants, street railways, waterworks, gas works, telephones, and any other old thing. "A large order."

MR. STEINMETZ'S LABORATORY DESTROYED BY FIRE.—Charles Proteus Steinmetz met with a severe loss last week by the destruction of his private electro-chemical laboratory by fire, which probably had its origin in a coal stove. A considerable part of the apparatus was saved, but a number of interesting investigations being carried out in the laboratory are indefinitely delayed.

ELECTRICITY IN BRAZIL.—An excellent electrical review is now being published at Rio de Janeiro by the electrical and mechanical importing house of James Mitchell & Co., who, by the way, now employ 100 people. It is the first journal of the kind in Brazil, and doubtless in all South America, and is a laudable piece of technical enterprise. A member of the firm is Mr. Adolph Aschoff, who visited this country at the time of the Chicago Exposition, and was attached to the Brazilian Commission. His work and energy had much to do with the introduction of the electric railway into Brazil soon after.

WIRELESS IN 1869.—A wireless telegraph system, devised by Dr. Mahlon Loomis was, it appears, before the United States Senate in 1869, with the request for an appropriation of $50,000. The doctor lived in Washington and did not get the money. His petition said: "The nature of the discovery or invention, in general terms, consists in establishing an electrical current or circuit for telegraphing without the aid of wires or cables to form such electrical currents or circuits. As in dispensing with the double wire (which was at first used), and using but one wire, allowing and relying upon the earth to form one-half of the circuit, so now I propose to dispense with both wires and with all artificial batteries, and using the earth, as now, to form one-half of the circuit, and the continuous electrical element far above the surface of the earth for the other circuit."

TAXATION IN WISCONSIN.—The first report of the Wisconsin Tax Commission, created two years ago, recommends a continuance of the license fee system of collecting taxes from corporations, but would increase the rate to make the returns more nearly equal to what would be collected from the same properties on the ad valorem basis. For street railroads, telephone companies, and electric-power companies, the license fee recommended is a minimum of 3 per cent of the annual gross receipts, where these do not exceed $25,000, rising by one-tenth of 1 per cent for each additional $7 500 of receipts until $100,000 is reached, when the rate will be 4 per cent, and rising thence at the same rate for each additional $10,000 of receipts up to 5 per cent for receipts of $200,000 or more. For telegraph companies the ad valorem plan is advised.

VACUUM TUBE LIGHTING.—According to newspaper reports Mr. Tesla is again working upon vacuum tubes. In an authoritative statement in the New York *Sun* he says: "The lamps are glass tubes which may be bent in any ornamental way. I most generally use a rectangular spiral, containing about 20 ft. to 25 ft. of tubing, making some twelve to fourteen convolutions. The total illuminating surface of a lamp is from 300 to 400 square inches. The ends of the spiral tube are covered with a metallic coating and provided with hooks for hanging the lamp on the terminals of the source of oscillations. The tube contains gases rarefied to a certain degree, determined in the course of long experimentation as being conducive to the best results." After discussing the subject in general terms, he adds: "I have no difficulty now to illuminate the room with such wireless lamps, but a number of improvements must be made yet before it can be generally introduced." Wherein this system differs from that of Geissler, Moore and the several earlier ones of Tesla, is not stated.

ELECTRIC REDUCTION OF ORES.—A special dispatch from Kansas City of Jan. 29 says: Charles E. Finney, manager of M. Guggenheim's Sons of New York, the smelters; Charles S. Gleed of Topeka, a director of the Santa Fé Railroad, and Prof. Lucien Blake, head of the electrical department of the University of Kansas, met to-day to discuss a proposition that may produce most important results to smelters and owners of mines of precious metals. Prof. Blake has been experimenting for some time in his laboratory on an electrical process by which metal may be obtained from ore cheaper than by any process now in use. The purpose of the method is to increase the value of low-grade ore. If the proposition is carried out the test will be made in a Denver mill to be furnished by Mr. Gleed, while Mr. Finney supplies the ore. The laboratory tests already made have, it is claimed, gone far enough to show the possibility, if not the probability, of the use of electricity in the separation of metals from their ores. This method, if it proves successful, will be much cheaper than the methods now in use in smelters.

ELECTRIC POWER IN AFRICA.—At a meeting of Rezende, Limited, a Rhodesian company, recently held in London, the chairman said the Umtali Falls were near their mine, and from the outset it had been the directors' intention to use the power there available, but owing to conflicting claims they did not feel it safe to order the necessary machinery, but on the day that matters were put on a proper business footing with the chartered company they immediately proceeded to order the water power and electrical plant the specification and tenders for which had long before been obtained in anticipation. They had the right to half the power of the falls, and the plant, which was now in course of shipment, was calculated to deliver about 150 hp effective at the mine. Until the plant was erected and started they could not bring their additional 10 head of stamps into use. Two Pelton water wheels would drive a two-phase generator, which would produce current at 2500 volts. This current would be conveyed about 1½ miles to the mine, where it would be utilized in driving the motors, working the mill, rock breakers, cyanide works pump, mine pump, hoisting gear, rock drills, and other machinery, besides supplying electric light. Until this installation was complete they were dependent on wood and oil fuel. The plant ordered had now been practically all shipped, and some of the material was actually in Umtali.

ANOTHER TESLA DISCOVERY.—Through the daily newspapers of Wednesday of this week Tesla announced another new discovery in electricity, which he says will require a large part of technical literature to be rewritten. The discovery is that capacity is not fixed and unalterable. In the announcement Tesla says he has found that capacity increases as the conducting surface is elevated in open space, from one-half to three-fourths of one per cent per each foot of elevation, though in buildings or near large structures this increase often amounted to 50 per cent per foot of elevation. Moreover, he says he has observed that there is a diurnal variation of the capacity, with a maximum during the day and a minimum during the night; and the astonishing statement is made that while both the sun and moon cause a slight increase in capacity, in the former case it is due to sunlight, but in the latter case not due to moonlight. Summing up, he says he finds that the variation of capacity is dependent upon the absolute height above sea level, though in a small degree; on the relative height of the conducting surface or capacity with respect to the bodies surrounding it; on the relative change of the circuit with respect to the sun, caused by diurnal rotation of the earth; and—on the distance of the earth from the sun! He considers it probable that instruments will be perfected for indicating the altitude of a place by means of a circuit properly constructed and arranged, and adds that he has thought of a number of uses to which this principle may be put. It is also said that inductance is seemingly modified by the same causes that tend to modify the capacity. Although no reference is made to the Pupin theory concerning the use of inductance in overcoming the disturbing effects of the capacity of telephone lines, the "discovery" appears to invalidate that theory.

SHORT CIRCUITS.—An electrical concern in Detroit, on its business card, makes the following note in one corner: "Short circuit work a specialty." Such frankness is, to say the least, commendable.

A TELEPHONE DOOR BELL.—A patient calling recently on a physician in Brooklyn, N. Y., could not get any answer to his urgent ringing. He went to the nearest telephone, called up the doctor and went back. The reason for silence in the doctor's house was that the door-bell battery had been allowed to dry up. The doctor is glad he had a telephone, but will now keep his door bell in order also.

LIGHTING THE NATIONAL CAPITOL.—The plant at the National Capitol will light 17,000 incandescents and supplies also 150 arcs for the grounds. Current is also furnished for seven electric elevators, for ventilating fans, etc., for the graphophones of the stenographers, etc. No definite figures exist as to the wiring. In 1899 there was 40,000 ft. of wire strung. Twice as much was installed in 1900. If Superintendent Gliem's plan for illuminating the Capitol for inaugural week is adopted the extra lamps and wiring required will cost $6,500. The entire structure will be outlined by incandescent globes, so that it will be visible at night many miles away.

FRENCH AUTOMOBILE SHOW.—The annual show of the Automobile Club de France, held this year in the beautiful new Grand Palais des Beaux Arts on the Champs Elysees, is, it is cabled, a great success. There are over 5000 exhibitors. Exhibits are classified under 11 different groups: (1) Automobiles and motocycles, (2) cycles, (3) materials for construction, tools and machines, (4) tires, (5) accessories and detached pieces, (6) motors and accumulators, (7) coachmakers' portion of the automobile, (8) costumes and equipments, (9) ballooning, navigation and various sports, (10) inventions and appliances, (11) library, photography and publications.

WIRING REGULATIONS IN WISCONSIN.—A bill has been introduced in the Wisconsin Senate having for its purpose the regulation of electric wiring. It provides that electric wires entering any building or passing through a floor, ceiling, partition, or inner wall, shall be protected by a non-absorptive insulating tube. The bill also regulates the insulation of interior electric wires and the relative size of wires to the current used, and requires an automatic cut-off outside of the building, by means of which current can be entirely disconnected. It is made the duty of every contractor to make each splice without acid, solder, however, being used outside of the splice, and then the joint is to be covered with an insulation. The smallest wire that can be employed is 14 B. & S. gauge, and for this size not more than six amperes of current are permissible. The proposed penalty for violation of the law is $25 to $100 fine and imprisonment not exceeding four months.

TOLL MESSAGE ACCOUNTING.—In telephone exchange traffic, messages between sub-stations of different exchanges or between widely separated exchange districts, require especial attention and care on the part of the operating force, since for these messages a special charge is made. Each message on this account requires an entry on a ticket, and these tickets have heretofore been collected by messengers and taken to some central point or clearing house. A patent issued Jan. 22 to G. K. Thompson and E. C. Robes describes a system devised to dispense with messengers, which provides means for the safe conveyance of the tickets, first from the switchboard or section where the orders are received and written, to the various toll switchboards or sections where the desired connections are to be made or completed; and second, to forward these tickets, after the business to which they refer has been transacted, to some suitable depository for ultimate collection. The system consists in the employment of a pneumatic tube transmission, employing a form of tube having a rectangular bore in connection with special cards, one end of which is so bent and folded that they serve to act as a piston within the transmission tube. The claims cover the combination with the transmission tube of such a card or ticket, and the details of the transmission and receiving mechanism of the pneumatic system.

PARTY-LINE PRIVACY DEVICE.—A patent issued Jan. 22 to John A. Barrett, describes a device for party lines which provides that the telephone at a sub-station can only be connected with the main telephone circuit through the intermediary of an electromagnet of high resistance brought into operation by the removal of the receiving telephone from its circuit. The telephone branch when so connected being of relatively low resistance, it serves as a shunt not only for its own high resistance magnet, but for those at all the other sub-stations in the circuit. As a consequence, if any of the latter telephones is removed from its hook an operative connection cannot be established by any other station with the line for the reason that although such action does operate to throw the high resistance magnet into the circuit, there is not sufficient current to excite it since the major part of the current of the line passes through the low-resistance telephone branch of the station connected for conversation. The invention provides a positive and certain establishment of the telephone branch circuit at a station and insures the efficient operation of the privacy device on the discontinuance of the telephonic conversation, this being effected by the act of restoring the receiving telephone to its hook and the breaking of the normal earth connections at any station occupying the line for conversation. The main feature of the device is that the removal of the receiver from the hook and the following movement of the hook-lever does not at once bring the telephone into operative association with the circuit. Assume that one of the party stations has been called by the usual selective means which only actuates the bell of the station called. When the telephone is taken from the hook of the station, the high-resistance privacy magnet will be excited and attract its armature, thereby releasing a drop plate, which at the end of its motion bridges a connection which brings the telephone in circuit. The resistance of this circuit does not ordinarily exceed 1-50th that of the privacy magnet, and as a consequence it shunts the latter, whose armature is retracted and is ready to re-engage the drop plate when the same shall have been lifted to its normal vertical position upon the replacement of the telephone to its hook. Furthermore, the establishment of the telephone bridge shunt in this way at any one station acts also to shunt the high resistance privacy magnets at all of the other stations on the circuit; consequently if at any other station an attempt is made to use the telephone and the receiver is taken from the hook for that purpose, no connection can be made for the reason that the current of the main circuit is drained away by the low-resistance telephone bridge at the sub-station previously connected with the line. Hence when any one of the stations has obtained occupancy of the main circuit for conversation no other station on that circuit can interrupt, and any station desiring to use the line must await its turn. Means are also provided to enable two stations on the same party line to carry on conversation. The position of the drop controlled by the privacy magnet indicates at any station whether the party line is free.

LETTERS TO THE EDITORS.

The Blondel Oscillograph and Oscillographic Curves.

To the Editors of Electrical World and Engineer

Sirs:—In reading the interesting article by Mr. Wiler in the Electrical World and Engineer of Nov 10 and 17, 1900, on "The Alternating Current Arc," I noticed my name quoted in a connection with which I am not pleased, and not quoted where I think it should have been. I hope, therefore, that I may be permitted to add some remarks concerning the subject of the article.

1.—The extract from my paper to the Paris Electrical Congress, concerning which Mr. Wiler expresses surprise (that the vibration of the mechanism of alternating current lamps permits of employing a less resistance in series for the same degree of regulation), would have been perfectly clear to him if he had read the preceding paragraph dealing with closeness of regulation. Had he done so, he would probably not have thought it necessary to instruct the author of the paper as to the influence of the quality of cored carbons on the stability of the arc, a point which the writer himself established in a paper on "Alternating Current Arc Curves," read before the Chicago International Electrical Congress of 1893, and printed in *La Lumiere Electrique*, September and October, 1893.

2.—To those who have read the paper last mentioned in full it will be evident that all, or almost all, the results or discoveries attributed by Mr. Wiler to Mr. Duddell were published by the writer eight years ago, while the oscilligraph (even those of the bifilar type) was described and employed by me at the same period (see my communications to the *Comtes Rendus* of 1893). In his paper read at the Toronto meeting of the British Association, Mr. Duddell acknowledged that his apparatus was originally made after my description. Oscillographic curves of the alternating current arc were published by me, not only in the papers above referred to, but even more fully in a more recent communication to the Academie des Sciences printed in December, 1898—that is, two months before the date of the paper of Messrs. Duddell and Marchant. Moreover, no facts relating to the curves of the alternating arc between carbon electrodes have during the past eight years been put forth that were not clearly indicated in the Chicago paper. The curves made by Messrs. Duddell and Marchant were more numerous and varied than those I published, because I took care to publish only a selection of the typical curves. I do not think, however, that quantity adds anything to the quality of a work which consisted of a study of these curves and their laws.

As to alternating-current arcs between metallic electrodes, Messrs. Duddell and Marchant—themselves anticipated by Eichborg and Kallir—anticipated me slightly in date of publication, their curves appearing some weeks before mine, though the latter had been in existence a long time. But some entirely new facts were nevertheless brought to light by me—for instance, with respect to the change of alternance in certain cases.

I do not wish to appear in the role of a critic of Messrs. Duddell and Marchant, whose work deserves the highest praise, and is admired by none more highly than by myself. Moreover, I have no cause of complaint against Mr. Duddell himself, who, as I stated above, has courteously recognized my anticipation of his work, while I have spoken highly of the improvements he has made in the bifilar bands. But a vigorous claim has been made for him by others, for instance, by an English firm of instrument makers, who, in a recent descriptive pamphlet, say, "The Duddell oscillographs are an entirely new departure in galvanometers," notwithstanding that not only is the theory of the oscillograph due to me, but the invention of the instrument itself, and of the very name. As a consequence, I feel compelled, though much against my desire, to break for the first time the silence I have maintained on the subject.

I have spent ten years of my life on the perfection of the oscillograph and on the study of the electric arc, contenting myself by publishing the results in scientific periodicals. It appears, however, that the atmosphere of scientific circles has undergone a change, and I hope I may be pardoned for resorting in turn to a reclaim as follows: That during the past two years a continuation of my study of the oscillograph has resulted in a number of improvements in its construction which enables its manufacturer, M. Dobkivitch, 14 Rue Liancourt, Paris, to supply at low prices oscillographs of high frequency (as great as 20,000 to 40,000 vibrations per second), which any one can employ and easily repair without special knowledge of laboratory work. Curiously enough, my paper on the oscillograph presented at the Paris International Electrical Congress of last summer, is the only one that was not reported—even by name—by the correspondent of the Electrical World and Engineer, in his interesting and able (I may gratefully add, complimentary and kindly) account of the proceedings of the Congress.

Paris, France. André Blondel.

Iron Pipe for Interior Wiring.

To the Editors of Electrical World and Engineer:

Sirs:—I have read with astonishment the letter from Mr. Fremont Wilson in your issue of Jan. 19, in which he makes the positive assertion that he received from me a letter about 1892 acknowledging that my ideas as to the use of the iron pipe system for interior wiring were due to him and that I asked permission to install such a system.

This statement by Mr. Wilson is absolutely unfounded. Of course, if Mr. Wilson has such a letter he can establish his truthfulness by publishing it, which I challenge him to do. If he does not do so, the inference will be obvious.

Furthermore, Mr. Wilson says, in speaking of me: "He would seem to take the credit of having been the first to have placed electric light wires within iron conduits or pipes for interior lighting purposes." I made no such absurd claim. I have no doubt that this was done before either Mr. Wilson or I were in the electrical business.

I know of many instances prior to 1885 where, for purposes of mechanical protection, electric wires were for a portion of their length placed within iron pipes. In my article I was discussing the importance of the fire risk due to the "high resistance leak," and, after pointing out that a system consisting of a single iron pipe metallically connected throughout and thoroughly grounded and containing both poles of the circuit was a complete protection against this risk, I stated that the first system of that kind was installed by me in 1892.

I fully appreciated the "high resistance leak" in 1887, when I was sent to Rockford, Ill., by the Western Edison Electric Light Company, of which I was general superintendent, to investigate, in connection with the chief of the fire department of Rockford, an electric fire which had occurred in a hat store there. This fire was evidently due to a high resistance leak caused by a damp mop being in contact with the two wires of the circuit for many days at a time, which had finally developed an arc on one pole only, without blowing the fuse.

At that time I devised the grounded, single iron pipe system as a remedy, and, after many years of opposition, I finally undertook several contracts for equipping large buildings in New York City with it in 1892, and made all the special fittings, such as iron contact cabinets, tees, elbows, junctions, switch boxes, etc. These plants are still in use, and, so far as I know, were the first installations of the kind.

It seems unnecessary to add that I never derived any ideas from Mr. Wilson. To any one familiar with the situation in the electrical business in New York City in 1892, his statement that I wrote to him to ask his permission to put wires in iron pipes, is ridiculous on its face. H. Ward Leonard.

New York.

Which is the Electrical Century?

To the Editors of Electrical World and Engineer:

Sirs:—At the recent most successful "New Century Dinner" of the American Institute of Electrical Engineers, held in this city, in common with many others, I had the pleasure of listening to the admirable remarks made by the various speakers. Two of them—both past presidents of the Institute—one of them a prominent engineer, and the other a college professor of electrical engineering, gave the undersigned, and I believe many others, considerable of a "jar," to use a vulgarism, by stating, practically, that there was little change of a radical nature, and little of absolute novelty, to be expected in the electrical developments of the coming century; that we could not look upon the new century as the Electrical Century, but must consider the century which had just passed in that light; and that the developements in the electrical field would be in the main extensions of and refinements of methods and principles already perfected to a greater or less degree.

One of the speakers, in closing, summed up his views as follows: "The change in kind was made in the nineteenth century; the change in degree will be made in the twentieth." The other gentleman, after indorsing the views held by the first speaker, summed up as follows: "I think that the great development of the century we are going to see is in the growth in degree—not in the creation of novelties."

I note that the Electrical World and Engineer, in its issue of Jan. 19, makes editorially an apologetic—though evidently half-hearted—defense of the position taken by these gentlemen. It would be interesting to know to what extent their views are supported by the men in their profession. While listening to these gentlemen the other evening, my thoughts ran back to the year 1882, when, during a residence in England, I was looking through an old library in London, and came across a book dated sixteen hundred and something—the exact date I do not now recall—which spoke of electricity as being "A peculiar effluvium," and the author went on to say—as nearly as I can recall his words: "We have doubtless now arrived at the point where we know all regarding the practical applications of electricity that will ever be known." How vividly this all came back to me the other night, and before the distinguished speakers had concluded their remarks it had occurred to me to wonder who would have believed just before the Centennial Exhibition of 1876, at Philadelphia, that the human voice would within a few months be transmitted over a wire by means of the telephone. Who would have believed—say seven years ago—that the human eye would be able to examine the anatomy of a living person, and observe not only all the bones, but even observe the action of the heart, etc., through the intermediary of the Rœntgen ray and the fluoroscope?

I have no desire or intention of posing as a prophet, but were I to cast a horoscope of the future, I would certainly not be so pessimistic as were the distinguished gentlemen to whom I have referred. In view of the fact that never in the history of the world have so many able men been engaged in scientific research and experimentation; that never have scientific men and educational institutions been so endowed with well-equipped laboratories, accurate instruments and other exceptional facilities for making the most delicate of scientific tests and carrying on of original researches; and, furthermore, backed as these men are with a theoretical training, coupled with a practical experience, such as their predecessors never have enjoyed, is it not perfectly rational to expect, and does not the past history of human development lead us to expect, that with all these advantages the new century will outstrip the old one in electrical development, as well as in other matters?

Electro-chemical research offers an enormous field, and which is almost "virgin soil." The wonderful work now being done in the study of the constitution of matter may lead to developments of a most revolutionary character; and who knows how much of the correlation of the vital and physical forces we shall have to set down to the credit of electricity? What has occurred in the past century which would lead the world to consider the discovery of a means of getting electricity direct from coal as of secondary importance; and who shall say this century will not see this problem solved; and who knows but that during this century a way will be discovered to make an electric light with the coldness and efficiency of that given out by the firefly; and what more important or of more radical nature has been done in the valuable electric lighting work of the past century?

Few indeed were there who believed fifty years ago that intelligence would be conveyed across the Atlantic Ocean by means of the telegraph in almost the twinkling of the eye, and how often have the telephone experts and eminent electrical engineers explained so convincingly why it would be forever impossible to telephone across the Atlantic cable; yet note how recently one of our own Institute members has so well succeeded in overcoming the well-known disturbing influences met with in telegraphic and telephonic work as not only to telephone over land lines of a length heretofore prohibitory, but to give us reason to hope that telephoning across the Atlantic will early in this new century be an accomplished fact. It may even now be said to be merely a commercial question.

Who knows but that in the coming century we shall learn what electricity is, perhaps what gravitation and heat and other things, the effects of and uses which we are so familiar with, really are? A distinguished scientist recently said, "It seems surprising that no one knows what draws two pith balls together and holds them together, though the phenomenon itself is as old as the century." Perhaps the new century may tell us.

In conclusion, I would ask, should not the electrical profession insist that the Electrical Century started fifty years ago, and that it has still fifty years yet to run? Personally, I believe that were a canvass made among electrical men, by far the greater number of them would agree that by all odds the best fifty years of the Electrical Century are yet to come. W. J. HAMMER.

NEW YORK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Design of Alternators.—FYNN.—A communication in which he criticizes several points in the paper of Heyland (Digest, Jan. 5, 12). He makes a remark about the definition of voltage drop, which is usually taken as the difference in terminal voltage observed between no load and full load, at constant speed, with a constant excitation, such as to give the normal voltage at no load, while Heyland also uses such a difference, but based on the excitation which gives normal voltage at full load instead of at no load, as in the other case. The voltage drop and increase in excitation, as required from no load to full load, to maintain constant terminal voltage, are predetermined by Heyland and are not the results of tests; but while Heyland's diagrams are useful, they always give too small values both for the drop and the increase in excitation. He totally disagrees with Heyland's recommendation to saturate the poles as highly as possible; he says that the saturation of the pole body has only the slightest influence on the drop of an alternator. The bulk of the drop is due to armature self-induction. The best way to guard against this self-induced field is to make its path as difficult as possible; this can be achieved by saturating all the iron in the immediate neighborhood of the slots, therefore by working with very high densities in the armature, by using a large air-gap, or by keeping this smaller and saturating the pole shoes; it is not necessary to go further than the pole shoes. The degree of saturation in all or any other parts of the machine has no further influence on the drop of the alternator, as far as the self-induced field is concerned. It has, however, a very marked influence on the amount of increase in the exciting energy required to keep the terminal volts constant from no load to full load. This increase should not be too large, not only on account of the additional expense in copper, but also in order that if occasion requires, the normal terminal volts may be kept up without undue heating of the field coils, even if the power factor should occasionally sink below the expected limit. The high saturation at the point mentioned by him, is not always in itself sufficient to bring the working point beyond the knee of the saturation curve; it is therefore quite possible to design a perfectly regulating alternator with the working point on the straight part of this curve. He agrees that the variation of magnetic leakage from no load to full load should be reduced. The open slots are preferable from the point of view of drop; they are, however, apt to set up pulsations throughout the whole magnetic circuit, and that is the point to be avoided, and one which can be avoided. "Open slots often necessitate laminated pole shoes, and this can only be advantageous since it leads to an increased shoe density, all else being equal." He gives results of actual tests of machines designed by him, which prove to be better than the results obtained by Heyland. —Lond. *Elec. Rev.*, Jan. 11.

REFERENCE.

Testing Dynamos.—CRAMER.—An illustrated article in which methods for testing direct-current dynamos are described.—*Elek. Anz.*, Dec. 20, 23, 30.

POWER

Electric Power in Engineering Works.—BELL.—An illustrated article in which he first shows the saving in power by adopting electric driving. He then gives examples showing the advantages of the singular mobility which electric power distribution permits, in order to utilize to the fullest the portable machine tools of various sorts which are now coming into extensive use. The complete abolition of shafting and belts clears things up and frees the space of encumbrances. Electric power also enables one to adapt the trolley system to the oftentimes onerous task of transportation within the works.—*Eng. Mag.*, Jan.

Electric Power in a Printing Establishment.—A brief illustrated description of the electric installation of the printing establishment of Breitkepf & Haertel in Leipzig, Germany. There are 18 motors of together 78 hp for individual or group driving. There are 1100 incandescent lamps and 8 arc lamps of 8 amperes. The current is supplied by two direct-current dynamos, giving 665 amperes at 110 volts and a storage battery of 62 Pollak cells, giving 639 or 845 ampere-hours, if discharged in 3 or 10 hours, respectively.—*Elek. Anz.*, Dec. 30.

Development of Water Powers.—An abstract of a discussion at the Engineer's Club of Toronto, which was introduced by Lambe, who said that engineers frequently overlook the fact that the commercial side of any enterprise is the most important one. The cost of developing water power varies from $30 to $1,000 per hp. The financial success of a water-power development costing $200 per developed hp is very problemetical. The average cost of plants possessing no unusual characteristics is from $40 to $100 per hp. The market for power is a factor requiring careful consideration.

Pressure wheels are operated successfully under heads as low as 3 ft., and jet wheels under heads as high as 2100 ft.—*Can. Elec. News*, Jan.

Canadian Water Power Plant.—An illustrated description of the plant of the Jacques Cartier Water Power Company, supplying light and power to the city of Quebec. There are two turbine-driven, three-phase alternators of 750 kw, giving 2000 volts at 150 r. p. m. The transmission line has a length of 17 miles. The voltage of transmission is 20,000.—*Can. Elec. News*, Jan.

French Transmission Plant.—PERKINS.—The fourth of a series of illustrated articles on high-tension power transmission plants in France. This installment deals with the Lancey single-phase plant in the valley of Cresivanden. The length of the transmission line is 18 miles, the pressure of transmission 12,000 volts. The power-house contains two single-phase alternators of together 600 kw.—*El'ty.*, Jan. 16.

REFERENCES.

Water Power for Electric Purposes.—YORKE.—A paper, read before the Glasgow section of the Inst. of Elec. Eng., giving practical notes on water-power for electrical purposes, especially on water-wheels, turbines, suction, lades, pipes, intakes, etc. The paper does not seem to give anything new.—Lond. *Elec.*, Jan. 11.

Canadian Water Power Plant.—BOWIE.—An illustrated description of the power plant at Montmorency Falls, from where current is transmitted to Quebec for lighting and traction. There are five 600-kw generators. The two-phase system is used.—*Can. Elec. News*, Jan.

Group-Driven Lathes with Electromagnetic Couplings.—LOEWY.—An illustrated description of a compact arrangement for four small turning lathes, whereby the individual lathes can be stopped or started without complicated switching apparatus.—*Zeit. fuer Elek.*, Dec. 23; translated with the illustrations in Lond. *Elec. Eng.*, Jan. 4.

TRACTION.

Electric Motor Coaches on the Belgian State Railways.—An illustrated description of these coaches, provided with storage batteries. They are intended at present for the use of passengers only. Each coach can transport 80 passengers and 2 officials, and weighs 46 to 57 tons, of which 9.5 and 12 are the weights of the motors and batteries, respectively. The accumulators are 264 in number. At starting, the current taken by the motors is 180 amperes at 520 volts, which gives a tractive force of nearly 78 lbs. per ton. When running on the level at an average speed of 18.5 miles per hour the current is 50 to 60 amperes at 500 volts. The distance traveled for every charge is limited to about 31 miles in order not to run the cells down too much; but they can, if necessary, run a car for 56 miles. The motors consume from 1.2 to 1.6 kw-hours per mile, with stoppages about every two miles, these stoppages being included in the above average speed. On the level lines in the Antwerp district, for which these coaches were made in the first instance, the batteries often run a train of one electric coach and one trailer, comprising in all 75 tons weight, without excessive current. The speed which normally is 25 to 31 miles per hour, without stoppages, can attain 43 miles per hour. The charging is said to take from 6 to 8 hours, with from 40 to 70 amperes, but in this direction it would seem that there is room for improvement. It is not suggested that the cells should be charged by running the motors as dynamos when coupled to the express. In the first place, the express would not run long enough for this purpose, and in the second place, the effort would no doubt be too much for the engine when pulling a loaded train. Besides these coaches the Belgian State Railways have built an improved electric coach, which was exhibited at the Paris Exposition. The number of cells has been reduced to 180, the two motors are series wound, and take 200 amperes each at 350 to 400 volts.—*Lightning*, Jan. 10.

Electric Traction for Heavy Railway Service.—BURCH.—A paper read before the Northwest R'y Club. In the first part he gives a historical outline of the development of electric traction in general and especially of the use of electric locomotives for heavy railway service. In the second part he discusses in detail several special items of operating expenses of steam railways, and finds that the relative economy of fuel by the central station and steam locomotive is 100 to 35. "This is a most conservative estimate." With the electric system 35 per cent additional power are required for the losses in transmission, transformation, etc. The total net relative economy of power required at the drawbar, by the electric and steam locomotive, is 100 to 47. The total net saving in fuel, reduced to draw-bar of locomotive, is 53 per cent. This saving of over half the coal bill on existing steam roads, made possible by the introduction of electric traction, means a net saving of 5 per cent of the total operating expenses of railways.—*St. R'y Rev.*, Jan.

Electric Freight Railway.—EHRETIART.—A communication in favor of a State electric freight railway as a substitute for a barge canal from Buffalo to the Hudson River. He shows that such a railway is preferable for financial reasons. There is enough water-power to be utilized. It would require only two stations on the Hudson River, one about at Fonda, on the Mohawk, and one between Syracuse and Rochester, to be operated with steam from coal as fuel. No technical details are given.—*Eng. News*, Jan. 17.

Influence of Storage Batteries Upon Railway Generating Apparatus.—HULL.—An article, in which he first gives diagrams showing the fluctuations in load in several railway stations without batteries. These load fluctuations are the only cause of the ratio of the weights of a railway engine and one to furnish the same average power when the load is practically steady, being about two to one. The remedy is, of course, the use of a battery. In a diagram curves are given, showing fluctuation in voltage with and without a battery.—*Elec. Rev.*, Jan. 19.

REFERENCE.

Railway Generator.—An illustrated article on the historical development of the modern railway generator.—*St. R'y Rev.*, Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Station Statistics of Great Britain.—A very large and well-filled table, giving a great amount of information, also an article with diagrams compiled from this table. In the case of the London stations, traction and other applications of electric motors still form an almost insignificant proportion of the whole load, but several large provincial stations now supply electrical energy both for lighting and tramways, and the effect of the tramway motor load is already noticeable in the diagrams. While electricity supply in the provinces has increased in popularity at a greater rate than ever before, the total lamp connections in London, although still growing rapidly, has not maintained last year's rate of increase. "The grand total for London and provinces is nearly 300,000 kw, or about 10,000,000 8-cp lamps—more than 3,000,000 greater than last year, the increase in 1899 and 1898 having been 1,500,000 and 1,225,000, respectively." Direct-current distribution is steadily superseding single-phase alternating. Where the latter system has been retained, moreover, it has to a large extent been supplementd by direct-current distribution, and thus there is a further increase in the number of stations supplying both direct and alternating current.—Lond. *Elec.*, Jan. 11.

Parallel Running for Central Stations.—LEE.—An article in which he discusses the following three methods. First, parallel running in which both the generators supplying the network and the network itself, are coupled in parallel. Second, parallel running in which the generators are coupled in parallel and the network is divided into districts, each district being fed by a separate feeder or a group of feeders. Third, running in which neither generators nor network are coupled in parallel. "Providing, then, that the very best materials and workmanship have been employed, No. 1 method may be used and a satisfactory supply given under the conditions which generally obtain. However, No. 2 seems to be the ideal method as far as efficiency is concerned, though No. 3 would most likely be the best method to use—that is, parallel running through light load and separate running on heavy load, providing that ordinary work was put down and that cheapness had been indulged in—if one could only bring oneself to look at a switchboard design such as would be entailed. Engineers who have been used to high-tension working, would at once grasp what such a design would be like, though for a low-tension supply such a board could be easily designed and made. Insulation and protection to the users of the switches, would play a part of first importance in the design of such a board for use with high-tension currents."—Lond. *Elec. Rev.*, Jan. 4.

Beckenham.—An illustrated description of this British munipical-lighting plant, which is combined with a refuse destructor. The high-pressure alternating current system has been adopted for distribution, power being generated at 2000 volts and transmitted to sub-stations, from which it is distributed on the three-wire system, with 200-volt pressure on consumers' terminals. There are two 120-kw alternators running at 380 r. p. m., and a 60-kw alternator running at 500 revolutions. The frequency is 50. At present 6500 lamps of 8 cp are connected with the mains.—Lond. *Elec. Rev.*, Jan. 4.

Nottingham.—A long and well-illustrated description of the municipal electric lighting and tramway plant of Nottingham. The capacity has increased in 6 years from 390 kw to 5600 kw, and a new station having a capacity of more than 10,000 kw is to be erected. The three-wire direct-current system, with 400 volts between the outers is used. One of the chief factors in the popularity of the supply, is the low price charged—10 cents and 4 cents by the Wright system. There are now over 1500 consumers, with a connection equivalent to 127,000 lamps of 8 cp, in addition to a total motor load of 600 hp. The first section of tramways has just been opened. The ultimate length of track will be 30 miles.—Lond. *Elec. Rev.*, Jan. 11.

Chicago Polyphase Plant.—A long, well-illustrated description of the new polyphase plant of the Commonwealth Electric Company in Chicago. There are two three-phase alternators of 400 and 1000 kw capacity, respectively, generating three-phase currents at 4150 volts, with a frequency of 60. In order to provide for a load of induction motors, which is being developed in the territory, four-wire three-phase feeders for both lights and motors have been arranged for. The motors will be operated on the three-phase circuits, while the lighting load will be connected between the neutral and one of the three main outside conductors. The transformers for the motors will have 4150-volt primary windings, Y-connected, while the secondaries will be delta-connected to the motors. The arrangement is such, however, that standard transformers are used for both lighting and power service.—*West. Elec.*, Jan. 12.

Southampton.—Nicholson.—The first part of an illustrated article on the Southampton municipal electric tramway and lighting system. The plant, which was formerly put down for lighting purposes only, has been adapted for supplying the necessary power to the tramways. There are six direct-current dynamos, varying between 100 and 37 kw, generating current at 200 volts for lighting and 240 to 250 volts for traction. There is also a large battery of 236 Tudor accumulators of 1900 ampere-hours capacity, when discharged in 5 hours at 380 amperes, the maximum discharge rate being 570 amperes and the normal charging rate 320 amperes. There will also soon be a 300-kw generator running, which can then be utilized to generate current at 500 or 600 volts for the tramways and at 200 volts for lighting.—Lond. *Elec.*, Jan. 11.

REFERENCES.

Switchboard.—Seager.—An article in which he gives some notes on the arrangement of the cable connections to the switchboard from dynamos, battery and mains, in a central station.—Lond. *Elec. Eng.*, Jan. 4.

Circuit Breaker.—An illustrated description of a high-tension circuit breaker, made by a French company.—*L'Elec.*, Dec. 29.

Wires, Wiring and Conduits.

Aluminum Conductors for Power Distribution.—Hoopes.—An article in which he first gives some comparative data on copper and aluminum. Regarding reliability of aluminum for conductors, he says, that a considerable quantity of aluminum containing a small percentage of alloy was put into service on transmission lines on account of the higher tensile strength; but this alloy is not always homogeneous in structure, and as a result there were breaks in the lines. With lines made of pure aluminum there have occurred no breaks. Water and ice do not appear to adhere on the surface of aluminum feeders in any quantity. The cost of erecting aluminum conductors is very low, because of their light weight. It is possible to handle it in much greater lengths, having therefore fewer joints and less delay in construction. He notices some instances showing that aluminum conductors are now used throughout the country in surprisingly large quantities in view of the short time they have been on the market.—*St. R'y Rev.*, Jan.

Electro-Physics and Magnetism.

Spark Lengths Between Plates for Small Distances.—Earhart.—An account of an experimental investigation of the sparking distances between a convex and a plane plate. If the abscissas represent the potential in volts between 0 and 1000 volts about, and the ordinates the distance in "micra" between 0 and 100 micra, all the curves show the following characteristic features. The curves start from the zero point in straight lines, taking then a sudden bend, and proceed in straight lines. This may perhaps be due to the existence of an air film surrounding the surfaces of the bodies.—*Phil. Mag.*, Jan.

Specific Velocities of Ions in the Discharge from Points.—Chattock, Walker and Dixon.—An account of an experimental investigation of the specific velocities of the ions concerned in the production of the "electric wind." They were measured in five substances—hydrogen, carbon oxide, air, oxygen and turpentine. The values of the specific velocities for point discharge in gases are in approximate agreement with those obtained for the same gases when ionized by X-rays. In non-conducting liquids the specific velocity appears to be of the same order of magnitude as in ordinary electrolytes. In hydrogen for negative discharge only, and probably in turpentine for both kinds of discharge, a considerable "back-discharge" of ions seems to occur from a brass or platinum ring toward the point. The amount by which this back-discharge lowers the wind pressures in the case of hydrogen is closely proportional to the strength of the current from the point. Negative ions in constant fields travel at very varying rates in hydrogen, the same being true of oxygen and air, but to a much less extent. These variations are real and not attributable to errors of observation. Positive ions are not similarly affected to anything like the same extent, if at all. To account for this it is suggested that a certain number of the negative ions may owe their origins to occluded gases in the point; that this number may be variable owing to changes in the accessibility of the occluded gases and other causes; and that the specific velocity of the positive ions may be constant, owing to being formed exclusively of the gas outside the point.—*Phil. Mag.*, Jan.

Transparency of Metals to Radium Rays.—Mizuno.—A brief, illustrated description of a simple spark method for showing the transparency of metals and other substances to radium rays. To each of the two poles of an induction coil are attached respectively two wires forming two alternative spark-gaps, these spark-gaps being formed by spark micrometers, so that the spark-lengths can be finely adjusted at will. One of the spark-gaps is drawn apart just beyond its critical spark-length, and the other spark-gap is lengthened just below its critical length. In this sensitive state of the spark-gaps, if a radium preparation is brought into the neighborhood of the first gap, vivid sparks take place there, while the sparks in the second gap are very much enfeebled or annihilated. If plates of metals or other substances of 1 to 6 mm. thickness are placed below the first gap and the radium preparation is then brought just below those substances, the sparks will nevertheless take place in the gap.—Lond. *Elec.*, Jan. 4.

Electro-Chemistry and Batteries.

Electro-Chemistry and Electro-Metallurgy in 1900.—J. B. C. Kershaw.—The conclusion of his review, the first part of which was noticed in the Digest, Jan. 26. The total world production of nickel in 1899 was estimated to amount to 7350 tons. The bulk of this ore is still treated for extraction of the metal by purely metallurgical methods; but the crude nickel is being electrolytically refined in England, Germany and Canada, and the Hoepfner process of extracting the nickel direct from the ore by electrolytic means, is now operating upon an industrial scale at Papenburg in Germany. The ores used are roasted and leached with a mixed solution of cuprous and calcium chlorides. This solution is electrolyzed with carbon anodes and copper cathodes to remove the copper. After the nickel in solution has risen to 10 per cent the copper, iron and lead remaining in solution are removed by chemical methods, and the resultant pure solution of nickel chloride, is then electrolyzed with nickel cathodes in order to obtain the nickel. At Hamilton, Ont., the Frasch process of electrolytic extraction is about to receive a trial. It has been described at some length in the Digest. At Saulte Sainte Marie in Canada, ferro-nickel alloys are said to have been produced direct from the ores of the Sudbury district, by treatment in the Clergue electric arc furnace. The alloys produced contain 7 per cent nickel, but silicon and other impurities are present, and it is not yet proved that the alloys obtained in this comparatively simple way are sufficiently pure for the manufacture of nickel steel. "Should this be the case the process will have a great future." Some information is given about the ozone industry, and also the zinc industry. The Hoepfner zinc process, which is the only one operated on an industrial scale in England, appears to be a financial success. In the conclusion he estimates the aggregate number of plants in which electricity is used for carrying out chemical or metallurgical operations, at over 230. The majority of these works use water-power for generation of the electrical energy; but he thinks that the use of blast furnace gases for power generation, in connection with electro-chemical and electro-metallurgical manufactures, may prove in the future a wide and profitable outlet for capital and ability, especially in Germany and England. The power used in 1900 in the manufacture of alkalies and bleach is given at 52,000 hp, aluminum 28,000 hp, chlorates of potash and soda 24,000 hp, copper 16,000 hp, calcium carbide 85,000 hp, hypochlorite, ozone, bullion, nickel, and zinc together 10,000 hp, which gives an aggregate of 215,000 hp.—Lond. *Elec.*, Jan. 11.

A Chromium Cell for the Rectification of Alternating Currents.—Morgan and Duff.—An account of experiments with an electrolytic cell, containing a 10 per cent sulphuric acid solution, a strip of platinum foil as cathode, and a fragment of metallic chromium as anode. This cell "was found to prevent the passage of a continuous current, if the external electromotive force was gradually increased, until the latter reached a value of 75 volts. The polarization is broken down at this voltage, and a current passes from chromium to platinum in the cell. The chromium electrode, however, then acquires the property of polarizing in the reverse direction; i. e., a current in the reverse direction will now no longer traverse the cell from platinum to chromium until a certain voltage (which appears variable) is reached, when the cell is again broken down, a reversal takes place, and the chromium again becomes capable of opposing 75 volts when acting as anode. This remarkable behavior the authors attribute to the chromium passing from the 'active' to the 'inactive' state.—(Hittorf, see Digest, July 29, 1899, and Dec. 22, 1900.) —*Jour. Am. Chem. Soc.*, 22, p. 331; abstracted in *Tech. Quart.*, Dec.

Concentration at the Electrodes in a Solution.—Sand.—A very long account of theoretical and experimental investigation "on the concentration at the electrodes in a solution, with special reference to the liberation of hydrogen by electrolysis of a mixture of copper sulphate and sulphuric acid." He derives an equation for calculating the concentration at the electrode of a solution of a single salt from which the metal is being deposited under the conditions that the solution is contained in a cylindrical vessel bounded by the electrode, that no convection currents occur, and that the diffusion of the salt obeys Fick's law, and its transport values are constant. This formula can be made the basis of a method for roughly determining diffusion co-efficients. In the case of mixtures, it is possible to arrive at limits for the concentration. Hydrogen always appears at the electrode of an acid solution of copper sulphate in which no currents of liquid are taking place between the limits of time, for the concentration to go down to zero. This time can be calculated. Convection currents play a great part in determining the ratio of the two constituents given off at the electrode of an acid copper-sulphate solution. By artificial stirring hydrogen can be made to disappear altogether in cases where it would otherwise have presented over 60 per cent of the equivalents carrying the current from the solution to the electrode.—*Phil. Mag.*, Jan.

REFERENCE.

Electrolytic Refining.—Ulke.—An article on the present status of the electrolytic refining industry in the United States. Tables give information on different technical details and the output of electrolytic copper, nickel, silver and gold refineries of this country.—*Elec. Rev.*, Jan. 12, 19.

Units, Measurements and Instruments.

Weston Cell.—Barnes.—An account of an investigation of Weston cadmium cells of various construction with reference to the change in their temperature co-efficients, which the experiments of Kohnstamm and Cohen on the inversion point of cadmium sulphate in the neighborhood of 15 degs., would lead one to anticipate. Their experiments all show the temperature co-efficient of these cells to agree remarkably well between 15 degs. and 40 degs., and that they are expressed well by the formula, $Et = E\ 15 - 0.086\ (t - 15)$, where Et and E 15 are the values of the e. m. f. at t or 15 degs., respectively. Between 0 and 15 degs. different cells behave quite differently, however, some of them showing an abrupt change in their temperature co-efficient at about 2 degs., others between 8 and 15 degs., while still others showed no sudden change at all. The values of the e. m. f. for different cells at 0 deg. varied as much as 2 millivolts. The mean corrected ratio of the e. m. f. of the Clark cells at 15 degs. to that of the cadmium cells at 20 degs. was found to be 1.40658, while Kahle gives the nearly identical value, 1.40663. —*Jour. Phys. Chem.*, 4, p. 339; abstracted in *Tech. Quart*, Dec.

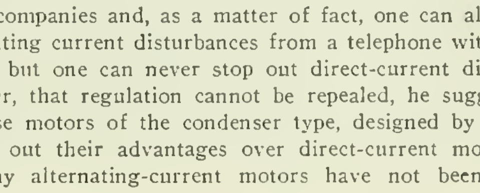
Effect of Oil on the Insulating Qualities of Mica.—Maloney.—A brief article in which he points out that the presence of oil materially reduced the insulating quality of mica. In one case a piece of the best India mica was placed between two planed surfaces, and withstood an insulation test of 16,000 volts alternating current without fracture. When coated with paraffine oil it broke down at 9000 volts alternating current. The same effects are observed with mica immersed in oil. Paraffine, linseed and lubricating oil all give approximately the same results. The surface of the mica can be coated with water, without lessening the insulating qualities.—*Elec. Rev.*, Jan. 19.

Magnetic Observatories and Traction Disturbances.—Glazebrook.—A communication referring to the controversy between the London United Tramway Company and the Kew Observatory. The tramway experts have asserted that they have actually discovered leaking along and from their track rails currents which exceed the limit the Kew authorities desired to have imposed, and this notwithstanding that no current was fed into their trolley wire. Such currents are believed to have strayed into the tramway rails from the leakage of the Central London Railway. The tramway experts conclude from this that as the Kew instruments are not disturbed at present the precautions asked for by the observatory authorities are excessive. He shows that this argument is not correct, as the magnetic records are not affected by existing leakage currents for the purposes for which they are used. The case is different, however, when the currents are those of the line itself. He shows this by mathematical analysis.—Lond. *Elec.*, Jan. 4. A correspondence on the same question which has appeared in the London *Times* is also reprinted.

Disturbances of Magnetic Observatories by Electric Traction.—Fessenden.—A communication pointing out that a perfectly simple method of doing away with all interference due to electric railway currents, is to use alternating-current motors on the cars. He refers to a "very foolish regulation," passed some time ago to the effect that alternating currents with earth returns should not be permitted. He calls it foolish, as it was made in the interest of the telephone companies and, as a matter of fact, one can always stop-out alternating current disturbances from a telephone with a proper condenser, but one can never stop out direct-current disturbances. If, however, that regulation cannot be repealed, he suggests using single-phase motors of the condenser type, designed by Steinmetz. He points out their advantages over direct-current motors. The reason why alternating-current motors have not been used for street railways is "because the street railway material is now standardized, and the slight gain in efficiency and up-keep which would ensue from the use of polyphase motors is not sufficient to warrant abandoning the millions of dollars of patterns, special jigs, etc.. now in use. But for special cases, such as that of the Greenwich Observatory, there is no reason why single-phase two-trolley condensered or non-condensered motors should not be used."—Lond. *Elec.*, Jan. 11.

Telegraphy, Telephony and Signals.

Tuned and Multiple Wireless Telegraphy.—Slaby.—His very interesting paper in full, an abstract of which was noticed in the Digest, Jan. 19. He describes the system devised by him and Count Arco. The action is illustrated by the following mechanical analogy: A steel wire is bent, as illustrated in the adjoining figure, so that each of the two free ends has one-sixth the length of the whole wire. When the free end a is made to oscillate, the end b also begins to oscillate, the points 1, 3, 5 are nodes of the oscillation, while at 3 and at the ends of a and of b the oscillation is a maximum. The lengths of a and b must be a fourth of a whole wave length. The case is analogous in wireless telegraphy. The length of a corresponds to the length of the vertical wire at the transmitting station connected to earth through the spark gap; the length of b corresponds to the length of the vertical wire at the receiving station, the lower end of the latter being earthed and thus made a node of the electric oscillations. The best means of obtaining visible signals



FIGS. 1 AND 2.—TUNED AND MULTIPLE WIRELESS TELEGRAPHY.

at the receiving station is the coherer, which ought to be connected to the vertical wire at the receiving station at that point of the vertical wire where the alternating voltage is a maximum; i. e., it would have to be connected to the upper end. This is, of course, impossible for practical reasons, but it shows that the usual arrangement, in which the coherer is connected between the lower end of the vertical wire and earth, is wrong in principle. This difficulty has been solved in the following simple and ingenious way: The receiving vertical wire is directly earthed, so that its lower end is a node for the electric oscillations, this lower end is connected to another wire of the same length as the vertical wire. At the end of this second wire the oscillation is also a maximum, just as at the free upper end of the vertical wire. This second wire may be wound on a spool, so that its end is easily accessible, and to this end the coherer is connected. This arrangement enables one to use lightning rods, masts of ships, etc., as vertical wires. The system of tuning is as follows: Two corresponding stations work with the same wave length, agreed upon. The receiving station may be tuned to a certain wave length by making the length of the vertical wire equal to a fourth of the wave length; only this wave is then received, all waves of other wave lengths traveling into the earth. It is, however, possible to receive also at this station with the same vertical wire, waves of other length by the following arrangement: The vertical wire may be a lightning rod of 40 meters, so that waves of 160-meter length can be received at once; if the prolongation has also a length of 40 meters, all waves of other length travel into the earth; but we can force such other wave to travel into the prolongation and thus become available to the action at the coherer by making the whole length of the wire; i. e., vertical wire plus prolongation, equal to the half walve length. The earthed point is then no longer a node, but allows only this special kind of wave to pass into the prolongation. In our numerical example, if we want to receive waves of 200-meter length, the whole wire length must be 100 meters, hence the prolongation, which is wound on a spool, 60 meters. It is, therefore, sufficient to have at hand a number of such spools connected to the lower end of the one vertical wire of the station, in order to be able to receive waves of different length. Each of these spools is connected to a receiving apparatus. He refers briefly to an apparatus which he has found very practical and which he calls a multiplier. It is a coil of wire of a certain form and method of winding, depending upon the wave length. It has the property of diminishing the speed of an electric impulse. The result of this is an essential increase of voltage. This apparatus is not to be confounded with a transformer, as there is no secondary winding. It is analogous to the action of a sounding board which intensifies the note emitted by a tuning fork. Such tuned multipliers are connected between the prolongation of the receiving vertical wire and the coherer, so that higher voltages are obtained at the coherer. The arrangement at the transmitting station is as follows: There is no single vertical wire, but a loop, as shown in the adjoining figure. To obtain a large quantity of electricity, the condenser K is used in the form of Leyden jars; AB is the spark-gap. For charging, the whole loop, $E\,D\,C\,A$, closed through the earth, is used. For the discharge, which begins with the starting of the sparks, only the vertical wire, $K\,C$, is used. In it the quick oscillations for transmission are generated. They cannot pass into the part, $D\,E$, as the coil, $C\,D$, which is very differently tuned and acts like a reflector, prevents it. The length of the waves emitted from such a wire depends upon the length of the vertical wire and the size of the condenser. It can be varied at will by inserting tuned coils. He describes the experiments with tuned multiple wireless telegraphy, which were already noticed in the Digest, Jan. 19. In an appendix he gives some mathematical and theoretical notes, which show how he has developed this system.—*Elek. Zeit.*, Jan. 10.

REFERENCE.

Cable Work.—Kingsford.—A communication referring to the paper of Barwell (Digest, Oct. 13), and describing some similar experiments.—Lond. *Elec.*, Jan. 11.

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Miscellaneous.

REFERENCES.

Westinghouse.—The very large issue, entirely devoted to the discussion of works management, contains an illustrated article, by McFarland, on George Westinghouse as inventor, organizer and director.—*Eng. Mag.*, Jan.

Paris Exposition.—An illustrated article on the exhibit of the International Electric Company, of Vienna.—*Zeit. fuer Elek.*, Dec 23.

An illustrated description of a Ruhmkorff coil, designed by Ducretet, giving sparks 80 centimeters in length.—*La Nature*, Jan. 12.

Lloyd-Pearson.—A student's report to the (Brit.) Inst. Elec. Eng. on bi-polar machines exhibited.—Lond. *Elec. Rev.*, Jan. 11.

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New Books.

BOOKS RECEIVED.

Annuaire Pour L'An 1901. Publie par le Bureau des Longitudes. Avec des Notices Scientifiques. Paris: Gauthier-Villars. 936 pages. Price, 1 franc, 50 centimes.

The Electromagnet. By Townsend Wolcott, A. E. Kennelly and Richard Varley. Jersey City, N. J.: Richard Varley. 135 pages. Illustrated. Price, $1.00.

Technical, Industrial and Commercial Vocabulary. English, French, German. By E. Hospitalier. Paris: L'Industrie Electrique. Price, 6 francs.

The Theory of Electrolytic Dissociation and Some of its Applications. By Harry C. Jones. New York: The Macmillan Company. 289 pages, 9 illustrations. Price, $1.60.

Introduction to Physical Chemistry. By James Walker, D Sc., Ph. D. London: Macmillan & Company. 335 pages, 47 illustrations. Price, $3.00.

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Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 17-20, 1901.

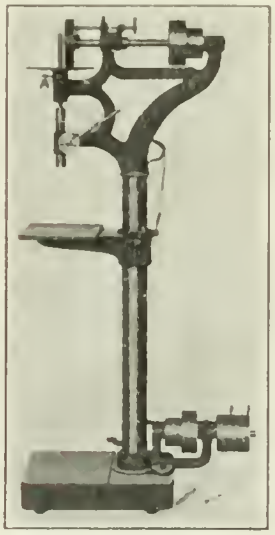
Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

Canadian Electrical Association. Next meeting, Ottawa, Ont., 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

National Electric Light Association. Next meeting, New York, 1901.

New Upright Drill.



The upright drill which is illustrated herewith is claimed to be of remarkable drilling capacity. It is a friction-driven tool, and has a great range of speed. The friction plate has a hub, which lies in a ball bearing on the main frame. This plate is brought in contact with the driving wheel by an eccentric ring, quickly and easily moved and locked in position. The variation and speed of the spindle is obtained by moving this wheel to and from the center of the friction plate, and it is secured in the desired position by the thumb set-screw shown on top of the frame. A ball bearing between the collar on the spindle and sleeve does away with practically all friction from end thrust. The power is greatest on the larger tools and drills and most sensitive on the smaller ones. The table is counterbalanced by a weight in the hollow column, can be quickly and easily raised or lowered, swung to either side, and locked in position. The column is graduated by a vertical line its full length, making it easily possible to set the center of the table in line with the spindle at any point of vertical adjustment. The size of the table is 10 by 10 in., the distance from the column to the spindle is 7¾ in., and it will drill to the center of 15½ in. Reference made to this machine a few weeks ago in this paper stated that it would drill to the center of 5½ in. This was a misprint. The capacity of the machine is from 0 to ½ in., and the speed of the drills 200 to 1500 revolutions. The countershaft is securely bolted to the base, and has a speed of 350 r. p. m. The drill is built by the Patterson Tool & Supply Company, Dayton, Ohio.

The Induction Motor in Iron Works.

The new plant of the Union Malleable Iron Company, of East Moline, Ills., affords a good example of the application of electricity to industrial plants. This plant employs about 500 men and is modern in every feature of its design. It is, in fact, one of the most complete establishments of its kind in the country. The buildings are of brick and steel, and are laid out with a view to the simple and efficient working of the plant. The foundry has a length of 415 ft. and a width of 150 ft. In separate annexes it has three air furnaces and one cupola. In the annealing room are 8 large gas-heated ovens and an electric traveling crane with a span of 51 feet.

In the engine room are two Westinghouse generators, one of 180 kw, giving three-phase currents at 440 volts, and driven by a belt-connected Russell engine of 300 hp.; the other machine is of 75 kw. giving three-phase currents at 440 volts, belt-connected to a 125-hp Buckeye engine. These machines operate in parallel.

Current is furnished for 45 Manhattan multiple-arc lights and 450 incandescent lamps, and to the following three-phase Westinghouse motors: Two 50-hp motors, each operaitng 32 tumbling mills, an exhaust fan and two stands of emery wheels; six 20-hp motors, three of which are connected to Sturtevant pressure blowers for reverberatory furnaces, one used for driving a Root blower for the cupola, one driving the machine shop equipment and one the carpenter shop equipment; three 10-hp motors, one running eight tumbling mills, one running the machinery of the pattern shop, and one operating a pug mill; two 5-hp motors, one running the resin mills and centrifugal sand mixers (shown in Fig. 2), and one the cupola elevator. In addition to these, variable speed induction motors are used for operating the electric traveling crane in the annealing room, shown in Fig. 1.

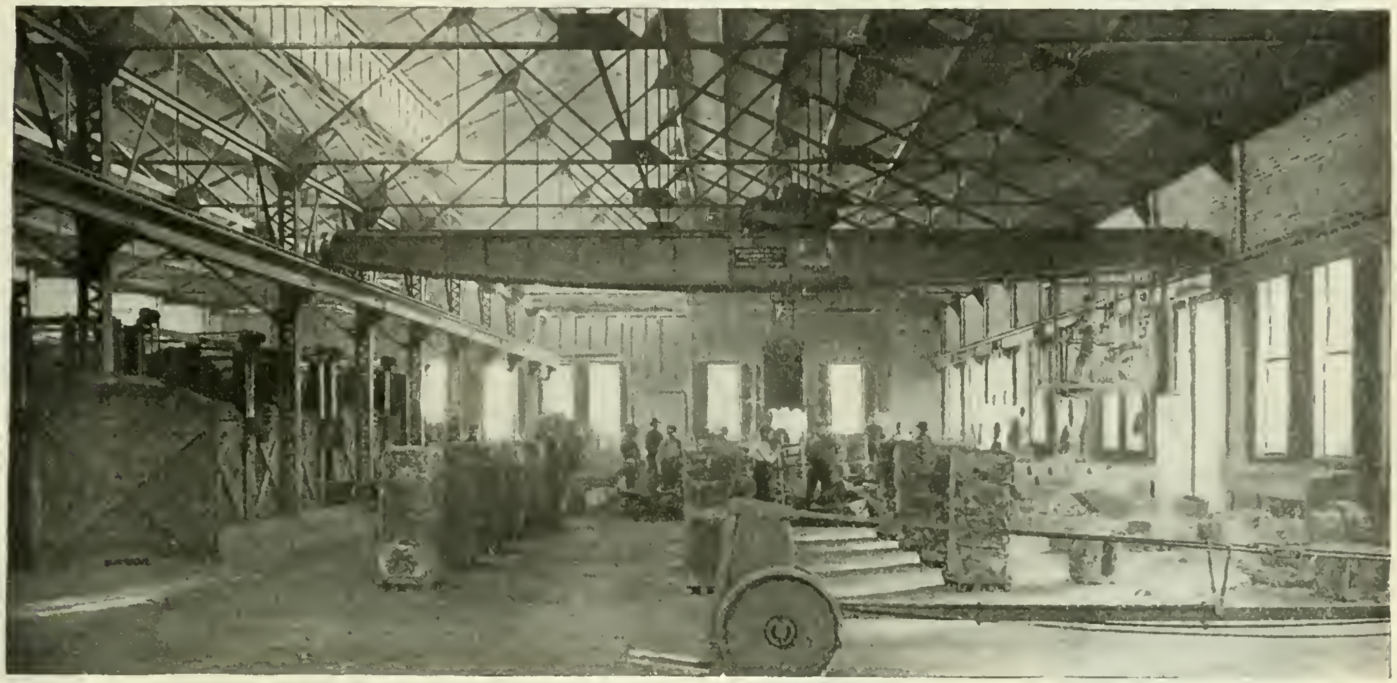


Fig. 1.—Induction Motors Operating Crane.

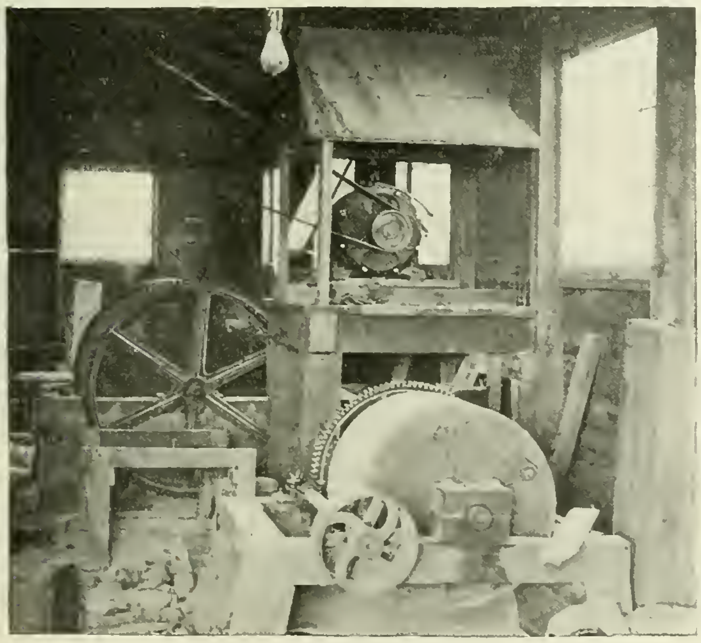


Fig. 2.—Induction motors operating two resin mills.

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Interior Telephones.

An artistic line of interior telephones manufactured by the Electrical Appliance Company, of Cincinnati, Ohio, is illustrated in the accompanying engravings. The instruments are compact, durable and reliable, and as they are wholly of metal this permits of their being finished in any metallic finish that may be required to match the hardware of the offices in which they are to be placed. Examples of these finishes are nickel plate, oxidized copper, barf-barf, etc.

The desk set is, as will be seen, especially handsome in appearance. It is complete within itself, the switch for inter-communication being on the base as illustrated. The absence of exposed wires is noticeable, all mechanism being concealed by the base and pedestal. The wiring for the inter-communicating system is so arranged that it is not necessary that the switch be returned to its "home button" after using in order that that station may be called, and they may be wired to suit any conditions that can be met by a telephone.

An important part of any telephone equipment is the receiver. This company is now manufacturing a watch case receiver especially designed for these instruments that is claimed to be a decided improvement over anything of the kind in that line. Its construction is such that although it has but a single coil it has double poles—coils of this kind with a core properly designed acting upon both poles with the greatest magnetic efficiency. The mechanical features contribute to the receivers' general efficiency in no small degree, viz., a full strong thread for the cap with correct and ample seat for the diaphragm which is of steel; double magnets of the best magnet steel; Norway iron pole pieces, correct, uniform and permanent distance between the diaphragm and poles; no exposed wires to be easily broken; cord-tip binding posts which cannot turn.

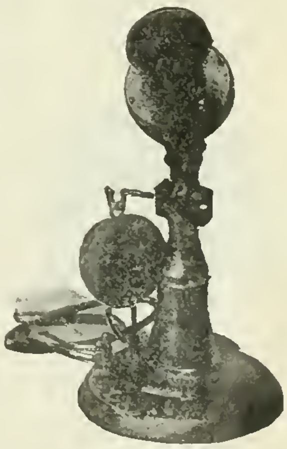
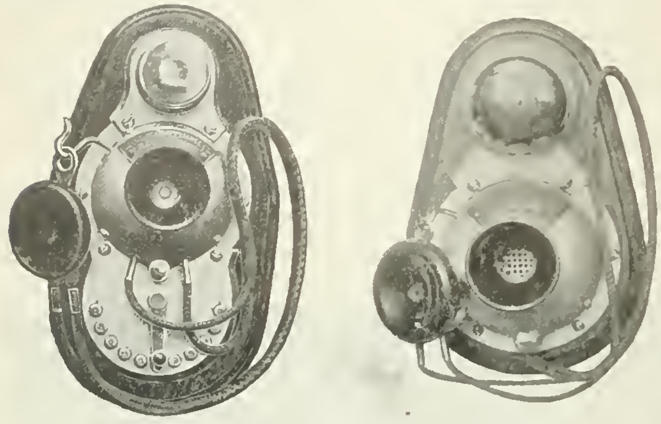


Fig. 1.—Desk Set.

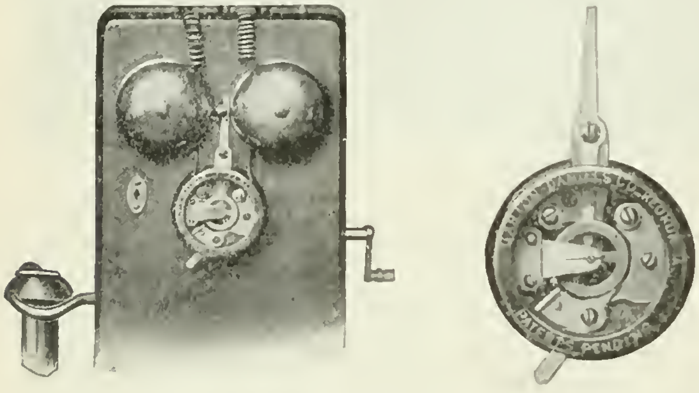
The transmitter is extremely sensitive and will transmit articulate sound correctly. It is a well-known fact that a transmitter may be sensitive to ordinary noise and yet not transmit articulate sound even in the absence of other noises. The presence of foreign sounds does not interfere with this transmitter, some of them being in use in close proximity to circular saws and kindred machinery in operation. These results are brought about by proper design of all parts of the instrument with reference to each other.



FIGS. 2 AND 3.—INTERIOR TELEPHONES

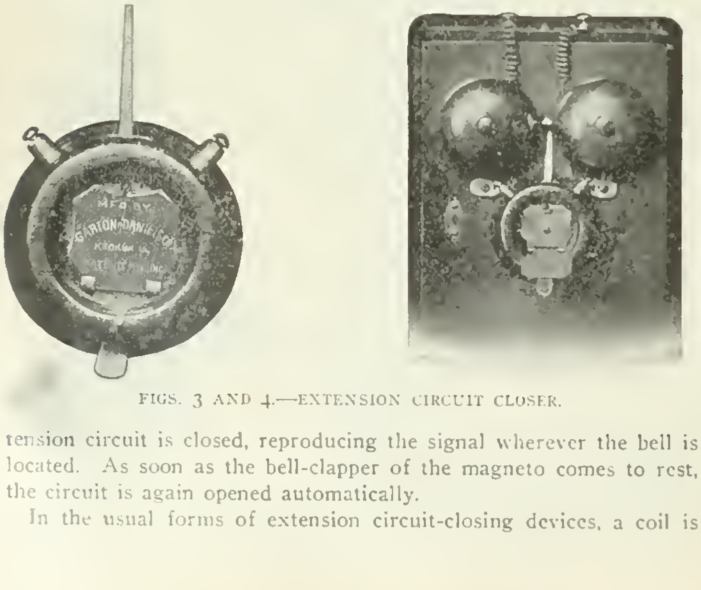
A New Extension Circuit Device.

A telephone extension signaling device without magnet coils of any description that does not insert any extra resistance in the circuit, and that resets itself after every signal, has been brought out by the Garton-Daniels Company, of Keokuk, Iowa, and is known as the G.-D. Extension Circuit Ringer. In Fig. 1 the device is shown attached to the front of the magneto box. Fig. 2 gives a larger view of the device.



FIGS. 1 AND 2.—EXTENSION CIRCUIT RINGER.

It will be noted that a lever, extending upward, is held against the bell-clapper of the magneto. When the bell-clapper vibrates, the extension circuit is closed, reproducing the signal wherever the bell is located. As soon as the bell-clapper of the magneto comes to rest, the circuit is again opened automatically.



FIGS. 3 AND 4.—EXTENSION CIRCUIT CLOSER.

In the usual forms of extension circuit-closing devices, a coil is depended upon to release a shutter, which closes the circuit when it falls. The troubles and annoyances incident to their use are obviated by the use of this type of ringer. This device may also be used on party lines, where an ordinary drop would be of no value. The fact, that it introduces no resistance in the circuit will appeal to practical telephone men.

Fig. 3 shows an ordinary drop shutter, circuit closing device, now being placed on the market by the same company. This differs from present forms, in that it is not dependent on the action of a magnet, but is dependent on the motion of the bell-clapper of the magneto. It differs from the ringer above described in that it must be reset after each signal. This circuit-closing device is shown in position on the front of a magneto in Fig. 4.

Direct-Acting Pressure Pumps.

We illustrate herewith one of the latest types of compound, direct-acting pressure pumps. The pump shown is one of the largest of its type built, and will be installed by the Columbia Gold Mining Company, of Oregon, and operated condensing.

The pump was built for mine station work, the water end being designed for a working pressure of 600 lbs. per square inch, with ample margin for safety. The valves are of bronze of a special composition and type, seating on steel seats and located in individual chambers easy of access.

The entire water end is made of a special semi-steel composition. An extension piece is provided with an adjustable shoe for the guidance and support of the plunger. The water plungers are of bronze and of the trombone type and packed, reciprocating through deep glands easily accessible. The entire water end is mounted on heavy cast iron foot pieces. The steam end is of the cross head type, lagged in polished steel. The steam valves are of the Corliss type, the area of ports for the induction and eduction of steam being especially liberal.

DIRECT ACTING PRESSURE PUMP

The valve adjustment is on the outside. Special equalizing valves are provided, and the rock stand supporting the valve gear is located in such a manner as to least interfere with the inspection of the working parts and to obviate any trouble due to vibration. The crossheads are of a special type, being guided on the lower tie rod. The pump is one of a line of similar ones made by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio.

Motor Controller.

The accompanying illustrations represent a type of motor controller manufactured by the Electric Controller & Supply Company, of Cleveland, Ohio, which have a number of distinctive features, making them unusually well suited for crane service and other similar uses.

The apparatus is self-contained, and all working and live parts are under cover, thus protecting them from injury, dust and consequent short-circuiting of the latter, and avoiding the possibility of the eyes of the operator being injured by flashing. At the same time all renewable parts are readily accessible, and repairs can be made without removing the apparatus from place, or in any way disturbing the parts other than those upon which repairs are to be made.

The apparatus is so designed and arranged that the electrical contacts are placed directly under top cover instead of on the vertical faces of the controller. Hence, in installing a series of controllers, as in case of a traveling crane, the controllers can be set snugly side by side, no clearance between them being necessary. This brings the handles close together and makes it easy for the operator to reach them. The throw of the lever is extremely short, which is also an important item of advantage to the operator in handling a series of three or four controllers set side by side

Ample resistance is provided for. The manufacturers state they can meet any specifications or requirements as to the resistance of these machines. The resistance is made up in compact, readily renewable sections, being wound around insulated tubes, which give it rigidity, preventing the coils from dropping down and avoiding consequent short-circuiting. The design of the apparatus insures thorough ventilation of the resistance, thus enabling it to carry a higher current without injury, and increasing the life and serviceability of the controller. All resistance is contained in the frame of the controller, no separate resistance boxes being required. Hence, with ordinary series-wound motors there are only four connections to be made. The contact arm is provided with blow-out magnets, which obviate arcing, and thus protect the brushes and segments and prolong their life. The controller is operated by a single lever which works smoothly, as is particularly desirable for crane service. A reliable center stop holds the arm firmly in the off position while not in use, thus preventing jarring onto contact. No separate reversing switch is required. The controller can be placed on the floor of a building or cage, or can be inverted, and anchored or suspended from above as is sometimes desirable in crane service. There is no combustible material whatever used in the construction of the apparatus.

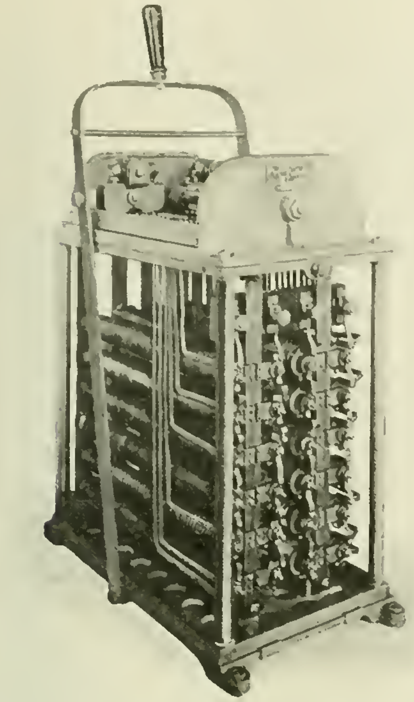


FIG. 1.—CONTROLLER WITH COVERINGS REMOVED.

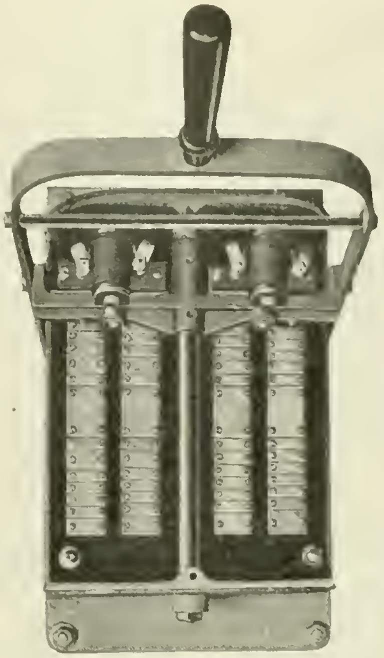


FIG. 2.—CONTROLLER VIEWED FROM OVERHEAD, SHOWING CONTACT FACE.

The controllers are made in three sizes with, respectively, 24, 16 and 12 steps. The 24-step machine is for crane hoists, and for other work where a wide range of speed control is required. The 16-step machine is particularly suited for the bridge-travel motion, and the 12-step machine for the trolley motion, of electric traveling cranes.

A Large Transformer Contract.

The Chambly Manufacturing Company has recently placed with the Westinghouse Electric & Manufacturing Company the largest single order for transformers ever recorded. This order comprises 20 2750-kw transformers of the Westinghouse air-blast type. Each of these, with an output of over 3600 hp of electrical energy, weighs approximately 11 tons and stands 9 ft. high.

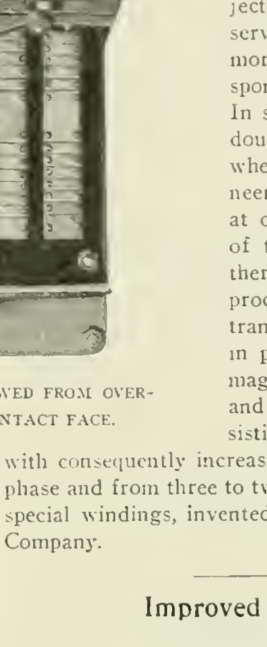
Of the 20 units, 10 are used to raise the voltage from 2200 to 25,000 volts at 8000 alternations. The input is two-phase and the output three-phase. The remaining 10 transformers, for lowering the voltage, receive the three-phase line current at 22,000 volts and deliver a two-phase current at 2400 or 4800 volts as required.

The blowers for furnishing the air blast for cooling both the raising and lowering transformers are operated by Westinghouse type C induction motors. The well-known Westinghouse methods of construction are employed in these transformers, both primary and secondary being divided into several flat coils wound with many layers, and few turns per layer, each coil being insulated separately. The advantages of this construction are that it divides the total e. m. f. between the several coils, reducing proportionately the strain of each individual coil; also it divides the e. m. f. in a single coil between many layers, thus reducing the potential between the adjacent layers. The regulation of the transformers is also improved, and the windings may be connected easily in series or multiple, thus giving a wide range of e. m. f. Also in case of damage to a coil a substitute may be provided with but little trouble, and without sending the transformer to the works.

Iron and copper have been carefully proportioned to secure the minimum losses, and the efficiency of the transformers is very high, being considerably over 98 per cent. It is however, not sufficient that the loss in a transformer be low when it is first installed, for, as is now generally known, much of the iron that has been used in transformers when subjected to the conditions prevailing in continued service is subject to a material deterioration, more or less rapid, with the result of a corresponding material increase in the iron losses. In some cases this increase has amounted to a doubling of the loss found in the transformer when first installed. The Westinghouse engineers early discovered this characteristic and at once began a careful and systematic study of the subject, with the ultimate result that there was established a special and thorough process for the manufacture and treatment of transformer iron. Entire success was attained in producing an iron at once capable of high magnetization with comparatively little energy and having a stable character completely resisting the tendency to deteriorate in service with consequently increased losses. The change from two to three-phase and from three to two-phase current is secured by means of the special windings, invented by Mr. C. F. Scott, of the Westinghouse Company.

Improved Hand Milling Machine.

The machine illustrated herewith is the new No. 2 Universal Hand Miller built by the Whitney Manufacturing Company, of Hartford, Conn. The patents on the Woodruff system of keying are controlled by this concern, who allow all manufacturers full privileges on simply purchasing keys and cutters from them. The Woodruff system is now well-known, and has been adopted by a large number of the leading manufacturers in various lines in the United States. The hand milling machine illustrated is furnished with a feed weight attachment by means of which both the head and table may be fed automatically through short distances. It will therefore cut automatically all sizes of key-seats for the Woodruff system. The spindle is double geared and the side driving pulleys are of different diameters and are interchangeable. This combination gives 12 spindle speeds. It also makes the machine sensitive for light and high-speed milling, and gives extreme power for heavy work. The vertical and horizontal feeds being independent, permit work to be held close to the table and make the machine adapted for a wide range of profiling operations. The spindle head is operated by a lever, as shown, and it is accurately counterbalanced. This feature may be readily appreciated, as delicate vertical milling may be done without danger of breaking cutters, regardless of the weight which may be applied to the table.



MILLING MACHINE.

Adjustable stops are furnished for limiting travel of both head and table in either direction. The table has both hand lever feed and hand screw feed, and the change from one to the other can be made instantly. The elevating screw for the knee is provided with ball-bearing thrust collars for reducing friction. These machines are well adapted for use in electrical manufacturing establishments, one such company in New York and Chicago having over 25 in use.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In the money market call money closed at 2 per cent. Time money is quoted at 3@3½ per cent for 30 to 90 days, and 3½@4 per cent for longer periods. The stock market was very irregular, and speculation was uncertain and variable. Tractions and electrics were, for the most part, steady and stronger, the tendency in all being upward. All the principal stocks of this class closed with substantial gains, the advances being as follows: Brooklyn Rapid Transit, 2⅝ points; General Electric, 2; Metropolitan Street Railway, 2⅛, and Western Union, 1¾. In outside securities the market was quite active. Early in the week the market was depressed, but this feeling gave way to one of buoyancy toward the end. Among the gains are noted Electric Boat, pfd., 2½ points, and General Carriage, 1¾ points. Following are the closing quotations at the four principal financial centers:

NEW YORK.

	Jan. 19.	Jan. 26.		Jan. 19.	Jan. 26.
Gen. Elec.	186	188	Elec. Veh.	15	16
Bklyn. Rap. Tran.	75⅜	78	Elec. Veh., pfd.	35	30
Met. St. Ry.	159¾	162¼	Gen. Car.	2¼	4⅛
Am. Tel. & C.	—	96	Ill. Elec. Veh. Tran.	¼	¼
West. Un. Tel.	81¼	83	N. E. Elec. Veh. Tran.	3	2¾
Am. Dist. Tel.	—	—	N. Y. Elec. Veh. Tran.	4¾	4½
Com. Cable	—	—	Tel. & Tel. Co. of Am.	4½	4
Elec. Boat	28	29	Hud. Riv. Tel.	116	117
Elec. Boat, pfd.	50	52	N. Y. & N. J. Tel.	174	174

BOSTON.

	Jan. 19.	Jan. 26.		Jan. 19.	Jan. 26.
New Eng. Tel.	—	—	Erie Tel.	65	57
Mex. Tel.	—	2¼	Gen. Elec., pfd.	—	*160
Westing. Elec.	—	*55	Am. Tel. & Tel.	157	161½
Westing. Elec., pfd.	—	—	Boston Elec. Light	205	—

PHILADELPHIA.

	Jan. 19.	Jan. 26.		Jan. 19.	Jan. 26.
Elec. Stor. Bat.	78	77	Phil. Elec.	6	7⅛
Elec. Stor. Bat., pfd.	80	80	Pa. Elec. Veh.	2	2
Elec. Co. of Am.	9	8	Pa. Elec. Veh., pfd.	1	1
Gen. Elec. Auto.	—	—	Am. Rys.	33¼	31½

CHICAGO.

	Jan. 19.	Jan. 26.		Jan. 19.	Jan. 26.
Chicago Edison	151	150	Chicago Telep. Co.	253	255
Chic. City Ry.	253	255	Union Traction	12	11
Nat'l Carbon	15¾	15¾	Union Traction, pfd.	49	49
Nat'l Carbon, pfd.	83	84	Northwest Elev. Com.	27	27

* Asked.

TELEPHONE, TELEGRAPH & CABLE.—President Latta, of the Telegraph, Telephone & Cable Company, has sent the following notice to stockholders: "The debts of the company, which were incurred in the purchase of a large block of stock of the Erie Telephone & Telegraph Company, have been liquidated, until now they amount to but $379,000. This sum, represented by several notes, is due and payable part on Feb. 1 and the balance on March 1, 1901. In addition thereto, there is due to your subsidiary companies for labor and material expended on construction, which will carry them to March 1 of this year, $75,000. With these paid, there will be in the treasury of your company, free and clear, $2,100,000 par value Erie Telegraph & Telephone Company, and stocks and other securities of companies controlled by this company of a par value of $2,289,966, which have cost your company $844,366. There are also due and payable assessments in arrears amounting to $1,164,817, which when paid will be used to liquidate the above floating debt, leaving a cash balance in your treasury of $710,817 besides the assets above noted." The notice continues with a request for the payment of assessments in arrears, and states that when this is done a plan to make the stock full paid will be laid before the stockholders. A special committee has been appointed to consider the question of recapitalization, as follows: Randall Morgan, Frank A. Cutting, James Moses, W. H. Butler, F. M. Kelley, Frank Tilford and H. R. Wilson.

SOUTH JERSEY ELECTRIC.—The South Jersey Electric & Traction Company, recently incorporated by the United Coke & Gas Company interests, is building a 100-oven coke and gas plant at Camden, and when completed gas will be piped to Trenton, Gloucester, Woodbury, Haddonfield and Merchantsville. All the connections have been made, excepting the main line to Trenton, 32 miles in length, now being laid. The South Jersey Company owns the Trenton Gas & Electric Company, the Camden Gas Light Company, the Camden Electric Company, the Camden & Gloucester Traction Company, the Woodbury Gas Company, the Haddonfield Gas Company, the Haddonfield Electric Company, and the Merchantsville Gas Company. Its capital is $6,000,000, all common shares, par $100, and it has $6,000,000 5 per cent bonds. About $5,000,000 of the stock and $5,000,000 of the bonds have been issued. No offering has yet been made to the public. The United Coke & Gas Company, W. L. Elkins, Jr., president, holds all the stock. The Otto Hoffman Bi-Product process will be used at the Camden plant. This is the same process as that employed by the New England Gas & Coke Company at Everett, Mass. The United Gas & Coke Company, which owns this process, is building 900 ovens at Chicago for the Chicago Bi-Product Coke Company, and 100 ovens for the Birmingham, Ala., Coke & Gas Company.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared a regular quarterly dividend of $1.50, payable Feb. 15. The Westinghouse Electric & Manufacturing Company has declared a regular quarterly dividend of 1½ per cent on the assenting stock, payable Feb. 15. Coney Island & Brooklyn has declared the regular quarterly dividend of 2½ per cent and an extra dividend of 2 per cent, payable Feb. 1. The Central London Underground Railway has declared a dividend for the first five months of its existence at the rate of 3 per cent per annum. The Cincinnati, Newport & Covington Street Railway has declared a quarterly dividend of ¾ per cent, payable Feb. 1. This is an increase of 1 per cent for the year over last year, and will be 3 per cent for 1901. The dividends are always declared out of the earnings of the previous year. Last year they were 7 per cent. The Twin City Rapid Transit Co. has declared a dividend of 1½ per cent on its common stock, payable Feb. 15; the company paid a dividend of 1½ per cent in August, making 3 per cent for the year. The Bell Telephone Company of Philadelphia has declared the regular quarterly dividend of 2 per cent, payable Jan. 28.

MORE MANCHESTER MANIPULATION.—The Manchester Traction, Light & Power Company has been incorporated to consolidate six traction, light and power companies, operating in and adjacent to Manchester, N. H. The new company will have $1,500,000 5 per cent bonds and $1,500,000 stock. The bonds have been sold to Vermilye & Co., and the stock has been placed through Messrs. Tucker, Anthony & Co. The Manchester Electric Company will be taken over. This company controls the Manchester Electric Light Company and the Manchester Street Railway Company. The following water-power companies have also been absorbed: The Garvins Falls Power Company, Hooksett Power Company, Greggs Falls Power and the Kelley's Falls Power. These four power companies represent over 10,000 hp, all the water-power within 15 miles of Manchester, outside of the power controlled by the Amoskeag Mfg. Co. The gross earnings of these companies at the present time amount to about $450,000 per annum. Dividends of 6 per cent wil be paid on the stock. This deal is the sequel to a number of others made recently and noted in these columns.

BOSTON LIGHTING SITUATION.—It is stated from Boston that the Morgan syndicate has not as yet released the Boston Electric Light Company from the option given it to lease the same at a 10 per cent rental. In consequence the directors of the Boston Electric Light Company have formally notified the Edison Electric Company that it cannot entertain the latter's offer for a similar lease. The executive department of the Boston Electric Light Company, owing to the sudden death of President Gilbert, is temporarily in charge of Director and Counsel Burdett, while the office of general manager is in charge of Sidney Hosmer. Regarding an additional issue of stock by the Edison Company an Edison director says: "During the past year our increased business has called for increased expenditures. In consequence it will be necessary for the company to issue additional capital stock as has been done nearly every year for 10 years past. When the new stock will be issued, or how much, has not yet been decided upon by the directors."

STANDARD UNDERGROUND CABLE CO.—The annual meeting of the stockholders of the Standard Underground Cable Company, of Pittsburg, was held last week. The report of the treasurer showed the condition of the finances of the company to be an excellent one. During the year $118,000 was paid in dividends. The three plants of the company located at Pittsburg, Perth Amboy, N. J., and Oakland, Calif., are in full operation, and the capacity of these works is estimated at an output of $4,000,000 per year. The following board of directors was elected: Mark W. Watson, James H. Willock, John D. Nicholson, John B. Jackson, John Moorhead, Jr., B. F. Jones, Robt. Pitcairn, J. N. Davidson and Josef W. Marsh. The officers are: Mark W. Watson, president; J. W. Marsh, vice-president and general manager; Frank A. Rinehart, secretary-treasurer, and Charles M. Hagen, auditor.

CINCINNATI, OHIO.—The directors of the Cincinnati Street Railway Company have voted to accept the proposition for the lease of the company's system to the Widener-Elkins-Dolan syndicate, subject, however, to the vote of the stockholders. A meeting of the stockholders will be held on Feb. 21 to pass upon the matter. The proposition is for the lease of the system to a company to be incorporated under the laws of Ohio for $2,000,000, for the remainder of the 50-year franchise held by the Cincinnati company. The lessee company guarantees 5¼ per cent on the stock of the Cincinnati company for the first year, 5½ per cent the second year, 5¾ per cent the third year, and 6 per cent per annum thereafter. The Cincinnati Street Railway Company now pays 5 per cent per annum, and has done so for some years.

MISSISSIPPI VALLEY TELEPHONE.—A receiver has been appointed for the Missisippi Valley Telephone Company, operating in St. Paul and Minnesota in competition with the Northwestern Telephone Exchange Company (Erie Telegraph). The plant represents an investment of about $700,000. The company has about $100,000 of outstanding debts, of which $80,000 is owing to the Roeblings. The company has 1114 subscribers in St. Paul and 2400 in Minneapolis.

THE YOUNGSTOWN & SHARON RAILWAY & LIGHT COMPANY, Youngstown, Ohio, has filed a mortgage for $1,000,000 to the New York Security & Trust Company to secure a bond issue of $2,500,000. The company controls all the railway and electric light properties in Youngstown, Sharon, Sharpesville and New Castle, which have been recently bought up by the Penhale-Devitt syndicate of New York and Chicago capitalists. The money will be spent in extensive improvements now under way.

Commercial Intelligence.

THE WEEK IN TRADE.—While there were some irregularities in different sections of the country and in the various industries, trade on the whole was satisfactory and of a practically normal volume. Relatively the best reports, as pointed out by *Bradstreet's*, come from the Pacific Coast, the South and the Southwest, where the spring demand is opening up well. Unseasonable weather, particularly in the East, had a depressing effect on retail trade; yet the situation was not devoid of points of strength. Bank clearings and railroad earnings make very good comparisons with similar periods in preceding years, while business embarassments are about normal. Gross railway earnings on 61 roads for the first two weeks of January aggregate $16,800,000, a gain over the same period a year ago of 9.6 per cent. For the month of November net earnings of 13 roads show a gain of 2.1 per cent on a gain in gross receipts of 3.9 per cent. The business failures for the week, as reported by *Bradstreet's*, number 281, against 290 the week previous; 252 the same week a year ago, 246 in 1899, 288 in 1898 and 326 in 1897. In the iron market the feature of the week was the placing of orders for Bessemer pig at equivalent to $13.25 at Pittsburg. This has steadied the market generally, except for foundry grades, which are weak. A feature in the export line was the shipment of 3000 tons steel billets to Glasgow from Birmingham, the largest shipment of this material ever sent abroad from the South. New business in export trade in crude iron or steel is reported small. Heavy quantities of railway material to replace that destroyed in China may be placed in this country. In the metal market copper was quiet but steady. More business was done for the home trade, but very little for export. Quotations are 16¾ cents for Lake; 16¼ cents for electrolytic in cakes and ingots; casting, 16⅛ cents.

ORDERS FOR CRANES.—The Case Manufacturing Company, of Columbus, Ohio, report to us the following recent orders: Complete 15-ton trolley, Rarig Engineering Company, Columbus, Ohio; 75-ton 65-ft. span, 3-motor traveling crane, St. Louis Transit Company, St. Louis; 8-ton 23-ft. jib crane, Gerst Bros. Manufacturing Company, St. Louis, Mo.; 5-ton 18-ft. jib crane, Humphreys Manufacturing Company, Mansfield, Ohio; 3-ton 30-ft. jib crane, Abendroth Bros., Port Chester, N. Y.; 2-ton 13-ft. jib crane, P. C. C. & St. L. R'y, Denison Shops; 10-ton and 1 12-ton jib crane, New Jersey Foundry & Machine Company, Passaic, N. J.; 75-ton 47-ft. span, 4-motor crane, St. Lawrence Construction Company, Massena, N. Y.; 40-ton 3-motor trolley, complete, Rarig Engineering Company, Dakrum, Ohio; 12-ton trolley, complete, Pittsburg Steel Foundry, Pittsburg, Pa.; 2-ton 36-ft. span, 3-motor crane, F. Hammer Paint Co., St. Louis, Mo.; 3-ton, with 5-ton auxiliary, 4-motor crane, Copper King, San Francisco, Calif.; 25-ton trolley, complete, with connections, Totten & Hogg Iron & Steel Foundry Company, Pittsburg, Pa.; 15-ton 5-motor crane, Canton Roll & Machine Company, Canton, Ohio; 15-ton 2-motor, 2 5-ton 2-motor trolleys, Scullin-Gallagher Iron & Steel Company, St. Louis, Mo.; 4-ton 3-motor 18-ft. span traveling crane, Otis Elevator Company, Chicago, Ills.; 15-ton 56-ft. span, 3-motor crane, Niles Iron & Sheet Company, Niles, Ohio; 30-ton 3-motor crane, with auxiliary hoist, Bullock Electric & Manufacturing Company, Cincinnati, Ohio; two 50-ton 60-ft. span, 1 25-ton 39-ft. span and 25-ton 24-ft. span, 4-motor traveling cranes for Chicago & Alton R'y, Bloomington, Ills.; 15-ton 41-ft. span, 3-motor crane, National Gear Wheel & Foundry Company, Allegheny, Pa.; 5-ton 11-ft. jib crane, American Rolling Mill Company, Middletown, Ohio; 10-ton hand-power traveling crane, McCloud River Electrical Power Company, San Francisco, Calif.; 5-ton 26-ft. span 3-motor crane, National Tube Company, McKeesport, Pa.

MR. A. L. BAGNALL, of Bagnall & Hilles, of Yokohama, etc., who is making his headquarters at 15 Cortlandt Street, has just placed some large contracts for their sixth electric road in the Far East. It is the equipment for the Tokio Electric Railway Company, for which Mr. Kodama is consulting engineer. There will be 35 miles of track with 55-lb. rails. There will be three General Electric generators of 250 kw each, and three Skinner engines, direct-connected compound. The boilers will be of Babcock & Wilcox type, 1000 hp. The track will have Crown bonds, and the line material, like the motors, will be General Electric. The trucks will be Peckham, but the 40 car bodies will be made in Japan. There will also be two 25-kw boosters. Mr. Bagnall has also been buying additional G. E. equipment for the lighting concern at Manila called La Electricista. It has 600-kw incandescent and 4 Brush arc lighters already, and this is now being supplemented by two 400-kw single-phase generators and an 80-arc lighter. The steam plant will be two 600-hp Buckeye engines, cross compound, and four 250-hp Aultman & Taylor, B. & W. boilers. New York Insulated wire will be used.

MACHINE TOOLS.—Quite an interesting consolidation of interests was the combining of the Niles Tool Works Company, the Bement-Miles Company and the Pond Machine Tool Company, as noted some time ago. The consolidation known as the Niles-Bement-Pond Company has now purchased the business of the Pratt & Whitney Company, of Hartford. The three first-mentioned companies were makers of heavy machine tools and had been leaders in their lines for years. The addition of the Pratt & Whitney Company's business will enable them to make a lighter line of machines and small tools as well as the heavier ones. The new officers of the Pratt & Whitney Company are R. C. McKinney, president; W. L. Clark, vice-president; C. L. Cornell, treasurer; Francis C. Pratt, secretary, the other directors being Messrs. T. T. Gaff, F. W. Gordon, Amos Whitney, C. C. Cuyler, George W. M. Reed and James K. Cullen.

THE CINCINNATI TOOL COMPANY, which has been situated at Pearl and Ludlow Streets, Cincinnati, for some years, has recently removed its plant to Waverly Avenue, Norwood. It has in its new quarters about 10,000 square ft. more space than it had in the old quarters, which is indicative of the prosperous condition of this company's business, built up by the efforts of Mr. E. H. Hargrave, president and general manager. He has great faith in the foreign business, and believes that the manufacturing concerns of this country will do more foreign business this year than ever before. As Mr. Hargrave has made some extensive trips abroad and has kept closely in touch with the foreign buyers, he is in a position to express himself with authority upon this subject.

CONTRACTS FOR RAILWAY EQUIPMENT.—Park & Hamilton, contractors for the Youngstown & Sharon Electric Railway, have placed a contract with the International Power Company, Providence, R. I., for two 1000-hp horizontal cross compound engines for the large power house now building at Youngstown. They have also placed a contract with the American Electrical Works, of Providence, for all the wire to be used on the Sharon and Sharpesville roads. The two contracts aggregate more than $150,000.

THE WESTERN ELECTRIC COMPANY, Chicago, is erecting a new cable factory 250 ft. square on its new property at Polk and Beach Streets. The building will be of common mill construction, and will be only temporary. It has completed and equipped its new foundry and machine shops, 50 x 160 ft., on the corner of Harrison and Jeffeson Streets. The company is extremely busy in all lines of product.

GENERAL ELECTRIC COMPANY has received an award of contract for $3,584 for direct-connected generator set for Puget Sound Navy Yard, and $410 for switchboard. The Pawling & Harnischfeger Company has a contract of $3,100 for an electric traverling crane; Dietrich & Harvey Machine Company, Baltimore, $5,193, for a motor-driven planer, and Niles Tool Works, Hamilton, Ohio, $2,810 for a motor-driven double angle shear.

MOSCOW TROLLEYS.—The Moscow, Russia, Municipal Council has decided on the extension of its present system of street railways, and also on the transformation of those now worked by horse-power into electric traction. The extension will be about 96⅓ miles. The trolley system will be the one adopted in almost every quarter of the city, with the exception of certain parts where accumulators will be used.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Jan. 16: Antwerp—30 packages electrical material, $4,790. Argentine Republic—119 cases electrical material, $7,131; 20 cases electrical machinery, $1,382. British Possessions in Africa—18 packages electrical material, $1,691. British Guiana—33 cases electrical material, $868. British Australia—64 cases electrical machinery, $30,888; 31 cases electrical machinery, $2,471; 26 packages electric railroad material, $11,655; 17 cases electrical machinery, $2,472. Bristol—1 case electrical machinery, $50. Brazil—256 packages electrical material, $15,483; 136 cases electrical machinery, $63,575. British East Indies—2 packages electrical material, $15; 3 cases electrical machinery, $2,434. British West Indies—88 cases electrical material, $2,434; 2 cases motor vehicle parts, $328. Cuba—60 packages electrical material, $132. China—2 cases electrical material, $132. Central America—9 packages electrical material, $324. Dutch West Indies—17 packages electrical material, $852. Danish West Indies—10 packages electrical material, $138. Ecuador—5 cases electrical material, $109. Genoa—30 packages electrical material, $22,043. Glasgow—31 packages electrical machinery, $12,210; 267 packages electrical material, $69,021. Havre—74 packages electrical material, $9,225; 2 packages automobiles, $2,520. Hamburg—2 packages electrical machinery, $2,653; 125 packages electrical material, $6,327. Japan—244 packages electrical material, $16,327; 1 automobile, $750; 32 packages electrical machinery, $10,853. Korea—53 packages electrical material, $2,555. Liverpool—45 packages electrical machinery, $4,225; 208 packages electrical material, $5,701; 80 packages motor trucks, $3,800. London—163 cases electrical machinery, $4,700; 188 packages electrical material, $17,117. Mexico—159 cases electrical material, $8,236; 1 case automobile parts, $17; 2 packages electrical machinery, $17. Newfoundland—18 packages electrical material, $2,475. Nova Scotia—6 packages electrical material, $236. Newcastle—233 packages electrical machinery, $8,400; 2 cases electrical material, $150. Philippines—187 packages electrical machinery, $12,810. Peru—88 packages electrical material, $3,474. Rouen—1 case electrical material, $140. Southampton—24 packages electrical material, $127. United States of Colombia—7 cases electrical material, $720. Venezuela—10 packages electrical material, $145.

THE FAN MOTOR SEASON is just beginning and the manufacturers now make their announcements as to the novelties in that line they are about to put on the market. From a humble start, the fan motor has been built up into an important part of electrical industry, and the current required to run them constitutes a welcome addition to the central station load at a time of year when the demand for light begins to fall off. In spite of the fact that thousands of fan motors now in service have been running for years, and are brought out of their curl papers with the first breath of spring, like the opening buds, the call for new stock and new styles is ceaseless; and in no piece of electrical machinery is improvement more manifest. This year manufacturers are looking for a good trade not only here but abroad, the taste for a cooling breeze being like that for ice cream—once acquired never lost. Interviews with all the makers show a hopeful state of feeling, with an indication of a firm resolve to maintain prices. It would seem the part of wisdom for purchasers to file their orders early, especially if outside this country, which is the great fan producer of the world; for it seems to happen each year with the burst of summer heat, that there is a terrible scramble for fans, and many a customer has to be disappointed; while on the other hand, the manufacturer, if advised by early orders, can plan his output on the proper scale.

WATER POWER IN MEXICO.—The Mexican Department of Public Works has made a contract with Señor Don Martin de Irigoyen, representing Messrs. Gastinel, Arnaud and Urquija, for the use, as motive power, of the waters of the Lerma River in the State of Michoacán. In conformity with the terms of this contract the concessionaires may employ up to 4,000 liters of water per second, diverting same from the channel of the Lerma River in the district of Maravatio at the natural falls which exist at a point called "Arroyo Hondo," situated on the boundary of the "Las Piedras" plantation, where it joins the village of Yurécuaro. The concessionaires are obliged to produce all the hydraulic power that may be obtained from the quantity of water mentioned, and to use same upon the spot or transform it into electric current and transmit it to such points as may best suit their convenience. A complete description, together with plans and detailed drawings, must be submitted to and approved by the Government. Construction is to be commenced within four months from the date of this approval, and must be completed within a period of five years from said date. The concessionaires have the right to import, free of duty, the instruments and apparatus necessary for the making of the survey and the construction and exploitation of the works.

KIMBERLEY, S. A., PLANT. The public electric-light plant at Kimberley was formally inaugurated on Oct. 15. The works have cost $125,000, and were carried out by Reunert & Lenz. The plant comprises the following: Two 212-hp boilers of 110 lbs. steam capacity, supplied by Messrs. Babcock & Wilcox; a 154-tube Green economizer; a Worthington horizontal and a compound vertical feed pump; a 7000-zinc tube Worthington condenser; a Worthington cooling tower served by a forced draught fan, driven by a 10-hp motor; two 2200-hp engines, supplied by McIntosh & Seymour, for driving two direct-coupled General Electric generators, each of 2500 16-cp lamp capacity; two 2½-ton overhead tramways for the engine room, and an 8-slab marble switchboard, fitted with 28 instruments. Accumulators are to be provided at an additional outlay of $25,000. The present capacity of the plant is 5000 16-cp lamps, but an increase is anticipated. A portion of the work was prosecuted during the siege, and the trenching operations were interpreted by the Boers to be connected with the laying of dynamite mines for their special benefit.

WORK IN HOLLAND.—Mr. Frank D. Hill, U. S. Consul at Amsterdam, says: "The City Council of Amsterdam has voted $2,412,000 for an electric plant which is to furnish power for street cars, lighting, etc., in the city. It is gratifying to state that prospects seem fair for part at least of the supplies required to come from the United States. The establishment of the plant will mark an epoch in Amsterdam's progress, and the sum voted is large enough to provoke zeal in attempting to secure the work." There are to be six generators of 650-kw capacity, six compound engines of 800-hp each, and fifteen Cornwall boilers. The dynamos are estimated to cost $96,000. For cables and transformers, $400,000 is set down, and $844,000 for 1000 meters.

THE SANTAGERTRUTIS JUTE MILL COMPANY, of Orizaba, Mexico, whose president is Sir Weetman D Pearson, of the well-known British contracting firm, who is building the $30,000,000 Tehuantepec Railroad for the Mexican Government, is about to increase its plant. The company at present operates a water-power plant of 1000 hp, which the directors have decided to immediately increase to 3000 hp. The original equipment is of European manufacture. Sir Weetman says that while the generators may possibly be purchased in Europe, the contract for the necessary additional turbines, etc., will come to the United States. He is authority for the statement that the plant will be augmented so as to develop 6000 hp in the near future

THE CHELTENHAM (ENGLAND) TRAMWAYS COMPANY is at present making extensive purchases of American equipment, etc The Lorain Steel Company has been awarded a contract for 800 tons of steel rails; the John A Roebling's Sons Company, of New York, have secured a substantial order for wire, while the Morris Electric Company will ship about 100 tons of trolley poles, brackets, etc., manufactured by the Electric Railway Equipment Company, of Cincinnati, Ohio, and a quantity of general supplies. These contracts were placed by Mr Thomas Nevins, of Thomas Nevins & Son, of East Orange, N J., who sailed last Saturday for Europe

ELECTRICITY IN ROUMANIA There is a constantly growing market in Roumania for turbine water wheel plants complete, and electric light and power machinery The plant which furnishes all the light and power to the four towns of Sinaia, Campina, Doftana and Bashtenari is to be enlarged by the addition of new turbines of 700 horse-power and a corresponding electrical equipment The Societe Steana uses electric motors in boring petroleum springs in the same region, and the use of electric power is becoming more general in the local industries.

ELECTRIC LIGHTING IN GREAT BRITAIN.—At the last session of Parliament many towns and cities secured electric lighting orders. The authorities at these places have so far completed their plans as to make preliminary estimates as to the probable cost of the work and the nature and extent of requirements in each case Long Eaton is to borrow $75,000 and Macclesfield $125,000 to carry out the proposed schemes. Applications for loans for similar purposes have been made by the City Councils of Ripon and Llandudno.

AUTOMOBILE OMNIBUSES.—Manager Howard Scribner, of the Fifth Avenue Stage Coach Line, has completed arrangements for the transfer of the automobile stages of the New Haven Stage Line to the Fifth Avenue line. The New Orange Street automobile stage line in New Haven, operated for more than a year as an experiment, has been given up because of lack of business sufficient to pay expenses.

THE McGUIRE MANUFACTURING COMPANY, of Chicago, has obtained an order for 15 pair of trucks, which will be shipped for utilization by the Perth Tramways, Western Australia. The order was secured through R. W. Cameron & Co., of South William Street, New York City, which concern is reported to be purchasing considerable quantities of equipment, etc., requisitioned for by the Perth road.

WIRING CONTRACT.—The contract for the electrical work for the large apartment hotel being erected for the Onward Construction Company, W. E. D. Stokes, treasurer, at West 73d and West 74th Streets and Boulevard, has been awarded to Mr. Frederick Pearce, of Rose Street. It is asserted that this is the largest single contract for wiring ever awarded in New York City.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER,
Jan. 19, 1901.

METROPOLITAN ELECTRIC SUPPLY.—The Metropolitan Electric Supply Company, Ltd., whose area of supply includes the parishes of Paddington, St. Marylebone, the St. Giles' District, the Holborn District and the Strand District, intends to apply to Parliament next session for powers to lay a second distributing system from each of its distributing stations. At the present time the company is dependent on a single line of cables passing from its generating station at Willesden, along the towing path of the Grand Junction Canal to the several areas of supply. The second distributing system now proposed will be separate and distinct from the existing trunk main, and will run by an entirely different route to the various areas of supply, and thus enable the company to give equal pressure and will better secure the continuance of the supply under all contingencies.

BIG ELECTRIC SCHEME FOR SYDNEY, N. S. W.—A colossal scheme for supplying the whole of Sydney with electro-motive power, not only for lighting, but for transportation and general motive purposes, is now being worked out by the Public Works Department. For the generation of the necessary force it is proposed to utilize the Blue Mountain rivers, and to provide for water storage on a large scale. In the wet season it is estimated that 40,000,000 gals., or enough to keep the generating plant running at its utmost capacity for 150 days, can be stored without difficulty. The plant is to be of the most modern type. For the Sydney train and tramway services alone some 25,000 horse-power is required. The total cost of the scheme is under £1,500,000, and the working expenses, including interest charges, are put down at £158,000. The estimated annual income is £639,000, but little doubt being entertained that a net profit of half a million sterling will be easily realized.

A BIG ELECTRIC POWER SCHEME.—A bill has been deposited in the House of Commons to incorporate and confer powers on a company to be known as "The Derbyshire and Nottinghamshire Electric Power Company," to be established for the purpose of "producing and supplying electrical energy" within the whole of the county of Nottingham and part of the county of Derby. The share and loan capital of the proposed company is fixed at £2,400,000, of which £600,000 may be raised by the issue of debenture stock, and £1,800,000 by the issue of £1 shares, but with the right to divide these shares into "preferred half-shares" and "deferred half-shares." The company asks for powers to proceed to acquire the lands authorized to be taken under this bill as soon as £100,000 "of the capital of the company shall have been subscribed under contract binding the parties." The promoters named in the bill are Sir Edward Hamer Carbutt, Bart., Mr. F. Faithfull Begg, Mr. F. Carver, Mr. F. Clench, Mr. Duke Fox, Mr. Archibald Grove, Mr. M. H. Mills, Mr. W. O. Plowright and Mr. J. W. Thonkerey.

ELECTRICITY SUPPLY IN LANCASHIRE.—The Lancashire Electric Power Company, in accordance with the powers obtained under its act last session, has now offered terms to several local authorities in Lancashire for the supply of electricity in bulk. To the smaller urban districts, rural districts, etc., it offers the following terms, which are 20 per cent below the maximum rates which it is entitled to charge under the act: For a supply averaging 300 hours per quarter, 1.87d. (3.74 cents) per unit; for a supply averaging 400 hours, 1.60d. (3.20 cents); 500 hours, 1.44d. (2.88 cents), and 600 hours, 1.33d. (2.66 cents). The following figures show the cost at which electrical energy is generated by the various local authorities who have generating stations within the area of supply, the figures being calculated from last year's official returns and including interest on capital expended on generating plant and a proportion of the expenses of management, but not including the cost of distribution or the interest, etc., on the capital expended upon distributing mains: Southport, 2.23d. per unit; Burnley, 2.40d. per unit; Oldham, 2.50d.; Bolton, 2.59d.; St. Helens, 2.65d.; Nelson, 2.67d.; Bury, 2.69d., and Blackburn, 2.73d.

ANOTHER YORKSHIRE ELECTRIC POWER COMPANY.—A bill for incorporating and conferring powers on the South Yorkshire Electric Power Company has been duly deposited for introduction into Parliament next session. The area within which the company proposes to carry on business is set out at great length in a schedule attached to the bill, but, by express enactment, the company is prohibited from exercising any powers in Bradford, Leeds and Sheffield, and, except for the purpose of obtaining convenient access to some other district, a similar restriction is placed upon the company in Halifax, Huddersfield, Wakefield, Dewsbury, Batley, Morley, Brighouse, Keighley, Doncaster, Barnsley, Rotherham and Todmorden. The capital of the proposed company will be £2,000,000, with the right to raise further moneys by the exercise of borrowing powers to an extent not exceeding one-third of the issued capital. The share capital will be divided into 200,000 £10 shares, with power to split the shares into "preferred half-shares" and "deferred half-shares." The first directors named in the bill are Sir Richard Mottram, Sir William Agnew, Mr. H. A. Earle and Mr. W. P. J. Fawens. The dividend payable on the capital is to be on a sliding scale, based on a standard price of 2½d. per unit. Subject to this the dividend is to be at a standard rate of 8 per cent.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LTD., has just issued an interesting catalogue giving its price lists in all the various branches of its work, with the exception of traction motors, electric cars, locomotive engines, railway carriages, omnibuses, etc., which are tabulated in separate catalogues. The catalogue illustrates and gives particulars of four different classes of manufacture: (1) Alternators, dynamos and motors; (2) universal steam engines; (3) steam alternators and steam dynamos; (4) electrical accessories. The first class describes the Mordey-Victoria alternators, Brush induction alternator, Brush series dynamos, universal two-pole and multipolar dynamos and motors and various types of alternating current single-phase motors. The second class gives particulars of its well-known universal steam engines, while the third describes a combination of the first and second class, or direct coupled units. The fourth class describes in detail Mordey-Victoria transformers, switches, fuses, lightning arresters, automatic regulators, Brush arc lamps for direct and alternating currents, carbons, incandescent lamps, etc. The catalogue is most carefully prepared and contains prices, out-puts, code words, approximate dimensions and weights, approximate efficiencies at various loads, and a mass of material of the greatest interest and use to all electrical engineers, who should all be in possession of a copy.

THE ROENTGEN SOCIETY.—At the ordinary monthly meeting recently an interesting paper was read by Mr. Isenthal on "The Progress of Radiography on the Continent," with special reference to the principle that differentiates Continental practice from that in this country. Continental radiographers were in some respects in advance of their fellow-workers in the United Kingdom, in that they used more powerful coils, with the result that they obtained a heavier discharge with a larger spark, and so were enabled to shorten the period of exposure. Out of a hundred public institutions on the Continent using the Roentgen rays, only three were satisfied with a 10-in. spark, seven used a 12-in., thirteen a 14-in., forty-five a 16-in., thirty a 20-in. and two a 24-in. spark. And on the Continent more attention was paid to the diagnosis of internal disease and injury than was the case in this country. Mr. Isenthal exhibited and described an ingenious form of reclining couch, never before shown in England. On this the patient is laid for examination. Two tubes below give a 12-in. spark, and the shadow of the organ to be examined is projected on a fluorescent screen. By means of a metal pen moving on an arm, it was also possible to make a tracing of the internal organ on a sheet of paper or on the body of the patient. The table was designed for use in cases of heart disease, but could be adapted for the examination of other organs, or to diagnosing diseases of and injuries to the bones.

ELECTRIC LIGHTING PRICES IN LONDON.—The City of London Electric Lighting Company (Limited) has given notice that as from the dates when the meter readings for the December quarter are taken, "and until further notice by public advertisement," the rates for electric energy supplied by the company for lighting purposes will be revised as follows: For the current consumed during March and December quarters, up to and inclusive of the first six units per 8-cp lamp (or its equivalent), 8d. (16 cents) per unit will be charged, and for all current consumed in excess of six units per 8-cp lamp, 2d. (4 cents) per unit will be charged; while for the current consumed during June and September quarters up to and inclusive of the first three units per 8-cp lamp (or its equivalent), 8d. per unit will be charged, and for all current consumed in excess of three units per 8-cp lamp, 2d. per unit will be charged. The necessity for revising the scale will be obvious when it is remembered that coal has advanced more than 100 per cent in price, and that during the year there has been an all-round increase in the price of materials. The consumers who will be chiefly affected are those known as the short hour consumers. Large users of electricity will scarcely feel the change. As a matter of fact, the company has felt that the short hour consumers should in some way bear at least a part of the expense they entail upon the company by being supplied at all. It does not pay the company to supply them, and this revision is made in order to lessen the expense. Motor prices—2½d. (5 cents) per unit—will remain the same.

General News.

THE TELEPHONE.

ST. CHARLES, MO.—A telephone rate war is on here between the Kinloch and Bell telephone companies.

PORTAGE, WIS—The Portage Telephone Company will construct a new line to Merrimack in the spring.

WARREN, OHIO.—The Central Union Telephone Company is putting up a new long distance line from Ashtabula through the local exchange to Williamsfield.

BRIGGSVILLE, WIS.—Kimball Bros. have their long distance telephone line from Portage in operation. There are now two separate lines running from Briggsville to Portage.

APPLETON, WIS.—The general offices of the Little Wolf River Telephone Company have been moved from Weyauwega to this city. Mr. F. H. Sweet has been elected secretary and treasurer.

RACINE, WIS.—The injunction cases of certain property owners against the Citizens' Telephone Company, restraining the company from erecting poles on their premises, have been discontinued.

CANTON, OHIO.—The Central Union Telephone Company is preparing for a hard fight with the newly organized Stark County Telephone Company. It has 1200 subscribers and to hold them has reduced rates from $24 to $18 per year.

KAUKAUNA, WIS.—The Fox River Valley Telephone Company has completed its line from this city to Little Chute, and two miles beyond, towards Appleton. The lines will be extended to Seymour, via Apple Creek and Layola.

MEXICO.—The Governor of the State of Tabasco has issued an order that the telephone line systems in that State shall be at once extended from Chontalpa del Paraiso to Ceiba and Dos Bacos, the last-named town being located on the seacoast.

MANKATO, MINN.—The directors of the Mankato Citizens Telephone Company have decided to increase the capital stock of the company to $100,000. They have for some time had under consideration the matter of outside extensions, and the increase of capital stock is preparatory to this work.

KNOXVILLE, TENN.—The Southern Telephone Company will apply for a charter, with capital stock of $25,000, to furnish supplies and construct exchanges for independent telephone companies. W. O. Rhode is president; Walter S. Roberts, vice-president, and Charles L. Myers, general manager.

SAN FRANCISCO, CALIF.—The Rogue River Valley Telephone Company was recently acquired by the Pacific States Telephone & Telegraph Company, which at once destroyed the telephones and took down the greater part of the competing lines. The line connected Grant's Pass, Medford and Ashland, Oregon.

CHARLOTTE, N. C.—The American Telephone Company of North Carolina has been incorporated under the laws of the State, with a capital stock of $25,000, which may be increased to $100,000. The incorporators are Edward J. Hall of New Jersey, A. B. Andrews of Raleigh, N. C., and their associates. The principal office will be at Raleigh, N. C.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has completed its new line between Wenatchee, Wash., and Leavenworth. A gap of forty-five miles is all that prevents direct telephonic communication across the Cascade Mountains between Spokane and Seattle. This gap, which lies between Leavenworth and Cle Elum, will be closed up next Spring.

SHEBOYGAN, WIS.—The Sheboygan County Telephone Company, which has nearly six hundred subscribers in this city, is to build a line to Cedarburg, Ozaukee County, touching Plymouth, Random Lake and other near-by towns. In the spring the company will have connection with the Eastern Wisconsin Telephone Company, which will extend its line to this city from Fond du Lac.

WAUSAU, WIS.—At the first annual meeting of the Marathon County Telephone Company reports showed that eighty miles of poles had been set and 160 miles of wire strung. The total cost of the system has been $11,514. Some of the lines have been in operation for two months, and others for a shorter time, yet the revenue to January was $178. This insures a profitable patronage.

NASHVILLE, TENN.—W. O. Rhodes and W. S. Roberts, of Knoxville, and C. L. Meyers, of Nashville, Tenn., are interested in the organization of the Southern Telephone Construction Company. These gentlemen were, until recently, connected with the Cumberland Bell Telephone Company. It is stated that they will build independent systems, having secured rights in all the Southern States and Mexico.

RICHMOND, VA.—The Southern Bell Telephone Company, which has been at war with the city for several years, has, as is reported, begun peace overtures by filing a petition with the city clerk, regretting the strained relations which have existed and seeking permission to use the streets of the city. The company promises, if privileges are granted, to install a fine plant. It is likely that the franchise will be granted. The ordinance favoring the company will probably be a severe one, though, and a bond for faithful performance of contract may be required.

YORKTOWN HEIGHTS, N. Y.—The Yorktown Telephone Company, the incorporation of which was recently noted in these columns, expects to begin operations in the spring. It will have about fifty subscribers. All franchises have been obtained, and all arrangements are completed for the building of the line next spring. Mr. E. B. Kear, of Yorktown Heights, is secretary of the company, Mr. James E. Rice, president; Charles I. Purdy, vice-president, and E. Munson Frost, treasurer.

ALBANY, N. Y.—The Atlantic Telephone Company, capital $5,000,000, has been incorporated to operate telephone, telegraph, telautograph, messenger-call service, stock quotation and other methods of communication in and about the cities of New York, Albany, Syracuse, Rochester, Buffalo, and to other points in the United States and the Dominion of Canada, or elsewhere. The directors are: William H. Stayton, of Yonkers; J. A. L. Campbell, C. B. Reed, A. B. Lafar and J. G. Shaw, of New York City; George H. Mann, of Brooklyn, and W. L. Sawyer, of Nyack.

MILWAUKEE, WIS.—The Badger State Long Distance Telephone Company, with main offices formerly at Evansville, Wis., has decided to move its headquarters to this city. At the meeting the following officers were elected: President, Ed. Reynolds Milwaukee; vice-president, W. D. Gray, Milwaukee, vice-president, A. S. Baker, Evansville; secretary, C. F. P. Pullen, Evansville; treasurer, George Pullen, Evansville. The company operates in Dane, Rock, Green, Lafayette, Jefferson, Walworth, and parts of other counties, taking in forty cities and villages and eighteen exchanges, has 300 miles of good poles and 400 miles of wire, and is still extending its business. It is one of the best equipped independent companies in the State.

MR. HENRY A. COIT, of St. Louis, who promoted the independent telephone plant at Terre Haute, Ind., has the work nearing completion. It promises to be one of the best equipped in the United States. The American Electric Telephone Company of Chicago is making all the apparatus. Mr. Coit does not expect to remain in Terre Haute definitely; in fact, now that all the matters and plans of his company are arranged, he has time to devote to new work and states that he has two large propositions in the West under consideration. Mr. Coit deserves considerable credit for the success of the Terre Haute plant. The franchise was granted in 1886 and since that date many attempts have been made to organize a local company and provide the funds, not only by Terre Haute people, but also by some prominent telephone men from other points. Mr. Coit took it up about a year ago and now the City Telephone Company is an assured fact and its plant almost completed.

ELECTRIC LIGHT AND POWER.

NORFOLK, VA.—The Board of Electrical Control has ordered all wires to be placed under ground at once.

MILWAUKEE, WIS.—The Phœnix Incandescent Light Company has increased its capital stock to $10,000.

LA CROSSE, WIS.—The city has under consideration the establishment in the near future of a municipal electric lighting plant.

BROOKLYN, N. Y.—The Brooklyn Bedstead & Bedding Company, T. McFarley, manager, will, it is said, put in a 500-hp electric power plant.

ST. LOUIS, MO.—The Magnetite Foundry Company is to put in a plant for electric light and power and will equip its crane with electric motors.

MENOMONEE FALLS, WIS.—The Wisconsin Sugar Company has intimated that it will offer to supply electric lights for village lighting.

CANFIELD, OHIO.—Charles Fowler, of this place, has been granted a franchise to build an electric light plant for city and private lighting.

SHREVE, OHIO.—Local citizens are organizing an electric light company, to be capitalized at $5,000. The greater part of the stock has been subscribed.

CELINA, OHIO.—C. Hanika & Sons' Architectural Iron Works are finishing their new factory and are in the market for machinery and electrical apparatus.

SPRINGFIELD, OHIO.—The Springfield Light & Power Company accepted the city's proposition to furnish 260 arc lamps at the rate of $73 per lamp per year.

MEMPHIS, TENN.—A private electric light plant will be installed in the new building of Colonel Napoleon Hill, for the erection of which bids are now being advertised.

KENDALLVILLE, IND.—The city council has appointed a committee to inquire into the advisability and feasibility of the city operating an incandescent light plant.

TWO RIVERS, WIS.—The council has granted a franchise to J. P. Miller & Company, of Chicago, for the installation of a combined system of electric lights and waterworks.

PLYMOUTH, IND.—The Plymouth Electric Light Company, capital $10,000, has been incorporated here. The directors are M. W. Simmons, E. B. Simmons and F. C. Simmons.

CATTLETTSBURG, KY.—The Carpenter Electric Light Company, of Cattlettsburg, has been fined $1,000 for failure to make proper reports to the State Auditor for the purposes of franchise assessment.

DEFIANCE, OHIO.—The stockholders of the Northern Ohio Electric Company have elected the following officers: Elias Bartholomew, president; G. L. McKibben, vice-president; H. C. Warren, secretary and treasurer.

MEMPHIS, TENN.—Hon. William M. Randolph is considering the installation of an isolated electric light plant in a large building in this city owned by him. The Memphis Light & Power Company is at present furnishing the current for this building.

BRANDON, MAN.—The Brandon Electric Company is establishing a long distance transmission system, and is erecting a plant at a water power ten miles distant from the town. The transmission will be carried out on the three-phase system at 10,000 volts.

CLEVELAND, OHIO.—The County Commissioners have voted for the erection of a lighting plant to furnish light for the county court houses, jail and soldiers' monument. It is estimated that the plant will cost $20,000. Propositions are being received.

PORTLAND, ORE., has suffered considerable inconvenience from lack of electricity for lighting and street railway purposes, owing to extreme high water in the Willamette River, which interfered with the operation of the Portland General Electric Company's power station.

WADSWORTH, OHIO.—W. E. Herwick, of Akron, and Garth A. Dodhe, of Talmadge, have secured a franchise to erect an electric light plant in this place. They will furnish lights for the streets as well as for private use. They are on the market for power house equipment.

LIMA, OHIO.—The city authorities have accepted the bid of the Lima Electric Railway & Light Company to furnish 180 arc lamps at the rate of $85 per lamp. The former figure was $89 per lamp. The company will overhaul the power house and install considerable new equipment

KNIGHTSTOWN, IND.—This city has become the owner of an electric light plant by purchasing the plant belonging to H. Watt & Company, for $2,500. The plant will be enlarged and improved by adding a commercial service and substituting arc lights for incandescents.

SAN FRANCISCO, CALIF.—The Woodland Gas & Electric Company was recently incorporated with Woodland, Calif., as the principal place of business. Directors, J. Martin, F. H. Pierson, R. U. Roeding, H. R. Noack of San Francisco, and J. Reith, Jr., of Woodland. Capital stock, $100,000.

CLEVELAND, OHIO.—The City Council has closed a contract with the Cleveland Electric Illuminating Company to furnish 892 arc lamps at the rate of $82.92 per lamp. In 1900 the city used 878 lamps and paid $87.60 per lamp. The Cleveland Electric Illuminating Company was the only bidder.

SAN FRANCISCO, CALIF.—The Sunset Electric Light & Power Company has been incorporated to carry on business in San Francisco. Directors, J. Magnin, M. H. Shoneburg, H. W. Hunsaker, B. Shariparo, S. S. Rau, W. W. Sanderson and H. N. Beatty of San Francisco. Capital stock, $200,000.

RICHMOND, IND.—A mass meeting was held in this city on Jan. 17 by business men, to protest against the construction of a municipal electric light plant here, to cost $143,000, the contract for which was awarded to the Varney Construction Company, of Indianapolis, by the council. The sentiment of the meeting was almost unanimous in condemnation of the award at such a high figure, and jobbery was charged. The fulfillment of the contract will be prevented if possible.

CHERUBUSCO, IND.—The Stecking Contracting Company of Chicago built a $25,000 electric plant and sold it to this city on the installment plan. The influential citizens who opposed unsuccessfully the purchase, retaliated by refusing to patronize the plant. It therefore became non-supporting and the first $1,000 bond is now due, with no money with which to meet it. The plant will pass again into the hands of the contractors, who will probably lease it to local parties to run it as a private enterprise.

CINCINNATI, OHIO.—Arrangements for substituting electric power on the Miami and Erie Canal in place of the mule, are progressing. Steel rails are being laid on the tow-path and trolley wires have already been strung a part of the distance. It is expected to have the system in operation between Cincinnati and Dayton, sixty-eight miles, within the year. The contract calls for the new system to be in operation in its entirety within six years. The Westinghouse company secured the contract for motors, aggregating a cost of $150,000. Thomas N. Fordyce, of Detroit, is in charge of the contract.

VINCENNES, IND.—The electric and gas light war has again assumed an interesting aspect. The attempt of the new electric light company to run out or cripple the Home Electric Company has proven futile, and, we are informed, a second mortgage amounting to $165,000 has been filed by the new company in favor of the Royal Trust Company of Chicago. To make matters more interesting, the Home Gas Company is in the war with 100-cp Welsbach burners, 333 hours, for 95 cents. The Home Electric Company, composed of residents, is paying no attention to the cut rate war and is extending its light service; also putting in new power apparatus.

THE ELECTRIC RAILWAY.

DEFIANCE, OHIO.—F. J. Frost, of this place, is at the head of a project to build an electric railway from Defiance to Antwerp.

GOLDSBORO, N. C.—There is some talk of a trolley or automobile line from Goldsboro to Seven Springs, a distance of 18 miles.

CLEVELAND, OHIO.—The Chagrin Falls & Eastern Electric Railway Company has increased its capital stock from $300,000 to $400,000.

COLUMBUS, OHIO.—The annual meeting of the Columbus Railway Company was held recently and the old board of directors was re-elected.

CHARLESTON, S. C.—Robert P. Evans, J. W. Simons and others are interested in a plan to build an electric railway from Charleston to Summerville.

WINDSOR, ONT.—A number of American capitalists, of Ypsilanti, Mich., propose building an electric railway from Windsor to Chatham. Mr. Joseph Webb is interested.

HAGERSTOWN, MD.—Surveys are being made for an extension of the Hagerstown Electric Railroad to Boonsboro, Md. The extension will be about 12 miles in length.

BELOIT, WIS.—T. F. Rowley, J. T. Barber and S. G. Moffatt, of Eau Claire, have asked this city for a franchise to build an electric street railway to cost about $75,000.

CONNEAUT, OHIO.—The Conneaut & Eastern Electric Railway Company has been incorporated, with $10,000 capital stock. It will build a road from Conneaut to Erie Pa.

CLEVELAND, OHIO.—The report of the Southern Ohio Traction Company for last year shows: Gross receipts, $294,907.44; operating expenses, $154,325.26; net receipts, $140,542.18.

EAST LIVERPOOL, OHIO.—The East Liverpool & Youngstown Railroad Company has been incorporated, with $15,000 temporary capital stock. The promoter is H. G. Folts, of Salem.

AKRON, OHIO.—The annual meeting of the stockholders of the Northern Ohio Traction Company will be held Feb. 9. Action will be taken upon a proposition to build a new line to Canton.

GEORGETOWN, OHIO.—John R. Moore, of this place, represents a company which is securing right of way for an electric railway to extend from Dayton to Aberdeen on the Ohio River.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon Electric Railway Company has closed a contract for 12 modern cars, each with a seating capacity of 50 people. The contract price was $84,000.

PARKERSBURG, W. VA.—The Williamstown Railroad, Bridge & Terminal Company has been incorporated. Among those interested are William R. Ryan, of Cleveland, Ohio, and Thomas F. Barrett, of Parkersburg.

DAYTON, OHIO.—The Dayton & Northeastern Traction Company, with $10,000 temporary capital stock, has been incorporated by Allen C. McDonald, Charles J. Hall, William Ammon, Horatio G. Cress and others.

BIRMINGHAM, ALA.—The Metropolitan Rapid Transit Company has applied for a franchise in this city. Mr. Eugene F. Enslen states that over $400,000 will be expended if the desired concessions are obtained.

RUSHVILLE, IND.—Announcement has been made here that all financial arrangements have been made, and the contracts will soon be awarded for the construction of the interurban line between this city and Indianapolis.

CLEVELAND, OHIO.—The last cable cars in Cleveland were withdrawn a few days ago from the Payne Avenue line of the Cleveland City Railway Company. At the same time the large addition to the company's power house was started up.

CLEVELAND, OHIO.—The Cleveland, Ashland & Mansfield Traction Company has been incorporated by S. T. Everett, Richard M. Parmeley, T. K. Dissette, E. J. Kennedy and C. V. Hard, all prominent local capitalists. Temporary capital stock, $10,000.

CLEVELAND, OHIO.—The annual statement of the Cleveland, Elyria & Western Electric Railway Company is as follows: Gross earnings, $179,697.68; operating expenses, $102,394.47; net earnings, $77,303.21; interest, $34,561.75; net to stock, $42,741.46.

SANDUSKY, OHIO.—The Sandusky & Interurban Electric Railway Company has amended its charter to permit the building of a line from Ceylon, through Berlin Heights, to Norwalk, and another from Oak Point, through North Amherst, to South Amherst.

SALEM, OHIO.—U. G. Smith, of Cleveland, is securing right of way for an electric railway from Salem to East Liverpool. This is a project distinct from the Salem, Lisbon & East Liverpool Railway, promoted by Eastern people, and previously mentioned in these columns.

TOLEDO, OHIO.—The charter of the Toledo & Western Electric Railway has been altered to permit the building of a branch line west from Sylvania passing through Metamora, Lyons, Morenci, Mich., Fayette, Alvordton, Pioneer and Northwest, which is near the Indiana State line.

JANESVILLE, WIS.—Articles have been filed incorporating the Rock River Electric Company, of Beloit, Wis. The capital stock is $50,000. A franchise has already been secured for an electric line from Belvidere to Rockford, and the Beloit-Rockford branch is an extension.

MARION, OHIO.—The promoters of the Marion, Green Camp, Prospect & Richwood Electric Railway announce that all of the right of way has been secured and that the line will be completed to Prospect by next summer. A park and summer resort and the power house will be located at Prospect.

INDIANAPOLIS, IND.—Regular hourly traffic on the interurban electric line of the Union Traction Company between this city and Anderson began recently. The first trip made over the new road was with a train of four cars, loaded with 150 invited guests, officials and newspaper men.

ADRIAN, MICH.—The stockholders of the Toledo, Adrian & Jackson Electric Railway Company held their annual meeting a few days ago and elected the following officers: Judge C. M. Stone, Cleveland, president; A. P. Southworth, Adrian, secretary. It is believed that cars will be running from Toledo to Adrian by July 1.

YARMOUTH, N. S.—A company has been formed at Yarmouth, N. S., for the purpose of constructing a street railway from Yarmouth to Port Maitland, a distance of twelve miles. The company is capitalized at $250,000. The incorporators are: B. B. Law, James Burrill, John Killam, E. K. Spinney and George Bingay, all of Yarmouth.

YOUNGSTOWN, OHIO.—The stock of the Youngstown-Sharon Railway & Light Company to the amount of $1,987,000 was issued a few days ago. The remainder of the capitalization of $2,000,000 will be issued as soon as the old stock of the consolidated companies is turned in. The companies in the syndicate will retain their separate identities.

MECHANICSBURG, OHIO.—Local business men say there is an excellent opening for an electric railway to run from Springfield to Marysville, and possibly Delaware, passing through Mechanicsburg, Irwin, Milford Center and other towns. Such a road would traverse a rich farming district and connect with several large manufacturing establishments.

CLEVELAND, OHIO.—The Western Ohio Railway Company, which is building a road from Lima to St. Marys, has closed a contract with the Westinghouse Electric & Manufacturing Company for two 400-kw railway generators, operating at 400 volts and 100 r. p. m., and three 200-kw three-phase rotary converters. The engines and boilers have not yet been contracted for.

AKRON, OHIO.—As a result of the purchase of the lines of the Akron & Cuyahoga Falls Rapid Transit Company the stockholders of the Northern Ohio Traction Company have decided to increase the capital stock from $2,000,000 to $2,500,000. The new road to Barberton will be extended to Canton and perhaps to Massillon, while the line to Kent will be extended to Ravenna.

FORT WAYNE, IND.—The Fort Wayne & Southwestern Railway Company has been incorporated and will build a trolley line along the old Miami and Erie Canal from Fort Wayne to Huntington. The incorporators are George Edison and Will Reed, Chicago; Fred Morehouse, Detroit; Chas. Miller, Wm. Moran and M. D. Doughman, Fort Wayne, Ind. The capital stock is $600,000.

CINCINNATI, OHIO.—The electric railway from Cincinnati to Dayton is assuming tangible form. The company will be known as the Cincinnati, Lebanon & Dayton Traction Company and the promoters are James B. Swing, C. A. Bosworth, Albert McCullough, Tilden R. French, L. C. Black and Harry E. Langdon of Cincinnati, S. Probasco and C. A. Hough of Lebanon, and several Dayton people.

AKRON, OHIO.—The lines of the Akron & Cuyahoga Falls Rapid Transit Company, which were sold about a month ago to an Eastern syndicate headed by Andrew Radel, of Newark, N. J., have passed into the hands of the Northern Ohio Traction Company, of which Henry Everett, of Cleveland, is president. The consideration is said to have been in excess of $500,000, the price paid by the Eastern people.

CLEVELAND, OHIO.—At the annual meeting of the stockholders of the Lorain & Cleveland Electric Railway Company, held a few days ago, the old directors were re-elected. It was decided to increase the capital stock from $700,000 to $1,000,000 and to spend $300,000 on improvements. New equipment will be installed in the power house, the entire road is to be double tracked and the roadbed greatly improved.

GALVESTON, TEXAS.—The Galveston City Railway Company has filed a mortgage on the company's property to secure the holders of a $600,000 issue of 40-year 5 per cent bonds. The Guaranty Trust Company, of New York, is named as trustee for the bondholders. This money is for rebuilding the power house, reconstructing the electric lines destroyed by the storm, and a complete restoration and improvement of the property.

INDIANAPOLIS, IND.—The Board of Public Works and the several interurban railway companies whose lines center in the city have at last agreed upon a franchise contract. It is as follows: Straight five-cent fares may be charged by the interurban companies; no transfers are to be issued or received; two cents a trip for each car is to be paid to the city for the first ten years and three cents a trip for the remaining twenty-two years.

EAST LIVERPOOL, OHIO.—The United Power Company, of this city, has been incorporated with a capital stock of $900,000 to build and operate electric railways and to sell electricity. The incorporators were Louis H. Healy, Jason H. Brooks, George O. Anderson, William F. Halstead and Louis D. Water. The new company is said to be a reorganization of the East Liverpool Street Railway Company and the Ceramic City Light Company.

ASHTABULA, OHIO.—The Pennsylvania & Ohio Electric Railway has placed a contract with the Westinghouse Electric & Manufacturing Company for the electrical equipment for its power house at this point. The installation will consist of three three-phase 375-kw generators, 400 volts, 100 r. p. m., 25 cycles, with exciters and switchboard apparatus. Also 1 200-kw three-phase rotary converter. Engines and boilers have not yet been contracted for.

CINCINNATI, OHIO.—It is stated that the Whitney-Elkins-Widener syndicate, which is about to lease the Cincinnati Street Railway Company's system, will also secure control of the Mill Creek Valley Street Railway Company's lines. The Company is owned largely by Charles Kilgour and H. H. Hoffman and has a capital stock of $1,750,000. The company is at present extending its road from Carthage to Glendale, and proposes to extend to Hamilton in the near future.

CANTON, OHIO.—The stockholders of the Canton-Akron Electric Railway Company have elected the following directors: T. L. Childs and J. A. Kobler of Akron, W. H. Hoover of New Berlin, John C. Welty and Charles A. Kolp of Canton. The company will not use the Canton Street Railway Company's line into Canton, but will build an independent track. An independent line will also be built into Akron unless traffic arrangements can be made with the Northern Ohio Traction Company.

COLUMBUS, OHIO.—The Market Street Railroad Company has been incorporated with $10,000 capital stock by S. B. Hartman, O. A. Schenck, Louis Seidensticker, W. H. Luchtenberg and Ben Monnett. S. B. Hartman is president, Ben Monnett vice-president, O. A. Schenck secretary-treasurer. The company has asked for franchises on two routes through Columbus and proposes to build a road to Lancaster and another to Portsmouth, passing through Chillicothe, Circleville, Waverly and other towns.

SPRINGFIELD, OHIO.—At a meeting of the stockholders of the Miami Traction Company, held a few days ago, the following officers were elected: John P. Martin, Springfield, president; W. H. Marlatt, Cleveland, vice-president; Charles Orr, Cleveland, treasurer; S. J. Fitzsimmons, Detroit, secretary and assistant treasurer. The road will extend from Springfield to Cincinnati and will be 75 miles long. The third-rail system will be used. The company has increased its capital stock from $50,000 to $550,000.

MANCHESTER, N. H.—Eugene S. Whitney and Albert Merrill, have, in company with Portland, Me., capitalists, purchased the water power privilege at Bonny Eagle Falls, in the towns of Standish and Hollis, Me. The privilege is one of 7000 hp, and will be utilized as a power plant for supplying electricity for an electric railway which is contemplated between Saco and Steep Falls. The road will be 20 miles in length, and the entire enterprise represents an outlay of $500,000. The Maine Legislature is to be petitioned to grant a charter for the road.

SCRANTON, PA.—A concurrent resolution has been adopted by the Councils directing the Scranton Railway Company to issue transfer tickets to all connecting and intersecting lines owned and operated by the company. If the company refuses to issue these transfers, the City Solicitor is instructed to declare forfeited all franchises enjoyed by the Street Railway Company. The resolution has received the Mayor's signature. The Street Railway Company will oppose the ordinance and a legal battle is expected.

CLEVELAND, OHIO.—At the annual meeting of the stockholders of the Cleveland, Elyria & Western Electric Railway Company, held a few days ago, the following officials were elected: Directors—A. H. Pomeroy, E. A. Akins, M. A. Sprague, M. J. Mandelbaum, L. M. Coe, F. L. Fuller, S. C. Smith, Will Christy, E. S. Schneider, F. T. Pomeroy. Officers—A. H. Pomeroy, president; E. A. Akins, vice-president; E. S. Schneider, secretary; F. T. Pomeroy, treasurer and general manager. A dividend of three-fourths of 1 per cent. was declared. The company is planning an extension from Berea to Medina, and thence to Wooster, and another from Oberlin to Norwalk. The new power house at Elyria will soon be placed in full operation and the old power house at that place is to be enlarged.

THE AUTOMOBILE.

THE ROBINSON MOTOR & VEHICLE COMPANY, of New York, has been incorporated in Delaware. Capital, $100,000.

AN AUTOMOBILE SERVICE will soon be established to connect with the F M. Smith line of steamers at Alviso, Calif., on the arrival of the San Francisco boats. The run to San Jose, nine miles distant, will be made in one hour.

THE STANDARD MOTOR VEHICLE COMPANY has been organized in San Francisco, Calif., with a capitalization of $30,000, by Sol. D. Rogers, Henry A. Brown, A. E. Brooke-Ridley, Wilson H. Sigourney and Henry C. Barrow.

AUTOMOBILE EXHIBITION IN PHILADELPHIA.—An automobile show will be held at the Second Regiment Armory in Philadelphia Feb. 4 to 9, inclusive. There is promise of a large display of automobiles of all classes by all of the well-known manufacturers. The Pennsylvania Automobile Club and the Automobile Club of Philadelphia are taking an active interest in the event.

MORRISTOWN, N. J.—In view of the fact that the New Jersey Traction Company has met with such a decided check in its efforts to secure the necessary right of way through Madison to Morristown for its loop from Newark to this city, Mayor Norman L. Fox and other prominent citizens of this place are inquiring into the cost of conducting an automobile line between the two places.

NEW INDUSTRIAL COMPANIES.

THE GENERAL ENGINEERING AND CONSTRUCTION COMPANY, of New York City, has been incorporated. Capital, $55,000. Directors, H. W. Ludlam, Bayonne, N. J.; H. K. Boch and H. W. Showers, New York City.

THE RICHMONDT ELECTRIC WIRE CONDUIT COMPANY, Milwaukee, Wis., has filed articles of incorporation. The object of the company is to manufacture wire conduit tubing and electrical supplies generally. The capital stock is placed at $50,000, and the incorporators are Daniel E. Murphy, C. D. Richmondt and D. Hayes Murphy.

LEGAL.

FRANCHISES IN OHIO.—The Supreme Court of Ohio has reversed its decision made some weeks ago to the effect that franchises granted by the Probate Court are unconstitutional for the reason that it gave legislative powers to a judicial officer. The question was found to have wide application, for the reason that many corporations were operating in the cities of the State under franchises secured from the Probate Court. In deciding the case of the city of Zanesville vs. the Zanesville Telephone & Telegraph Company, the Court took occasion in an indirect way to declare that it is illegal for a city to exact compensation for the use of its streets by a corporation securing a franchise. The decision is attracting considerable attention in all parts of the State, and there is a controversy as to whether it applies to franchises granted for street railway purposes.

DEATH FROM SHOCK.—Edward A. Twist, 19 years old, while crossing Mount Hope Avenue, in Rochester, N. Y., upon a dark evening, encountered a broken wire, hung within 4 ft. of the ground, and was instantly killed. His father, Charles Twist, as administrator, in a suit against the city of Rochester, impleaded with the Rochester Gas & Electric Company, has secured an affirmance by the Court of Appeals of a judgment in his favor on a verdict for $5,000. Poles were maintained on this avenue by the Rochester Gas & Electric Company, on which wires were strung diagonally from one side to the other under a contract with the city by which the latter reserved the right to use one arm upon such poles "for any and all municipal purposes, and the placing of any and all telegraph, electric, or other wires owned or used by it," and to change or remove the poles where the public safety or convenience demanded it. After the erection of the poles the city authorized the Rochester Railroad Company to install the trolley system upon the avenue, the contract providing that the company should place guard wires to prevent the trolley wire coming into contact with electric, telephone or other wires. More than a year before the city had abandoned the patrol line for which its wire was used and had left the wire disconnected and broken. Although the act of an employee of the railroad company in pulling down the wire was doubtless a concurring cause of the accident, it could not be contended, the Court said, that the negligence of the city was not the proximate cause, as, had the patrol wire not fallen upon the trolley wire, the accident would not have occurred.

OBITUARY.

MRS. R. W. POPE.—Mrs. Ruth Emma Whiting Pope, the wife of Ralph W. Pope, who is the secretary of the American Institute of Electrical Engineers, died at her home in Elizabeth, N. J., on Jan. 27, after an illness of several weeks. Mrs. Pope was a native of Great Barrington, Mass., and was widely known in electrical circles, in which great sympathy for her esteemed husband is felt in his deep affliction.

PERSONAL.

MR. J. H. WHITAKER was recently appointed as the City Electrician of Tacoma, Wash.

MR. J. C. LOTT will hereafter represent the Fort Wayne Electric Works in this city. He will have his headquarters at 40 New Street.

MR. EDWARD A. EVANS, general manager and chief engineer of the Quebec Railway, Light & Power Company, of Quebec, Canada, is at present visiting New York.

MR. F. A. WUNDER, who is well known in the electrical field, will open an office this week at 95 Liberty Street as general sales agent for the Ball Electric Company of New York City.

MR. ISAAC L. RICE, who is so prominently identified with the development of electrical enterprises of various kinds, has returned from Europe after a very interesting and successful trip.

MR. E. L. SIMPSON, an English electrical engineer who has been doing considerable electrical work in British Guiana for the Demerara Electric Company, has spent a few days in this city en route for England.

MR. GEORGE MATT, general manager and secretary of the Lancaster, Ohio, Electric Light Company, and the Lancaster Gas, Light & Coke Company, has resigned. He is succeeded by his son, Edward Matt.

MR. S. Z. MITCHELL, the manager of the Portland (Ore.) office of the General Electric Company, is visiting New York City again. Such trips come at rare intervals, Mr. Mitchell having been wonderfully active in the electrical development of the Pacific Coast for a decade and more. He speaks most hopefully of the outlook in his field.

MR. H. C. HAWKS, general manager of the Wheeler Reflector Company, of Boston, Mass., was in New York this week. Mr. Hawks says this company is enjoying a very good business this season in its entire line. Its desk fixtures and its street lighting fixtures are proving very popular and have been in better demand this year than ever before.

MR. THOMAS SCOTT is paying a visit to the United States in the interest of Messrs. Macartney, McElroy & Company, Ltd., of England. This company recently secured the contract for equipping the street railway system about to be built at Durban, South Africa. Mr. Scott's visit is made in connection with this work, which he is going to South Africa to superintend.

MR. J. W. PETERSON, who has for some time been identified with Mr. J. Holt Gates, of Chicago, has associated himself with the Chicago office of the Northern Electrical Manufacturing Company and the Stanley Electric Manufacturing Company, and will hereafter direct his well-known zeal and energy toward selling the apparatus of these two companies. Mr. Peterson enjoys an extensive acquaintance with Western manufacturers, and no doubt will now have the opportunity of adding largely to his reputation as a selling engineer.

EDUCATIONAL.

LECTURES ON ELECTRO-CHEMISTRY.—A special course of lectures on electro-chemistry will be given at the Corcoran Scientific School, Columbian University, New York, by N. Monroe Hopkins during the second half-year, beginning Feb. 1. The lectures will treat of the use of electric energy in analytical and synthetical operations in the laboratory and in the arts.

PURDUE UNIVERSITY.—The annual reports of the president and other officers of Purdue University, Lafayette, Ind., for 1899-1900, are given in a 40-page pamphlet of recent issue. Reference is made in the report to the extensive tests made by Prof. W. E. Goldsborough relating to arc light photometry, their purpose being to develop methods for and to conduct actual tests of commercial arc lamps.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—*The Popular Science Monthly*, for July, 1900, contained an article by Prof. G. F. Swain, entitled "Technical Education at the Massachusetts Institute of Technology." This article, which is illustrated by views of the various buildings of the institute, the different laboratories, and portraits of the past presidents and President-elect Pritchett, has been reprinted in pamphlet form.

UNIVERSITY OF VERMONT.—The catalogue of the University of Vermont for 1900-1901 contains 128 pages. The usual information regarding the institution, the course of instruction, etc., is given, together with the list of students. A course of electrical engineering is given at this university, Mr. W. H. Freedman being in charge of this department. The electrical engineering department is well equipped with leading standard electrical instruments and machines.

Trade Notes.

HOLOPHANE GLASS.—The Holophane Glass Company, New York, has just issued a price list of holophane glass.

THE RICE & BALDWIN ELECTRIC COMPANY has been incorporated in Hartford, Conn., to deal in electrical supplies.

RECEIVER APPOINTED.—A receiver has been appointed for the Automatic Telephone Exchange Company (Ltd.), Baltimore, Md.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has recently built a 1500-ampere 60-volt generator for the Niagara Electro Chemical Company, Buffalo.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has sold to the Armour Company, Chicago, a number of small motors to be installed in the latter company's plant.

THE AMERICAN ELECTRIC COMPANY, Detroit, Mich., has passed into the hands of Mr. William J. Hartwig, who is now sole proprietor of the business, Mr. Archibald Miller having retired from the firm.

THE CONANT RAIL JOINT testing instrument is now handled by the Albert & J. M. Anderson Manufacturing Company, of Boston, for the foreign markets. They report export orders for these instruments coming in freely.

THE JANTZ & LEIST ELECTRIC COMPANY, Cincinnati, Ohio, reports an extraordinary demand for medium-sized machines running from 50 to 60 kilowatts, principally for commercial lighting. Ohio, Kentucky and Indiana seem to be the most fruitful field.

THE HAZARD COMPANY of Wilkesbarre, Pa., has issued to its friends and patrons a very charming calendar in four sheets, in colors, with American Indian studies by Burbank. The studies of aboriginal types in feathers and war paint are exceedingly well done.

THE CONNECTICUT ELECTRICAL COMPANY, of New Haven, Conn., capital $10,000, has assigned, with J. T. Manson as trustee. Mr. A. B. Underwood, of Bridgeport, is president, and E. B. Underwood, of New Haven, treasurer. It makes small electrical supplies.

THE NATIONAL DISTILLING COMPANY, of Milwaukee, Wis., has contracted for one 75-kw Sprague belted generator and motors aggregating 50 horse-power for its works. The company will start on a small scale to replace the mechanical transmission by electricity.

THE JONES BROTHERS ELECTRIC COMPANY, Cincinnati, has placed a contract with the Westinghouse Electric & Manufacturing Company for an additional 250-kw engine type generator. The new machine is to accommodate the increasing demand for power at the Jones Bros.' plant.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Norwood (Cincinnati), a few days ago entertained its agents and salesmen from all parts of the world. A series of entertainments were provided both at the works and in the city. The gentlemen visited other manufactories and were given a hearty reception.

BELT TYPE MACHINES.—Small multipolar sizes of belt type machines form the subject of Bulletin No. 10 issued by the Crocker-Wheeler Company, Ampere, N. J. The bulletin is illustrated with a view of one of this type of machines, and views of various machine tools and a printing-press driven by Crocker-Wheeler motors.

THE LAWTON-BEATTIE COMPANY, Cincinnati, Ohio, has just installed in the big carriage plant of the Sayers & Scoville Company a complete electric service. A point worthy of notice in this connection is that nearly every carriage plant in this, the greatest carriage manufacturing centre of the United States, is equipped throughout electrically.

GAS AND GASOLINE ENGINES.—The New Era Iron Works Company, Dayton, Ohio, has issued a pamphlet on the subject of its gas and gasoline engines. These types of engines are described and very fully illustrated. They are particularly adapted for electric lighting. Such a plant is easily installed and requires little attention.

"DRAFT WITHOUT A CHIMNEY" is the title of an interesting little booklet of which the fourth edition has just been issued by the B. F. Sturtevant Company, Boston, Mass. This brings the total number of copies printed up to 50,000. It relates to the experience of the Sturtevant Company in the use of a fan to produce draft without a chimney in its own works. Copies will be furnished on application.

THE NEW YORK INSULATED WIRE COMPANY has just issued price list No. 21 of its telephones, telegraph and electric light wires and cables, electric railway feeders, insulating tapes and compounds. The pamphlet also gives a good deal of information bearing on the general subject of wires, such as an abstract from the rules of the National Board of Fire Underwriters, wire tables, telegraph code, etc.

THE ELECTRIC BATTERY RENEWING COMPANY, 1604 North Broadway, St. Louis, Mo., has an electro-chemical process of treating old battery carbons in such a manner that all salts and impurities are extracted, leaving the carbon in a condition which, it says, is "better than when new." The company claims that carbons, after being treated by its process, will show a higher voltage and longer life than when new.

THE MENOMINEE SUBMERGED ELECTRIC MOTOR COMPANY, of Menominee, Mich., capitalized for $100,000, has satisfactorily completed its preliminary experimental work, and is now ready to proceed to manufacturing. A suitable factory is being fitted up. The stockholders are mostly Menominee men, and include Senator J. H. Stout as president and John Hopwood as secretary and treasurer. The company hopes to be able to send a creditable exhibit of its machine to the Pan-American Exposition.

DEDION MOTORETTES.—Two interesting little stories about a 1600-mile trip over American roads and a thousand-mile tour of Great Britain are given in an artistic booklet just issued by the DeDion-Bouton Motorette Company, Brooklyn-New York. The stories are illustrated by views of the different styles of DeDion vehicles, and a map shows the route taken through England. The get-up of the booklet is particularly attractive and artistic, the cover being of unique design and highly calendered paper being used inside.

THE CINCINNATI MILLING MACHINE COMPANY has received an order from a prominent concern in France for a number of its cutter grinders. This company is one of phenomenal growth, its machines being recognized all the world over as leaders in their line. Business among the electrical manufacturers has increased considerably during the past year or two, and wherever its milling machines have been installed the manufacturers have expressed great satisfaction. Its methods of doing business are as satisfactory as its machines.

THE CUTTER COMPANY, Nineteenth and Hamilton Streets, Philadelphia, Pa., has sent us a calendar presenting a side and front view of its I-T-E edgewise circuit breaker for railway work, the nickled, copper, brass and insulated parts of which are printed respectively in aluminum, bronze, gilt and black ink upon a red card. The illustration gives one a good idea of the appearance of this special type of circuit breaker, and enables one to more clearly understand the points of merit enumerated on the back of the calendar.

INSULATING PAINT.—Messrs. Hubbard, Hall & Company, 213 West Fourth Street, Cincinnati, Ohio, are the sole manufacturers of O. K. insulating paint. It is stated that this paint meets every requirement of a first-class insulating paint for electrical uses, and is especially adapted for painting field coils, armatures, dynamo and motor bases, mouldings, cut-out boxes, lamp frames, underground cables, storage battery racks and terminals, iron and wooden poles, cross-arms, etc. This paint is recommended for a great variety of uses besides those mentioned.

CARBON BRUSHES FOR RAILWAY MOTORS.—The Quebec Railway, Light & Power Company, Quebec, Canada, has made some exhaustive tests of Le Valley Vitae carbon brushes, which tests show that this brush possesses superior merits. A very large saving per car per year, it is claimed, can be effected by the use of this brush, the economy being based simply on the saving to commutators. Over 150 street railways in the United States and Canada are using this brush exclusively, as are also many of the largest electrical concerns in the country. These brushes do not cut the commutator and the wear is almost imperceptible.

GENERAL ELECTRIC LITERATURE.—Recent literature of the General Electric Company includes five bulletins, as follows: No. 4233, "Rotary Converters for Railway Systems"; No. 4234, "Type H Subway Transformers"; No. 4235, "Polyphase Transmissions for Electric Railways"; No. 4236, "Direct-Connected Railway Generators"; No. 4237, "The GE73 Railway Motor." Also leaflets on interchangeable arc lamps, combined socket and attaching plug, flush pocket snap switch and pendant push button switches. A price list of the principal renewal parts for direct current enclosed arc lamps has also been issued.

THE CAPITAL ELECTRIC COMPANY, Denver, Colo., is manufacturer of the Hall incandescent lamps and is having a great demand for them. Situated as it is in the western part of the country, it is very natural that buyers in the West and Northwest and Southwest should feel like patronizing a "home" industry, to say nothing of the fact that the nearer the source of supply the quicker the goods are received after ordering. The business of the Capital Electric Company extends as far west as Honolulu and as far south as Mexico, including the country in between, and the demands from these remote points are convincing evidence of the value of the Hall lamp.

MR. J. J. REIDY, New Haven, Conn., informs us that the following named firms have on hand a stock of the Donnelly improved climbers: National Electrical Supply Company, Washington, D. C.; James McGraw, Richmond, Va.; Tower-Binford Electric & Manufacturing Company, Richmond, Va.; Watkins-Cottrell Company, Richmond, Va.; Richmond Hardware Company, Richmond, Va.; Edward Lovell's Sons, Savannah, Ga.; Carter & Gillespie Electric Company, Atlanta, Ga.; A. Baldwin & Co., New Orleans, La.; Electric Gas Lighting Company, Boston, Mass.; Pettingell-Andrews Company, Boston, Mass.; Belcher & Loomis Hardware Company, Providence, R. I.; Charles K. Reed, Worcester, Mass.; Edwards & Walker Company, Portland, Me., and John B. Varick Company, Manchester, N. H.

COAL HANDLING AND CONVEYING MACHINERY.—The problem of conveying and handling coal, ashes, etc., in steam-generating and other industrial plants is always an important one, and the modern machinery used in this work has reached a high degree of perfection and economy. The apparatus employed in the mechanical methods of handling and conveying coal, coke, ashes, ore, and similar materials, manufactured by the Steel Cable Engineering Company, 92 State Street, Boston, Mass., is very fully and clearly described and illustrated in a handsomely designed catalogue just issued by this company. The construction of the apparatus is clearly set forth, and its practical applications are illustrated by views of various installations. The illustrations are very artistically executed, and show in a very clear manner the details and operation of this system.

PROVIDENCE, R. I.—The street floor and basement, corner of Weybosset and Flint Streets, Providence, R. I., are to be occupied by the Union Hardware & Electric Supply Company, for the incorporation of which articles of association have been filed at the State House. The incorporators have all for some time been employed as clerks or otherwise connected with the well-known Belcher & Loomis Hardware Company. They are William H. Angell of Swansea, Clarence S. Angell of Barrington, Howard L. Perkins of Cranston and William L. Adams, Charles E. Dudley and Frederick S. Clark of Providence. The charter states that the corporation is formed for the purpose of engaging in the business of selling and otherwise disposing of hardware and other kinds of merchandise. The capital stock is stated at $100,000, consisting of 500 shares of preferred stock and 500 common of the par value of $100 a share. The electrical part of the business will be in the hands of Mr. W. L. Adams, who has had ten years' experience in that line.

MR. ALEXANDER HENDERSON, who is in charge of the conduit department of the Sprague Electric Company, New York, says that the Greenfield flexible conduit has gone to the front with great strides. Its endorsement by the Board of Underwriters two years or more ago, coupled with the excellent service it has given wherever it has been installed in any class of building, has served to make it recognized most favorably in interior wiring. The sales were much larger last year than could have been expected, being at least three times greater than the sales of the preceding year. The Sprague Company has had to build new machinery to take care of the immense business Mr. Henderson is building up for it in this department, especially for the armored conductors, both the flexible conduit and the conductors having been recognized by the United States Government as a decided advance in the art of electric wiring, and the various responsible officials are now using them in Washington in the new Government printing offices and at several of the large navy yards.

ELECTRICITY ON THE STEAMSHIP "VADERLAND."—The new twin-screw Red Star steamship "Vaderland" is lighted throughout by electricity, the installation being fitted by the builders, as is also a complete system of electric bells. The generating plant is situated in a large room, convenient of access from the engine room, and consists of four dynamos driven by engines built by the B. F. Sturtevant Company, of Boston. The system of artificial ventilation is also by the Sturtevant Company, and is similar to the systems installed on the "St. Louis" and "St. Paul." Powerful fans exhaust the air from every room and compartment, and fresh air is drawn from the bridge deck and distributed throughout the passenger accommodations. Fresh air is thus constantly supplied, and in cold weather this air is heated by passing over steam pipes, and the heat supplied may be regulated for each deck independently. The Ellis & Eaves system of induced draft is fitted to the boilers. The fans are eight in number, and 7 ft. 6 ins. in diameter, and are driven direct by Sturtevant direct-acting engines. These fans, situated directly under the funnels, induce a draft through the furnaces, the air having previously been heated by passing through tubes placed in the way of the waste gases from the furnaces.

THE GREGORY ELECTRIC COMPANY, Chicago, has received within thirty days some large shipments of transformers, aggregating several hundred thousand lights in capacity. The shipments of this company in its transformer department are more than double the shipments of a year ago. Among its recent shipments of generators are the following: To the Malvern, Iowa, Light & Power Company, one 60-kw 500-volt and two 30-kw 110-volt Edison dynamos; Williamsport, Ind., one 60-kw General Electric alternator; Kankakee, Ill., Electric Light & Power Company, one 120-kw Westinghouse alternator; one 75-kw 550-volt Westinghouse generator to the City Railway Company, of La Salle, Ill.; one 60-kw Thomson-Houston alternator to the Virginia, Minn., Water & Light Company; one 35-kw Siemens & Halske 250-volt generator to the Rico, Colo., Light & Power Company; one 100-kw General Electric generator to the Aurora, Ill., Gas Light & Power Company; one 100-kw Thomson-Houston generator to the Oelwein, Ia., Electric Light Company; one 45-kw Edison generator to Ozier & Hardeman, Henderson, Tenn.; one 150-kw Detroit 500-volt generator to the Archer Starch Company, Chicago; one 75-kw Wood alternator, City of Sheridan, Ind.; two 80-light Standard arc machines to the Capitol Electric Company, Springfield, Ill. In addition to the above many shipments were made of smaller motors and dynamos.

Record of Electrical Patents

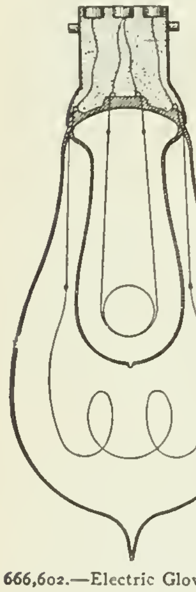
UNITED STATES PATENTS ISSUED JANUARY 22, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

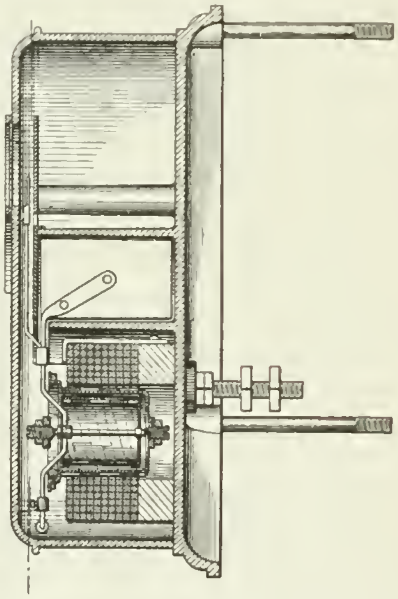
666,255. ELECTRIC SWITCH AND RESISTANCE; C. W. Atkinson, Cardiff, England. App. filed June 2, 1900. A magnetic controller is adapted to automatically prevent the switching on of the current to the motor until the field magnets of the motor are energized.

666,258. ELECTRIC TRACTION; R. Brown, Birmingham, England. App. filed Aug. 21, 1900. The collector consists of a flexible conductor hanging between posts below the car, and entering the slot of the conduit to pass over contacts therein.

666,262. PROCESS OF MAKING PAINT; C. G. Collins, New York, N. Y. App. filed May 10, 1897.



666,602.—Electric Glow Lamp.



666,454.—Electrical Measuring Instrument.

666,271. COLUMN PRINTING TELEGRAPHIC INSTRUMENT; F. H. W. Higgins, London, England. App. filed Dec. 10, 1899. The instrument is rendered sensitive for supplying power at the instrument itself for operating the printing frame, the traversing mechanism, and the paper feed, by using a spring, or a local battery, called into operation by the signalling current from the main line.

666,302. PROCESS OF MAKING PAINT; C. G. Collins, New York, N. Y. App. filed April 12, 1900.

666,303. STORAGE BATTERY TRANSFER CAR; G. H. Condict, New York, N. Y. App. filed Sept. 3, 1898. The battery is attached to the car by means of hangers and is lifted into position by an elevator on a traveling truck located in a pit.

666,306. ELECTRIC RAILWAY; J. W. Ehlers, Hamburg, Germany. App. filed Dec. 19, 1899. An insulating bed for the conductor is formed in the track rail.

666,315. METHOD OF CONSTRUCTION OF ELECTRIC MOTORS; F. A. Johnson, Binghamton, N. Y. App. filed Aug. 30, 1900. The speed is regulated by means of a hollow field magnet core into which a body of iron is adjusted to vary the resistance of the magnetic circuit.

666,329. LIGHTNING ARRESTER; C. A. Rolfe, Chicago, Ill. App. filed July 13, 1899. A lightning arrester provided with carbon blocks, arranged so as to have opposing adjacent faces, and having these faces coated with a permanent adhesive insulating material.

666,335. HAND LIGHTING ACETYLENE GAS BURNER; H. C. Thomson, Boston, Mass. App. filed April 13, 1900. Details.

666,381. ILLUMINATED CLOCK; R. R. Gareau, Detroit, Mich. App. filed Dec. 18, 1899. A lamp and reflector are supported in front of the clock face so that the light is concentrated in a circular beam upon the dial.

666,387. APPARATUS FOR PRODUCING ALKALI, ELECTRICITY AND HYDROGEN FROM ALKALI-METAL AMALGAM; J. W. Kynaston, Liverpool, Eng. App. filed Dec. 5, 1899.

666,403. RAIL BOND; M. M. Wood, Chicago, Ill. App. filed Nov. 22, 1900. The end of the bond is held in an opening in the rail by an internally expanding plug.

666,418. ELECTRIC CAR HEATER; E. E. Gold, New York, N. Y. App. filed Aug. 1, 1900. A corrugated metal casing inclosing the heater.

666,431. ELECTRO-THERAPEUTIC APPARATUS; J. S. Mead, Buffalo, N. Y. App. filed Aug. 25, 1900. Details.

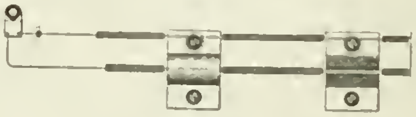
666,444. TELEPHONE EXCHANGE CENTRAL STATION SWITCHBOARD APPARATUS; G. K. Thompson, Malden, Mass., and E. C. Robes, Medford, Mass. App. filed Feb. 13, 1900. (See Current News and Notes.)

666,451. HIGH AND LOW WATER ALARM; C. E. Zimmermann, Syracuse, N. Y. App. filed April 6, 1900. A cylinder connected with the boiler and having contact at each end is provided with a float which runs on a guiding rod, and makes contact above and below in accordance with the movement of the water line.

666,454. ELECTRICAL MEASURING INSTRUMENT; H. P. Ball, New York, N. Y. App. filed June 12, 1900. Two spirally disposed members, one movable and the other fixed, are arranged to be cut by lines of force; the movable member indicates.

666,457. PRIVACY DEVICE APPARATUS FOR POLYSTATION TELEPHONE LINES; J. A. Barrett, Summit, N. J. App. filed Sept. 8, 1900. (See Current News and Notes.)

666,533. PROCESS OF PURIFYING WATER; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed July 10, 1900.



666,628.—Fire Alarm.

666,534. PROCESS OF REFINING PERFUMES; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed July 10, 1900.

666,535. PROCESS OF AMELIORATING AND PASTEURIZATING FERMENTED LIQUIDS AND BEVERAGES; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed July 10, 1900.

666,545. LIGHTNING ARRESTER; W. N. McAnge, Suffolk, Va. App. filed March 23, 1900. Details.

666,586. INSULATORS; H. W. Woolbert, Smethport, Pa. App. filed Aug. 27, 1900. The insulator is made of fragile material strengthened by inserted metal pieces.

666,602. ELECTRIC GLOW LAMP; A. Couch, London, Eng. App. filed June 11, 1900. An incandescent lamp having two globes, one within the other, each with its own filament and all connected to a single neck.

666,605. APPARATUS FOR SIGNALLING FROM GRAVES; M. E. Griffith, Sioux City, Ia. App. filed March 8, 1900. Details.

666,618. ELECTRIC IGNITER; C. D. Wright, Chicago, Ill. App. filed May 29, 1899. A wire bent into the form of a handle, two ends of the wire forming electric terminals with which a spark can be made by squeezing the handle.

666,628. FIRE ALARM; W. J. Partridge, Norwood, Mass. App. filed July 14, 1900. The insulator supporting electric conductors are of fusible material, so that when melted the conductor will be allowed to sag and make contact with the metal bracket supporting the insulator.

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GRAMME.

France has given to electricity many of its most notable philosophers and inventors, and in the latter group no one was more prominent than Gramme, who has just passed away full of years and honors, interested in the art to the last, and one of the active attendants at the recent Paris Congress and Exposition. We do not forget that he was of Belgian birth, like Van Depoele, but all his work was done in France, with French aid, and from the French Government came the first recognition of the intrinsic value of his work. While doing him full honor ourselves, we cannot but reflect somewhat sadly on the fate of the American inventor Fuller, who, taking up in this country the crude Gramme machines of 25 years ago, did so much to put dynamo construction on a scientific industrial basis, but died poor and all too young to reap any reward.

THE TICKER.

Now that the stock printer, better—or worse—known as the "ticker," has fairly well crystallized as a machine and is not likely to undergo any radical changes or improvements, it is well to have its history summed up as Mr. Calahan has done it for us this week. Himself foremost in the development of a machine which has literally made and unmade more fortunes than anything else in this speculative land, Mr. Calahan furnishes a most interesting narrative in regard to the apparatus. One is apt to regard the telephone industry as being like Melchisedek or Japhet, without a progenitor, but in the distribution of bank and stock news, many of the fundamental features of telephony were worked out, and the evolution can be pretty closely followed by those familiar with the two branches of electrical application as Mr. Calahan is.

THE INSTITUTE PRESIDENCY

Of late years the practice has grown up in the American Institute of Electrical Engineers of making the presidential term two years, by re-election; so that unless a president received this compliment, it might almost be assumed that some kind of a reproach or stigma applied to the man who was able to hold the office for one year only. Now that the nomination ballots are going out to the members, President Hering, with the courage of his convictions, has requested us to give publicity to the fact that under no circumstances will he allow his name to be submitted for the candidature this year. It is well known that he has always been opposed to two-year terms, and his action at this juncture is in keeping with the admirable stand that he has taken upon the subject.

We must congratulate Mr. Hering on the benefit he has thus conferred on the Institute at the close of a year of distinguished service. If re-election can be earned, he has certainly made the strongest possible bid for the suffrages of his fellow members by the excellent work done since last May, including leadership of the visit of the Institute to England and France, active participation in the International Electrical Congress, and a personal honor to himself in the award of the coveted Legion of Honor for invaluable services as an Exposition juror on behalf of the United States. But it is obvious that if every president is to have two years, very few of the available men can ever reach the chair. The presidency of the Institute is justly regarded as the "blue ribbon" of the profession, and it is not fair to shut out from the prize those who might attain it on any reasonable basis of rotation in office. As a matter of fact, the majority of presidents of the Institute—such men as Thomson, Weston, Sprague, Anthony and Bell—have held office for one year only, and Mr. Hering's fine example now affords the opportunity to revert to the earlier, healthier practice. All the later proposed revisions of the constitution have embodied the rule of a term of only one year, and so far as we know the minds of the members, the feeling in favor of such a restriction is universal among them. With a membership now approaching 1500, the Institute has had barely a dozen presidents in 16 years, and we make bold to affirm that there has thus been injustice done already to the men whom the Institute at large would delight in honoring on the sole ground of their engineering attainments or their contributions to electrical science.

STANDARDIZING ENGINE SPEEDS.

The distinguishing characteristic of modern manufacturing methods as compared with antiquated manufacturing methods lies in the standardization of parts and types and their rapid reduplication by machinery. Once the labor and expense of making the tools for the first machine have been paid for, successive copies of that machine can be made at a comparatively small expense. The same rule undoubtedly applies to dynamo-electric machines, and the large factories in this country have followed as far as possible the plan of developing lines of machinery suited to the average use and of standardizing them in such a manner as to admit of their reduplication at a low factory cost. This standardization is readily carried out in motors, where the voltage of the circuit or the voltage and frequency are themselves standardized.

In the case of generators, however, the matter is not so simple for the reason that the electric generator is only part of the generating plant, consisting of dynamo and prime mover. If the dynamo builder also made the turbine, or the steam engine, to drive the dynamo, there would be little difficulty in standardizing both for the best joint output. But as the matter stands to-day, the dynamo builder does not usually make the prime mover, and the prime mover builder does not generally make the dynamo. In the case of large alternators, therefore, when an attempt is made to purchase a large engine from one factory and a large dynamo from another, it is usually hopeless to meet the standard requirements of both manufactories. The result is that either the engine is made specially to suit the dynamo or the dynamo is made specially to suit the engine. In either case special tools have generally to be made for the manufacture of one machine, and not only is delay incurred by reason of the novelty of size, but also the expense incurred to both manufacturer and purchaser is increased relatively to that of standard machines. Not only is the purchaser burdened by the additional expense and the manufacturer burdened by the additional stock and labor, but future prospective or actual purchasers of machinery of the same class are hampered with some additional cost by reason of the additional delay in the shops and by reason of the departure from a recognized standard. In a certain sense and in a lesser degree, the entire foreign dynamo trade of the country is hampered by reason of the departure from the methods of scientific manufacture.

Unless, then, the manufacture of dynamos is taken over by prime-mover builders, or the manufacture of prime-movers is acquired by electrical manufacturers—in either case a very large increase of operations—the only hope is for both to agree upon standard sizes and speeds suitable for meeting the average requirements. There is already a tendency manifested to do this on both sides and a committee of the American Society of Mechanical Engineers, together with a similar committee from the American Institute of Electrical Engineers are understood to have further practical suggestions under consideration looking towards general recommendations to the manufacturers on both sides. It is earnestly to be hoped that in the interest of all parties concerned a useful and effective standardization can be brought about, with due care, however, that free development in either branch shall not thereby be hampered.

SYNTONIC AND MULTIPLE WIRELESS TELEGRAPHY.

In the Digest of last week a concise account was given of the Slaby system of tuned and multiple wireless telegraphy, which system has recently been the subject of some successful experiments in Germany. As will be seen, the selective or syntonic feature consists first, in corresponding stations working with the same wave length, and in the employment at the receiving station of a vertical wire equal in length to a sub-multiple of the wave length agreed upon. By this means the receiving instrument will not respond to wave signals sent from the same or other stations where this condition is not complied with. Moreover, by a certain disposition of the aerial conductor it is made possible to receive simultaneously at a station messages of different wave length—this part of the system thus corresponding to multiplex wire telegraphy. Another part of the system consists in an "intensifier" arrangement corresponding to the local battery circuit of an ordinary telegraphic system, by means of which the potential of the received wave is increased, resulting in an increased effect on the coherer. The work of Prof. Slaby forms the most important contribution recently made to wireless telegraphy, and the system also appears to be a practical one. In tests made some weeks ago before the German Emperor, simultaneous messages were successfully received from two stations, one eight and the other two and one-half miles distant from the receiving point. The waves from the more distant station had to pass across the city of Berlin and were naturally attenuated by the high buildings and chimneys in its path, which effect, however, was counteracted by the application of the "intensifier" principle.

The work of Dr. Slaby above referred to received considerable prominence in cable newspaper dispatches, and—not unexpectedly—Mr. Nikola Tesla now comes forward with a claim of priority. In a letter to the New York *Sun*, Mr. Tesla says he has read with "deep astonishment" the statements made in his lecture before the Emperor by the Charlottenberg professor, who, moreover, had acknowledged that he—Tesla—is the "father of wireless telegraphy." Mr. Tesla also expresses disappointment that Dr. Slaby does not give him credit "for a beautiful invention which he [Dr. Slaby] calls the 'multiplier.'" "Have I not first described this device," he says, "and given rules for its construction and attunement? Was I not the first to apply it to wireless transmission?" For obvious reasons we have not been able to keep pace with all the numerous newspaper ascriptions to Mr. Tesla of revolutionary discoveries in electrical science, which probably explains our ignorance of the claim that he is the "father of wireless telegraphy," or indeed that the art of wireless telegraphy has in any manner benefited from his labors

If Mr. Tesla would do what may fairly be asked of a man of his prominence—prepare a paper for the American Physical Society or the American Institute of Electrical Engineers covering the work he has accomplished in this branch—we shall be able to repair our own seeming neglect in not laying before our readers hitherto the record which would entitle him to be called "the father of wireless telegraphy."

CAPACITY OF ELECTRIC CONDUCTORS.

In our issue of last week we quoted from a letter over the signature of Mr. Nikola Tesla in the New York *Sun* of Jan. 30, in which it is stated that the capacity of a fixed insulator conductor is not a fixed quantity, but varies with the hour of the day, with the season of the year, that it is influenced by moonlight, etc. It is also intimated that in consequence of this newly discovered fact a large part of technical literature will have to be rewritten. May we venture to express our doubts upon these propositions, with all due deference to Mr. Tesla. So far as text books are concerned, they are only stepping stones, and not keystones, in the structure of our faith. The sooner they have to be cancelled, amended and rewritten, the healthier and more sturdy the growth of the science to which they relate, but the evolution of text books and of the knowledge they disclose must be like all other evolution, in a definite and orderly manner, in obedience to certain rules.

We have every reason to believe that the capacity of the condensers in our laboratories is within certain small limits a definite and constant quantity. The capacity of aerial wires insulated on poles and supported many feet from the ground seems to be a substantially constant quantity from day to day and year to year, provided that the surface of the earth is uniformly conducting. It has long been known—though not, it would seem, by Mr. Tesla—that when the surface of the earth is dry and ill-conducting, the apparent capacity of single wires supported above it is less than when the earth is wet and well-conducting. If, therefore, Mr. Tesla refers to variations of capacity between a fixed aerial conductor and the ground due to variation in the conductivity of the surface soil, he is virtually repeating a known proposition.

Concerning the variation in capacity of a conductor relatively to the earth with elevation above the earth, it is not a discovery that there must be a change of some sort in capacity. The experimental knowledge we possess concerning the capacity of very elevated conductors, is, however, so limited that there is room for valuable technical results to be observed in this direction, and if Mr. Tesla has made reliable observations of this character the science would owe him so much the more for their announcement. We hope that Mr. Tesla will publish any results which he may have obtained, in such form as may be available to electrotechnical workers.

It is quite clear that not only is no substantial technical information imparted to electrical engineers by articles of the nature which Mr. Tesla communicates so frequently to the daily press, but also that it is impossible for an electrical engineer to judge from such articles of the validity of the conclusions which are therein reached. It is quite possible that the apparent capacity of very elevated conductors might vary in a manner not generally appreciated or understood, and yet that the capacity of the ordinary conductors in the neighborhood of good conducting ground should be as fixed and constant a quantity as has always been supposed.

RESONANCE AND "STATIC."

We print elsewhere an interesting letter from Dr. F. A. C. Perrine on certain phenomena sometimes classified as resonance. He deals particularly with the sparking around switchboards and other points in the connections known in the vernacular as "static," and suggests that many or most cases of this kind may properly be charged up to plain lack of sufficient insulation. There is small doubt that his position is for the most part correct, and he has assuredly done an excellent thing in calling attention to the so-called static discharges with which every electrician who has worked around high voltage stations is familiar. Of course, there is such a thing as a genuine static charge on an overhead line, due to purely atmospheric causes, and we have known workmen to get sharp shocks from lines quite disconnected from any circuit and neither crossed nor paralleled by any circuit. When a thunder storm is in progress there may be greatly increased differences of potential and snapping discharges from overhead wires which yet by no means rise to the dignity of lightning.

But as to "static" of the genuine kind playing the roles often attributed to it—that is a very different matter. When there is a steady stream of spark discharge from a high-voltage line in the absence of any particular atmospheric disturbance, it is quite safe to say that, whatever else it may be, it is certainly not a static discharge of any kind; and the steadier and fiercer it is, the more surely can it be traced to the energy properly belonging to the line. If the discharge follows along or in the material of a slate or marble switchboard, there is no reason for crediting it with any extraordinary voltage, and it is simply amazing to find how many crevices and conducting streaks there are in these materials, particularly the former. When the discharge is sneaking along such surfaces there is little need of invoking resonance or any other unusual cause in explanation.

But there certainly are many cases of discharge from high voltage lines through the air in which the line voltage is absolutely inadequate to account for the sparking distance. The striking distance of various alternating voltages between needle points is well known from direct experiments, and when, for example, one finds a discharge steadily streaming and singing across gaps aggregating an inch or more between the cylinders of a high voltage arrester, the line voltage being only 10,000, there is need of more explanation than leakage will furnish unless the discharge is shown to be along a surface. This should be sought as a possible explanation, on the other hand, before calmly charging up the case to resonance. If a steady spark discharge visible through air takes place over a distance two or three times as great as the sparking distance due under the most favorable conditions to the line voltage, then it is time to look into the question of resonance. And if in addition a violent discharge of this kind occurs simultaneously with a sudden disturbance of the electrical conditions on the circuit, it is high time to examine the conditions of resonance on that line. For example, a case recently came under our notice in which the burning out of a ground detector in making a test was instantly followed by a discharge across a bank of lightning arresters two miles distant that leaped double the striking distance due to the voltage and utterly demolished the arresters. Within a few months on the same system, opening a switch shot a 10-inch discharge across air from the switch point to a cut-out on another phase, with a nominal voltage of less than 5000 to help it on its way. In general, phenomena of this sort suggest resonance too forcibly to justify neglect.

But it is by no means easy to tie up the facts of resonance with the theory thereof. For unless one has a rather precise knowledge of the e. m. f. curve of the generators upon the system, it is no easy matter to know what harmonics are likely to cause trouble, and even then the change of the harmonics under varying conditions of load requires examination. And even were these known the capacity and inductance of the system are by no means easy of determination. If only the line were concerned all would be smooth sailing, but the constants of the system involve the apparatus as well as the line, and the effect of this is very difficult to compute. Under certain conditions the capacity of large transformers and the like may enter, causing resonance with harmonics that would be quite unsuspected on the evidence of the line alone. This whole question of discharges of abnormal length on high voltage lines deserves a thorough examination, for it involves some very singular phenomena. Static discharges there certainly are, and leakage discharges, and resonant discharges. When the latter occur under conditions that make their nature clear, they are sometimes very violent, but sparking of a more trivial nature is a bit dubious in character and deserves as much investigation as if it were highly dangerous. For example, we remember noting once a clear brush discharge from the corner of a switch into the surrounding air, which persisted steadily for a considerable time, although the voltage was a scant 3000. It is certain that there are encountered on high voltage lines very abnormal sparking distances which are not to be accounted for in any simple way, and an investigation of which may lead to very interesting results

Death of Zenobe Theophile Gramme.

Zenobe Theophile Gramme died at Bois Colombes, near Paris, on Sunday, Jan. 20. Gramme was born at Jehay-Bedegnee, near Liege, Belgium, in 1826, of poor parentage, and early in life learned the trade of a carpenter. Not content with this occupation, he attended scientific lectures at Liège and afterwards went to Paris, where he obtained employment as a fitter in a factory where the "Alliance" dynamo was constructed—the first dynamo-electric machine to enter into practical use. Later he worked under Ruhmkorff in his celebrated ateliers, and up to the time of his great invention followed the occupation of a machinist.

The first patent on the Gramme ring dynamo was taken out in 1870, the date of the English patent being June 9 of that year, and his first machine was submitted to the French Academy of Sciences in July of the following year. In 1872 Gramme constructed a machine with three ring armatures on the same shaft, which was used in the production of the electric light in a competitive trial with gas light for illuminating the lantern of the clock tower on the Houses of Parliament, London. Among some of the earlier machines made by Gramme was a type for use in the Russian and French navies.

In relation to the original English Gramme patent, Prof. S. P. Thompson relates a curious history. "It may appear strange," he says, "that so slight a specification—a few lines of description, a single claim, unaccompanied by any drawing—should constitute the whole of the patent of Gramme and d'Ivernois. The simple fact is that at the date when the filing of the final specification became due Paris was besieged, and it was impossible to send drawings to the London agent, who simply filed the materials that were to hand." The rapid commercial success of Gramme's machine, Prof. Thompson ascribes to the fact that it was the first practical machine in which were combined the features of the continuity of commutation, the self-exciting arrangement, good lamination in the armature core, and reasonably good proportions in the magnetic circuit.

THE LATE Z. T. GRAMME.

With each succeeding year Gramme improved his direct-current machine, and those exhibited at the Paris Expositions of 1878 and 1881 had already arrived at the definitive form which so largely influenced the development of the electrical industry. Gramme received many honors on account of his invention. The French Government awarded him a prize of 20,000 francs, and from the Academy of Sciences he received the Volta Prize, carrying with it the same amount of money. He also received decorations from the French Government and several of the European governments.

In 1877-78 he designed and supplied a number of alternating current machines for the operation of the Jablochkoff light. In these machines the field revolved and the armature was stationary, and the latter was so wound that a number of circuits could be led from it. In the case of one machine, 32, 16, 8 or 4 circuits could be supplied from one machine, according to the manner in which the coils were connected. In 1879 he produced a machine for Jablochkoff lighting which combined in one structure a direct-current exciter and an alternating current generator.

Up to the end of his life Gramme retained his connection with the original company founded to manufacture his apparatus—the Société Gramme—though in recent years this connection was merely nominal. In a letter just received from a Belgium correspondent we learn that Gramme persistently refused to become naturalized in France and died a Belgian subject. The accompanying portrait was engraved from a photograph which Gramme had specially taken for the historical collection of Mr. W. J. Hammer.

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New York Electrical Society.

One of the most brilliant and successful meetings of the New York Electrical Society was held on Jan. 30 at the Edison station of the New York Gas & Electric Light, Heat & Power Company, Elm and Duane Streets, where Dr. Louis Bell delivered an experimental lecture on the subject of "Electrical illumination at the beginning of the twentieth century." The society were guests of the company, who, by arrangement, also invited electrical contractors doing work on their system to participate Members were also permitted to bring ladies, so that in spite of the fact that the first snowstorm of the winter was in hearty progress, no fewer than 450 people gathered in the large central hall of the company's office floor. This and the surrounding gallery, hallways, etc., were filled with seats, and even then many remained standing. At one end a platform was built, with temporary switchboard, banks of lamps, etc., so that Dr. Bell was able to illustrate his remarks with every kind of lamp and every kind of current, as noted in the report given elsewhere in these pages of his able, fascinating and instructive address. A speech of welcome by Mr. John W. Lieb opened the exercises, it being accompanied by an admirable little historical epitome of the electrical art as illustrated in the frescoes running around the hall After the lecture, an enthusiastic vote of thanks was passed on motion of Messrs. Sheldon and Mailloux to Messrs. Murray, Brady, Lieb and other officers of the company, for their courtesy, and to Dr. Bell for his lecture. Thereupon a collation was served by the generous hosts, and visitors were afterwards allowed to inspect the station, under the direction of Messrs. Arthur Williams, Burnett, Littlefield, Donshea, Shepherd and other officials, who did everything in their power to make their guests at home and to impart information It was universally agreed that although noted for the uniform success of its "visiting trips" the society had never had a more delightful evening than this—the first in the new century By arrangement with Dr. Bell, the lecture was repeated the following evening by Mr J W. Lieb for the benefit of the staff and force of the company

During the evening the following new members were elected: J L. Kebler, vice-president Ward Leonard Electric Company; W. P Henshaw, New York Telephone Company; W. I Donshea, superintendent, with New York Gas & Electric Light, Heat & Power Company; H. L. Patteson and H. J., Fuller, with Crocker-Wheeler Company, Ampere, N J

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Street Railway Legislation.

The Massachusetts Railroad Commissioners have submitted that part of their annual report on street railways having to do with recommendations connected with legislation. The present street railway laws are termed patch-work, partly inoperative and often conflicting, being first adapted to horse car service. A general revision, however, may be postponed, as a special revision has been made by able authorities. It would be well to let experience keep school a while longer. As to giving street railways power to carry on freight business and run over private land, the commission believes there is yet no call for thus having the street railway work against, not with, the railroad. The commission recommends that if it is to regulate fares it be given full opportunity to exercise this power. The roadbed, tracks and structures of new companies should be inspected by the commission before the railway is opened. During 1900 the board approved stock issues aggregating at par $14,538,000, and bonds aggregating $4,085,000, against $15,360,500 stock and $4,204,000 bonds asked. Investigations have shown impairment of capital or assets in five cases, all of which, to the extent of $203,921, was made good. The anti-stock-watering laws are commended as protecting investors from over-capitalization. Exemption from these laws should be granted only under unusual conditions. Thirteen street railway consolidations have been effected during the year. Consolidations have been accompanied by reductions in fares and the extension of the transfer system.

The Automatic Telephone Exchange at New Bedford, Mass.

By Alton D. Adams.

SCIENTISTS tell us that types reach perfection only to disappear. Some may therefore hold that the time for the passing of the "Telephone Girl" has come—presuming she is perfect. Whatever the soundness of this argument, it is a fact that a strong tendency exists in telephone development, away from manual operation at exchanges. A concrete example in this line is found in the system of the Automatic Telephone Company, of New Bedford, Mass. This corporation is organized under Massachusetts law, with a paid-in capital of $100,000, nearly all of which has been invested in the exchange which occupies the first floor of an excellent brick building owned by the company, at 41 William Street, in the center of the business district. This building is about 50x90 ft. on the ground, and three stories high, the two upper floors being let to other parties by the Automatic Telephone Company. As all of the telephone cables enter the basement of the building, the first floor is the one best suited for the exchange. The system at this exchange is adapted for 10,000 subscribers, automatic instruments have been installed, with a capacity of 900, and about 500 are already connected.

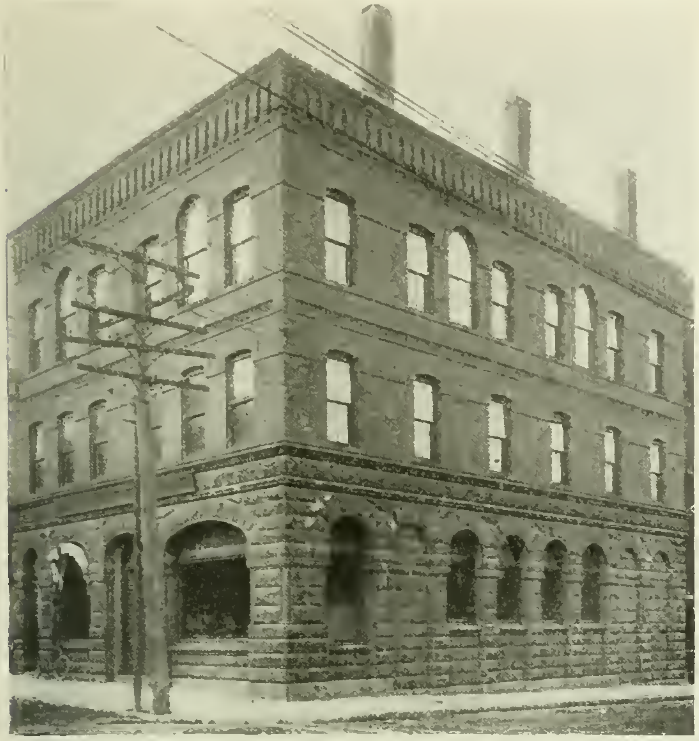

FIG. 1.—AUTOMATIC TELEPHONE BUILDING.

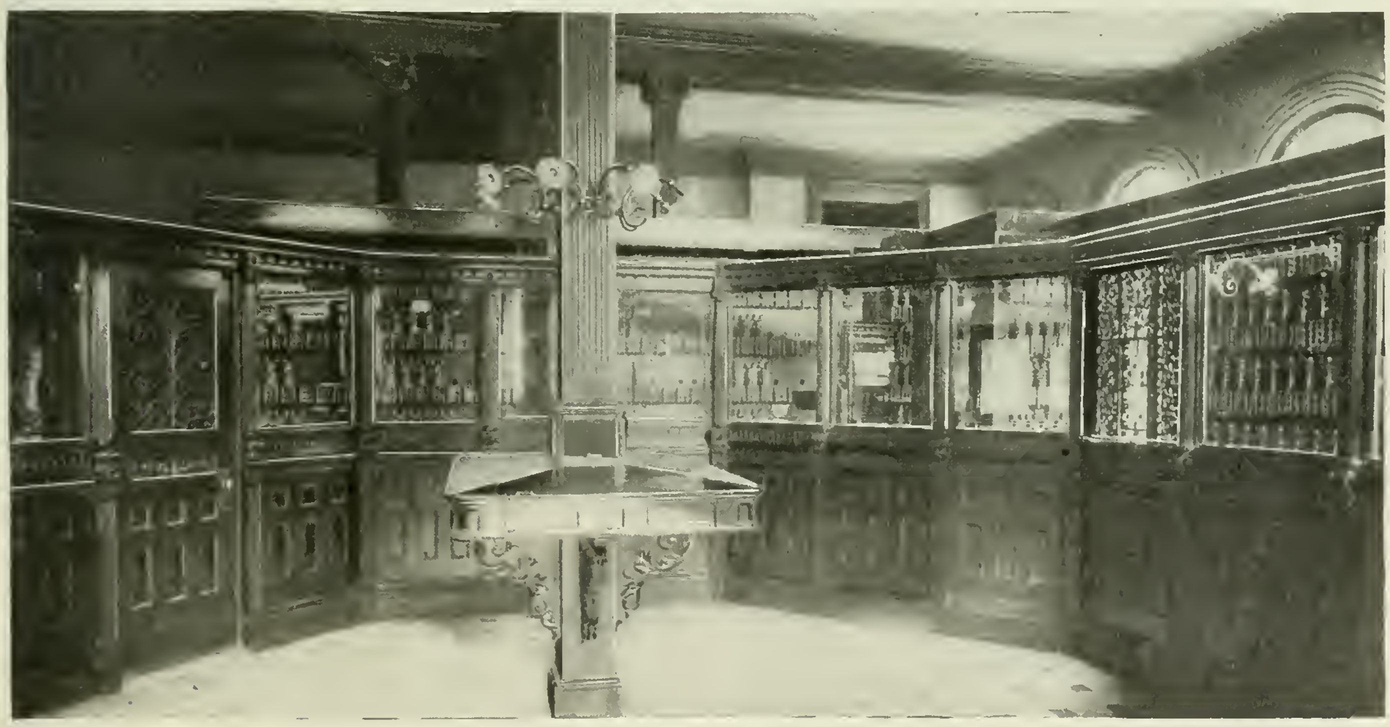

Fig. 2.—Office and Switch Room, Automatic Exchange.

All telephone lines leave the exchange through underground conduits of wooden pipe, laid in cement concrete. The subways contain 40 of these wooden ducts at the exchange, whence they extend through the principal business streets, with manholes for nearly every block. Single wooden ducts to a total length of 124,000 ft. are included in these subways. The leaded telephone cables thus far installed include 5000 ft. of 10 pair, 8000 ft. of 25 pair, 25,000 ft. of 50 pair, and 30,000 ft. of 100 pair for subscribers' wires. There are five miles of underground conduits, two miles of overhead cables, and about 10 miles of open-line construction on the poles of the Automatic Company.

The New Bedford automatic exchange began business in November, 1900, and has steadily gained in popular favor, a considerable number of new customers being constantly on the list waiting for connection. Before the automatic exchange was opened the yearly rates charged by the older telephone company at New Bedford, for an unlimited number of calls by a business house, are said to have ranged from $48 on party lines to $96 on private lines. The rate charged by the Automatic Telephone Company for unlimited service on private lines is $24 per year in residences and $36 per year in business houses.

The Automatic Telephone Company, of New Bedford, uses the equipment made by the Strowger Automatic Telephone Exchange Co., of Chicago, under license from the Eastern Automatic Telephone Company, of John Hancock Building, Boston, this last corporation controlling the apparatus in the States of Massachusetts and Rhode Island. As the readers of this journal are generally aware, it is the distinct feature of the system, compared with manual exchanges, that each subscriber is able to call any desired number by a few simple movements at his own telephone, and is at once automatically connected to the required number by a private line.

In this series of operations no person save the one calling has any part. If the number called is already engaged with some third instrument, the person calling cannot break in on the conversation, but is automatically warned that the desired number is in use.

The automatic telephone exchange does with machinery exactly what is done at a manual exchange by the operators, that is, it connects the telephone calling to the desired number. The operating room at such an exchange has no operators, save the little machines that instantly respond to every signal sent over the lines from any subscriber. At New Bedford, only a single attendant is employed in the operating room to look after the machines, and even he is absent a considerable part of the time. As a large part of the cost of operation for a manual system is included in the wages of the telephone girls, it is evident that automatic telephones must effect a material saving in this particular. A further important and distinctive feature of the Strowger system is the absolute secrecy of conversation had over its lines. Not only is it impossible for any third subscriber to break in on, or to overhear the conversation between any two telephones, but no one at the exchange is in a position to listen to the talk of any subscriber, as an operator at a manual exchange may readily do. If any number called is shown to be busy by the automatic action of a buzzer, the call may be repeated as often as desired without disturbing the parties engaged in conversation, and the desired number may be obtained by a call as soon as it is released, without waiting for the attention of an exchange operator.

If a certain number of subscribers wish to so connect their telephones that each may hear all that is said by any of the others, as is at times the case with boards of corporation directors or college faculties, this result may be attained by either a permanent or temporary arrangement at the exchange, whereby each subscriber may call and automatically obtain connection to a certain number set apart for the purpose.

Another special feature is that any subscriber may be limited as to the number of telephones that he can call, or from which a call can come to him. This feature is said to be of advantage in the cases of certain important officials, such as train dispatchers. The cost to an exchange of unlimited is only a little more than that of limited service to its subscribers, because no manual element is involved in the automatic connections.

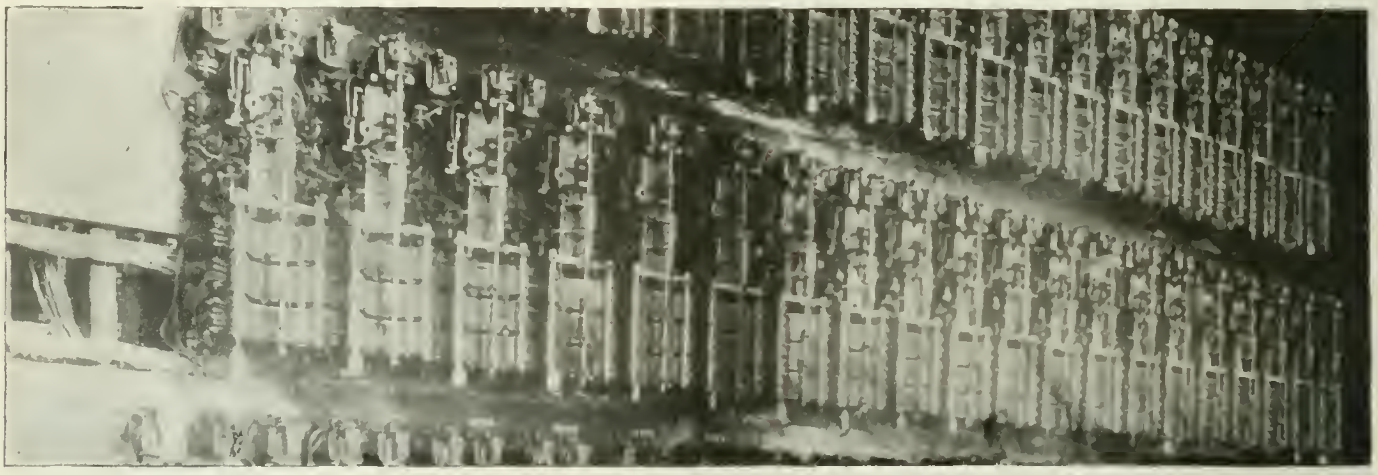

Fig. 3.—A Portion of the Switchboard, Automatic Telephone Exchange.

If it is desired, however, to limit the service to some subscribers, this can be accomplished by means of a record automatically made at the exchange of the number and duration of calls for each telephone. The savings to be made by limited service include a small amount of wear on telephones and on the exchange apparatus, also the energy required for their operation.

Energy to work the automatic apparatus at exchanges and to ring the call bells of subscribers is furnished by storage batteries and motor generators in exchanges of the Strowger system. A primary battery is retained in the telephone box on the subscriber's premises, but the current from this battery simply serves to actuate magnets that connect the generator for ringing to the line when desired. In calling, a subscriber does not turn a generator crank, but first makes a series of connections, corresponding to the number he desires, and then connects the ringing generator at the exchange to his line by pressing a button on his telephone box. Figures from 0 to 9 are indicated on a small metal dial, with a finger-hole opposite each number, located on the front of each telephone box. This dial may be revolved by hand in the direction of the hands of a clock, until any figure and finger-hole on it is brought to the lowest possible position, then when released it immediately turns back to its original position. When the first figure on the dial of the number wanted is turned to its lowest point an electrical connection is made, and the automatic apparatus at the exchange begins a movement toward the selection of a number that contains that figure in the extreme left-hand place. When the figure second from the left hand in the number wanted is turned to its lowest position by revolving the dial, the apparatus at the exchange makes a further movement toward the selection of a number that contains the two figures, in the order selected, at the left-hand end. The movement of other figures on the dial to the lowest position produces like action of the selecting apparatus at the exchange until the number wanted is complete and the connections are made. A pressure of the button on the telephone of the subscriber calling then closes the circuit of the local primary battery on an electromagnet that connects the ringing generator at the exchange to the line, and this rings the bells of both the number called and of the one calling. To illustrate this method of calling: Take the telephone number 5762. The figure 5 on the dial is first brought to its lowest position by revolution of the dial in the direction of the hands of a clock, the dial is then released and as soon as it has automatically returned to its original position the figure 7 is in like manner brought to its lowest point and the dial again released This operation is then repeated for the figures 6 and 2 successively. The receiver is removed from its hook before the dial is moved to make a call, and after the conversation is finished the receiver is returned to its hook and then again removed before a second call is made. No ring off is necessary or possible in this automatic system, as the weight of the receiver on its hook opens the circuit and all of the connections between the two telephones engaged in conversation are at once released.

One second is sufficient time in which to bring any figure on the dial to its lowest position and allow its return; one second is also ample time in which to press the button and get a ring at both telephones. Five seconds is thus about the average time required to make calls on a system of numbers having four figures each. Conversation over the lines of the automatic system is quite as clear and satisfactory as that to be had through manual exchanges, as the writer can testify from his own experience in calling some of the most distant subscribers on the lines of the New Bedford Company. Several city officials and prominent business houses were engaged in conversation by the writer, through their telephones of the automatic system, and in every case entire satisfaction was expressed with the prompt and distinct qualities of the service.

Each telephone on the automatic system is connected to the exchange by a complete metallic circuit of two wires. When the dial with figures is rotated on any telephone, the connections of these two wires are so varied that impulses of current operate the electro-magnetic mechanism at the exchange in a way to produce connection between the metallic circuit of the calling telephone and that of the telephone called. The push button that is operated as soon as a call has been made, introduces the earth as a third conductor between the two telephones and the exchange, but this connection to earth lasts only while the ringing apparatus at each telephone is in operation, and the line over which conversation is carried on is entirely metallic.

At the exchange each pair of wires from subscribers' telephones is connected to a small machine contained in a space less than 12 x 6 x 6 in., that is the essential element of the system. This little machine is made up of moving contacts, actuated by electro-magnets, the energy for these magnets being drawn from the battery at the exchange and controlled in its application by the rotation of the disk on the subscriber's telephone. In exchanges with 100 subscribers or less only one of the small machines just described is necessary for each subscriber. For this case the machine belonging to the calling telephone makes connection at once with the machine belonging to the telephone called. It is also possible to extend this system of one machine for each subscriber to a case where as many as 200 telephones must be served. In a larger exchange, up to 1000 subscribers, the connections of machines corresponding to each telephone must be made through one of 10 trunk lines, each of which leads to a group of similar machines. One of the machines on the trunk lines then makes an automatic connection with the machine corresponding to the telephone of the desired number. Where the number of subscribers is larger than 1000, a so-called 10,000-system, such as that at New Bedford is used, where each trunk line, first connected with a calling telephone, selects another trunk line, and this in turn the machine of the telephone desired. The 10,000-system involves the use of about one and one-half machines at the exchange per subscriber served. The present state of patent claims on the system do not permit drawings of the automatic machines and line connections to be presented at this time. It should be noted that as this system is made up at the exchange of a number of exactly similar automatic units, any desired extension of capacity can be made by additions of these units, without changes in those already installed.

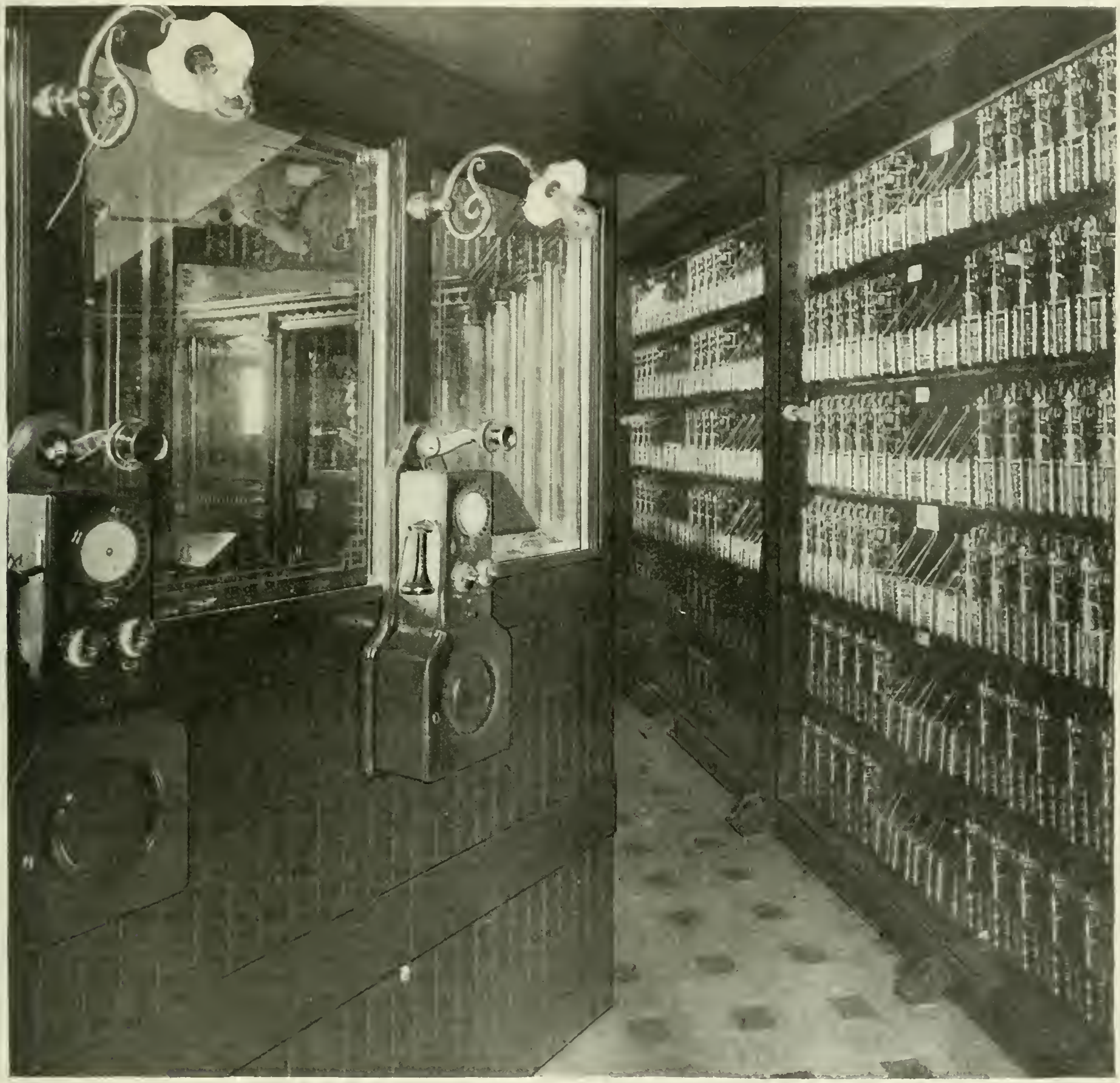

Fig. 4.—Switchboard and Telephones, Automatic Telephone Exchange.

With these general principles of the system in mind, we may return to the exchange of the New Bedford Company, to consider the apparatus by which the lines are connected to the automatic apparatus and the energy for operation is supplied. The underground cables end at the exchange in cable terminals, which are in turn connected to a very compact distributing board, that has contacts for 1000 subscribers on a surface 5.5 x 5.25 ft. These cable terminals and distributing board are shown in one of the accompanying cuts (Fig. 5) near dynamotor. The dynamotor operates at 110 volts, and is of 1-3-hp capacity. Energy for the magnets in the automatic machines is drawn from either of two storage batteries, one battery being of 20 and the other of 80 ampere-hour capacity, and each composed of 50 cells. These batteries are charged through a resistance from the 220-volt mains of the local light and power company. These batteries were furnished by the American Battery Company, of Chicago, and the cable terminals and fuses, also the pole top terminals were made by the Sterling Electric Company, of the same city. The dynamotor is from the Holtzer-Cabot Company, of Brookline, Mass. The wooden conduits came from the

Williamsport Wooden Pipe Company, Williamsport, Pa. Switches and switchboard were supplied by the local Hill Electric Company, and the Standard Underground Cable Company furnished the leaded cables.

It is the intention of the Automatic Telephone Company, of New Bedford, to extend its lines to a number of towns within a radius of 10 miles at an early date, and also to Fall River, 14 miles distant, by next spring. At Fall River a Massachusetts corporation has been formed to erect and operate the automatic system, with a capital of $135,000. A large amount of underground work is already in at Fall River, a vitrified conduit being used, and the contract for a large exchange building has been let. This exchange is expected to be in operation during the early summer. Meantime, the Hampden Automatic Telephone Company has been organized at Springfield, Mass., to install and operate exchanges in Hampden County. All of this serves to indicate that the automatic telephone system is here to stay, and is demonstrating an economy and practicability that many have doubted.

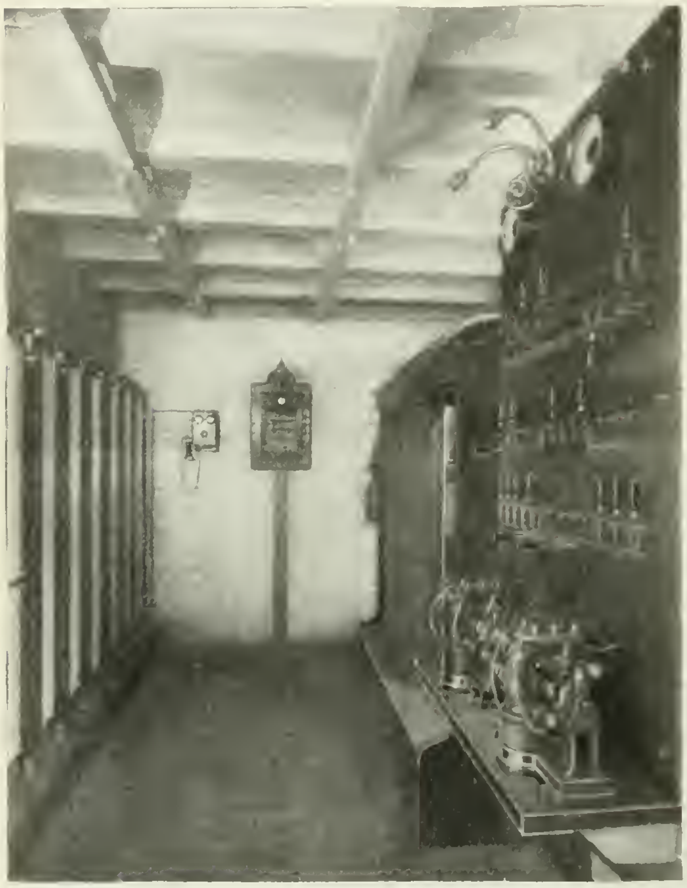

FIG. 5.—TERMINAL ROOM.

Calcium Carbide in Europe.

Mr. S. W. Hanauer, Deputy U. S. Consul-General at Frankfort, Germany, reports as follows: On Nov. 30 last, the convention of Swiss, Austrian, Swedish, Norwegian and German manufacturers of calcium carbide, which was in session at Frankfort, combined in establishing price schedules and a mode of controlling the sale of their products. The Deutsche Gold und Silber Scheide-Anstalt, of Frankfort (which has branches in the United States and other countries), was appointed the sole agent for the sale of the syndicate's products. It is expected that by this combination the acetylene industry will be considerably strengthened. The members have adopted measures to avoid the fluctuating and ruinously low rates which, owing to heretofore existing sharp competition, have made the manufacture of their products unprofitable. The German acetylene industry is very important, there being at present in the Empire over 200,000 plants making the gas. New patents for improved methods of production are constantly being issued. Thirty-two of the smaller towns in Germany are lighted by acetylene gas, and a number of other plants are in course of erection. The gas is also used by the railroads for lighting passenger cars. This year's production of calcium carbide in Germany is estimated at 20,000 metric tons, equivalent to 360,000 hectoliters (9,500,000 gallons) of petroleum.

Placer Mining Dredges in California.

SEVERAL placer mining dredges in California are now using electric power supplied by water power transmission plants in their vicinity. One of the largest of these dredges is at Sailor Bar, on the American River, about 6 miles from Folsom. It is supplied with power from the transmission line of the Sacramento Electric, Gas & Railway Company, which has its power plant at Folsom on the American River, and transmits 22 miles into Sacramento at 11,000 volts. To supply power to this dredge a small sub-station was erected in which were put three 325-kw oil-cooled transformers stepping down to 500 volts. From the sub-station to the dredge the current is carried by three 350,000 circ. mil. cables wrapped together. The cable is put on saw horses, which can be moved as the dredge moves.

These dredges are among the more recent developments in placer mining methods, and they afford a means of washing over placer deposits for the extraction of gold where water under high head for hydraulic operations is not available, or where it is desired to work the river bottoms. This particular dredge is designed to work into the banks of the stream above water level. It floats in a pond of its own making, dredging into the bank in front, washing the dredgings for gold and discharging the tailings behind it into the pond so that the pond is kept constantly the same size, although continually shifting as to location.

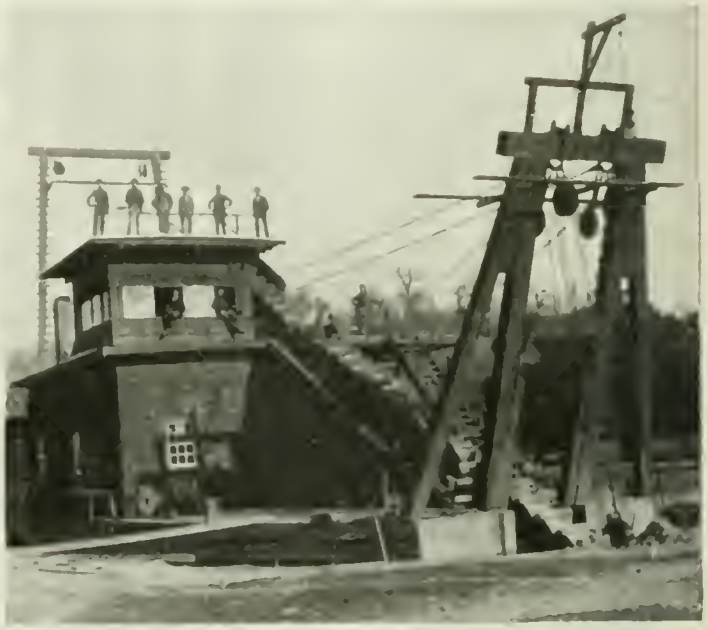

FIG. 1.—DREDGE WORKING INTO BANK.

The accompanying illustrations show the dredge of the Ashburton Mining Company previously mentioned. The buckets are of heavy cast steel, weigh 82 lbs. each, and form an endless chain. Fig. 1 shows the dredge with the buckets working into the edge of the bank and in Fig. 2 they are down in the water, working near the bottom. To operate this chain of dredge buckets a 150-hp, three-phase, variable speed motor is used. The dirt is carried up by these buckets and dumped into a revolving screen, which takes out the larger stones and lets the remainder fall into a sluice box, where it is carried down by a stream of water over riffles, which catch the gold and let the dirt be discharged as tailings behind the dredge. To drive the revolving screens and the pumps which furnish water to wash the dirt through the screens a 75-hp, three-phase motor is used. To run the 26-in. centrifugal pump, which furnishes a large volume of water to the sluice boxes, another 150-hp, three-phase motor is used. On the dredge there is also a 20-hp hoisting motor running winches for raising the buckets and moving the dredge, and for working two spuds, which run down into the mud under the dredge for holding it in place. As the level of the pond in which the dredge floats may be above the level of water in the river it is necessary to have a pump for keeping the pond full. This is done with a centrifugal pump run by a 40-hp, three-phase motor. All the electrical equipment is General Electric Company's manufacture, and the wiring was done by the Sacramento Electrical Engineering & Supply Company.

Another large dredge electrically equipped with induction motors is the "Continental," operating near Oroville. In this the electrical equipment is somewhat similar, but is of Westinghouse make. This is supplied by the Bay Counties Power Company.

The use of electric motors is very attractive to the owners of such dredges, because of their simplicity and ease of control. Engines and boilers of sufficient capacity to do the work done by the motors on the dredges mentioned would be very cumbersome and expensive as compared to the motors, and a much larger crew would be required to operate the dredge. Although the field is not a very large one for supplying power for this kind of work, many of those familiar with the local conditions believe that with power available there will be a rapidly growing demand for power from dredges which will go over ground which has been hitherto untouched because of the cost of handling the dirt in former days. Lower wages, cheaper power and improved machinery make possible the working of placer gold deposits that have hitherto been passed over as unprofitable. Most of the hydraulic placer mines in California were stopped by the law which forbade discharging the tailings from such mines into the rivers. This leaves the dredges the only cheap method at present known for working placer dirt.

The Bay Counties Power Company is supplying electric power to seven dredges in the vicinity of Grass Valley and Nevada City in Nevada County, which call together for 800 to 900 hp, and from the way dredges are increasing in number it would not be surprising if 2500 hp were called for for that purpose in another year. There is an enormous amount of placer ground, as gold exists in all the river bottom deposits in some localities, and these cover a large area. The financial returns from the dredges in operation are not public, but from the way they are increasing in number it is not unlikely that they are many of them very good dividend payers. The common report is that any ground that will yield 10 cents a cubic yard in gold can be worked at a profit.

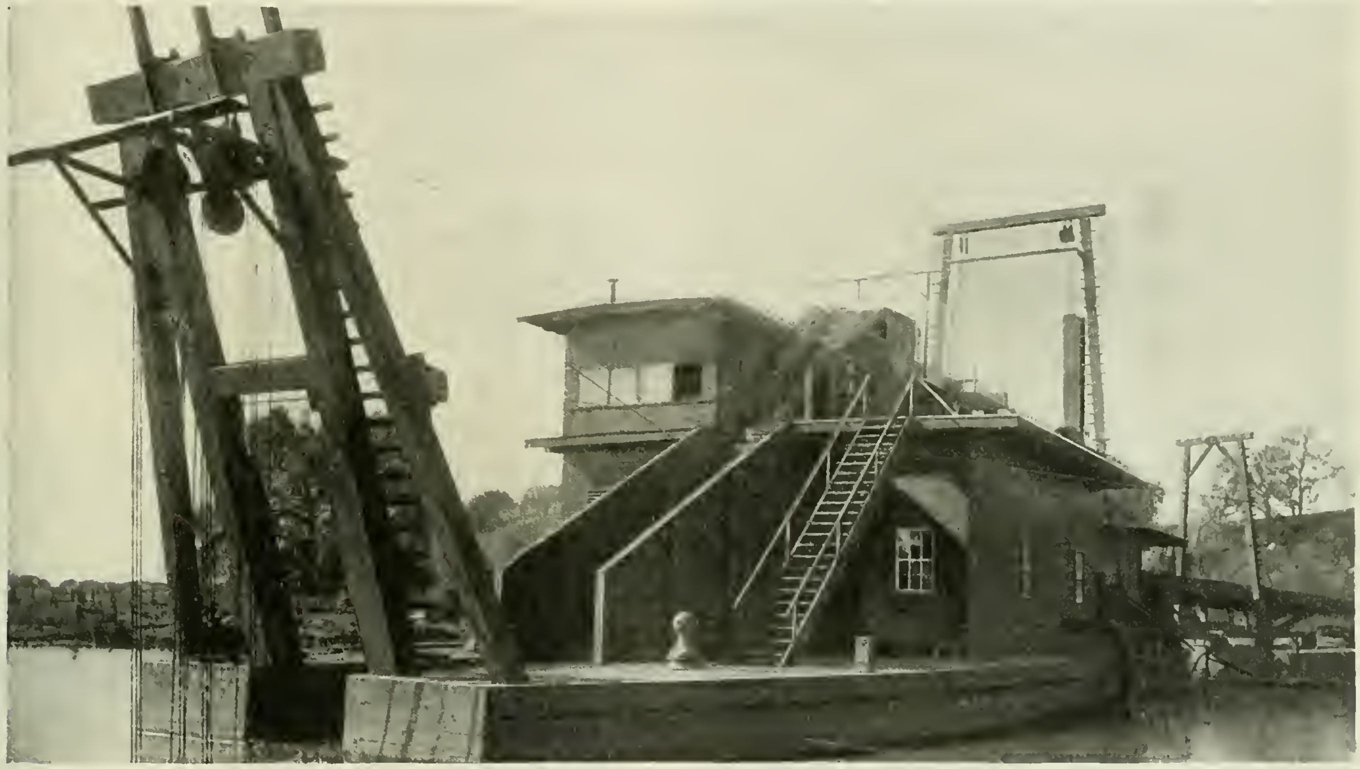

Fig. 2.—Placer Dredge Working on Bottom of Pond.

The Roentgen Society.

The Council of the Roentgen Society, London, announces that the president has placed at its disposal a gold medal to be awarded to the maker of the best practical X-ray tube for both photographic and screen work. The competition is open to makers in any country. The jury will be chosen by the president and council of the society, and their names will be announced in the London *Times* of March 1. Tubes intended for competition must be sent in addressed to the Röntgen Society, 20 Hanover Square, London, W., marked "Tube for Competition," the package containing full name and address of sender, and must reach the society not later than May 1, 1901. Conditions can be obtained on application to F. Harrison Low, M. B., honorable secretary, 12 Sinclair Gardens, West Kensington, London, W.

Some Recent Tests of Magnetic Circuit Breakers.

By Hugh A. Brown, E. E.

The following investigation formed part of a graduation thesis in electrical engineering at Columbia University, the object being to determine how accurately circuit breakers act, with what definiteness they open, how the current rises in the circuit before the breaker finally opens, and how the time required for opening varies with different overloads and settings. The general method was similar to that employed by Messrs. Clark and McMullen, Class of '97, in a similar investigation.*

In testing, the overloads were prearranged by adjusting the resistance in a 115-volt circuit to give the definite overload current required for any test. The current was then thrown in by means of a main switch, and the time which elapsed from the moment the switch was closed to the moment when the circuit breaker opened was measured. The method of measuring the duration of the period in which current flowed in the circuit was as follows: A wooden drum 47 in. in circumference and about ½ in. thick was arranged so as to be driven by a small shunt motor. On the periphery of this drum was placed a smooth strip of German silver which was a little wider than the thickness of the drum. Upon this was placed a strip of "ticker" paper ½ in. in width, which was sensitized by being permeated with a specially prepared solution, consisting of 1.5 ozs. red prussiate of potash; .75 lb. ammonium nitrate; .50 lb. ammonium chloride and 1 gallon distilled water.

Upon this paper rested a steel brush. The brush and German silver surface of drum formed two terminals, shunted across grids of iron or German silver which formed part of the necessary resistance of the circuit. The potential difference between these two terminals was used to record the length of time current flowed before interruption, for the potential difference lasted only as long as the circuit was intact.

The effect of applying this P. D. across the prepared paper was to cause chemical decomposition of the solution and the iron of the brush, resulting in the production of a deep Prussian blue line, which ceased when the circuit opened. Now, by ascertaining the speed of the periphery of the drum and the length of line produced thereon while the circuit was closed, the interval of time which the blue line corresponded to—that is, the time required by the circuit breaker to open—could be readily calculated.

The method of determining the number of revolutions of the disk per minute was by means of a specially adjusted, firmly fixed, short piano wire, which made contact each revolution with a copper wire attached to the drum. This made a distinct tick at each revolution. It was found that best results were obtained by having one operator hold the brush on with proper tension during the time that the record was being made, while the other counted the number of revolutions per minute.

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* Tests on Automatic Circuit Breakers, *Electrical Engineer*, July 15 and 22, 1897.

To avoid error due to the variation of speed during the counting of revolutions, the count of seconds was started first, then at the middle point of the count the main switch was closed and record made, the count of the number of revolutions continuing through the remaining half of the seconds. By this means the element of error was due to the speeding up or slowing down of the motor during the period of counting.

There is a time factor which enters into all circuits. The time factor depends on the self-induction in the circuit and the value of the current thrown on. A current will not rise to its full value, $\frac{E}{R}$ immediately if there is self-induction, and the greater the self-induction the larger will be this time lag of the current. In the tests it was found that in all cases the time lag was so small that the current rose to full $\frac{E}{R}$-value before the circuit breaker opened. In one case we short-circuited a 115-volt, 200-kw generator through the circuit breaker. The current indicated by our galvanometer was 1300 amperes, the total resistance in circuit being presumably nearly .1 ohm. With this resistance the value of the current would be $\frac{E}{R}=$ 1150 amperes.

It was thus conclusively proven that, contrary to the results of previous investigations, a galvanometer for the purpose of measuring the value of the current in such a circuit is unnecessary.

A circuit breaker does not prevent the current from rising to its full value even though, as will be seen later on, it does open faster in proportion as the overload is greater.

Another use for the galvanometer was presented immediately. It was employed instead of an ammeter to measure the current when the resistances of the circuit were being adjusted for permitting the desired overload current to flow during each observation. The advantage in its use was that the current was on but momentarily, whereas with an ammeter as the current reading device, an appreciable time must elapse for the needle to come to rest and the reading be made. With large currents such as were used, the employment of an ammeter as the measuring instrument would interfere with all other tests being made by other students using the same dynamo.

The galvanometer was calibrated by adjusting the current in circuit to any value and reading that current by an ammeter; then the main circuit was opened by use of a circuit breaker, producing thereby through an induction coil, a kick of the galvanometer proportional to that current.

In the calibration it was found that the curve between current as ordinates and kick as abscissæ formed a straight line.

It was also found that a water resistance barrel was the only suitable form of resistance to use. Other resistances, such as metal grids, do not keep constant long enough to enable the two readings of ammeter and galvanometer to be taken with proper accuracy.

The galvanometer circuit was so connected that when current in the main circuit was switched on, the e. m. f. produced by the induction coil produced a kick in the galvanometer proportional to that e. m. f. which, in turn, is proportional to the current flowing in the main circuit. An arrangement was made whereby the small galvanometer switch was opened by the circuit breaker, but this opening effected before the circuit breaker actually opened, and therefore before the circuit was interrupted. Hence a kick was obtained corresponding to the "making" of the maximum current and no back kick due to the breaking of the circuit.

The speed of opening of a circuit breaker depends upon mechanical construction. The time required for the plunger to trip the releasing latch depends upon the magnetic force which is exerted to suck the plunger up into the solenoid of the circuit breaker. This depends upon the value of the current in the solenoid. Now, it is seen that the speed of opening depends upon two factors, one a constant depending upon mechanical construction, the other varying with the current. By assuming a value for the constant of mechanical construction and subtracting it each time from the total time of opening, the following tables show that the product of the remaining time and the current is for each setting approximately constant, the time of opening varying inversely as the current. Each reading in the tables represents an average of four observations:

CIRCUIT BREAKER *A*.

Constant of Mechanical Construction, $K = .012$.

Setting Amperes	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec. — K.)
75	77	50	.076	8.55	7.43
75	77	75	.069	9.05	7.48
75	77	100	.064	9.60	7.80
100	102	50	.086	12.90	11.10
100	102	75	.077	13.42	11.37
100	102	100	.071	14.15	11.80
125	125	50	.089	16.59	14.44
125	125	75	.073	15.92	13.34
125	125	100	.066	16.50	13.50
150	150.5	50	.085	19.18	16.43
150	150.5	75	.075	19.62	16.54
150	150.5	100	.067	20.02	16.50
175	175	50	.090	23.49	20.47
175	175	75	.085	24.65	21.13
175	175	100	.066	23.01	18.90

CIRCUIT BREAKER *B*.

Constant of Mechanical Construction, $K = .005$.

Setting Amperes.	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec. — K.)
60	59.5	50	.055	4.97	4.50
60	59.5	75	.049	5.12	4.62
60	59.5	100	.041	4.02	4.32
80	59.5	50	.055	6.54	6.00
80	59.5	75	.048	6.65	6.12
80	59.5	100	.042	6.68	5.92

CIRCUIT BREAKER *C*.

Constant of Mechanical Construction, $K = .023$.

Setting Amperes.	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec. — K.)
45	46	50	.076	5.13	3.58
45	46	75	.071	5.75	3.78
45	46	100	.069	6.30	4.14
60	62	50	.098	8.75	6.75
60	62	75	.084	8.75	5.41
60	62	100	.082	9.78	6.41
75	76	50	.103	11.56	9.00
75	76	75	.092	12.04	9.06
75	76	100	.083	12.45	9.00
90	90	50	.104	14.00	10.94
90	90	75	.087	13.96	10.08
90	90	100	.078	14.04	9.90

CIRCUIT BREAKER *D*.

Constant of Mechanical Construction, $K = .02$.

Setting Amperes.	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec. — K.)
45	44	50	.080	5.41	4.05
45	44	75	.072	5.67	4.10
45	44	100	.061	5.54	3.69
60	60	50	.091	8.15	6.39
60	60	75	.077	8.11	5.78
60	60	100	.073	8.73	6.36
75	75	50	.092	10.38	8.10
75	75	75	.082	10.79	8.14
75	75	100	.076	11.40	8.40
90	90.5	50	.094	12.61	9.99
90	90.5	75	0.84	13.23	10.08
90	90.5	100	.074	13.38	9.72

The constant of mechanical construction, K, is different for each circuit breaker, but is a constant for any one. It depends upon the strength of the spring which opens the switch and the inertia of that switch arm.

The expression, current multiplied by time of opening minus a constant equals a constant, is approximately true for any setting of the breaker only when the curve of magnetic density in the plunger is a straight line.

The equations which were found to satisfy the results obtained were as follows: For current breaker A, $I \times (T - .012) =$ constant. For circuit breaker B, $I \times (T - .005) =$ constant. For circuit breaker C, $I \times (T - .023) =$ constant. For circuit breaker D, $I \times (T - .02) =$ constant.

Hence it is seen that except for the constant time element introduced by the mechanical action of the spring, it is shown that the current × time factor is constant, which is what has been claimed by manufacturers of circuit breakers.

Electric Furnaces at McGill University.

Two electric furnaces were installed in the physical chemistry department of McGill University, Montreal. They are large enough to take a current of 100 amperes at 110 volts. The principal use to which these furnaces, with their immense heat of 3000 or 4000 degs. Centigrade, are to be put is the splitting up of compound substances into their component parts.

European Types of High-Tension Alternators—IV.

By C. F. Guilbert.

KOLBEN ALTERNATOR

A Kolben alternator, shown at the Paris Exposition (Figs. 20, 21 and 21*a*), was direct connected to a Ghent tandem compound engine with Sulzer valve gear and deserves especial mention. The drops in this type of machine, as given in the table which will appear at the end of this series of articles, and which were obtained in a test of an identical machine installed in the Prague central station, are very small. Moreover, the characteristics and the section of the field conductor show that the minimum power factor can be much reduced or the apparent power augmented. This machine is one among the alternators with saturated poles, which possesses the greatest elasticity of power, and in the writer's opinion deserved a higher award at the Exposition than was received—a gold medal. This was the only alternator exhibited having laminated polar surfaces cast in flowed steel cores, though this kind of pole construction has been frequently used in Europe for some time past.

LIEGE ALTERNATOR.

The alternator exhibited by the Compagnie Internationale D'Electricite de Liege (Figs. 26, 27 and 27*a*), was driven by a Ghent compound tandem engine, and presents no point of particular interest except its winding. All of the armature coils—one per phase and per pole—are identical and are form wound and placed similarly to the armature coils of a direct-current machine. The exciter is supported on a shelf cast with one of the bearing pedestals.

CHARLEROI ALTERNATORS.

The alternator exhibited by the Societe Electricité et Hydraulique de Charleroi, consisted of two three-phase machines (Figs. 19, 22 23, 37 and 38), one driven by a cross-compound Bollincks engine and another by a Wehyer et Richemond engine; and a single-phase machine (Figs. 30 and 31), driven by a vertical, triple-expansion Augsbourg engine. These machines were noticeable for their lightness and for the very complete manner in which the metal is usefully employed.

BROWN-BOVERI ALTERNATOR.

The Brown-Boveri alternator exhibited at Paris (Fig. 45) was direct-connected to a triple-expansion, horizontal Sulzer engine of the well-known standard type of the Winterthur firm. One of the features of this Brown-Boveri type is that the armature is carried by two spider frames with trunnion rings cast on the bearings, a concentric position of the armature with respect to the field magnets being thus assured. This construction also facilitates repairs to the armature. The winding is disposed in such a manner that all the coils of one and the same phase are similarly placed. This machine, the saturation on which has a medium value, has an over-load capacity of about 20 per cent.

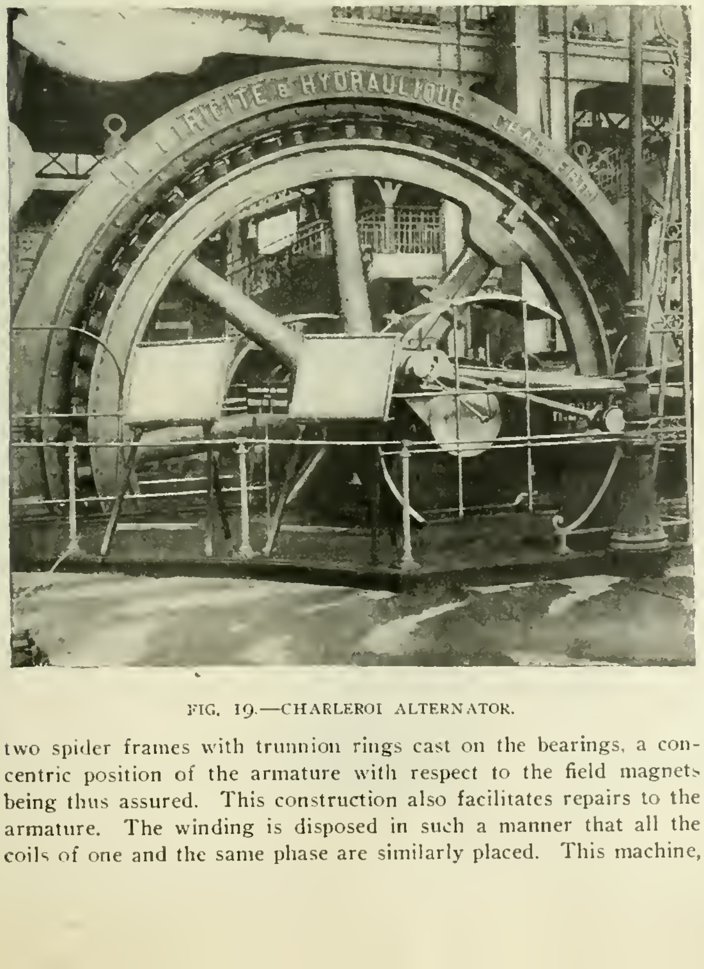


FIG. 19.—CHARLEROI ALTERNATOR.

OERLIKON MACHINES.

The alternators exhibited by the Oerlikon Works were three in number, one of which was driven by an Escher-Wyss engine, another by a Sulzer Winterthur engine, and the third (Fig. 42), by a Picard turbine. All three machines had laminated poles of low saturation. The alternator of 1375 volt-amperes capacity with a minimum power factor of .8 is the only one with alternate poles shown by this company (Figs. 34, 35 and 39). The armature is provided with a special means for regulating the air-gap, being supported on three foundation plates, two of which are supplied with double wedges and a screw for adjustment. The third plate, located at the bottom of the pit, supports the weight of the armature through the intermediary of two small jack screws. The over-load capacity of this machine is very large with respect to the margin allowed for excitation, but the drop is considerable. An inductor alternator exhibited by this company (Fig. 44), was driven by a Sulzer engine and had an armature adapted for three-phase winding, but at the Exposition was provided with a special winding to enable it to operate as a single-phase machine.

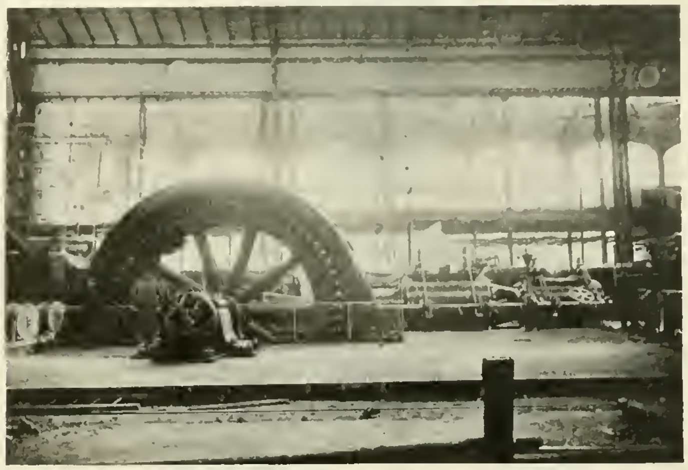


FIG. 21A.—KOLBEN ALTERNATOR AT PARIS EXPOSITION.

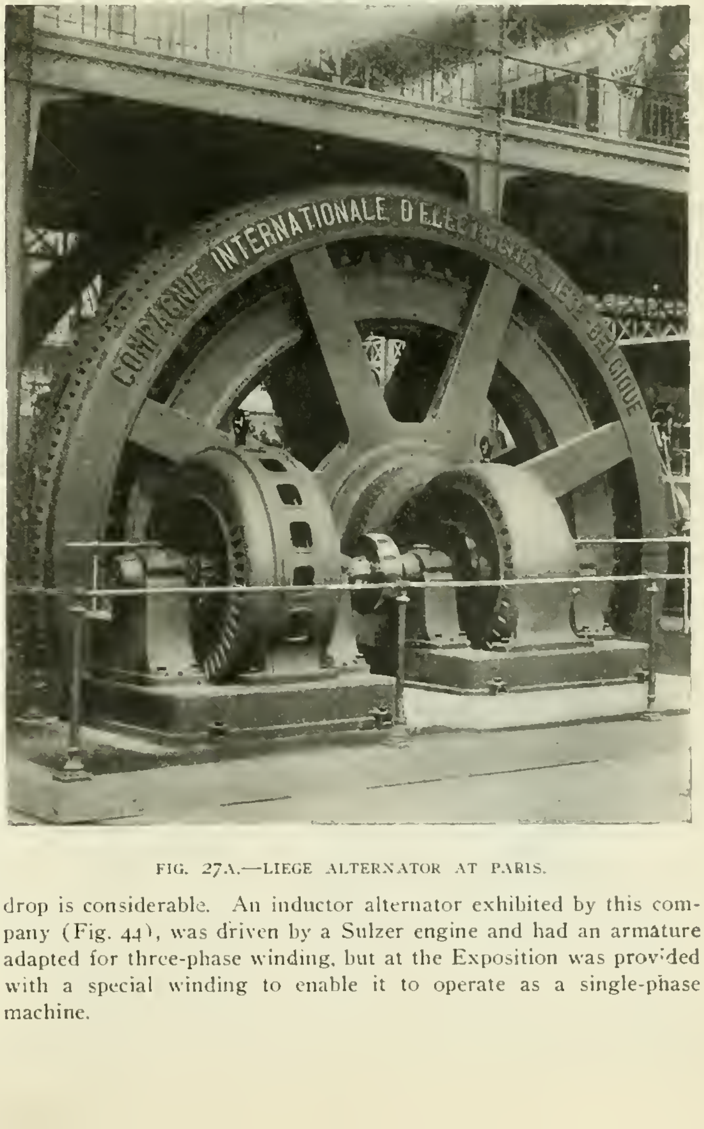
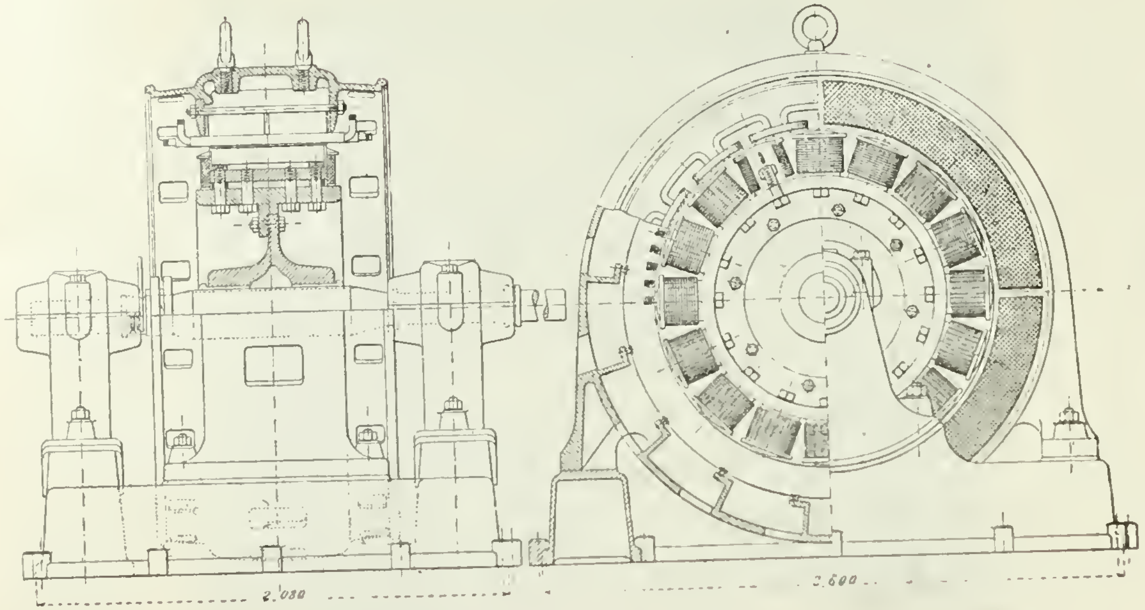
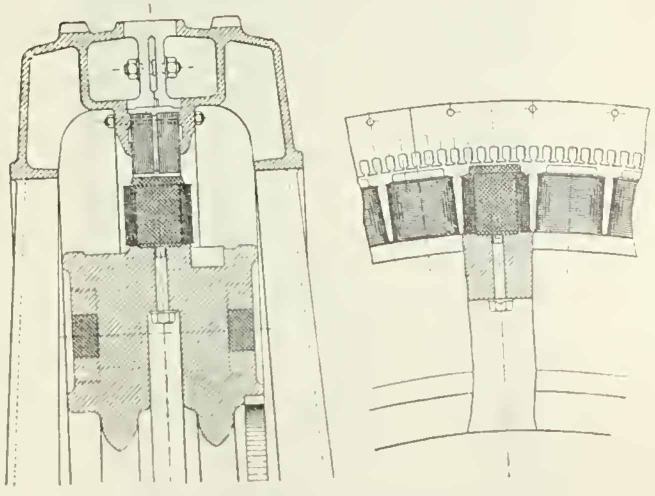


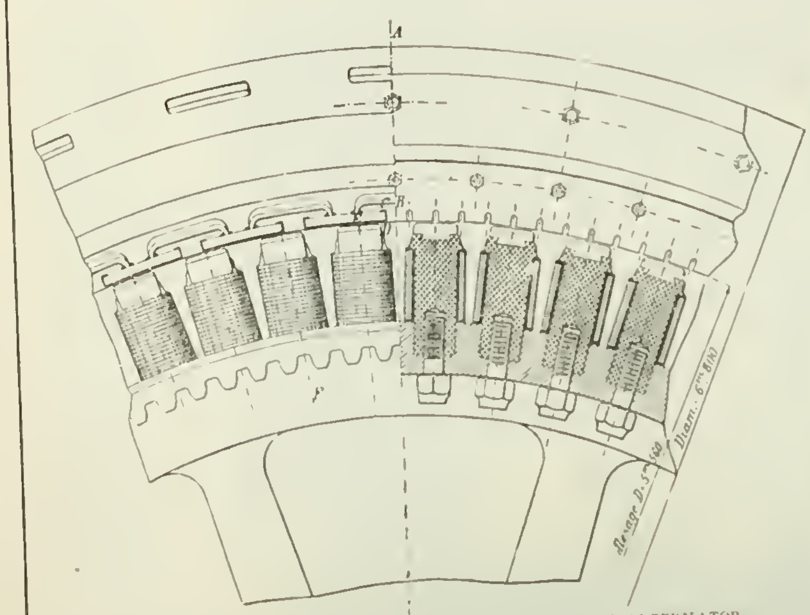
FIG. 27A.—LIEGE ALTERNATOR AT PARIS.



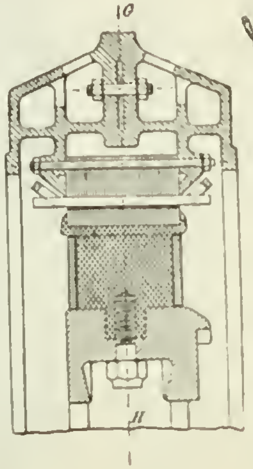
FIGS. 24 AND 25.—THURY ALTERNATOR.

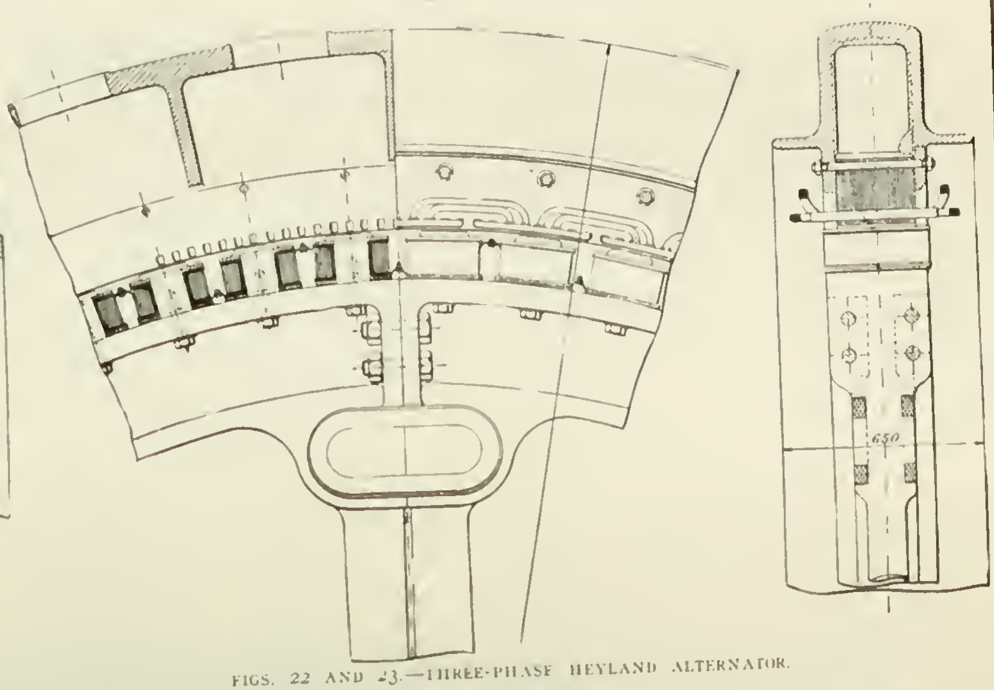


FIGS. 26 AND 27.—LIEGE ALTERNATOR.

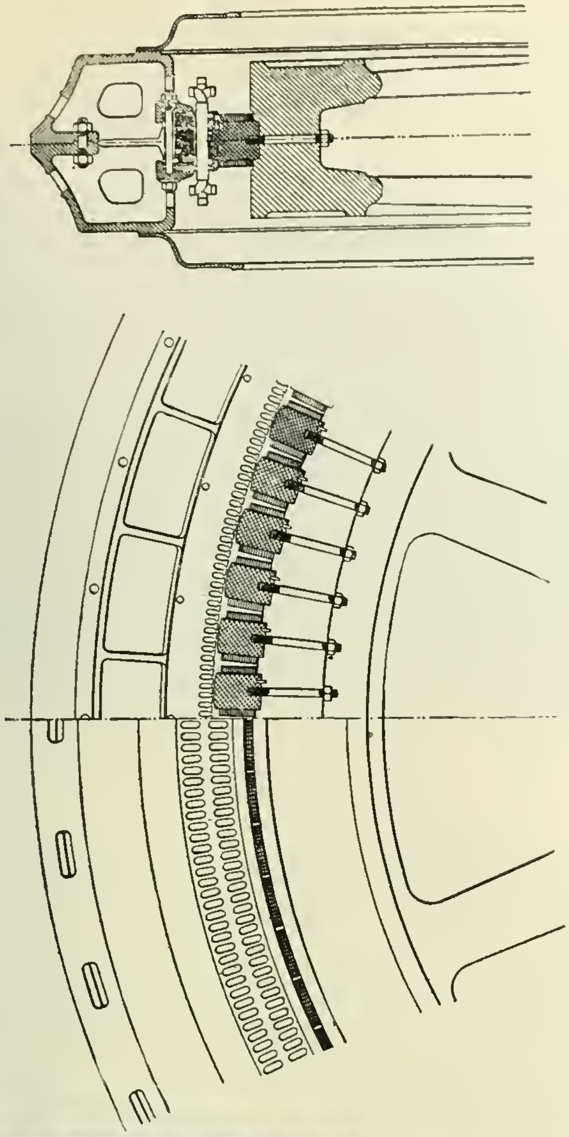


FIGS. 20 AND 21.—KOLBEN ALTERNATOR

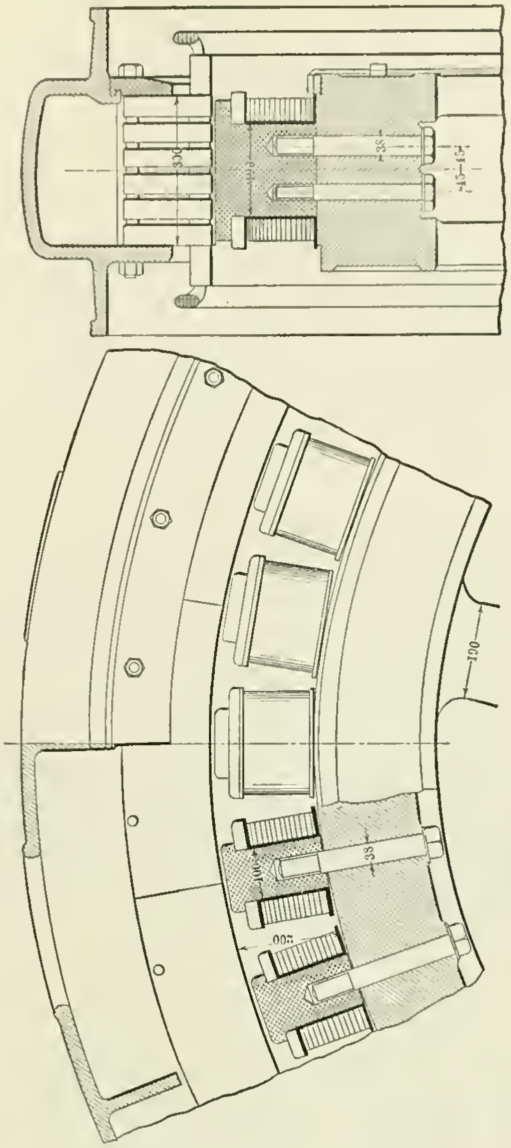




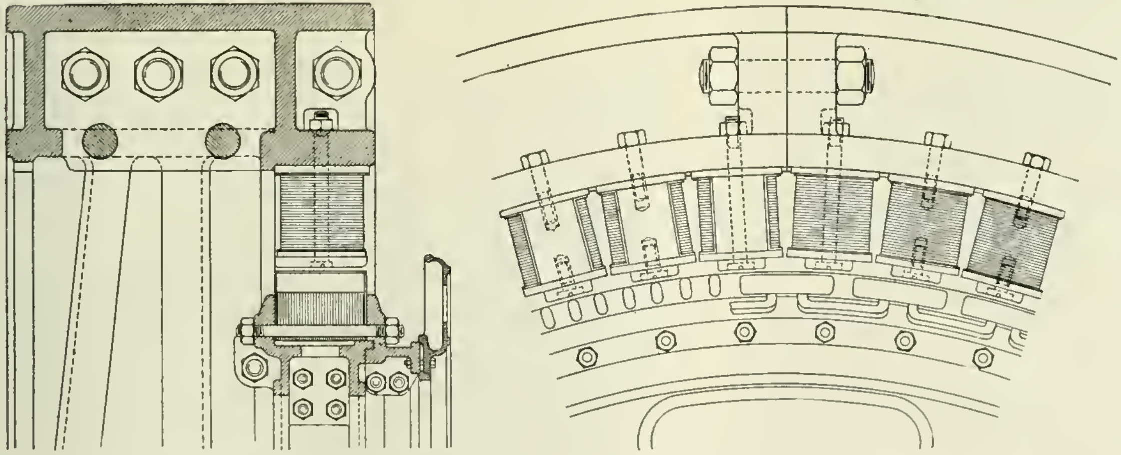
FIGS. 22 AND 23.—THREE-PHASE HEYLAND ALTERNATOR.



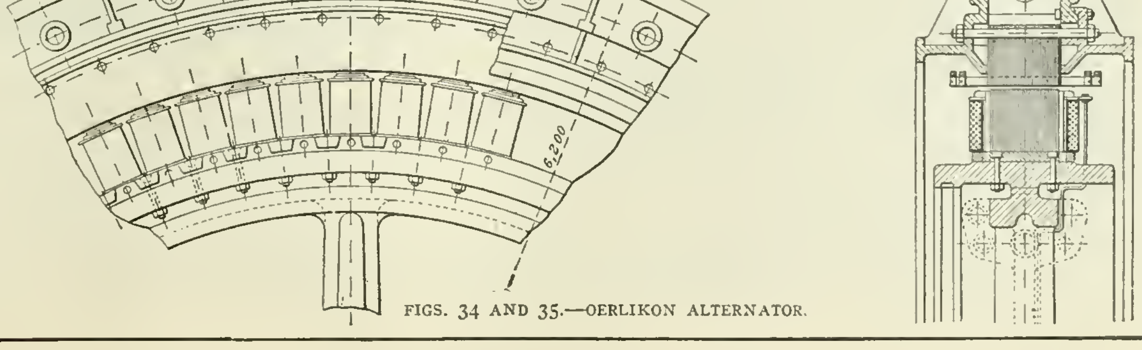
FIGS. 28 AND 29.—CREUSOT ALTERNATOR



FIGS. 30 AND 31.—HEYLAND SINGLE-PHASE ALTERNATOR.



FIGS. 32 AND 33.—RIETER ALTERNATOR



FIGS. 34 AND 35.—OERLIKON ALTERNATOR.

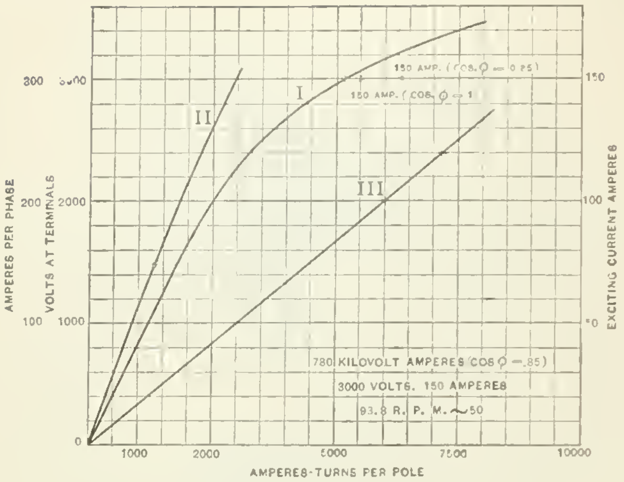


FIG. 36.—KOLBEN ALTERNATOR.

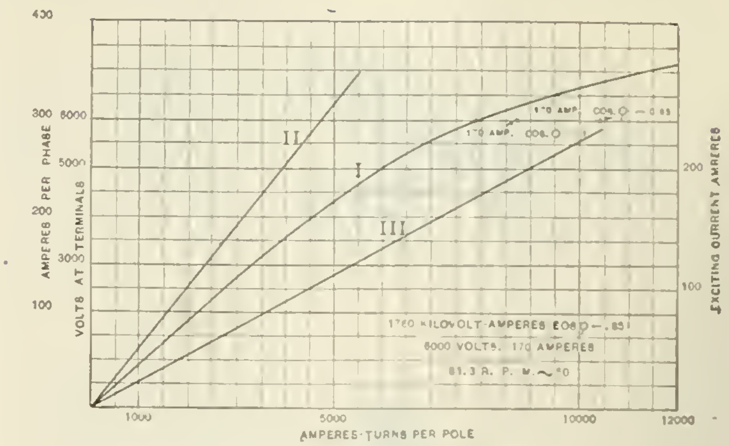


FIG. 40.—BROWN-BOVERI ALTERNATOR.

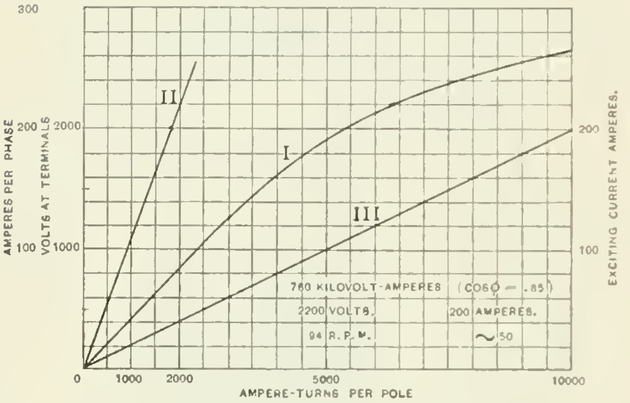


FIG. 37.—HEYLAND ALTERNATOR.

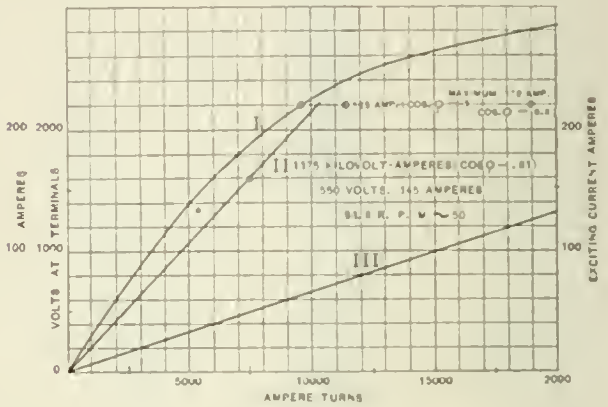


FIG. 41.—OERLIKON ALTERNATOR.

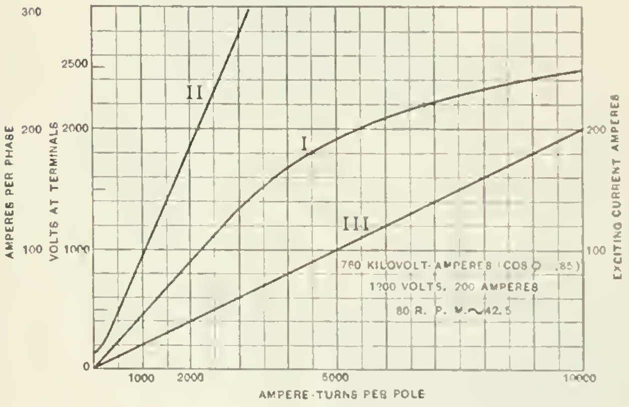


FIG. 38.—HEYLAND ALTERNATOR.

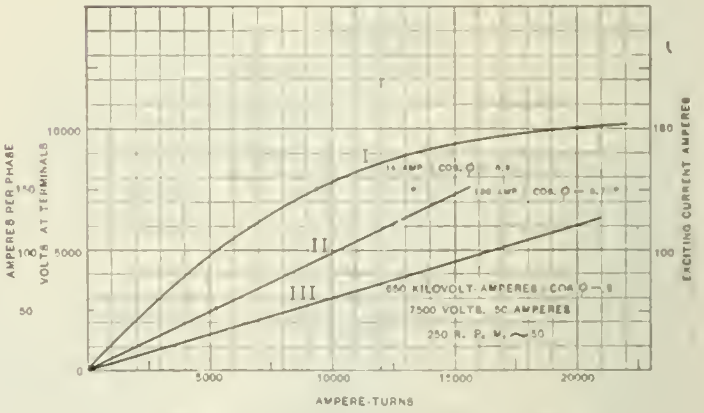


FIG. 42.—OERLIKON POLYPHASE ALTERNATOR.

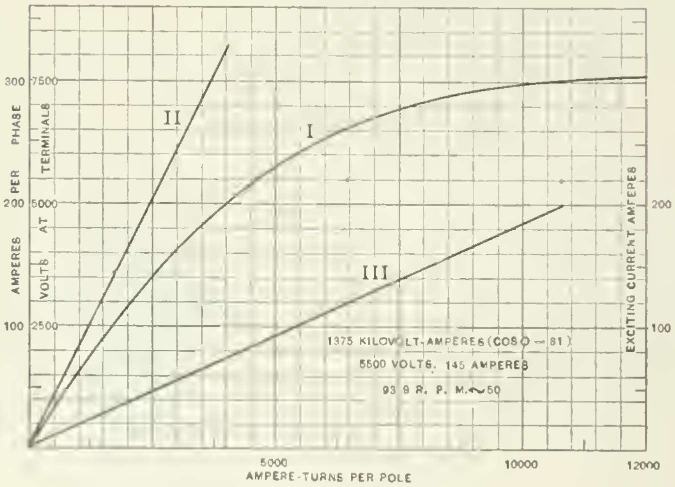


FIG. 39.—OERLIKON ALTERNATOR.

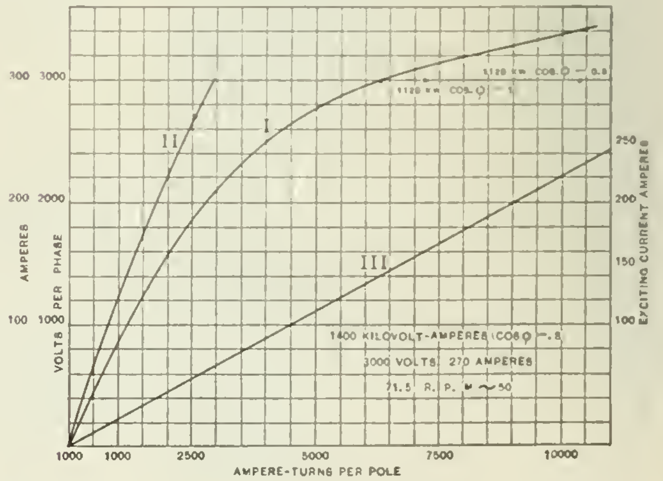


FIG. 43.—CREUSOT ALTERNATOR.

I.—No-load Characteristic. II.—Short-circuit Characteristic. III.—Excitation line.

CHARACTERISTICS OF ALTERNATORS.

RIETER ALTERNATOR.

The alternator exhibited by the Rieter et Cie., of Winterthur (Figs. 32 and 33), was direct connected to a tandem compound Sulzer engine, and was the only machine at the Exhibition having a fixed armature placed in the interior of the field—an arrangement particularly appropriate where it is desired to increase the flywheel effect. The frame of the armature could be turned in pedestal bearings so as to make any part of it accessible.

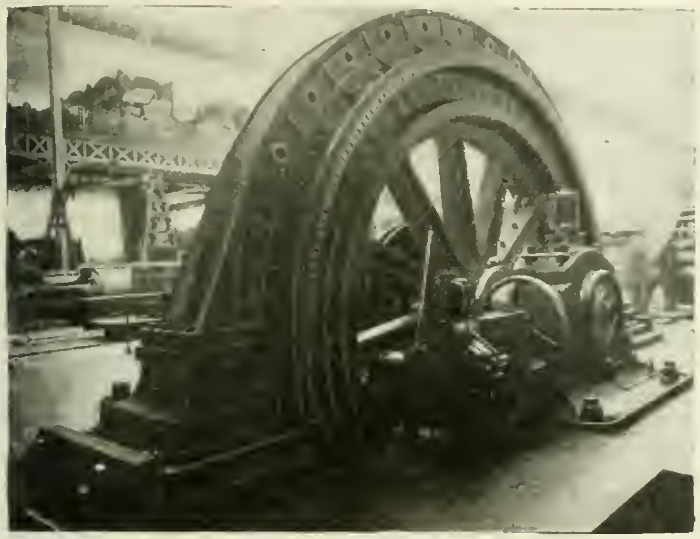


FIG. 44.—OERLIKON ALTERNATOR AT PARIS EXPOSITION.

THURY ALTERNATOR.

The Thury alternator exhibited at Paris (Figs. 24 and 25), was driven by a vertical Escher-Wyss engine, and was one of the two two-phase machines shown in the Exposition. A feature of interest in this alternator consisted in radial grooves in the field poles analogous to those in certain direct-current machines, and having for an object, as in the latter machines, to reduce the armature reaction flux. The drop in this machine is quite small.

GANZ ALTERNATOR.

Schneider & Co., Creusot, exhibited an alternator (Figs. 28, 29 and 43), driven by a horizontal triple-expansion Dujardin engine, which, though a Ganz machine in design, differed in appearance from the Ganz alternators exhibited in the Hungarian and Austrian sections. All the coils of the same phase are similarly placed. In order to facilitate dismounting of the machine, the winding at the joints of the frame has been partially omitted. The fixed part of the machine comprises two half crowns assembled on a horizontal diameter and supported by two lugs fixed on the armature at surfaces slightly vertical, thus permitting the dismounting of the upper half crown in case of necessity.

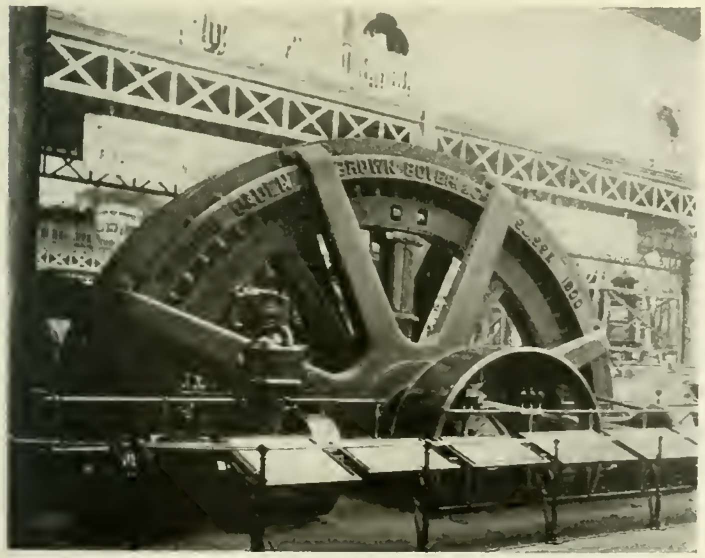


FIG. 45.—BROWN-BOVERI ALTERNATOR AT PARIS EXPOSITION.

Work of the Signal Service Corps in China.

It has been asserted and generally understood that the Japanese troops were first to enter Pekin with their telegraph field line on the famous "relief expedition." The report of the chief signal officer claims this honor, however, for the American Signal Corps, and after describing the preliminary stages of the work done by Col. James Allen to get an equipment from Manila to China and to Tientsin, he gives the following narrative of the course of events:

The conditions under which these operations were conducted in the field were most trying. They entailed not only marching as fast as the army and the construction of a telegraph line equal in length to the daily marches, but also the establishment of telegraph stations at night, their dismantling in the morning, and the dispatch of telegrams during a considerable part of the night. The difficulties were greatly enhanced by the fact that for days at a time the detachment was obliged to work without escort or any protection other than reliance on its own members.

Most unfortunately, this labor, exhausting at the best, was done under most unfavorable climatic conditions, the heat being so excessive as to frequently disable for hours the most energetic men of the Signal Corps. Many of the Chinese laborers were prostrated, and in one day two of them dropped dead from heat and overexertion.

Lieut. Stamford was alive to the necessities of the occasion, realizing that the nearest telegraphic force was two days behind him. This was the military telegraph organization of the Japanese army, which, being near home, not only had its full equipment, but also a force of 100 enlisted men and 20 or more army carts. As it was, all telegraphic reports of advance operations of the allied armies in the march to Pekin necessarily passed over the Signal Corps line. The occupation of Pekin was thus reported.

It is to be added that during the advance the first information as to the capture of Yangt-sun, on Aug. 6, was received from Major Scriven, Signal Corps, although his telegram of that day was delayed three days in transmission—doubtless owing to the demoralized and congested condition of the Chinese land lines between Chefoo and Shanghai.

In view of the trying and unfavorable conditions recited, it is a source of gratification that the Signal Corps detachment justified the confidence placed in it by General Chaffee and by the chief signal officer. Through the labors of Lieut. Stamford's men the American army carried the first telegraphic wire into Pekin, where the first telegraph office was installed in the house of Minister Conger.

Fortunately, this action permitted General Chaffee, in Pekin, to extend courtesies, in the way of transmitting telegrams, to officials of the British, Russian, French, German, Italian and even Chinese governments, and likewise to the press.

So strenuous were the labors of the enlisted Signal Corps men, both before and after their arrival at Pekin, that it was with difficulty that telegraphic work was maintained at Pekin, owing to the large number of operators incapacitated by sickness.

The Proposed German-Dutch Cable.

The *Deutsche Wochenzeitung* announces that Germany has come to terms with Holland with regard to providing the Dutch East Indies with a cable system which shall be free from British control. According to the project a main line will be laid to Shanghai, and thence branch lines will be laid northwards to Kiao-chau, eastwards to Japan and the United States, and southwards to the Indian Archipelago. The southern line will first touch land on the Bismarck and Caroline Islands. It will then take a westerly course, and passing through the Dutch Indies by a circuitous route so as to avoid any British possessions, will be brought to land on the North Natuna Islands, which are to form the terminal point of the Dutch Indies cable. The authorities of the Dutch Indies will lay the three following cables; a cable from the Natuna Islands to Pontianak, Billiton, Banka and Palembang, in connection with the land telegraph, which crosses the interior via Kalianda through the Sunda Straits to Anjer, and finally reaches Batavia; a direct cable between Palembang and Batavia, and a cable from Macassar to Amboyna. At the latter point Germany will resume the laying of the cable in order to take it to German New Guinea, where a junction will be made with the main line. It is believed that Germany will set about the work at once.

The Evolution of the Stock Ticker.

By Edward A. Calahan.

OPPOSITE the Stock Exchange, on the site of the present Mills Building, in Broad Street, New York City, there stood in 1867 an old building tenanted almost entirely by members of the rival stock exchanges, viz: "The Regular Board," the "Open Board," "Long Room" and the "Gold Exchange." A large room on the ground floor of this building had been divided by a partition. It had one main entrance from the street to a V-shaped hallway, from which entrances to the offices of two prominent broker firms were situated. Each firm had its own army of boys, numbering from 12 to 15, whose duties were to ascertain the latest quotations from the different exchanges. Each boy devoted his attention to some particularly active stock. Pushing each other to get into these narrow quarters, yelling out the prices at the door and rushing back again for later ones, the bustle made this doorway to me a most undesirable refuge from an April shower. I was simply whirled into the street.

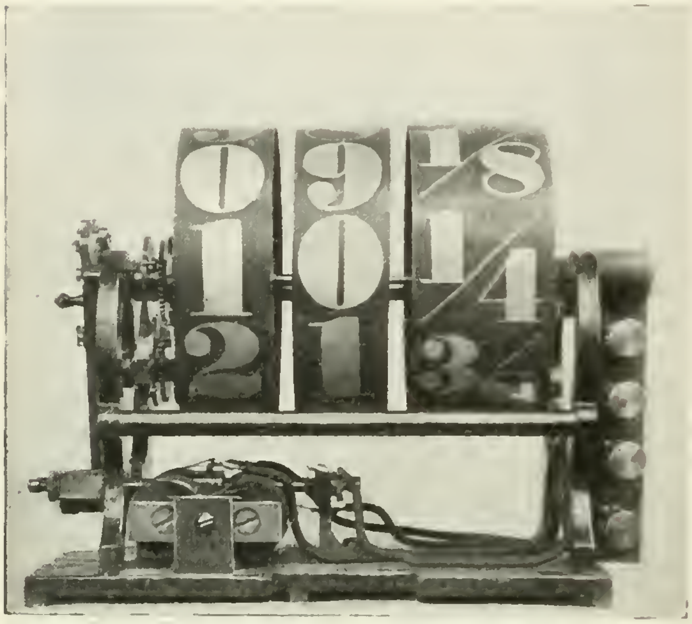


FIG. 1.—LAWS GOLD INDICATOR.

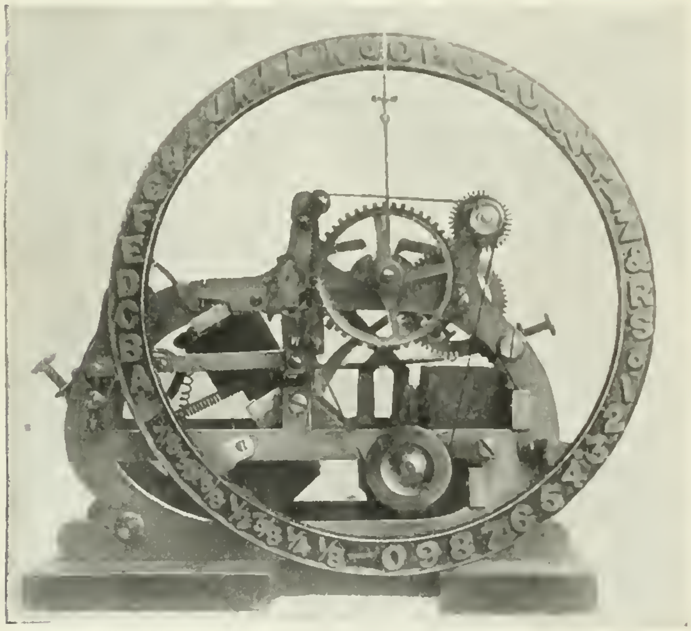


FIG. 2.—LAWS STOCK PRINTER.

This being my first experience in this locality during the active hours, I naturally thought that much of this noise and confusion might be dispensed with and that the prices might be furnished through some system of telegraphy which would not require the employment of skilled operators, who at that time were much in demand on the regular lines.

The conception of the "stock ticker"* dates from this incident. Gold at that time being at a very high premium, the fluctuations, which were quite frequent, were more interesting to the general public than were the prices of stocks. Yet the latter were often seriously affected by them.

Within a few weeks I devised an "indicator" for showing the price of gold at each fluctuation. This consisted of two dials, separately mounted, and each revolved by the direct action of an electro-magnet until the desired figures were brought to an aperature in the case in which the apparatus was enclosed. Each shaft containing its dial was provided with two ratchet wheels, one the reverse of the other. While one was used in connection with the propelling lever, this lever was provided with a lug to fit into the teeth of the reversed ratchet wheel on its forward movement, thus making it practically impossible for either dial to go by momentum beyond its limit.

On exhibiting this, I received encouragement to proceed. After constructing a few of these indicators, we found that we were anticipated in that field by Mr. S. S. Laws, who had secured the exclusive right from the Gold Exchange to send out the price of gold on visual indicators. While he had none of his indicators placed in a single subscriber's office, nor his lines constructed, we concluded to take up the more difficult problem of quoting stocks, which would be impracticable on an indicator or a series of indicators.

I at once transformed an "indicator" into a "stock ticker" making a printed record. This I accomplished by removing the two dials and substituting type wheels, and turning the movements face to face so that each type wheel could be impressed upon a paper tape in two lines. One wheel contained the letters of the alphabet and the other the figures and fractions and a few letters. It was then necessary to provide means for taking the impressions, inking the wheels and feeding the paper tape. The question then arose as to the form of the instrument; whether to construct it as a single wire instrument, which would be very complicated, expensive and unreliable, since it must of necessity be semi automatic, or whether to construct it in the simplest possible form, using three wires, one for furnishing power for rotating the alphabet wheel, the second for the figure wheel and the third for taking the impressions from both wheels.

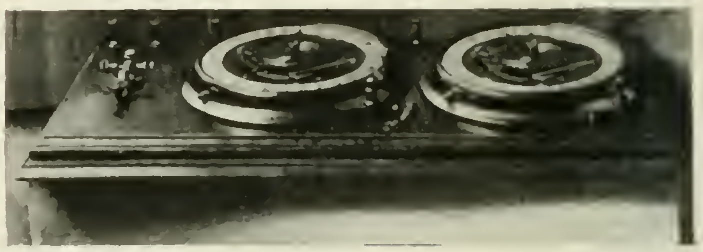


FIG. 3.—ORIGINAL TRANSMITTER, FIRST CALAHAN STOCK PRINTER.

Many buildings contained from thirty to forty brokers' offices. The necessary lines or wires would be largely internal and therefore not subject to interruptions from the elements or other causes. This would be comparatively inexpensive when the complication in each instrument, if constructed on the single-wire plan, were to be considered. I concluded to adopt the three-wire system. Nearly eighteen years of practical work was an endorsement of such conclusion.

At this time there were no less than six general telegraph companies competing for the business of the brokers. Nearly every housetop in the neighborhood was cobwebbed with naked or uninsulated wires. I felt that to trust our system to the danger of contact with any of them would result in failure to our enterprise, and that insulated wires only should be used. I had much difficulty in impressing my associates with the advisability of resorting to this innovation (for such it was at that time). The difference in cost then was about 40 to 1 in outside construction. I received much gratuitous criticism from the Western Union wise heads for my extravagance. That company was not then interested in the quotation business.

Having thus developed the ticker, the Gold & Stock Telegraph Company was formed for the purpose of putting it into practical use. A working model in an office not connected with any lines or wires was not very convincing or alluring to the brokers. It was therefore with much difficulty that we secured the names of thirty-six members of the different exchanges as subscribers.

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* The name "ticker" was given to this instrument by a lounger in a broker's office and for some reason was adopted by the public. The different companies advertising their "tickers" in the windows of barrooms and restaurants served to endorse this meaningless and most inappropriate name.

In December, 1867, we placed the first ticker in the office of David Groesbeck, and on the following day in the offices of Work, Davis & Barton, and Greenleaf, Norris & Company, and a few days later in the office of Lockwood & Company, each in the order of their subscription.

Before the fourth ticker was fairly in position our subscription list had increased to about 100 without any effort on our part. Demonstration was all that was necessary. At the end of the first year we had about that number of subscribers beyond our ability to place machines in circuit, although four manufacturers were working their shops full time on contracts to supply these tickers. The brokers were clamoring, many claiming that we favored members of one or the other exchanges. In consequence of such a demand we found it necessary to increase our modest capital from $200,000 to $500,000, paying 12 per cent on the latter. Within the first year the capital was again increased, this time from $500,000 to $1,000,000, and 10 per cent dividends were paid. With such immediate and astonishing success, it was scarcely to be expected that we would be permitted to enjoy the fruits of our labors without competition. Our first competitor was S. S. Laws, whose gold indicator plant we respected by not opposing it. He followed my plan of using the same movement for his type wheel that he employed in his indicator apparatus. It was a "three-wire system." One wire was used to furnish the necessary power for propelling the single type wheel forward, another to propel it backward, and the third for taking the impression and bringing into action a unison device which will be referred to later. The transmitter consisted of three ordinary Morse keys, one each for the advance, the retrograde and the press. He retired early from the field, selling both his gold indicator and his stock ticker plants to the Gold & Stock Telegraph Company. This company at once discontinued the latter, but continued the gold indicator plant until gold ceased to be quoted at a premium.

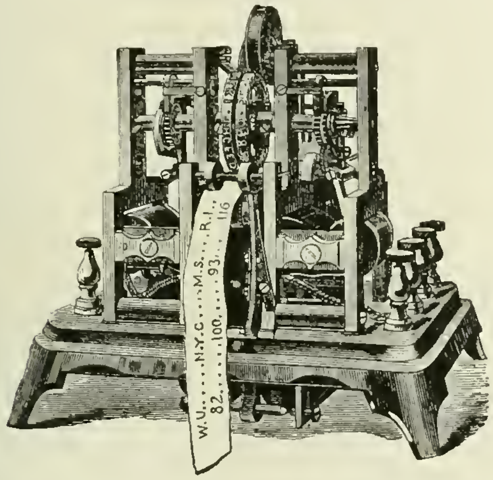

FIG. 4.—CALAHAN'S STOCK PRINTER.

Edison next produced a ticker which was designed to use two type wheels, fastened together on the same shaft, and to be worked on one wire. A polarized switch was used to transfer the current from the type-wheel magnet to the press magnet, and vice versa. These type wheels, while fastened together, had a lateral motion on the shaft. They could at the desired time be moved, the letter wheel shifted directly over the impression pad, and alternately the figure wheel took that position. The pad was only large enough to take the impression of one wheel at a time. This was changed later. Instead of the type wheels conforming to the pad, the latter was made to conform to the type wheels. Lines were constructed to the offices of the members of the Cotton and Produce Exchanges. This ticker proved a failure from the beginning, and an additional wire was run to each subscriber's office, the polarized switch was removed, and it was therefore transformed into a two-wire ticker. As such, it was only a partial success, owing principally to inferior workmanship. It was replaced by a ticker invented by G. M. Phelps, which was vastly superior in workmanship, speed and accuracy, but more expensive and delicate, which may account for its limited use. It was expected to revolutionize the stock ticker business. It contained some of the Edison devices, among them the unison and the shifting devices. As both the Edison and the Phelps tickers were the property of the Gold & Stock Telegraph Company, they are not here classed among the competitors. After Laws, came Gallaher and many others who did not remain in the field long enough to be recorded. The next was the Manhattan, with a ticker invented by Mr. J E. Smith. Its principal features were that the name of the stock and the price were printed in a single line from a single type wheel, and it was provided with a unison device. As that company had secured a number of subscribers in various lines of business without taking any from the G. & S Company, it was absorbed by the latter company before it became a real rival.

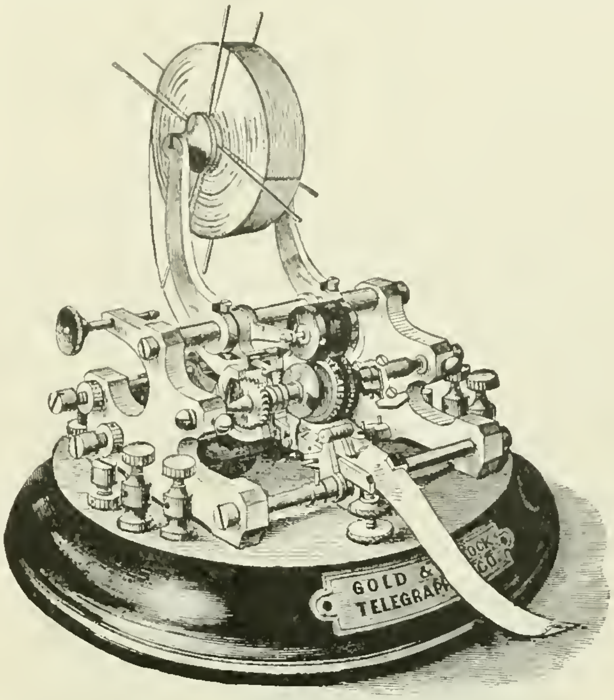

FIG. 5.—UNIVERSAL STOCK PRINTER.

The increased activity of the business on the Stock Exchange made it necessary for the Gold & Stock Company to increase the speed of its tickers. This was accomplished by substituting a star wheel for the reverse ratchet wheels. By this change each forward and back action of the lever moved the type wheel one point, while with the reversed ratchet-wheel device the type wheel was moved by the forward action only. An increase of nearly double the number of cells of battery, already numbering more than 1000, was necessary, the battery being the direct and only power used. The Manhattan was followed by the Commercial. They ignored all patent and other rights, and entered the field with a much superior apparatus, the production of Mr. Stephen D. Field. It became a most formidable rival. Two

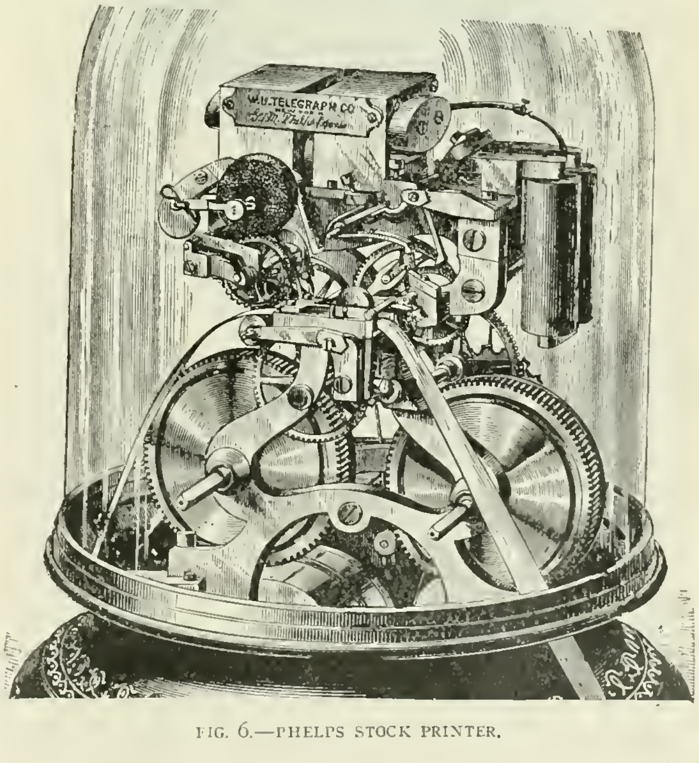

FIG. 6.—PHELPS STOCK PRINTER.

type wheels were employed, mounted on separate shafts with a weight and clockwork for motive power. It was very rapid, and contained many novel features, and is to-day without a peer.

The competition was so sharp that the subscription price fell from $25 to $10 per month, while the actual cost to the Gold & Stock Company was $13 per month per ticker. This condition could not last indefinitely, therefore a suit was brought against the Commercial Company for damages caused by infringing the Calahan patent, and a judgment was rendered in favor of the patent for $266,000. This patent having expired a few months later, the Commercial Company remained in the field.

The name of the stock and the price printed in two lines on the same tape became so popular with the subscribers that any single-line printer would not be accepted by them. This fact was well known to the Commercial people, who paid the penalty for infringement as above stated. Anticipating the expiration of the Calahan patent and in order to keep pace with the increased business of the Stock Exchange, and also in view of the Commercial Company's fine ticker, it was necessary for the Gold & Stock Telegraph Company to produce one which would be equal if not superior to all others. That company was the owner of numerous patents from which all the necessary devices could be assembled without fear of infringing any existing patent. Mr. Geo. B. Scott produced an instrument which was not only very rapid, but was in every way all that could be desired. Were it not for the rupture between the Gold & Stock Telegraph Company, and the New York Stock Exchange, the Scott ticker would without doubt be the official recorder of the New York Stock Exchange.

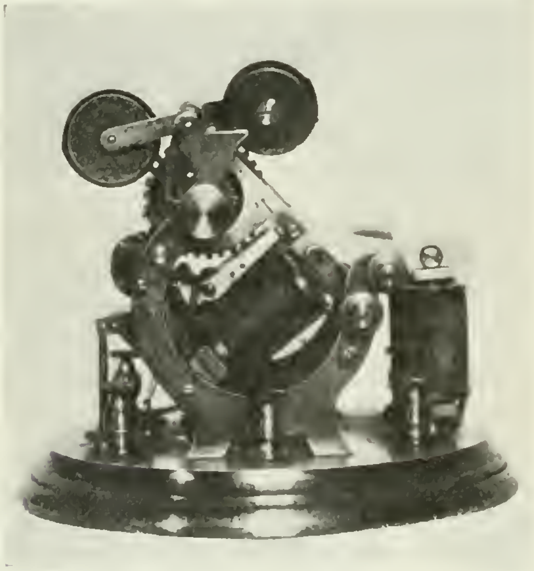

FIG. 7. MODIFIED CALAHAN TICKER.

The Gold & Stock Telegraph Company being so many years in the Stock Exchange felt that it was irremovable. It refused to submit to what the general public would consider a reasonable request, with the result that it was practically expelled, and the defeated "Commercial" became its successor and the official ticker of the New York Stock Exchange. The Gold & Stock is now on the outside, taking subscribers from any but Stock Exchange members. The Consolidated Exchange followed in the same line, and adopted as their official ticker one used and owned by the Stock Quotation Telegraph Company to the exclusion of all others. It is a very neat, fast and reliable instrument, the invention of Mr. A. Wirsching. It has recently been improved by Mr. John Burry, who dispenses with the weight and adds, without diminishing the speed, a small and simple device called a self-winder.

A "ticker" at the present time would be considered as impracticable and unsalable if it were not provided with a unison device, either automatic or controlled by the transmitting operator. My first tickers were provided with neither, and yet it was at least four years before such an attachment was made. In my original tickers the shaft of each type wheel extended slightly outside the frame. A small pointer was inserted in this shaft, and a slot was cut in the frame. When both together, they corresponded with the zero point on the type wheel, and with the transmitter. The same on the other shaft. When from any cause one of the wheels was thrown out of correspondence with the transmitter, a subscriber or office boy would bring the points to unison by hand. This means appeared to be satisfactory.

Mr. Henry Van Hoevenbergh invented a special device which was very successful. Briefly described, if one of the type wheels fell behind, the other wheel would pick it up while passing and leave it at the zero point, and still go on its journey. The delinquent wheel would perform the same service for the other one under like circumstances. This being fully automatic, no time was consumed in bringing the whole system to unison as in all other devices, because of one ticker falling behind.

The first unison device on stock tickers was one used on the Laws printer. It was a crude and unsatisfactory piece of mechanism, and necessitated the doubling of the battery in order to bring it into action. It was short lived. The Edison unison comprised a lever with the free end traveling in a spiral or worm on the type wheel shaft until it met a pin at the end of the worm, thus obstructing the shaft and leaving the type wheels at the zero point until released by the printing lever. This device is too well known to require further description. It is not applicable to any instrument using two independently moving type wheels, but on nearly if not all other instruments will be found in use.

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Exports of Manufactures.

No feature of the exportations of the calendar year 1900 has been more remarkable than that of manufactures of iron and steel. When the total for 1899 passed the $100,000,000 line much surprise was felt in other parts of the world, and the opinion was expressed at home and abroad that the high prices which prevailed in the beginning of the year would cause a reduction of these exports rather than an increase. This expectation has not been realized. On the contrary, the year 1900 made even a larger gain than did the year 1899, and brought the grand total of iron and steel, exclusive of iron ore, up to $120,633,480, or more than $100,000,000 in excess of the year 1890, when the total was a little above $27,000,000, and more than double that of 1897, when it was $62,737,250.

Almost every important article shows an increase in 1900 over any preceding year. Pig iron amounts in 1900 to $4,500,000 against $3,225,000 in 1899, and $2,500,000 in 1898. Builders' hardware shows a gain of about $1,000,000 over 1899, and $2,000,000 over 1898. Steel rails amount in value to nearly $11,000,000 in 1900, against about $6,000,000 in 1899. Electrical machinery, which is greatly in demand in all parts of the world, increased from $2,500,000 in 1898 to $5,225,000 in 1900. Sewing machines increased from $3,000,000 in 1898 to $4,500,000 in 1900, and typewriters from $2,000,000 in 1898 to nearly $3,000,000 in 1900.

The destination of the articles of American manufacture, and especially of our machinery, is literally to every part of the world. Our sewing machines, typewriters and scientific instruments go to Asia, to Africa and to the islands of Oceania; and what is more remarkable, they go to experienced Europe with all her facilities for manufacturing and her skilled workmen. Of the $9,788,000 worth of instruments for scientific purposes, including telephone and telegraph instruments, over $1,000,000 worth went to the United Kingdom alone, nearly $1,000,000 worth to France, and $500,000 worth to Germany. The United Kingdom and Germany each take over $1,000,000 worth of our sewing machines out of a total exportation of $4,500,000 worth. Over $1,000,000 worth of typewriters actually went to the United Kingdom, and $500,000 worth to Germany. Of the total exportations of builders' hardware, amounting in value to $9,782,402, over $2,000,000 worth went to the United Kingdom, nearly $1,000,000 worth to Germany, about $500,000 worth to France, and another $1,000,000 worth to other parts of Europe. Of the $10,895,416 worth of steel rails exported in 1900, over $1,000,000 worth went to Europe and nearly $4,000,000 worth to British North America.

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Platinum vs. Copper.

The London *Daily Mail* is authority for the marvelous statement that the British Post Office authorities are considering the use of "platinum" as a substitute for copper! Fortunately "it has been practically decided not to use plantinum wire unless some means can be found to toughen it." Wonder if the *Mail* means "aluminum"?

Electrical Illumination at the Beginning of the Twentieth Century.

We brief below a lecture by Dr. Louis Bell on "Electric Illumination at the Beginning of the Twentieth Century," given at the station of the New York Gas & Electric Light, Heat & Power Company, Duane Street, New York City, before the New York Electrical Society, on Wednesday, Jan. 30, 1901.

In his opening remarks Dr. Bell said he would not speak of the science of electric lighting, but rather of the art of electric illumination. The art has been as much neglected, perhaps, as the science has been cultivated. He did not propose to waste any time in explaining the doctrine of the electric current, which he would take for granted, and take the appliances which we have for granted, and try to briefly explain what we can do with them in the way of getting illumination, which is, after all, the object for which the whole science of electric lighting has been developed.

To begin with, there is generally a good deal of misconception as to what we want by artificial illumination. There are two radically different doctrines, one may say, although they have not been formulated as doctrines, with regard to electric lighting and to artificial illumination of all sorts. One is that when we do artificial lighting we must try to vie with Nature herself, beat Old Sol at his own game. The other recognizes some of the limitations which finite intelligence and finite resources have imposed upon us, and goes at the subject of illumination, not as rivalling the illuminants of Nature, but merely as furnishing such amount of light as we actually need for some useful purpose. Our grandfathers, or great grandfathers, as it may be, did all their reading by the light of the tallow dip, save and excepting such of them as rose to great fame and did their reading by the light of pine knots, which was considered a sign of great genius for many centuries. These two views of electrical illumination have come from, on the one hand, a lack of comprehension of illuminants, and on the other hand, from a realization of what the actual conditions are when we attempt to furnish artificial light.

To begin with, at the present time it is safe to say that more illumination fails from being too bright than from not being bright enough. By too bright is meant too intense, as will be presently shown. The eye is a very curious optical instrument. Helmholtz used to say it was one of the worst optical instruments with which he was acquainted; that if an instrument maker had sent him such an instrument so badly constructed with reference to all scientific principles as the human eye, he would send it back, with thanks. Nevertheless, it has one peculiarity, one power, which is the basis of all our attempts at artificial illumination, which makes it possible, practically, to get artificial illumination, and that is the human eye can work over a tremendous range of brightness and still do its work effectively. We can read in brilliant sunlight, or by the light of a single candle, with fair comfort in both cases, although the candle is nearer than the sunlight. It makes comparatively little difference whether we read by the light of one of these arc lights or a single candle, so far as comfort goes. For other purposes the arc light is very valuable, but the eye itself gets along very comfortably, even when the amount of light is considerably reduced. That comes from the expansibility of the iris of the eye, widening or narrowing the pupil, in accordance with the demands of the occasion. Cats, bats, owls and all nocturnal animals have a tremendously expansive pupil, as you know; the cat's ranging from a mere infinite narrow slit to a full and wide pupil, as night comes on. An eye contracts ten or a dozen times less than its maximum dimension when a brilliant light comes on. As the light increases the pupil contracts; as the light decreases the pupil expands, letting in more light, and so enabling us to work satisfactorily with all sorts of artificial light.

Think, for a moment, what would happen if we had to have the equivalent of daylight to do our work, or have our pleasure, in the evening. It would be substantially impossible to furnish the equivalent of daylight, except with an enormous number of arc lights. Fortunately, the eye is so constituted that, provided we work within a fair range of illumination, we get along very well; and that, moreover, enables us to produce some of the most useful effects which we get from artificial illumination.

Whatever the source of illumination, there are some fundamental principles we must not forget in trying to do artificial lighting. The first is that the source of lighting ought to be unobtrusive, and, if you stop to think of it, that is the direction in which most artificial lighting errs. Instead of the source being unobtrusive, it is obtrusive, even unpleasantly so, and instead of helping the vision, often hinders it, for the reason that a bright point of light in the field of vision causes the pupil to shut up and protect itself and lessens the amount of light entering the eye, so that one cannot see with anything like the convenience which the amount of light would indicate. Excessive brightness of a particular spot is a thing to be avoided in all illumination. That is the reason for globes enclosing the lamps. The eye sets itself as regards the width of the pupil, as regards the effective aperture through which light falls on the retina, approximately to suit the brightest point in the field of vision, and as a result of that a very bright light dazzles the eye, and makes it extremely difficult to see objects which are not given bright illumination and causes trouble. Any one driving along a street or road, particularly in the suburbs, particularly where there have been shadows, on a road illuminated by electric lights, realizes how difficult it is to see beyond them. At the time we had the towers, with large lights, at Hell Gate and along the entrance to the Sound, there was constant complaint from the pilots of various boats that the lights bothered them. At that time the persons who put the lights there turned up their noses and said, "That cannot be; we are giving you fine illumination." So they were, but they were giving it from radiants so bright that the eyesight of the pilot was somewhat dazzled, the pupil contracted, and light coming from objects beyond and around, not equalling in brilliant illumination the lights in question, did not make sufficient impression upon the eye; in other words, you cannot see across a brilliant light.

A very little experience with the arc light convinces us that, although it is a magnificent light, the light is unsatisfactory because it gives too much light in one place. The increase in brilliancy in arcs of that character is enormously great. It amounts to, say, 30,000 to 50,000 candle-power per square inch of radiant surface, and that is a brightness of which it is really hard to form any conception. Imagine, if you can, 10,000 candles concentrated in the flame of a single candle, and you get some idea of the intrinsic brilliancy, the dazzling rays, that proceed from an unshielded arc light. Anything of that kind is simply bad illumination. It may be an extremely good light, but for illuminating purposes it is unsatisfactory, except in certain rare cases where, as in some of the early arc light experiments, the lights were put so high they would be out of the field of vision. Under these circumstances, when the rays would not fall directly on the eye, one could get along comfortably with the bright lights. On the other hand, the lights were put so high that the actual illumination from them was much reduced, so that one may say that the unshielded arc light has no place whatever as a general illuminant. There are cases where it is very valuable, but for general purposes it has been, as you see in this city, superseded by arc lights enclosed, not in one globe only, but two, with the inner globe immediately surrounding the carbon.

The intrinsic brilliancy of the arc light is the highest artificial brilliancy with which we have to deal. We have all the way from 20,000 or 30,000 to 50,000 candle-power per square inch in some portions of a very bright arc. Some estimates have run as high as 100,000 candle-power per square inch of radiant surface. The calcium lights, with which we were familiar as bright illuminants, have only 5000 candle-power to the square inch, while the ordinary incandescent light has only a matter of about 200 candle-power to the square inch. And even that is too bright. If you will look at it intently for a moment, you will see, when it is out, that you will catch an after-image in the eye of that bright filament. The after-image is a symptom of what may be serious effects on the eye if long continued. As a result, one can safely say that even the ordinary incandescent lamp, valuable as it is as an illuminant, is intrinsically too bright to yield entirely satisfactory results. That is the reason why people used to say so often—they are getting over it now—that the electric light was hard. What they meant by that was that it was too intense in its brilliancy; although giving an abundance of light, the brilliancy was too intense to give thoroughly satisfactory results as an illuminant. Better results are obtained from a smaller lamp of 8 candle-power against 16 candle-power in another, and provided with a ground globe. The result is that the brightest spot on which the eye has to dwell is very much less bright than the naked filament of the incandescent lamp. This brilliancy has fallen off, from being 200 to 250 candle-power to the square inch, to being, perhaps, a matter of 15 or 20 candle-power to the square inch. That means that the eye adjusts itself with reference to the brightness of the entire lamp, the central portion being the brighter, and the pupil does not close as far, and one can see almost as readily with one lamp as with the other. In fact, the smaller lamp with ground globe is preferable, for the reason that the brilliancy being less, the pupil of the eye is wider, the effective aperture for the light used much greater, and the ability to read much greater, than it is with the very brilliant light, such as is given by the other lamps. In view of the automatic adjustment of the eye for the maximum brilliancy with which it has to contend, it does not matter much how it is done, so that the light is diffused, and lamps of that kind give a much more satisfactory illumination than lamps with naked filaments, in spite of the fact that the grinding of the globe cuts off from 25 to 30 per cent of the total light, but the 70 to 75 per cent left is enormously more useful than the original 100 per cent, because the intrinsic brilliancy is lower, so that the eye adapts itself to the more favorable condition.

Another fundamental point in illumination, which is sometimes forgotten, and which is really important, is its direction. One would suppose at first that it would not make any particular difference what way light fell upon an object which is to be illuminated; whether you got it horizontally from the side, whether you got it from below or from above, yet, in point of fact, it has been found by long experience that light from above is much more useful than light from the side, or, particularly, from below. This is probably due to the fact that the eye, through the many centuries of its development in man, has gotten habituated to getting sunlight from above, rather than light from below. It is a well-established fact that light which comes from an abnormal direction into the eye is sure to produce fatigue in one way or another. For example, light reflected from snow is peculiarly severe and often produces a species of inflammation resulting in snow blindness. Not because of its great brilliancy, for it really is not any brighter than the sunlight, nor nearly as bright, but because it comes upward from the snow, entering the eye from an unfamiliar direction, and probably concentrating its strength on that part of the retina less able to bear that particular sort of pounding from a brilliant light. It has been found that blacking the lower eyelid with burnt cork will stop the development of the snow blindness. You cut out the ground light which comes from below and remove the principal cause of the irritation. So there are two things to be specially considered; first, the maximum brilliancy of the illuminant should not be very great; it should be rather moderate; it should not be obtruded on the eye, and the direction should generally be downward and not upward.

The foregoing leads to the value of diffused lighting. Anything like diffusion of light means there will not be any one particular point which is very brilliant. The brilliancy will be rather moderate. At the same time an enormous amount of light can be successfully diffused in practice, and on diffusion we depend for some of our most valuable results in illumination. You can easily get an idea of the amount of the diffused light in any room by a simple experiment: that is, by turning out the lights which are available, and then shielding yourself from the only source of light which you have left, when you will find, in spite of being in the shadow, considerable light will still be manifest all about you. A room with white walls will give two or three times the effective illumination, with the same radiant, as a room which is painted in dark colors. A white painted surface is the very best diffuser of light. A white surface will diffuse from 60 to 80 per cent of the light which falls upon it. The light shades of yellow, almost as much. The distinctly yellow shades are also admirable for diffusing light. Then come the shades of red and orange of various kinds. Then come the light blues, and, last of all, the very deep blues and the greens. A dark green is perhaps the worst diffusing surface that can possibly be found. A room light in color can be successfully lighted by diffusion alone, where there is no direct radiation falling upon the eye at all. Sometimes it is a very excellent scheme to avoid too brilliant radiance, also to get a correct direction for the illumination, by depending entirely upon diffusion. Diffused light is apparently not as efficient as the brilliant light you get from an unshaded arc. It takes, undoubtedly, a great deal more of energy to give an equal amount of light in candle-power; at the same time it is a question whether lights supplied in that way consume the same amount of energy as a single arc light would to give the same illumination in the room. It is safe to say that the diffused light will give a much better illumination in spite of its lessened gross amount, on account of the fact that the light comes from the direction which is most useful, and is faintly toned to a pleasant color by the slight tingeing of the ceiling.

Color is a matter of great importance to illumination, for two reasons and in two particular ways. In the first place, the color of the light which we are wont to receive is not white; it averages a rather yellowish white. We sometimes think it necessary to obtain extreme whiteness of illumination. An illumination of normal color, that is to say, a somewhat yellowish white, is the one to which we are all used, and by which we are wonted to judge the colors of objects about us. If one were judging colors, exclusively, the particular kind of light you would want would be daylight, or as close an approximation of it as could be obtained, so that we find in order to get a correct judgment of color it is sometimes necessary to have a clear white light, and that color we have to get practically by arc lamps. Deep colors are always unpleasant and entirely unsuited to any practical illumination. In general, it is safe to say you cannot trifle with the color of your illuminant without producing disagreeable results; it makes no difference what the exact shades are. It is very desirable to confine one's self in the use of colors in illuminants to colors to which one has became habituated—that is, white or yellowish light. A light derived from shaded arcs placed above us is not as pleasant as the cornice light I have just shown. Certain colors of light are associated with certain things in the theatre. They always attempt to get moonlight by a curious shade of bluish-green, and it may be interesting to note that moonlight is greenish. That arises from the fact that moonlight, measured in candle-power, or in any terms by which we usually measure illumination, is a very weak light, and the eye loses its sensitiveness to red and blue before it loses its sensitiveness to green. As the light fades out toward the sunset, just as daylight is merging into darkness, one's judgment of color gets warped and twisted by the faintness of the light. Reds and blues lose their brilliancy, and so when the moonlight comes on, there is actually left a preponderance of greenish rays, which are mimicked on the stage by putting the proper shade of green before the projector.

Practically all our sources of light at the present are incandescent solids of one sort or another. The flame is merely the aggregation of white hot, yellow hot or red hot particles of carbon. The incandescent filament is merely a filament of carbon heated red hot, or white hot, as the case may be, by the current. In the case of the arc lamp we have the same thing, the radiant point there being the crater of the arc at the ends of the carbon, which are heated to a very a high temperature indeed, and are brilliantly radiant. It should be borne in mind that the temperature of the flame, or the temperature of the radiant matter, is the thing which largely determines its color. A piece of iron heated moderately is red hot. After a bit it gets nearly white hot, and yellow hot, and finally it comes to a dazzling brightness, or whiteness. The same is true of any incandescent solid. We find certain oil lamps give a distinctly orange tinge; we find candles giving a pronounced yellowish tinge, with much red, and the gas lamps give a yellowish hue, with less red. Finally, the incandescent lamps, when they are thoroughly energized by the current and heated extremely hot, give a light which is almost pure white—as white as the arc; and the arc lamp, which has a higher temperature than all the others, gives a light which is distinctly white or bluish white.

It should be borne in mind that in incandescent lamps the question of color has not anything to do with the amount of light; simply the temperature of the filament which gives the light. For instance, take 5 incandescent lamps of precisely the same candle-power (16), all working on the same circuit, with the same voltage; yet of the one having its filament at a higher temperature if near the others on a fixture nine persons out of ten would say that is the brighter lamp, whereas it may not be as bright as the others. The color in the lamp is simply a matter of the temperature which it carries, and with a given number of inches of filament in a lamp at the same temperature you will get the same total light in every case. It may be distributed in one way or another, but the candle-power of the lamp really means so many inches of filament at such a temperature, the filament being of a specified size. The ordinary lamp, as used in practice, gives a bright, clear, slightly yellowish light, but, on the whole, it is a very satisfactory color for general purposes.

For the purpose of obviating the extreme brilliancy which we get from the unshielded light, the best general expedient is the frosted globe. There are many others which can be used successfully. The ordinary lamps which we have in commerce are either 16-cp lamps or 8-cp lamps. For example, if we place a 16-cp lamp of the frosted type, which gives a very excellent, soft, clear light, alongside a 16-cp naked filament lamp, the frosted light seems to give, and for practical purposes does give, by far the better light. The basis of all practical electric illumination in this country for interiors is the 16-cp lamp. It should always be used in a frosted form, or otherwise shaded, except in instances where indirect illumination is attempted, when it can be used with the naked filament successfully. The 8-cp lamp should be the favorite. Lamps of 32, 50, 100 and 150 candle-power are freaks. They are useful for some occasions, but not lamps to be considered standard or convenient for the ordinary purposes of interior lighting. A 4-cp bare filament lamp makes a pretty light where a small amount is needed. The filaments in this lamp are delicate; indeed, so fine you cannot see them except in a good light, and the lamps have not the endurance of the 8, 16 and 32-cp lamps which are mostly used.

There are various ways of lessening the extreme brilliancy of incandescent lamps besides the use of the frosted globe. For example, we have lamps which can be toned down very materially by the use of shades, which produce, in not a very striking way, the same softening of the light which you get from the use of the frosted bulb. Various sorts and kinds of shades have been tried. These shades produce the same effect in toning down the apparent brilliancy that the frosted surface produces, and they, moreover, cut off less light than the frosted globe, and throw it conspicuously down or out sideways, as the case may require. This particular form is what is known as the holophane globe. There is a wide range in these globes. One is a diffusing globe, which throws the light out in a very satisfactory way, and produces precisely the same effect, as far as the eye is concerned, as the softening which you get from a ground or frosted globe; and, in point of fact, the loss of light in holophane globes, which are accurately cut, is only about 10 or 12 per cent., whereas in the ordinary ground globe it is a matter of 25 or 30 per cent.

The incandescent lamp, in spite of its usefulness in a general way, is, from a scientific point of view, unsatisfactory. You cannot get a high enough temperature in the filament to give the efficiency you want to get. Of the total energy which goes into a lamp, even if a 2-watt lamp, only about 5 to 6 per cent is returned to you as light. The rest of it goes into heat. The amount of heat radiated, in spite of the fact that the incandescent lamp is of all the ordinary illuminants the one that gives the least heat, amounts to 94 per cent or thereabouts of the total energy supplied to the lamp. The low efficiency is due purely to the fact that we cannot carry the filament at a temperature high enough to get the desired increase in efficiency. For the purpose of improving the efficiency there have been conducted experiments innumerable, but the best product of to-day are lamps running at 3 watts per candle or a little under, but they still have an efficiency of only between 5 and 6 per cent.

For better results than that we have to turn to other sources of illumination, and the obvious thing to do is to carry up the temperature of the illuminant to a point far beyond that which is found in the incandescent lamp. That is done in the arc lamp. At the temperature of the arc the carbon is vaporized very rapidly. Carbon, such as you find in the arc lamp, and in the filaments of incandescent lamps, is a substance somewhat volatile. It volatilizes somewhat like iodine, passing from solid into the form of vapor and softens and gets putty-like, so when incandescent lamps are carried to a high temperature the filament softens and rapidly breaks. As a result we have to look to the arc for help. There are small arcs made for the purpose of getting from lamps of moderate power an efficiency which we cannot get from even the best incandescents. Such lamps, in mere candle-power, may only be equal, in actual illuminating power, to these incandescents, but they seem brighter. The intrinsic brilliancy is greater, and the lamp itself appears to be a very bright object. It is very white, and it is very bright, as regards its intrinsic brilliancy, but the absolute amount of light is probably less than from the incandescents. Yet one of these lamps takes only the energy which would be taken by three 16-cp incandescents. The arc is a different kind of a flame. It is much more powerful as an illuminant, and is enormously brighter, owing to the fact that its efficiency, while perhaps not doubled, is probably as high as 9 or 10 per cent., as against 5 or 6 per cent on the incandescents. Lights of this kind could probably be shaded if they are going to be put where they would fall within the range of the eye. If you do not shade them, you will find the same trouble as with the incandescent lamp with naked filament.

Small arc lamps of this kind give more efficiency than the incandescent lamps, and for some purposes they may be quite useful. They are intensely white, giving a light by which it is possible to judge colors with great accuracy, and are highly efficient; but, of course, they are open to the objection to which all arcs of too great brilliancy are open. The brilliancy of the arc can be cut down in various ways, the most obvious one being by the use of globes. An arc light which would be intolerably bright, and entirely unsuited to practical illumination when unshielded, becomes, when hidden behind globes, a very satisfactory source of light, providing it is not thrust down where you have to look directly at it.

There is a difference, even in arcs, in point of brilliancy, and there again, just as in the incandescent lamp, it resolves itself into a question of temperature. The bigger the arc is, the larger the volume of current and the hotter the arc gets, the more efficient it becomes. Some of the earlier lamps, which carried a heavy current and gave a very short arc, were tremendously brilliant and very efficient. A lamp with a short, flat arc, taking a heavy current, is enormously efficient. It has perhaps 25 per cent more efficiency in producing light than small arcs, because the carbon is carried to a much higher temperature. It is, however, an arc which is not now a favorite, by reason of its unsteadiness and hissing and sputtering. We have passed now almost entirely to the enclosed arcs.

The enclosed arc is simply an arc with an air-tight globe around the carbon, the air-tight globe having a sleeve at the top into which the carbon fits nicely, so that the air has the oxygen burned out of it, the carbon burning in an atmosphere which does not oxidize rapidly and consequently gives a better light. The enclosed arcs generally have around them a second globe. If the second globe is a holophane globe, there will result an admirable distribution of light, which is softened in a way highly satisfactory, without, at the same time, cutting off any considerable amount of the light. The absorption of the globe is probably not over 10 per cent, while the light still looks bright, but is not by any means as dazzling as it would be without a globe, or with a very light ground globe. These enclosed lamps are somewhat subject to different classes of color. The earlier ones gave a very perceptible bluish-white light, a light not altogether satisfactory for general purposes, but, on the whole, a very useful one. As time has gone on, the enclosed arc has become more and more effective, so the light as we have it there is entirely satisfactory in color.

The alternating arc is another example of the way in which the temperature of the heated body affects its efficiency. The first type of alternating arc brought out was the Jablochkoff candle, which was used years ago for illumination in Paris. The light it gives off is curious in color, because between the two carbon elements conveying the current there is a thin strip of kaolin which becomes very hot, and the kaolin gives out, like the lime light, a considerable amount of light of its own. In fact, the principle of the Jablochkoff candle, with its bridge of kaolin between the light and the carbon, is quite similar to the principle of the Nernst lamp which has recently been brought out. In that case there is conduction across a stick of substance which is normally a non-conductor. In this case there is a kaolin strip which passes between the two carbons. The lamp had, from the earliest times, the unpleasant habit of going out on small provocation, and as the lamps were practically used, they had several carbons with a very ingenious way of shifting the current from one to the other, in case one came to grief. The carbon, if you can call it a carbon, consists really of two conducting strips of metal rather than a carbon, properly so called, and between them a stick of kaolin composition. These edges are barely more than copper-plated on the surface, so that while the conductors are really along the edges of the carbon, the white central strip is the thing which gives the majority of the light. They originally started off by using strips of carbon, but the particular sample shown to the audience is a metal conductor running down each edge of the light-giving element, and between the two is a mass of kaolin which becomes a conductor and gives a very brilliant light after it is once started. The principle of using the kaolin, which is itself a non-conductor except at high temperature, as the light-giving element, is, as stated, similar to that in the Nernst lamp, of which we have heard much in the past few months, and probably will hear more. Next we have an example of the alternating enclosed arc, which has the same general appearance of comparative steadiness and long-burning of the carbons that the continuous current enclosed arcs have, but at the same time it is, for obvious reasons, principally lack of sufficiently high temperature, somewhat less efficient. The lights are very serviceable, however, where the direct current is, for one reason or another, not available.

After all, you will say that the efficiency of even our best illuminants is not very high. The efficiency is not anything like what we would have it. It is not a very comforting thing to think of putting in 100 horse-power of energy and getting out 5 horse-power in this form, the form in which you want to use it. It is not consoling to think of utilizing any arc lamp, and getting out, if you have good luck and use a first-rate lamp, 10 per cent of the energy you put in. The efforts of many inventors have been bent in many directions trying to get an arc lamp or incandescent or some kind of a lamp which would return a reasonable amount of the energy put in, but so far none of these experiments have led to anything commercial. The Nernst lamp is extremely interesting as an attempt in this direction. The weak point of the carbon, as I have already stated, particularly in the form of an incandescent filament, is the fact that it will not stand high temperature. It vaporizes, smokes up the inside of the globe. and generally goes to pieces. The Nernst lamp utilizes a little pencil, hardly bigger around than the lead of a pencil, perhaps 1 in. or 1½ ins. long, of some refractory material, like magnesia; in point of fact, the material used is much like the material used in the mantels of the Welsbach gas burner, but this material possesses the property of being a conductor at high temperature. At ordinary temperatures, it lets through no current, but at high temperature it becomes quite as good a conductor as carbon.

The principle involved is the same as in the Jablochkoff candle. That is, the formation of an electric arc, heating to an enormous degree a pencil, in that case a little thin slip of highly refractory material, which becomes conducting and goes to an enormous temperature, and gives out a great deal of light. By the use of that refractory material, and handling it as deftly as may be, a fair efficiency is obtained, an efficiency, however, which is not greater than we have in the arc light, probably (indicating); that is to say, the highest claimed is about 1½ watts per candle, but the chances are that the filament of more refractory material would outlast the lamp, and in that fact lies its chance for success.

There is a determined effort going on to better the efficiency of the incandescent lamp, but the result is not by any means certain. It is certain, however, that a lamp has been produced which does give an efficiency as high, or higher than can be obtained by any incandescent lamp, and approximating that which can be obtained by the smaller light of the electric arc, and that is one very encouraging direction for experiment. I imagine that in six months or a year the Nernst lamp will become, perhaps not a common sight, but a lamp which will be found more readily than one could be found for the purposes of this lecture.

An interesting line of operation is that which depends on the dropping of incandescent solids and passing to incandescent gas. The phenomenon on which experiments of this kind are based is that of the passage of electricity through rarefied gas, such as seen in the ordinary Geissler tubes. There is every reason to believe it is possible to extract from incandescent gas perhaps as high as 25 or 30 per cent put in it, in the form of light. Nevertheless, the difficulties in the way are many. We have available very good incandescent lamps, very good arc lamps, and we have an enthusiastic hope of getting something along the line of the Nernst filament which may be useful. We have an earnest wish that we may perhaps discover in the use of incandescent gas a higher efficiency than we can get from solid incandescence, and we have an illusory sort of an idea that, if fortune favors, we may discover the secret of the glow worm, but of that the glow worm himself will have to speak. Science does not know his mind in that regard. So we can say, in summing up the progress, at present we have a very useful means of illumination, but we have not, by any means, yet reached the point where we can look pleasantly on our artificial illumination and say we have anywhere nearly what we want.

Detective Telephony in France.

A most extraordinary scandal has come to light at Lyons. Charles Meyer, a permanent police official of many years' standing, is found to have been the centre of a reactionary conspiracy in which 2000 men of the detective and police forces, who were devoted to him, have been kept busy shadowing successive prefects and local functionaries. The revelations were due to Meyer's illness. The Prefect, M. Alapetite, required documents out of Meyer's room. He sent to him for the keys, but Meyer kept putting him off. At last he said he had lost the keys. The Prefect then threatened to break open the door. Meyer was desperately ill, but he dragged himself to the office and removed an enormous quantity of documents and opened all the drawers and cupboards. The Prefect searched the room and discovered evidence of Meyer's complicity with the reactionary movement. But his astonishment was still greater when he found under the false bottom of a big box a powerful battery, such as is used for microphones, with wires leading into the wall. He afterward discovered wires that communicated with the Prefect's study, dining room and bedroom with receivers concealed under the Prefect's desk. Meyer was thus able to hear every word the Prefect uttered, whereever he might be. Meyer has been dismissed, and further investigation is being made.

Electric Fountains for the Pan-American Exposition.

By Orrin E. Dunlap.

Henry Rustin, chief of the mechanical and electrical bureau of the Pan-American Exposition, is in receipt of the plans for an electric fountain which is to be located on an island to be built in the North Bay, a section of the Buffalo Park lake system. It is a beautiful body of water, and has been included within the limits of the Exposition grounds. It has a width of about 800 ft., while its length is about 900 ft. The banks surrounding it are thickly wooded and about 28 ft. high. They slope gradually to the water, and in their height and forest growth they will serve as a most appropriate setting for such a display as that proposed in connection with the electric fountain. While there will be water and light effects in and about the electric tower and the adjacent basins, there will be no other spectacle that will be called an electric fountain, and it will remain for the North Bay to have all the glory connected with this magnificent display.

At present there are no islands in the North Bay, but to provide the necessary accommodations for the fountain an island is to be built 160 ft. long, 80 ft. wide and 10 ft. above the water level. It will be constructed of rock, and its form will be quite irregular. The entire interior of the island will be a submerged chamber in which the necessary installation and operators will be located. The rock will be whitened on the rough sides in order that better light effect may be obtained, but in no feature will the island construction be such as to in the slightest mar the beauty of the scene by day. In the daytime the island will appear as a rock-bound shore, quite in keeping with the bay and woodland surroundings.

The intention is not to have it in constant operation but each evening for about 25 minutes. It will commence at a specified hour, in order that all who care to see it may be on the wooded shore. The evening displays will be varied night after night, in accordance with a previously arranged programme. There will be nine different piping systems, each of which will be controlled by operating levers, which will permit of from 100 to 150 combinations of light and water effects. There will be a total of about 102 fountain orifices and 22 holophote orifices. The individual jets making up the several combinations will be grand geyser, ring curtains, ring jets, wheat sheaves, geysers, lily jets, pulverizers, fan jets and mist banks.

The grand geyser jet will be located approximately at the center of the fountain. It will throw a 1½-in. solid stream perpendicularly 250 ft. in the air. It will be unbroken. At certain periods of the programme the grand geyser jet will be the center of a mammoth pyramid of water in motion, while in other water figures, which will appear on the programme, it forms a jagged outline not unlike a pine tree in shape. The ring curtains when in operation with other jets will form a cylindrical figure of water cut off at the top evenly by the limit of the force given to the jets by the operating valves. The ring jets of the electric fountain will be not unlike the ring curtains, except that the individual jets are farther apart and each orifice maintains its pillar of water to the highest point of projection without breaking, thus giving, when illuminated, an appearance of threads of light thrown vertically in the air.

The wheat sheaves will be of the form their name indicates. In height they will be of a most impressive beauty, and the proper outline will be carefully adhered to. The geysers will be similar to the giant geyser, but not so large, nor will the jet rise to the height of the grand geyser. In the lily jets all the purity of the calla lily, together with its beauty, will be portrayed. These water flowers will be 14 ft. high, approximately. The pulverizers will throw the water in pulsating vertical streams to a height of 25 ft. These streams will be intermittent in their action and automatically controlled. The fan jets will be all that their name suggests. The figures will be 15 ft. high, and 20 ft. in extent at the top. By means of the mist banks the whole surface of the electric fountain will be covered with a very dense mist formation.

All of the different effects of both light and water will be controlled by the operators in the submerged chamber. When certain levers are pulled by the water operator to give specified water effects on the fountain surface, the programme that the operator of the lights will play will correspond in every particular, so that the switches he will throw will cause the proper light and color effect to fall upon the water effect. Each will have his programme before him, and each will play his part on time. The lighting of the fountain will be accomplished by 22 projectors so arranged that they can be diaphragmed and focused at will. The searchlight to be used will be the regular fountain projector lamps of 22-ampere capacity, and they will be supplied by Mr. Charles J. Bogue, of New York City. There will be 22 color screens in the form of circular disks, each having the primary colors, and these colors will be projected on the different water effects when in operation. The light will reach the water display through the holophote openings, which will be equipped with clear glass plates, varying in size from 30 in. up. The glass of these openings will be so arranged as to make an absolutely water-tight joint, so that it will be impossible for water to find its way through them to the operating room.

The operating chamber proper of the fountain will be located below the central portion of the fountain deck. In this chamber will be located two pumps which will be supplied by the P. H. & F. M. Roots Company, of Connersville, Ind. One of these pumps will have a capacity of 3000 gallons per minute, with a pressure of about 50 lbs. The other will have a capacity of 600 gallons per minute, with a pressure of 150 lbs. The pumps will be located on the north side of the chamber, and will take their supply direct from the bay. The larger pump will supply all the fountain orifices with the exception of the grand geyser, the orifices of which will receive its water from the smaller pump and under the greatest pressure, which is, of course, necessary to force the solid stream 250 ft. in the air. In this chamber there will also be a 500-volt, direct-current motor of Westinghouse make. This motor will operate the countershaft which will be belted to the pumps. The current for operating the motor-driven pumps will be obtained from the 500-volt circuit provided for use of motors on the Exposition grounds, and will come from the service plant. The current for operating the lamps will be derived from a motor-generating set, to be furnished by an exhibitor, as yet unannounced. This motor-generating set will be located in an artistically designed booth on the west bank of the North Bay.

The direction of the Electric Fountain Island will be southwest by northeast, and it will extend full in front of the New York State Building, but it will be possible to get a good view of it from all the surrounding points. Mr. Luther Stieringer, who has had more electric fountain experience than any other man in the world, is the consulting electrical engineer of the Exposition.

Illuminating the Pan-American.

Considerable interest attaches just now to the electrical illumination of the Pan-American Exposition, and we have been given to understand that the plan adopted under the advice of Mr. Luther Stieninger, the consulting electrical engineer, will involve the use of 200,000 incandescents of 8 cp. He believes this unit quite large enough for effective exterior work, and says that, in fact, admirable results would probably be obtained with an even smaller unit, in spite of the great extent of the grounds and buildings.

With regard to this subject, a rather amusing art note appears in the New York *Times* as follows: "The electric illumination for the Pan-American is exercising the wits of the authorities of the exposition. The ordinary method of giving brilliant effects at night to buildings is to outline the chief architectural members with rows of electric bulbs. This has been done hitherto with little understanding, because the men who have the work to do are engineers, not artists. Will the Pan-American turn over a new leaf in this respect? That is the question that agitates the very respectable number of the Buffalonians who are abreast of the times in things artistic. There was a charming suggestion last year to have the banks of the canals set with torch holders, the torches to give out a combination of steam and natural gas, which can be had from the soil at the expense of laying mains of no great length, thus affording a fitful moving flame, lighting up clouds of steam. What has become of this suggestion? During the hot months the Pan-American will be crowded at night, and some system of illuminating the grounds and buildings other than the regular lines of electric bulbs will be appreciated by the public. In such matters there should be a conference of the color director, the sculpture director, and the architect with the manager of the external lighting of the fair, and experiments made in the way of concentrating the lighting elements. Hitherto our expositions have suffered from scattering of lights. Distributed over large surfaces, they look meager and ineffective, when by an artistic scheme of concentration here and there they might reach very beautiful results. It would be a pity if the Pan-American should neglect this important feature under the stress of the many other matters that keep the managers of the fair on the jump."

It might be added that the architects have little idea how they distress the engineers with their plans for using light, a subject which, it would seem, very few of them have ever studied. At the World's Fair in 1893, one or two of the architects wanted for their own individual buildings all the light available for the great show itself; failing moreover to realize that light means horse power, with a big bill for apparatus, coal, water and attendance. In other words, lighting is not exactly a matter for architects nor for engineers, but a special art and a subject of special investigation.

The Society of Model Engineers.

The Society of Model Engineers held a meeting on the evening of Feb. 2, in New York City. Two preliminary meetings had been held, but this was the first one in which the actual organization of the Society was begun. Mr. Arthur J. Weed was elected president; Mr. M. Toepel, vice-president, and C. Kehrer, secretary and treasurer. A committee was appointed to draft a set of by-laws. About 25 gentlemen were present, and nearly all were enrolled as charter members of the Society.

An exhibit of models was held in conjunction with the meeting. The electrical portion was shown principally by Parsell & Weed, who had an operative display of their well-known Franklin dynamos and motors running both from the Edison circuit and from a 5-cell Perret storage battery. This battery, interesting on account of its light weight, about 83 lbs. per kw-hour, was loaned through the courtesy of Mr. William H. Meadowcroft, the manager of the Perret Storage Battery Company. This is the first public exhibit of the new cell.

Messrs. Toepel and Widmayer showed one of their 1-hp bicycle motors complete. Mr. B. R. Wicks, of Bridgeport, Conn., sent a photograph and blue prints of his ¼-hp high-speed engine. Mr. C. Kehrer exhibited two electric motors, one of which was series wound and could be adjusted to various speeds by a movable third brush on the commutator, which was connected to act as a variable shunt to the field. He showed also a sectional model of a valve gear and a D'Arsonval galvanometer in a nearly finished state.

The object of the Society of Model Engineers is to bring together all who are interested in the construction and making of electrical and mechanical models and apparatus, and to aid and instruct those members who meet with difficulties in their work. Competitive exhibits are also to be held at which prizes will be awarded the finest models. Any one who is desirous of associating himself with the Society is requested to communicate with the secretary, Mr. C. Kehrer, No. 1200 Madison Avenue, New York City.

Post Office Tubes.

The joint committee representing 19 commercial organizations of this city, which are united in an effort to secure a new post office and generally improved postal facilities in this city, at a meeting held in the room of the Board of Trade and Transportation last week, approved heartily of the favorable report of Senator Platt's bill made by the Senate Committee on Public Buildings and Grounds, and adopted resolutions urging the Senators and members of Congress from this State to use their influence to secure its enactment. The joint committee of commercial bodies also adopted resolutions relating to the pneumatic tube service in this city, urging the extension of the service to the several boroughs of this city and post office stations to which it can be made with advantage. The resolution says that the daily average of first-class mail matter transmitted by the tubes amounts to over 1,000,000 pieces, and in the tube between Manhattan and Brooklyn more than 160,000 pieces of first-class matter are transmitted daily.

Ducretet Coherer.

One of the first instrument makers in the world to engage in the commercial manufacture of wireless telegraph apparatus was Ducretet, of Paris, which house has introduced a number of new features in the apparatus. One of these is the subject of a patent granted Jan. 15 to Eugene Ducretet, of Paris, in which an improvement in the Branly tube is described. Hard-tempered steel powder is used, confined in the usual tube between the end rods, which latter are adjustable by means of threads therein engaging with threaded caps on the ends of the tube. Renewal of the air in the tube is prevented by suitable joints at the ends of the tubes. Means are provided for locking the rods in position.

CURRENT NEWS AND NOTES.

AMERICAN PHYSICAL SOCIETY.—The annual meeting of the American Physical Society will be held in New York, Feb. 23.

PASTRY AND ROENTGEN RAYS.—English papers note the case of a Hampstead matron who, having lost a valuable ring while kneading paste for some cakes, and not having discovered the loss until the dainties were baked, took them to a scientific man for the purpose of having them examined by means of the X-rays.

THE COLUMBIAN UNIVERSITY, Washington, announces that it will give a course in electro-chemistry, in the form of a special course of lectures by Mr. N. Monroe Hopkins, during the second half year, beginning Feb. 1, 1901. The lectures will treat of the use of electrical energy in analytical and synthetical operations in the laboratory and in the arts, and will be illustrated by numerous experiments. The various means by which electric energy is generated and the means by which it is conveyed and employed will be described and the student will be taught how this form of energy can be practically utilized in many kinds of chemical operations. Abstruse mathematics will be avoided, and an effort will be made to present the theory in a simple manner.

THE IMPERIAL CABLE INQUIRY.—Official advices have been received at Ottawa to the effect that a departmental committee has been appointed by the Imperial Government, consisting of Lord Balfour, of Burleigh, chairman; Lord Londonderry, representing the Treasury; Lord Hardwick, Under-Secretary for India; Lord Onslow, Under-Secretary for the Colonies, and one representative each from the intelligence branch of the army and of the navy. The terms of the reference are as follows: To inquire into the present system of telegraphic communication between the different parts of the British Empire, and to investigate the relations between private cable companies and the Imperial and Colonial Governments (including the Government of India), the amount of control at present exercised by these Governments, and the policy which should be pursued by them in future, especially when new concessions are sought; to examine existing rates; to report how far they are fair and reasonable, and, if not, how much reduction should be effected.

IOWA ELECTRICAL ASSOCIATION.—The annual meeting of the Iowa Electrical Association will be held in the club rooms of the Savery Hotel in the city of Des Moines, Feb. 20 and 21, 1901, beginning at 10 o'clock a. m. The executive committee has prepared a good programme, and a most interesting meeting is anticipated. Papers have been prepared and will be read upon the following subjects: "An Analysis of the Cost of Supplying Electric Current and the Various Systems of Rates," "The Regulation and Control of Wiring," "Central Station Heating—Mechanically and Financially," "The Renewal of Incandescent Lamps," "The Gasoline Lamp," "Experiences with Mechanical Draft," "Pounds of Coal Required to Produce One Kilowatt Hour," "How Can Delinquent Bills Be Prevented Without a Net Loss of Business," "The Massachusetts Laws." The officers are: President, W. J. Greene, Cedar Rapids; vice-president, H. H. Caughlan, Ottumwa; treasurer, George S. Carson, Iowa City; secretary, W. B. Keffer, Des Moines. Executive Committee—W. J. Greene, H. H. Caughlan, W. B. Keffer, W. S. Porter A. Edgecomb.

NEW YORK ELECTRICAL SOCIETY.—The 212th meeting of the Society will be held at the College of the City of New York, Twenty-third Street and Lexington Avenue, on Thursday, Feb. 14, at 8 p. m. Mr. Kempster B. Miller, whose writings on the subject of telephony have made him the foremost exponent of the art in this country in technical literature, will address the society on "Modern Telephone Engineering." This will be the first lecture on telephony which has been delivered in New York City in many years, and will constitute a most important review of the engineering situation. Mr. Miller will start with the power plant of an exchange, describing its functions, and will then go on to treat of the whole system in detail and discuss rather the engineering problems than merely the design of apparatus or circuits. He will also devote attention to the question of exchange location in any given city, so as to obtain the greatest economy and efficiency, and will present actual statistics and curves illustrative of telephone exchange activity. The lecture will thus be of the most lively interest, not only for those occupied in telephony, but for the general public. It will be illustrated by lantern slides.

MEANS FOR PREVENTING HUNTING OF SYNCHRONOUS MOTORS.—When a synchronous motor is driven from a generator direct-connected to a steam engine, the moving parts of which do not possess sufficient inertia to preserve a uniform angular velocity throughout each revolution, the generator speed fluctuates periodically with that of the driving engine, thereby producing an alternating current of pulsating frequency, which will cause a synchronous motor driven from the source of supply to pulsate in speed correspondingly. To remedy this defect is the object of a patent issued Jan. 29 to H. W. Buck, which describes means for varying the field excitation of synchronus motors within certain limits, and in time with the engine stroke, an interference being thereby caused and the pulsation broken up. The field resistance is actuated by a mechanical connection with the shaft of the motor. A worm on the latter drives a wheel which carries a crank pin. A connecting rod from this pin gives motion to a contact device, which moves back and forth over rheostat contacts, thus periodically varying the resistance in the field circuit of the motor.

ROTARY CONVERTER PROTECTIVE DEVICE.—Under certain conditions existing in practice, rotary converters or similar machines are liable to increase abnormally in speed or to "run away." The most serious danger in this respect exists when a rotary converter is fed with direct current to be converted into alternating current, which in the case of an inductive load may lead to a weakening of the field of the converter, thus causing it to speed up in the same manner as in a direct-current motor with weakened field. Again, if the direct-current end of a rotary converter be connected with a direct-current end of rotary converters or other sources of direct current, and the alternating-supply mains are interrupted, the immediate result is the reversal of current in the direct-current side of the machine, and if provided with a series field winding, as usual, the field strength is reduced by the reversal current and the machine speeds up. A patent issued Jan. 29 to H. W. Buck describes automatic means to interrupt the supply of current to a rotary converter or other supply when the speed rises a predetermined amount above the normal, the device described being responsive to the frequency of the current in the alternating mains. In one form of the device a solenoid provided with a core is connected across the alternating current mains, the core being adapted to establish the circuit of a circuit breaker. Under normal conditions the core is drawn within the solenoid; in case of an increase of speed in the rotary converter the increase of frequency in the line increases the inductive e. m. f. of the solenoid, thereby decreasing the flow of current through it. The solenoid core then, through gravity or by means of a spring, is caused to close the circuit of the circuit breaker, which latter then throws the converter out of circuit.

TELEPHONE PATENTS.—Commencing with the statement, "It is, of course, well known that the distance over which speech can be transmitted by the telephone apparatus now in use is limited by the amount of current which can be sent over the line wire, and that the amount of this current is fixed by that which can flow through the transmitter without arcing or producing a hissing sound," G. L. Hogan in a patent issued Jan. 29, describes a form of transmitter devised to increase the amount of current on the line wire. In the arrangement the inductance coil of the usual transmitter, instead of connecting to the line, makes connection with the coil of an electromagnet, the core of which serves to operate a diaphragm on which there are a plurality of microphone contacts, in connection with each of which there is a battery and induction coil. When the diaphragm of the transmitter is caused to vibrate by the sound waves, the telephonic current operates the second or repeater diaphragm, which in turn operates the multiple contacts, which finally cause the impulses to be sent over the line circuit. A multiple microphone is the subject of a patent issued the same day to A. G. Holcombe. In the microphone case opposite the diaphragm is a spring strip, and secured to this strip at one end and to the diaphragm at the other is a rectangular frame. This frame consists of two metallic strips secured to insulating end pieces, the latter in turn being secured to the diaphragm and spring strip, respectively. One pole of the electrical circuit of the microphone is connected to one of these strips, and the other pole to the second strip. Between the two strips are mounted the microphonic elements, which outwardly have the appearance of cylinders with trunnions, which enter into holes in the two strips. Each element consists of two carbon cups, with a loose carbon kernel; granulated carbon being arranged around the loose kernel and between it and the cup-shaped end members.

SLABY ON TESLA.—A special cable dispatch of Jan. 30 from Berlin says: "Prof. Slaby, of the Technische Hochschule, said in an interview to-day that he expected to revolutionize telegraphy if he was successful in applying his etheric system, which he calls spark telegraphy, to the present system of transmission by wire. He added that thousands of telegrams could then be transmitted simultaneously by the same wire. He characterized Nikola Tesla's expectations of an enormous reduction in the cost of electric currents as those of a fanatic, and said that the immediate future does not promise an improvement in the cost of conduction."

ELECTRICAL PROCESS OF MAKING PAINT.—Among the patents of Jan. 22 are two granted to C. G. Collins, on a process for making pigments, in which the electric current is employed. The object of the invention is to insure the more intimate and positive union between the soluable coloring matter, such as coal tar or aniline dye and the body with which they are united to form a paint. As an illustration of the process, to an aqueous solution of barium diathonite an aniline salt is added capable of electrolytic dissociation. The mixture is then subjected to the action of an electric current, when insoluble bi-sulphate in a freshly generated state and in a condition of extreme sub-division will be generated. At the same instant the aniline salt dye will be electrolytically dissociated and the circulating ions will recombine with the precipitated barium and fall to the bottom of the vessel as an insoluble fine powder having the color of the coal tar or aniline dye which was before in solution. A second patent relates to the production of silica paint from hydrated silica or silicic acid in the presence of a solution containing a dye salt.

ELECTROLYTIC PROCESS FOR WATER PURIFICATION, REFINING PERFUMES AND STERILIZATION.—Three patents granted Jan. 22 to J. H. Lavollay and G. E. Bourgoin, of Paris, France, relate respectively to electrolytic processes of purifying water, of refining perfume and the sterilization of liquids and beverages. The latter consists in subjecting the fermented liquids to the combined action of an electric current and a suspended alkaline earth-metal manganate or other insoluble manganate. In carrying out the process, a small quantity of, say, calcium manganate is added to the worts and a current of from one-tenth to one-half ampere per square foot is passed through the mass for 5 to 10 minutes. The advantages stated to be derived from this process are complete and rapid decantation, the bettering of the flavor of the product and the destruction of foreign or parasite germs or ferments, thus insuring the preservation of the liquid. The same process is applied to the refinement of perfumes and purification of water—that is, the addition of a small quantity of an alkaline earth-metal manganate with subsequent electrolysis.

ELECTRIC LIGHTS IN CANADA.—Mr. George Johnson, of Ottawa, the Dominion statistician, says that the development in the use of electric lamps in Canada is marvelous. In 1891 the census returns gave 80 establishments selling electric light in the Dominion. 1897 there were 187, which number increased to 297 in 1900. The electric lamps supplied by the establishments selling light numbered 443,897 in 1897, and 807,772 in 1900. The largest establishment in Canada in 1900 was the Royal Electric Light Company, of Montreal, supplying 78,762 incandescent lamps and 1805 arc lights. The next largest is the Toronto Electric Light Company, supplying 75,000 incandescent lamps, and 1650 arc, while the Ottawa Electric Company stands well to the front with 77,255 incandescent lamps and 621 arcs. The Province of Ontario has made rapid strides in the employment of electricity for lighting purposes, using 418,573 lamps in 1900, against 201,955 in 1897. The Province of Quebec increased the number from 185,892 lamps in 1897 to 235,322 lamps in 1900. The other provinces have all developed the use of electricity for lighting purposes in a very satisfactory manner. British Columbia had a couple of establishments selling electric light in 1897, and these operating only a very small number of lamps. In 1900, however, this province had 13 electric companies, with an equipment of 52,653 lamps. The use of the arc light in Canada has increased from 9,516 lamps in 1897 to 11,917 in 1900. In gas lighting, the census of 1891 gave 49 gas works in Canada. In 1900 there were 43, thus showing a decrease of 6 gas works.

DR. SHELDON ON ELECTRO-CHEMISTRY.—Last week in the chemical lecture hall of the new Polytechnic Building, Brooklyn, Prof. Samuel Sheldon, Ph.D., lectured before the members of the Brooklyn Institute (Department of Electricity), on "Electro-Metallurgy and the Storage-Battery." He thought that for the young man who is intending to devote himself to electrical engineering as a profession and as a means of livelihood, the field of electro-chemistry is very attractive. Another advantage is that it is not crowded as yet, for many chemists are too deficient in mathematical and electrical training to do effective work in it and electrical engineers are equally uninformed in chemistry. "The twentieth century," said the lecturer, "promises much to the person well trained in each of these branches." One of the most interesting portions of the lecture was where Prof. Sheldon explained the workings of the electrical furnace which makes it possible to maintain evenly any temperature up to 6000 degs. F. "By its use," said he, "Moissan was enabled to make diamonds, microscopic as to size, but equal in quality to the cosmic article." As to the battery, he said: "The storage battery of the present is the result of the expenditure of much time and money coupled with brains, but is still," the lecturer said, "an unsatisfactory thing, though playing an important part in the operation of electrical plants."

ELECTROLYTIC PRODUCTION OF ALKALI.—In the manufacture of caustic alkalies, the usual method is through the medium of an alkaline metal amalgam obtained by the electrolytic decomposition of solutions of alkaline and chloride with mercury cathode. In most of these arrangements, the alkaline metal amalgam is caused to pass through the compartments in which decomposition is produced, to a second or more compartments supplied with water. In this latter, the amalgam is partially denuded of its alkali metal and then returned to the first compartment to receive a fresh charge. A patent was granted Jan. 22 to J. W. Kynaston, of Liverpool, England, on a form of denuding apparatus which, it is claimed, will permit of a more perfect denudation of large quantities of amalgam in a comparatively limited space, allow the use of amalgam much richer in alkali metal and enable hydrogen and electricity to be produced at the same time. The apparatus consists of an iron casing having on its interior walls a large number of tiers of narrow horizontal shelves, also of iron, and hollowed out on the upper surface to a depth of about one-half an inch. In the central space left by the shelves in the case is suspended an iron tube or box extending almost to the bottom of the case, this serving as a cathode element in relation to the amalgam upon the shelves, the arrangement thus constituting a voltaic cell. In starting to manufacture, the case is first about half filled wtih water and a liquid amalgam is then passed in on the upper shelf, which falls through an opening in the farther end thereof to the next shelf and so on until all the shelves are charged. The stream being continued, the amalgam falls and covers the bottom of the vessel, when the mercury is almost completely denuded of alkaline metal and allowed to flow out of the vessel. When the solution of caustic alkali has attained a sufficiently high degree of concentration, it is withdrawn by means of a tap. The hydrogen gas liberated passes away through an aperture provided for the purpose, and may be utilized as fuel for driving gas engines or other purposes.

LETTERS TO THE EDITORS.

Resonance and Leakage Effects.

To the Editors of Electrical World and Engineer:

Sirs:—Certain phenomena arising on high tension transmission lines are frequently ascribed to resonance when a careful consideration of the entire circumstances might show that they are in reality leakage effects. The phenomena to which I refer are commonly called in the West "static," and consist in an apparent discharge from the lines to insulated bolts and from metal work. An explanation offered as to this effect is that resonance accumulates a charge on the line which is discharged through the air to some neighboring insulated piece of metal work, which discharges itself gradually through the air and again receives charge from the line. These sparks are rarely occasional sparks, but generally consist in an almost continuous sparking.

In no case have I ever known the bolt or other piece of metal to have an area sufficient to account for the apparent charge it was taking, and in no case have I ever been able to examine such an effect where it was not found that the insulation of the apparently insulated piece of metal was defective. In one case on a 10,000-volt line, switches were used with ash handles about 4 ft. in length, these handles being held in place by a clamp set in the centre of a 24-in. block of marble. The handles were painted black with carbon paint and a continual sparking was observed between the handles and the clamp. In one case the handles caught fire and burned up, showing that a very considerable amount of current e. m. f. was passing. The effect was finally gotten rid of entirely by placing a sheet of micanite between the handle and the so-called insulated clamp.

In another case, when experimenting with 34,000 volts, I noticed a spark passing through an insulated bolt and while the men about were calling my attention to the "static," the line short circuited across the face of the marble switchboard and in the path of this previous spark, the e. m. f. jumping across 18 ins. of marble, showing that in this case again the so-called "static" was due to leakage. I might continue reciting such cases in great number, but as they all result in the same conclusion that the discharge was the discharge of the line voltage to ground through defective insulation, I do not think it necessary to increase the number of instances.

It is my opinion, therefore, that many of the effects attributed to resonance are due simply to defective insulation, and, taking this into account, are no more remarkable than could be expected from the voltage of the line. Resonance undoubtedly occurs in some cases, and in a recent paper before the American Institute of Electrical Engineers, I cited a case of a motor action which is difficult to explain in any other manner, particularly as the difficulty was experimentally corrected by a correction for resonance.

Pittsfield, Mass. F. A. C. Perrine.

The De Laval Steam Turbine.

To the Editors of Electrical World and Engineer:

Sirs:—In a paper by Mr. Francis Hodgkinson, read before the Engineers' Society of Western Pennsylvania, and published in part in your issue of Dec. 29, 1900, Mr. Hodgkinson, speaking of the bearings and rigid shaft of the Parsons steam turbine as compared with the slender flexible shaft of the De Laval steam turbine, does so in a way that may possibly convey the idea to the minds of your readers that the De Laval flexible shaft is liable to crystallization and eventual rupture. Judging from the thorough knowledge Mr. Hodgkinson seems to have of the De Laval steam turbine, such an implication can not have been intentional. The object of the De Laval flexible shaft is to allow the turbine wheel to revolve around its true centre of gravity, thereby decreasing the pressure and friction in the bearings, and also eliminating all vibrations. This in fact it does, and there is not a single record of the shafts having ever been broken on account of crystallization.

At the Paris Exhibition a De Laval turbine was exhibited which has been in daily operation for seven years, during that time completing about 20,000,000 revolutions, and without any of its original parts having been replaced. The writer knows of one instance where a flexible shaft and turbine wheel, having run about the same length of time as the above machine, were cut into testing pieces and tested, and the material was found to be practically unchanged.

Philadelphia, Pa. E. Meden.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Determining the Slip of Induction Motors and the Co-Efficient of Non-Uniformity in the Revolution of an Alternator.—Hospitalier. An article describing a stroboscopic method for these purposes. It is based upon the observation made by Samojloff, that when a disk, consisting of black and white sectors and illuminated by an alternating current incandescent lamp, is revolved at a speed per second equal to the double frequency of the current, divided by the number of white sectors, then the disk appears to stand still (Digest, Nov. 17). To determine the slip of an induction motor, a disk is mounted on the motor axle, with white and black sectors of a number equal to twice that of the poles of the motor, and it is lighted by an incandescent lamp supplied with the same alternating current as the motor. On account of the motor slip, the disk appears to revolve in the opposite direction with an angular speed which is equal to the difference between the synchronous speed and the real speed of the motor. This apparent speed is measured, and the slip may then be easily calculated. For measuring the co-efficient of non-uniformity of revolution of an alternator, a 110-volt 5-cp incandescent lamp can be used, but an arc lamp, supplied with current from the alternator to be tested, is more practical. This alternator supplies current to a synchronous motor, which is provided with a flywheel large enough to make the speed of revolution uniform, so that it does not follow the variations of angular speed of the alternator during a revolution, but rotates with a uniform mean speed. The disk with white and black sectors is mounted on the motor-axle. If the rotation of the alternator were entirely uniform, the disk would appear to stand still. If, however, the speed of the alternator during a revolution is not uniform, the disk appears to oscillate to and fro and the amplitude of the oscillations represents the degree of non-uniformity of speed of the alternator.—*L'Ind. Elec.*, Jan. 10.

Lights and Lighting.

A New Electric Welsbach Light.—Michaelis.—A brief note stating that Auer von Welsbach, the inventor of the Welsbach light, had made a new and very important invention, but the description of the principle involved is not very clear. It is claimed that in the new Welsbach electric incandescent lamp only one watt is consumed per cp, against 1.6 to 2.0 with the Nernst lamp and 3.1 to 3.5 with the ordinary incandescent lamp. Welsbach is said to have invented a process of making osmium filaments. The lamp is said to yield a pure white light. Prof. Slaby is said to have examined it and to have made a very favorable report.—*Elektrotech. Rund.*, Jan. 15.

Train Lighting.—An article on the different systems of train lighting. Reference is made to a recent railway accident in Germany, in which the train was lighted by gas and an explosion occurred. The trial of the Stone system of electric train lighting, which has been made between Berlin and Cologne, is said to have been unsuccessful, not because the principle is wrong, but because it was not well carried out. Care must be taken that the storage battery is not overcharged by the dynamo. Furthermore, the commutator must be spared, for as lighting is required only for five hours per day, the commutator is being worn off uselessly 79 per cent of the day; the variations of the lights must be prevented, when the dynamo is being connected or disconnected. These requirements are claimed to be fulfilled in a new system devised by Zehden, which is briefly described. The following three systems of train lighting are compared: Gas lighting, electric light from a storage battery and electric light from a storage battery in combination with a dynamo. The result of the comparison is that the last is the cheapest and the best. The cost of a 12-cp lamp hour is given as 0.58 cent for gas, 0.63 cent for electric light from a battery and 0.49 cent for electric light from a battery in combination with a dynamo.—*Zeit. f. Beleucht.*, Dec. 20, 30.

Power

Power Distribution in Workshops.—Esson.—A paper read before the (Brit.) Civ. and Mech. Eng. Soc'y. He first considers the two older forms of power distribution in workshops. First, the power being supplied by a number of engines driving individual machines or departments of the plant; second, one engine furnishing the whole power which is distributed to the various machines by shafting and belts or ropes. The first of these systems is very wasteful, as the fuel consumption is extravagant beyond all reason. Regarding the second system, he gives the following data: From the results of tests in eight factories in the United States the power utilized to drive the machine tools averaged 26 per cent of the indicated horse-power, while in one extreme case, that of the Baldwin Locomotive Works, the return was only 20 per cent. From tests in over 300 factories in France, an average return of less than 60 per cent was obtained. The percentage of useful return always decreases rapidly as the machines are thrown out of work, or as the load on them is diminished. He then begins to discuss electric power distribution. He gives in a diagram the curves of ihp and hp useful returned, with varying load. At full load we get from the motors 66 per cent of the ihp, at three-quarter load 64.3 per cent, at half load 59 per cent, and at one-quarter load 47 per cent, if the motors are stopped as the machines they drive are thrown out of action. He then gives a diagram in which the system of shafting and of electric power distribution are compared. It shows that at full load about 10 per cent in the ihp are saved by electrically distributing the power, and at three-quarter load, half and one-quarter load, 16, 24 and 38 per cent, respectively. He also discusses more briefly the other advantages of electric power. There is a saving, as electric motors require considerably less attendance than do shafting and belting or small engines. Furthermore, electric driving places no restriction as to the position of the machines, and they can be placed with regard only to economy in production. In displacing shafting and belting, the increased output constitutes the chief advantage of electric driving. Wherever electric motors have displaced small steam engines, large savings have resulted, and cases have been known where the whole cost of the electric plant has been returned in one year as saving in fuel and wages. The discussion which followed is also reprinted. Hanssen believed that in future electricity would have a very formidable rival in compressed air.—Lond. *Elec. Eng.*, Jan. 11. The first part of the paper also in Lond. *Elec. Rev.*, Jan. 11.

Richmond Water-Power Plant.—A long illustrated description of the plant of the Virginia Electric Railway & Development Company, of Richmond, Va., which is to supply current for lighting and railways. There is to be an elaborate hydraulic plant in the James River Rapids, with a steam auxiliary plant. The final equipment of the power house will consist of 11 generating units, of which 4 are at present installed. These units consist of 2 turbines connected on the same shaft to a 750-kw, 12-pole, 550-volt direct-connected dynamo, a 76,000-lb. flywheel and a "steeple" tandem compound steam engine, rated at 700 hp. The dynamos give 550 volts direct current at no load, and are overcompounded to give 580 volts at full load. For the distribution of light and power a three-wire system, with 470 volts between the outers, was adopted, and to make use of the 550-volt generators on the lighting load, two 100-kw balancer sets were installed. They consist of two 50-kw, 250-volt machines, rigidly coupled together, giving a neutral wire balancing current of 400 amperes at normal load and 580 amperes at 40 per cent overload. For equalizing the voltage of the different feeders at time of maximum load, a three-unit booster set is used.—*Elec. Rev.*, Jan. 26.

TRACTION.

Electric Tramway Plant.—Booth.—An article on "Economies in the installation of electric tramway plant." He defines the load factor as the ratio of the mean output of a station to the maximum load. An empirical formula, which he claims to be a fair approximation to the conditions of ordinary English tramway work, is that the load factor in per cent is 11 times the third root of C, where C is the average number of cars run per hour the line is at work, and is found by "dividing the number of car-hours in a given time by the number of hours run by the station." Thus if in a system an average of 27 cars are always at work, the load factor is practically 33 per cent. In other words, while a plant must be capable of doing a maximum duty of 100 its average duty will be only 33. He speaks strongly in favor of condensing, and prefers simple to compound engines. "A point in which American electrical manufacturers have scored great success is in the close designing of their traction generators." Practically it is desirable in small systems to select the smallest and simplest engine, and to provide for its most economical working by running it on a condenser with superheated steam from boilers fed through a flue-feed heater.—Lond. *Elec. Rev.*, Jan. 18.

Electrolysis from Railway Return Currents.—Herrick.—An article on this question. Where current flows into a water pipe it forms a film of hydrate on the pipe, which protects it effectually from the natural corrosion due to any condition of soil. Where, however, current flows out from a water pipe oxides or chlorides or nitrates are formed and the pipe may be destroyed. Trouble has been principally complained of where service pipes pass underneath the track in the locality of the power station. Service pipes with insulated coverings may be used there or the pipes may be imbedded in cement or inserted in terra cotta pipe filled with cement. All of these methods introduce a resistance in the electrical circuit at the point to be protected, and, if properly applied, can reduce the flow of current to a negligible quantity. Cast iron used in the mains of a water-pipe system is very much less susceptible to electrolytic action than either wrought iron or lead, and in some soils it is immune from any damage, even where large current densities have been known to flow from the surfaces for a period of years.—*St. R'y Rev.*, Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capacity in Alternating Current Working.—Mordey.—The first part of a paper read before the (Brit.) Inst. Elec. Eng. To give an idea of what a microfarad is, he says that it takes 0.6283 amperes at 2000 volts and 50 periods. He draws attention to the ease with which capacity measurements of systems of mains may be made. Knowing the e. m. f. and the frequency it is only necessary to measure the current. The capacity in microfarads is then 1,000,000 times the amperes, divided by the product of volts, the frequency and 2π. If the tests are always taken at 1 e. m. f. and frequency, the scale of the ammeter may be marked to read directly in microfarads. He then gives a table and diagrams for the capacity losses in cables, giving the capacity current, the apparent watts required by a cable of 1 microfarad, for various voltages between 1000 and 40,000, at a frequency of 50. The true watts of loss are made up first of ordinary copper loss or Joulean heat due to any charging current flowing in the conductor, to leakage, and to dielectric hysteresis. The first two parts are usually unimportant. The third, the loss from dielectric hysteresis, has been determined by him in a special case, and found to be 2226 apparent watts and 275 true watts per mile, at 2000 volts and a frequency of 100. When the cable is worked as intended at 6000 volts, 50 periods, the losses per mile will be 9726 apparent watts, and 1206 true watts per mile. This is on the assumption that the power factor is the same, namely, 0.124, at high pressures as at low, and that the loss in this instance was accurately determined. The dielectric loss is not preventible. It is always going on when the mains are energized—whether any power is being transmitted or not. He then discusses the following method by which a wattless current may be reduced and the power factor raised to unity or nearly so. An alternator supplies a circuit having capacity. A choking coil is placed in parallel with the capacity, and if it is so designed and adjusted that it takes a wattless self-induction current equal in amount to the wattless capacity current of the mains, the two will balance each other, and the generator will not have to produce any wattless current for either the capacity or the self-induction.—Lond. *Elec.*, Jan. 18.

Preventing the No-Load Loss in Transformers.—Osnos.—An illustrated description of a switch which can be used with motors supplied from transformers. When a motor is switched out the primary windings of the transformer are also switched out, so that the no-load loss in the transformer is avoided. In the adjoining diagram, M is the alternating-current motor, K_1 and K_2 are the terminals of the high-voltage supply circuit, B is a local battery, U is a switch, S is a coil, K an iron core, W_1 and W_2 are inductionless resistances. When the motor is to be connected to the circuit, the switch U is turned to the contact 2, so that a current flows from the battery, B, through the coil, S, the iron core, K, becomes magnetic and attracts the iron arm, h. The upper arm of this lever, which consists of unmagnetic metal, is thus released and the iron core sinks down on account of gravity and acts upon the lever, h_1, so that the primary windings of the transformer are connected to the supply circuit. The switch, U, is then brought back to its middle position, shown in the figure. When the motor is to be disconnected the switch, U, is connected to the contact, 1, so that the coil, S, is supplied with an alternating current from the secondary windings of the transformer, the iron core is attracted upwards until it acts upon the lever, h_1, and breaks the primary circuit. The secondary winding then no longer has any current. The iron core sinks again until it is fastened by the upper unmagnetic arm of the lever, h. f is a spring exerting an upward force.—*Zeit. fuer Elek.*, Jan. 13.

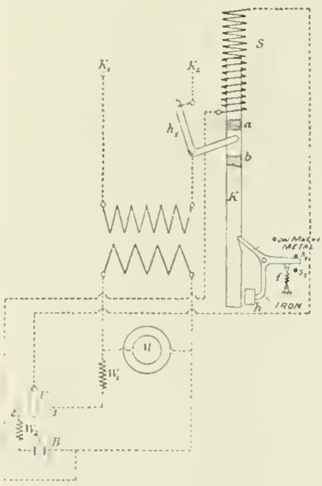


DIAGRAM OF CONNECTIONS.

Peterborough.—An illustrated description of this new British municipal lighting plant. There are two 4-pole dynamos, giving 150 amperes at 400 to 460 volts, at a speed of 460 r. p. m. There is also a combined balancer-booster set, consisting of two 4-pole balancers, rated at 50 amperes, 220 volts each, coupled together, and with two

2-pole battery charging boosters, rated at 60 amperes, 80 volts each, the whole running at 970 r. p. m. The battery consists of 240 cells, giving 325 ampere-hours at a discharge rate of 36 amperes and 240 ampere-hours at 60 amperes.—Lond. *Elec. Rev.*, Jan. 18.

Wires, Wiring and Conduits.

Aluminum Conductors.—J. B. C. Kershaw.—A paper read before the (Brit.) Inst. Elec. Eng. He gives a table showing that the price of aluminum has fallen, and the quality has improved with increasing output each year since 1890. Taking the specific gravity of copper and aluminum at 8.93 and 2.68, respectively, the conductivity at 100 and 59, the price per ton at $455 and $1,120, then $789, expended upon copper equals $1,000 expended upon aluminum for the same length of wire of equal carrying capacity. Aluminum is therefore the dearer metal of the two. If, however, a special price of 29 cents per lb. of aluminum is assumed, the $1,325 expended upon copper equal $1,000 expended upon aluminum, i. e., aluminum is cheaper. He refers to several installations of aluminum conductors in the United States and in Great Britain, and gives an account of tests which he has made during the last winter to determine the durability of aluminum and other metals under atmospheric exposure. He found that the aluminum wire at present sold for conducting purposes in Great Britain is not perfectly resistent to the atmospheric corrosion, and that in the atmosphere of a town where sulphurous acid gas exists as an impurity in the air, the metal is very badly attacked. In country districts or in small towns, where the impurities present in the air are reduced to a minimum, all metals experimented upon, seem to be fairly durable, but the slight pitting of aluminum which occurs, even in such an atmosphere, may prove serious, for by allowing the lodgment of small particles of foreign matter it may in time lead to the disintegration of the whole mass of metal. In the discussion which followed it was mentioned that Lord Kelvin is making experiments on a large scale. Gavey referred to experiments made by the post office, which had erected 15 miles of aluminum wire at the potteries near Hanley. The wire was handled well, but "within a fortnight of the erection of these wires a heavy gale of wind blew across the country and caused something like 8 or 10 breaks in the space erected. The wire employed weighed 78 lbs. to the mile. Its approximate diameter was 124 mils, its breaking strain 340 lbs., which being reduced to tons per square inch came out at 12.568 tons. It had stood 10 twists in 3 in. Its maximum resistance was approximately 6.158 ohms, and its specific resistance came out at 2.974 ohms." He also referred to the difficulty of soldering.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Jan. 18.

REFERENCE.

Wire-Drawing.—An illustrated description of the Pieper system for wire mills, which is claimed to be far superior to older systems.—*L'Ind. Elec.*, Dec. 25.

Electro-Physics and Magnetism.

Producing High-Frequency Sine Currents.—Wien.—A description of an "alternating-current siren" for producing alternating currents of a frequency up to 17,000. He says that a frequency of 50,000 may perhaps be obtained with his instrument. The currents are very nearly sinusoidal, as none of the higher harmonics is more than 1 per cent of the fundamental wave. A disk of brass or wood contains a series of iron pieces arranged similarly to the holes in an acoustic siren. The disk is set into quick rotation by a motor. It rotates between the poles of an electro-magnet, the poles of which have a winding of thin copper wire. The frequency of the alternating current generated is proportional to the number of iron pieces and the speed. This e. m. f. thus generated is not at all sinusoidal, but the current is purified of the higher harmonics by electric resonance. For this purpose a condenser and choking coils are inserted in the circuit. He shows, analytically, how they operate. This instrument is well suitable for experimental purposes and for measurements of electromagnetic quantities and their variation with the frequency.—*Phys. Zeit.*, Jan. 19.

Pressure and Temperature in the Electric Spark.—Haschek.—He has "supplemented his own and Mache's experimental work on the pressure and temperature within the electric spark by a theoretical treatment based upon the conceptions of Schuster. It is supposed that at the beginning of the discharge certain minute particles, whether of air or of electrode material, are projected with a great velocity from both electrodes. Their initial velocity between zinc poles would be about 3000 m. p. s., but owing to the resistance of the gas traversed, this velocity would fall to about 400 m. p. s. by the time the particles are 4 mm. away from the electrodes. The collisions which bring about this retardation also produce a rise of temperature, and the retardation itself produces an accumulation of particles which gives rise to an increase of pressure. Both pressure and temperature show a strictly corresponding distribution. With five large Leyden jars and a spark-gap of 8 mm. the maximum temperature would be some 1000 degs. in the centre, and the maximum pressure would amount to some 28 atmospheres. This is of the same order as the pressure determined experimentally"—*Ann der Physik*, No. 12; abstracted in Lond. *Elec.*, Jan. 11.

Roentgen Rays and Coherers.—Jensen.—An account of an investigation of the fact that Röntgen rays often exert an apparent influence upon the resistance of coherers. When he introduced a Röntgen tube into the secondary circuit of an induction coil, a Kohl detector for wireless telegraphy showed an immediate response, which occurred even after taking all kinds of precautions against stray sparks, but was entirely obviated by enclosing the Röntgen ray tube in a box with an aluminum window, through which Röntgen rays could freely penetrate, so that this effect could not be due to Röntgen rays alone. The real cause of the effect was found to be the appearance of "gliding sparks" inside the Röntgen tubes themselves. These gliding sparks play about the metallic conductors within the tubes, and appear to glide to and fro along them. The appearance or non-appearance of the response depends upon the position of the point at which the sparks appear with respect to the coherer. Preliminary experiments with Becquerel rays show that they have no influence upon coherers.—*Phys. Zeit*, Jan. 5; abstracted in Lond. *Elec.*, Jan. 18.

Motion of an Electrified Particle.—Riecke.—An investigation of the case in which an electrified particle or ion moves in a magnetic field upon which an electric field is superimposed, both fields being uniform. The result of analysis shows that the particle moves along a cycloidal curve. The results have a bearing upon the phenomenon in the vicinity of the cathode, the changes in luminous layers under magnetic influence, and the theory of the aurora.—*Phys. Zeit.*, Jan. 5; abstracted in Lond. *Elec.*, Jan. 18.

Specific Inductive Capacity of Dielectrics in a Magnetic Field.—Roberts.—A brief description of some preliminary experiments made to ascertain whether the presence of a magnetic field has some effect on the specific inductive capacity of a dielectric. The experiments were based on the fact that if a condenser be charged and insulated, any change in the specific inductive capacity will manifest itself as a change in the potential difference between the coatings. The results, so far obtained, are negative.—*Phys. Rev.*, Jan.

Remanent Magnetism.--Holitscher.—An account of an investigation of the remanent magnetism in an iron ellipsoid. "The remanent magnetic moment is distinctly dependent upon the time during which the magnetizing force is applied. It takes from one minute to three minutes to have its full effect in the case of fields varying from one unit to six units. This is all the more strange as the temporary magnetization is practically independent of the duration of magnetization. When the direction of the field is kept constant, successive impulses increase the remanent magnetism, the increase becoming slow after the first 10 impulses, but continuing to be perceptible until some hundred impulses have been given. On the other hand, when opposite magnetizations are induced in succession, the remanent magnetism remains sensibly the same."—*Ann. der Physik*, No. 12; abstracted in Lond. *Elec.*, Jan. 11.

Terrestrial Magnetism.—This issue contains a review by Nippoldt, of the development and the present status of the theory of the earth's magnetism. A note in French, by Morize, on a cause of error in the determination of the magnetic declination. A note, by Luedeling, referring to a communication of Moureaux on the periodicity of the disturbances of the horizontal intensity, observed at the observatory of Park St. Maur. Some supplementary remarks by Liznar on his former paper on the measurement of the horizontal intensity of the terrestrial magnetism by means of the magnetic theodolite. A note, by Van Bemmelen, on the magnetic "postturbation" and the current-vortices of Schmidt, and an account by Elster, of measurements of atmospheric electricity, made during the total eclipse on May 28, 1900, in Algiers. A reply by Sutherland on the criticism of Gilbert of his theory of the earth's magnetism, mentioned before in the Digest, and a biography, with portrait, of Prof. Schuster.—*Terr. Magnetism*, Sept.

REFERENCES.

Diminishing the Resistance by Cold.—Mewes.—A long article in which he gives theoretical notes on the phenomenon found by Dewar and Fleming that the electric resistance diminishes considerably with decreasing temperature, and on the method of insulation, based upon this fact and recently patented by Tesla.—*Elektrochem. Zeit.*, Jan.

Polarization with Alternating Currents.—Oliveri.—An account of a theoretical and experimental investigation. It seems that in the case of small polarization, a voltameter, inserted in an alternating-current circuit, behaves like a capacity.—*Phys. Zeit.*, Jan. 12.

ELECTRO-CHEMISTRY AND BATTERIES.

Storage Battery.—Wade.—An article on "The present and future of accumulators." He remarks that while the active materials constitute the most vital part of a storage cell, and the one which its success or failure almost entirely depends upon, yet the precise methods used for their production are known to very few besides the manufacturers. He gives a few notes on the Planté formation and on rapid formation processes. He says that substantial improvements may be effected in lead cells by largely increasing the molecular porosity of their active material. He prophesies that "the lead cell of the future will contain electrodes of much greater thickness than those now used—perhaps an inch or more. They will consist of a mass of exceedingly porous active material containing sufficient electrolyte for its complete discharge within its pores, and a current collector or support ramifying to all parts of it. These plates will be packed close together, with only a porous separator sheet of some kind between them, and will practically fill their containing box." Regarding the zinc-copper oxide alkaline combination with its low e. m. f., but large watt-hour output for weight, owing to its enormous ampere-hour capacity, he says that "so long as the copper oxide cannot with certainty be prevented from passing into solution when charging, this alone will be quite sufficient to destroy all chances of its success." The zinc-lead peroxide acid cell has two special merits, a large ampere-hour output for weight and a high e. m. f., both being due to the zinc electrodes, as also are its two chief failings, i. e., the difficulty of maintaining an efficient deposit of zinc, and of preventing it from passing back into solution by local action on open circuit.—*The Electrochem. and Met.*, Jan.

Electrolytic Alkali Process.—A note on the Hargreaves-Bird electrolytic alkali process. It is said that the large works using this process will be ready to manufacture in April next. The Farnworth experimental plant is still running with satisfactory results, alkali equivalent to 57.5 per cent of soda ash being obtained direct from the cell liquors by boiling them down. The current efficiency of the cell averages 93.5 per cent. At the St. Gobain Company's works at Chauny, near Paris, the small installation of the Hargreaves cell has ceased running, since it has been found that the cells were too small for economic manufacturing operations, and the generating machinery has also been giving some trouble. It is now intended to enlarge the plant at Chauny, and to erect cells five times the size of those originally put down. This enlargement is, however, postponed until after the commencement of manufacturing operations at Middlewich in order to profit by the experience gained there.—Lond. *Elec.*, Jan. 11.

Aluminum.—Leeds.—An article on the prospects of the aluminum industry. After some general remarks regarding the manufacture of aluminum, he briefly discusses the various uses of aluminum. It has proved very valuable as a means of preventing faulty castings of iron, steel and brass. The Goldschmidt process of using the energy stored in elemental aluminum, for the reduction of various refractory ores, is still in its infancy. The other Goldschmidt process of welding iron and steel is more capable of being appreciated. Aluminum is already finding its way largely into the construction of automobiles, etc. It is claimed to have been shown in practice that the use of aluminum in large kitchens to replace tinned copper, roughly halves the fuel bill. Another use consists in the construction of engineers' working patterns from aluminum. The construction of the exposed parts of sea-going ships of aluminum plates, and the use of aluminum wires for uninsulated electrical conductors, are briefly noticed. The question of the durability of aluminum in damp air or seawater has not yet been definitely settled.—Lond. *Elec. Rev.*, Jan. 11.

REFERENCES.

Manufacturing Storage Battery Plates.—An illustrated description of a system, patented by Levermann, for casting storage battery plates. At the bottom of the ladle which contains the melted lead, he places a valve with an exchangeable nozzle, so that he can get a stream of lead of any desired thickness.—*Centralblatt f. Accum.*, Dec. 15.

Elastic Materials in Storage Batteries.—A discussion of several arrangements which have been made to keep the active mass fixed, by means of elastic substances, as ebonite. The patents of Brown and Vaughan-Sherrin are discussed and the results of tests of a storage battery of the latter type are given.—*Centralblatt f. Accum.*, Jan. 15.

Sanitary Regulations for Storage Battery Manufactories.—Heffter.—An article in which he reproduces the very strict regulations made by the German Government since 1898, for the installation of factories in which storage batteries are made, in order to prevent the danger of lead poisoning. He also gives statistical data showing that these regulations have been successful.—*Centralblatt f. Accum.*, Dec. 15.

Electric Bleaching.—Engelhardt.—A long paper criticizing several points in the paper of Oettel, noticed in the Digest, Jan. 5. He endeavors to show that the Kellner apparatus for electrolytic bleaching is cheaper and more economical than the apparatus of Haas & Oettel. —*Zeit. f. Elektrochemie*, Jan. 3.

Deposition of Metals from Mixed Electrolytes.—Lehfeldt.—An account of the later researches, especially of Le Blanc, on this subject, based upon the electrolytic dissociation theory.—*The Electrochem. and Met.*, Jan.

Ferro-Titanium.—Dunlap.—An article on the manufacture of ferro-titanium at Niagara Falls and its use in steel making.—Lond. *Elec. Rev.*, Jan. 18.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Capacity in Alternating-Current Working.—Ayrton.—A communication referring to the paper of Mordey abstracted in another part of the Digest. He refers to the following method for ascertaining the outside limiting value of the dielectric hysteresis in a cable which is entirely free from the possible chance of serious error that might arise from using a wattmeter or integrating wattmeter with a circuit possessing an extremely low power factor. First calculate the self-induction which the inductive shunt to the cable should have in order that the alternator current may be a minimum. This is given by a simple formula. Next calculate what will be the alternator-current with such an inductive shunt, when using his "sine-curve alternator," if there be no dielectric hysteresis. This current may be a ampere. Thirdly, make the experiment with the cable shunted with an inductive shunt made without iron, to have this best value of the self-induction. The alternating current observed may be b ampere. Then an outside limit of the current due to dielectric hysteresis is obviously $b - a$ ampere, and an outside limit of the power spent in dielectric hysteresis in watts is this difference multiplied with the volts.—Lond. *Elec.*, Jan. 18.

REFERENCES.

Standard Cells.—Jaeger.—A supplement to his former serial. He deals with the investigations of the Clark cell by Barnes, and with the researches by Cohen, by which the theory of standard cells has been brought into good agreement with the thermo-chemical data; also with later investigations, especially by Cohen and Jaeger, on the usefulness of the cadmium cell as a standard cell. These were noticed before in the Digest.—*Centralblatt f. Accum.*, Jan. 1, 15.

New Interrupter.—Hirschmann.—An illustrated description of a new interrupter, which involves the use of mercury, but not as a conductor, as its function is that of amalgamating the two copper surfaces forming the contacts. The interrupter works noiselessly and well in an accumulator circuit or a 110 or 220-volt supply circuit.—*Phys. Zeit.*, Jan. 5; abstracted, with illustrations, in Lond. *Elec.*, Jan. 18.

Phase-Turning Apparatus.—Duddell.—A communication referring to the paper of Campbell "on a phase-turning apparatus for use with electro-static voltmeters" (Digest, Jan. 26). He points out some limitations to the methods therein proposed.—Lond. *Elec.*, Jan. 18

Volt and Ammeter.—Menges.—An abstract of a French Phys. Soc'y paper, in which he describes a galvanometer of the Deprez d'Arsonval type, which can be used as ammeter or as voltmeter, the magnetic field being adjustable.—*L'Ind. Elec.*, Dec. 25.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Electric Signals on Board Ships.—Dary.—An illustrated description of a system of signals, devised by Vialet-Chabrand, and in use on several French ships. Its principle is as follows: The transmitter is a simple commutator by which different circuits can be closed, which contain lamps and bells at both the transmitting and receiving stations. By closing a certain circuit by means of the commutator, the lamps in this circuit are lighted and the bells made to ring. At the receiving station the signal is thus received and the attendant there then turns a commutator so that the circuit is broken and the transmitting station knows that the signal has been received. The current is furnished by a battery.—*L'Elec.*, Dec. 29.

REFERENCES.

Central-Battery Telephone System.—ANDRE.—His. Internat. Elec. Congress paper, in which this system is described, together with other improvements in telephone exchanges. The arrangement of the lines is described in detail, the old and the new systems are compared, and an account is given of the results obtained, especially in the United States.—*L'Ind. Elec.*, Dec. 25.

Long Distance Telephony.—PRICE.—The conclusion of the mathematical article (Digest, Jan. 26), in which different methods of improving long distance telephony by means of inertia of induction coils in series or of leakage in the line, are discussed.—Lond. *Elec. Rev.*, Jan. 18.

MISCELLANEOUS.

REFERENCES.

Biographical.—A long account by Belok of the life and work of the late electro-metallurgical engineer, Carl Hoepfner.—*Zeit. f. Elektrochemie*, Jan. 10.

Assistance in Accidents.—CHARAS.—An illustrated paper read before the Elektrotechnical Society of Vienna on the best way to render immediate assistance in case of an accident due to an electric shock. —*Zeit. fuer Elek.*, Jan. 6.

Paris Exposition.—The fourteenth part of the illustrated serial, dealing with electrically driven machine tools and pumps which were exhibited.—Lond. *Elec.*, Jan. 18.

The first part of an illustrated article on electro-chemistry at the Paris Exposition. A table is first given to show that one must not rely too much on the general impression produced by the exhibits of a "universal" exhibition. This table shows the value of annual output of calcium carbide in the different countries and the number of firms exhibiting. For instance, the United States heads the list of value of annual output with $4.500,000, France is next with $2,625.000; no American firms had exhibited, while 14 French firms had. Under electro-deposition, descriptions are given of the Elmore and Secretan process for making seamless copper tubes, of the Cowper-Cowles copper process with a current density as high as 200 amperes per square ft., of the Rieder apparatus for electrolytically etching steel plates, and of the Siemens & Halske process of gold recovery. Notes are also given on the calcium carbide manufacture, on the aluminum manufacture, on the electrolytic manufacture of alkali and bleach, and on electric furnaces and products manufactured thereby.—*Electrochem. and Met.*, Jan.

Bainville.—An illustrated description of the Batault alternating current wattmeter, which was mentioned before in the Digest.—*L'Elec.*, Dec. 29.

REYVAL.—An illustrated description of the accumulator of the Chloride Electrical Storage Syndicate, Limited, of Manchester.—*L'Eclairage Elec.*, Dec. 20.

HEIM.—Some general notes on the exhibits of storage batteries. The general types are becoming more and more alike the differences between them disappearing. In Europe the following practice has become practically the standard. In railway plants, in street cars driven with accumulators, as also sometimes in lighting plants, Planté plates are used as positive and the pasted Faure plates as negatives; in many lighting plants both plates are of the Faure type, and are of heavy construction. For automobiles, thin, light pasted grids as positive and negative plates are used.—*Centralblatt f. Accum.*, Jan. 1.

An illustrated article on direct current apparatus, exhibited by the United Electric Company, of Vienna.—*Zeit. fuer Elek.*, Jan. 6, 13.

An illustrated article on three-phase induction motors, exhibited by the United Electric Company, of Vienna.—*Zeit. fuer Elek.*, Jan. 13.

SOULIER.—An illustrated description of the Rieter regulator for turbines with electric brake.—*L'Ind. Elec.*, Jan. 10.

GIRAULT. A well illustrated description of alternating-current machines exhibited by Schneider & Co. A 700-hp two-phase alternator, running at 600 r. p. m. and giving either 40 or 80 or 120 or 160 volts. A 105-hp, 3000-volt, three-phase alternator, and several types of three-phase and single-phase induction motors.—*L'Ind. Elec.*, Jan. 10.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 17-20, 1901.

NEW YORK ELECTRICAL SOCIETY. Next meeting, College of the City of New York, Feb. 14. Paper by Kempster B. Miller, entitled "Modern Telephone Engineering."

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

New Book.

TECHNICAL, INDUSTRIAL AND COMMERCIAL VOCABULARY. English, French, German. By E. Hospitalier. Paris: L'Industrie Electrique. 316 pages. Price, 6 francs.

This admirable compilation is arranged on an ingenious plan, which cannot be too highly commended. The words in the three languages—English, French and German—are not in separate sections, but are intermingled in alphabetic order. The language to which a word belongs is indicated typographically in the translation, the English words being printed in italics, the French words in small capitals, and the German words in ordinary Roman type. When a word is followed by no translation, the reader will understand that it is used in all three languages. If a word is followed by one translation only, it is the same in two of the three languages. Space is still further saved in case of words having the same root in the two or three languages, by printing the root but once, the various terminations being bracketed and in the respective type of the languages to which they belong. By this typographical means and use of some other devices, numerous repetitions are avoided and much space saved, the result being the combination in one small volume of three distinct vocabularies which, when in separate form, are subject to the disadvantages of being inconvenient to handle and expensive. As might have been expected of an author of the competency of Prof. Hospitalier, with respect both to a knowledge of the languages concerned and the electrical art and science, the work is thoroughly reliable, and is likely to become the standard electrical word book of the French, English and German languages.

A Novel Method of Operating Arc Dynamos.

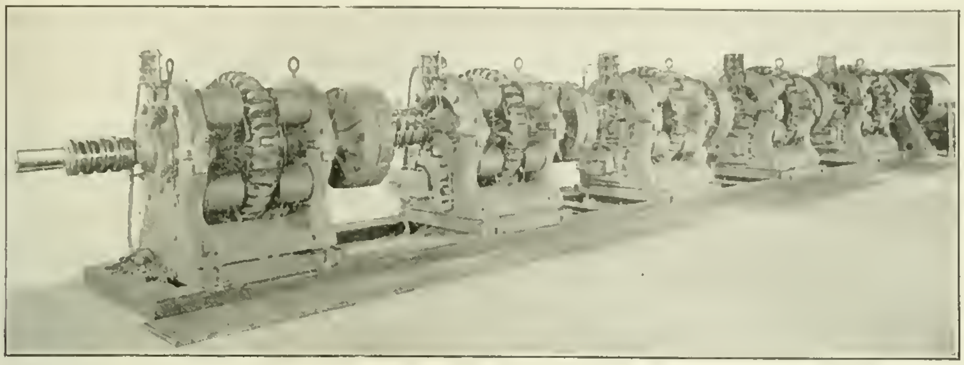
The problem of operating arc dynamos connected together at the shafts, and driven from a pulley at one end—the pulley in this way operating 3, 4 or 5 machines—has been frequently discussed by engineers, but nothing has hitherto come of it because it was considered necessary to provide means by the use of clutch couplings, hollow shafts, etc., of disconnecting any one of the dynamos without interfering with the operation of any of the others. As an arrangement of this kind would be delicate, complicated and very expensive, the idea was abandoned.

Mr. Ellicott, city electrician of Chicago, however, found it necessary to solve such a problem, because of the peculiar conditions in the Waller Station at Englewood, where the building was about 30 ft. wide and 125 ft. long. To install arc dynamos in the usual way would fill the room with jack shafts and belting. Mr. Ellicott finding that in three years none of the 11 large dynamos in service has been shut down, determined to risk running several dynamos on a single shaft. Mr. Ellicott's installation consisted of five Brush arc dynamos, coupled together at the shaft ends by the use of rubber buffer couplings. The only provision made for the cutting out of a particular dynamo in case of trouble was by shutting down the whole line, lifting the top part of the fields off, and lifting out the armature, and putting in its place a piece of shafting for the purpose of completing the connection between the dynamos on either side of the disabled machine. To make a change of this kind would probably occupy about 15 or 20 minutes.

The Brush arc dynamos used in this case are standard machines, with shafts of greater diameter than usual to stand the increased strain, and a few minor changes because of increased diameter of shaft. By use of the rubber buffer couplings, accurate alignment of the machines is not important, and at the same time the chance of any electrical connection between two machines at the coupling is reduced to a minimum.

This method of operating dynamos was not approved by engineers whom he consulted when originally suggested by Mr. Ellicott, but he felt from his own experience in the operation of arc dynamos, he was entirely justified in carrying out the plan, with results that have been exceedingly gratifying and satisfactory.

The five machines have been operated under full load, and are run with the greatest possible success. They operate smoothly, noiselessly and without vibration. From the accompanying cut it will be seen that aside from the economy of operation by reason of belt losses and economy in floor space, the general appearance of the central station is markedly improved. Mr. Ellicott believes that it is only a question of time when all the large stations operating arc dynamos will adopt this plan.



FIVE ARC DYNAMOS COUPLED TOGETHER AT THE SHAFT ENDS.

Operation of Cranes by Induction Motors.

In an article printed in these columns last week, descriptive of the induction motor power equipment of the Union Malleable Iron Company, of East Moline, Ill., an illustration is given of a traveling crane operated by variable speed induction motors. We are now enabled to give some further details of this interesting application of the polyphase motor.

The principle of variable speed operation consists in supplying the motors with variable e. m. f. by means of "auto-converters," which are transformers giving practical parts of the total available e. m. f., and used principally for starting and slow speed work.

There are four three-phase induction motors on the crane, two of 20 hp, one of 5 hp and one of 50 hp, their speeds being from 830 to 1100 r. p. m., dependent upon the position of the "auto-starters." They are also arranged to operate at from 100 to 400 volts, which gives a further and wide range of speed.

For the control of the motors, the standard Westinghouse alternating-current controller is installed, two types of which are shown in the accompanying illustrations. The controllers are carried on the car with which each crane is equipped, and are operated by a single attendant, the various motions of the crane and lifting gear being under the control of a number of switch handles placed conveniently on the car.

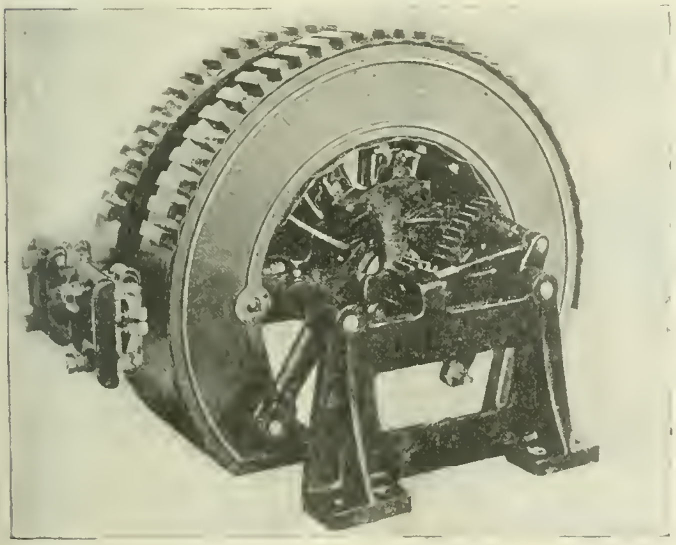


FIG. 1.—ALTERNATING-CURRENT CONTROLLER.

As implied previously, these controllers are designed for regulating and reversing variable speed polyphase motors. They are noncombustible, have a large number of steps for regulation, and are conveniently operated by a lever which is connected to the controller by a link. They are used in connection with a pair of auto-converters, which give the various steps in voltage.

In cases where several controllers are placed in close proximity to each other, such as in a crane cage, one pair of auto-converters will answer for all the controllers, the size depending on the demands made by the controllers considered collectively. It is easily seen that by this arrangement, in cases where heavy demands are not made by several controllers at the same time, comparatively small auto-converters will be sufficient for all the controllers. Fig. 2 is a type for use with alternating-current motors of large capacity. Its construction and method of operation is the same as in the smaller sizes, but it has more steps, the total number being 30. This latter is designed for use witn motors up to 50-hp capacity, on either 100, 200 or 400-volt circuits.

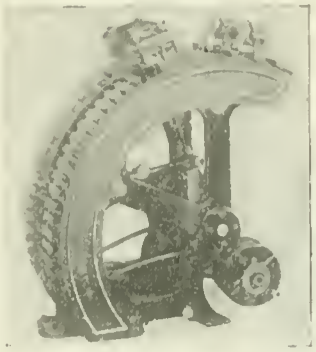
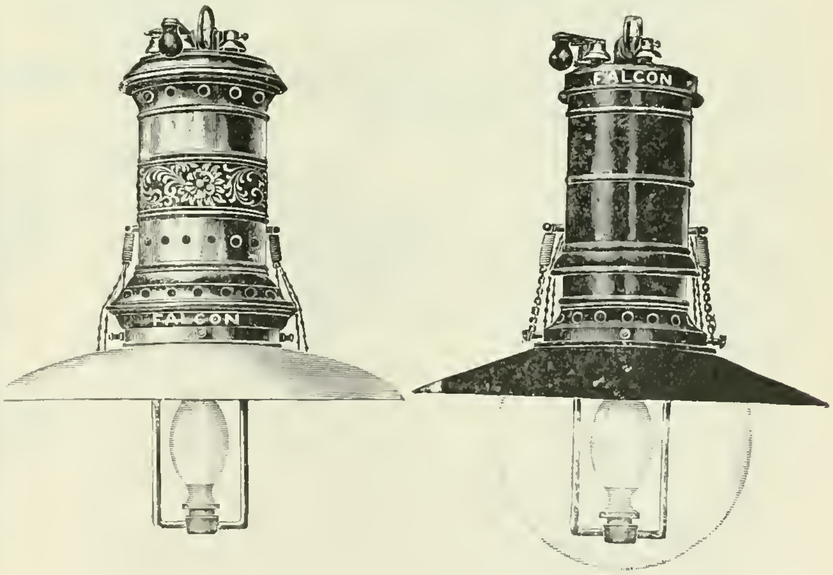


FIG. 2.—ALTERNATING CURRENT CONTROLLER.

New Designs of Falcon Arc Lamps.

To satisfy the increased demand for its arc lamps, the Falcon Electric Manufacturing Company, of New York City, during the last few weeks has added several new designs of arc lamps to its line, two of which are illustrated herewith. One is a brass lamp with opal reflector, for interior lighting, the other is intended for outdoor use. Both lamps, as can be seen from the cuts, are equipped with reflectors so as to direct as much light as possible to the floor or ground where it is required. Besides these two designs and the older ones, which have been manufactured for sometime, the black weather-proof lamp can be furnished with an opal reflector or with a metal reflector, but without an outer globe.

The mechanism of all these lamps is identical. Its extreme simplicity and the method of making the joints of its moving parts, insure reliability, and result in very close regulation and steadiness of light. The "Falcon" arc lamps are manufactured at present for all constant potential direct-current circuits, and prompt shipments from stock can be made. The Bulletin No. 7, just issued, fully describes all these various designs, and will be mailed to any intending purchaser upon application.



FIGS. 1 AND 2.—FALCON ARC LAMP.

Western Electric Fans for 1901.

The Western Electric Company's fan motors for the season of 1901 are, excepting some slight changes in details, practically the same as those of last year. The fact that little or no change has been found necessary indicates that these devices have reached a degree of perfection that entitles them to a place in the list of standard apparatus. The company is making desk, bracket and ceiling fans for operation on circuits of 110, 220, 250 and 500 volts.

The construction of the desk fan is clearly shown in Fig. 1, which is a cross-sectional view. The outer surface is spherical and the journal nicely fitted into the bearings, which are bored cylindrically. The gland of the oil cup, marked *B*, containing a felt wick, passes through without touching the bearing seat and fastens into the journal. The gland of the oil cup serves at the same time to steady the journal while leaving it perfectly free to move in any direction. The oil cup is provided with a large oil chamber which is filled with heavy cylinder oil, and one oiling will under ordinary conditions last an entire season. The magnet frame is a drop forging, and is held to the base by the slotted bolt, *E*, and the motor may be easily removed from the base by unscrewing this bolt. The armature is of the iron-clad type, and the commutator is made of the best hard-drawn copper segments separated by mica insulation.

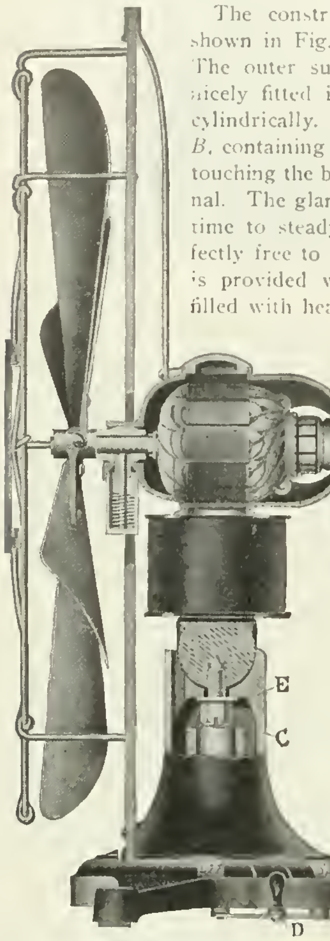


FIG. 1.—DESK FAN.

In these motors the commutator is always open to view, and injurious sparking of the brushes may be corrected before it has done irreparable damage to the commutator. The brushes are of specially prepared graphite and self-adjusting. By means of the switch, *D*, the motor may be operated at three different speeds, the position that the switch must occupy for any speed being marked upon the base of the motor. The speed is reduced by throwing more or less resistance into the circuit. The rheostat, *C*, consists of a porcelain spool upon which is wound German silver wire, which is carefully insulated with asbestos and mica. All switches are mounted upon porcelain bases.

The 220 and 500-volt motors are designed to be connected directly to the service wires, no series resistance being placed in the motor to cut down the voltage.

The 500-volt motors are provided with an added precaution of a double pole quick break switch placed beneath the motor. The motors are designed for continuous running at any of the three speeds without sparking and without heating to any appreciable extent.

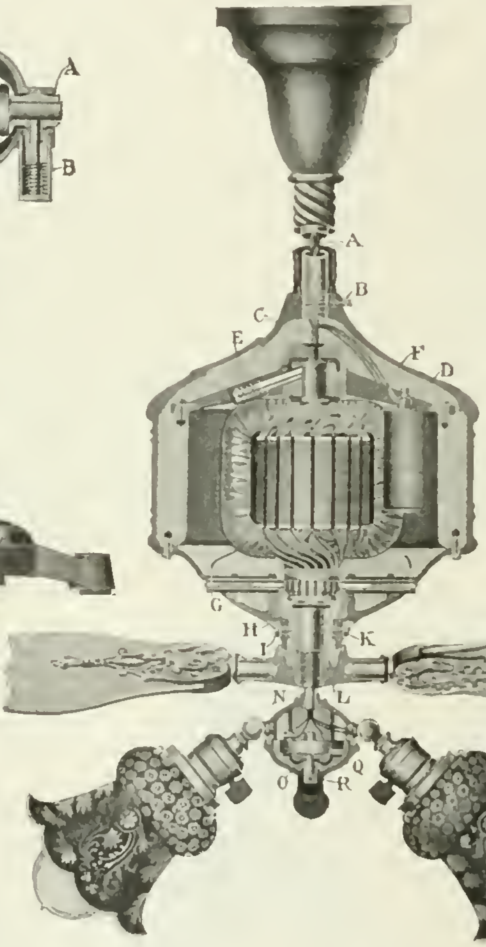


FIG. 2.—SECTION OF CEILING FAN.

In Fig. 2 is shown the construction of the standard ceiling fan. The self-aligning bearings marked *H* are similar to those used in the desk fan motors, and are turned out of the finest quality of babbit metal, the outer surface being spherical and nicely fitted into the bearings which are bored cylindrically. The upper journal is supported in a similar manner, the centering screws being placed at right angles to those in the lower bearing, thus giving ample opportunity for the journals to be brought into proper alignment.

Below the upper journal is a small oil pan intended to prevent any oil that may run from the journal getting into the armature. The upper part of the fan hub marked *L* is also made cup-shaped, which catches any oil that may drip from the lower bearing. These two precautions effectually prevent any oil dripping from the motor.

The armature is of the same type as that of the desk fan, already described, and the commutator is in all respects the same. The brushes, also, are identical, and the machine likewise has three speeds. Referring to the illustration, Fig. 2, the switch, *O*, is mounted on a porcelain base, and is used as a speed controller. The rheostat, marked *D*, fastened to the upper bearing bracket, marked *F*, consists of a porcelain spool wound with the best German silver wire.

The fan has a sweep of 60 in. and the blades are 8¾ in. wide across the face. The blades are fixed in a permanent position.

These fans are made with or without chandelier attachment, and are provided with cold-drawn hollow steel shaft through which an iron pipe marked *N* runs, which contains a double silk and rubber covered cable, *C*, connecting the rheostat with the switch. This cable also contains leads for the chandelier lights. When a fan is not used with the chandelier attachment these leads are coiled in the top of the switch box.

The hanger pipe, which is fastened to the motor casting, is covered with brass tubing of rope design. The motor is encased in a highly ornamental covering, the connections at the ceiling being concealed by a canopy having a fine polish, while the lower part of the motor is made of a very fine open-work casing. The motors are made with a bright or dull brass finish, or oxidized copper as desired.

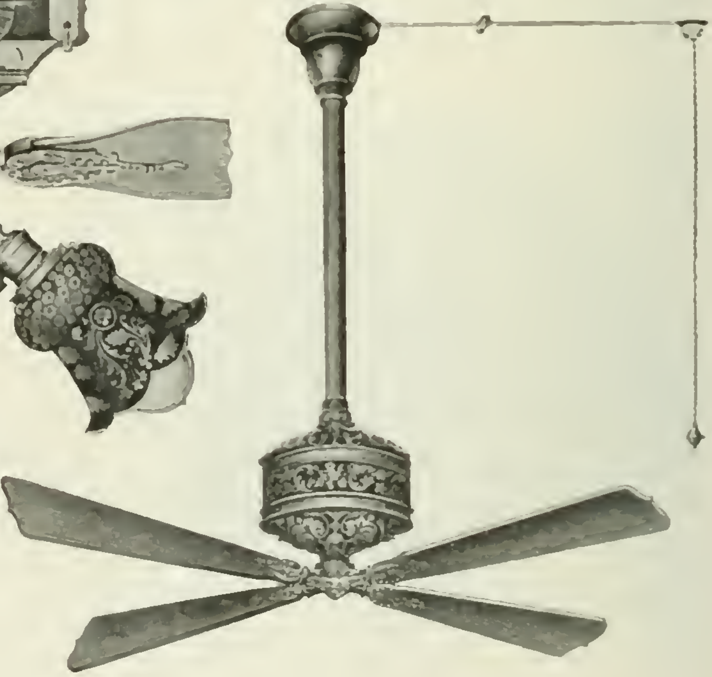


FIG. 3.—CEILING FAN.

Fig. 3 shows a ceiling fan without chandelier attachment. It is started and stopped by means of a pendant switch which may be placed at any convenient point.

The Western Electric Company also manufactures alternating-current desk and ceiling fan motors of the induction type. The fan motors of both the direct and alternating-current types are said to be efficient machines, giving a great wind output for a low consumption of current.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The rates for call money last week ranged from 1½ to 2 per cent, while for time loans the quotations were 3@3½ per cent, according to time and quality of collateral. Funds were freely offered, but borrowers were disposed to hold off. The closing rates for commercial paper are 3@3½ per cent for prime double names and 3½@4 per cent for choice single names. In the stock market advancing tendencies were renewed. Among the tractions and electric stocks some irregularity was exhibited. General Electric ranged between 188¼ and 192½, closing at 190½; this being a net gain of 2½ per cent. The sales for the week were 7315 shares. Brooklyn Rapid Transit lost 1 point, the sales aggregating 74,115 shares. Metropolitan Street Railway fluctuated within narrow limits—161 to 163¾—but closed with a net gain of 1¼ points. Western Union made a net gain of ¾ of a point. In the market for outside securities there was a general decline in quotations, and the volume of business transacted was smaller than during several months in the last half of 1900. The decline in market values during last month in the outside list is well distributed among the industrial, transportation and mining stocks. Sixteen of the 25 securities included show an average net loss of approximately 1¾ points, while 9 stocks have enjoyed advances averaging 2⅜ points. Following are the closing quotations on Friday at New York, Boston, Philadelphia and Chicago, the exchanges being closed on Saturday:

NEW YORK.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
Gen. Electric	188	190½	Elec. Veh	16	15
Bklyn Rap. Tran	78	77	Elec. Veh., pfd	30	30
Met. St. Ry	162¼	163½	Gen. Car	4⅜	2⅞
Am. Tel & C	96	—	Ill. Elec. Veh. Tran	¾	¾
West. Un. Tel	83	83¾	N. E. Elec. Veh. Tran	2¼	2⅞
Am. Dist. Tel	—	—	N. Y. Elec. Veh. Tran	4½	4¼
Com. Cable	—	—	Tel. & Tel. Co. of Am	4	4
Elec. Boat	29	27	Hud. Riv. Tel	117	117
Elec. Boat, pfd	52	53	N. Y. & N. J. Tel	174	174

BOSTON.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
New Eng. Tel	—	—	Erie Tel	57	58½
Mex. Tel	2¼	2½	Gen. Elec., pfd	160	*162
Westing. Elec	*55	55	Am. Tel. & Tel	161½	163
Westing. Elec., pfd	—	—	Boston Elec. Light	—	—

PHILADELPHIA.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
Elec. Stor. Bat	77	72	Phil. Elec	7⅛	7⅜
Elec. Stor. Bat., pfd	80	72	Pa. Elec. Veh	2	2
Elec. Co. of Am	8	8⅛	Pa. Elec. Veh., pfd	1	1
Gen. Elec. Auto	—	—	Am. Rys	31½	32½

CHICAGO.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
Chicago Edison	150	150	Chicago Telep. Co	255	255
Chic. City Ry	255	255	Union Traction	11	11¾
Nat'l Carbon	15¾	15½	Union Traction, pfd	49	49½
Nat'l Carbon, pfd	84	84	Northwest Elev. Com	27	*31

* Asked.

SOUTHERN NEW ENGLAND TELEPHONE.—The annual meeting of the stockholders of the Southern New England Telephone Company was held last week, when President Morris F. Tyler submitted his annual report, showing the business transacted during the past year. The year just closed has been a satisfactory one, and the report shows the wonderful growth of the telephone business in Connecticut. The total assets of the company are $3,660,839.54; the net earnings for the year amounted to $167,660. The amount of dividends paid was $150,660, and the amount carried to surplus is $17,000. During the year 2581 stations were added to the system, with a total increase of annual rentals of $49,580.97. President Tyler says that the business of the company has somewhat outgrown its equipment in the larger exchanges and the management is considering enlarging its premises in New Haven and Bridgeport. Twenty years ago there was $125,000 of capital invested in the business. To-day there is $3,513,000 of capital invested, of which $2,760,000 is represented by stock and $753,000 by bonds.

CHICAGO ELEVATED EARNINGS.—President Leslie Carter's report on the operations of the South Side Elevated Road in 1900, equipped with the Sprague multiple unit system, submitted at the annual meeting of stockholders, shows net earnings for the year amounting to $538,235, and a surplus, after interest and dividend payments, of $197,720. The net earnings are equivalent to 5 per cent on the outstanding stock of the company. A somewhat larger percentage than this could have been shown easily, but the policy of the management is to charge everything in the way of repairs and renewals to operating expenses, and to charge nothing to construction that does not strictly and legitimately belong to that account. In pursuance of this policy in the last two years there has been charged to operating expenses about $500,000, some of which might properly have been carried in accounts, and which would have produced a more favorable looking balance sheet.

CONSOLIDATION AT LANCASTER, PA.—A big deal was practically closed last week for the consolidation of the Conestoga Traction Company, the Lancaster Railway Company, the Lancaster Gas Light & Fuel Company, and the Edison Electric Light Company. These represent an aggregate of about $5,550,000 capital. The statement was authorized that William B. Given, of Columbia, and Samuel R. Shipley, of Philadelphia, both of the Conestoga Company, have become the owners of more than a majority of the shares of that company, and that they will incorporate the Lancaster County Light & Power Company, which will take and operate all lines of the traction company and the plants of the two light companies. The Conestoga Traction Company operated 86 miles of electric railway in Lancaster County. It is said that William B. Given, president of the Conestoga Company, will be the president of the new company.

NORTH AMERICAN COMPANY.—At a meeting of the stockholders of the North American Company J. P. Morgan & Co.'s interests were represented on the board by the election of Robert Bacon, he being one of the three new directors added to the board. About two-thirds of the entire issue of stock was represented at the meeting, and it was unanimously decided to accept the readjustment plans provided by the board reducing the capital stock of the company from $50,000,000 ($40,000,000 of which is issued) to $12,000,000. The other two new members of the board were Charles F. Pfister, of Milwaukee, and Charles A. Spofford, representing the Villard estate. The following is the board elected: George R. Sheldon, Charles W. Wetmore, William Nelson Cromwell, Robert Bacon, Edmund C. Converse, Charles A. Spofford, J. H. Herrick, J. R. Delamar, of New York; Henry C. Payne, Charles F. Pfister, John I. Beggs, of Milwaukee, and A. Q. Keasbey, of New Jersey.

AMERICAN STEEL AND WIRE.—By the meagre annual balance sheet of the American Steel & Wire Company profits are shown to have been nearly cut in half—amounting to $8,002,129 in 1900, against $13,362,530 in 1899. After charges for depreciation and bad debts—1,000,000 last year, against $1,200,000 in 1899—net profits available for dividends were equal to 8¼ per cent on the common shares, against 18¾ per cent a year ago. This heavy decrease in receipts the executive committee attributes chiefly to the slump in business in the first quarter of the year, when the company was overstocked with pig-iron, billets and raw material contracted for at high prices. But the directors state that business in the last half of the year improved, and now they have announced an advance of $2 per ton in manufactured products.

CHICAGO'S FRANCHISE FIGHT.—Chicago has on hand the most important mayoralty campaign in 25 years. The great issue is the street railway franchises. In 1902, 1903 and 1904 expire nearly all the important franchises. The railway companies desire franchise renewals for at least 20 years, and for 50 years if possible. They are adverse to paying over 3 per cent on gross earnings, and this they are willing to pay only on main lines. The Democrats now insist on franchises not longer than 20 years, 10 per cent compensation on gross earnings of both main and suburban lines, and eventual municipal ownership.

AMERICAN TELEPHONE.—It is said that General Counsel F. P. Fish, of the American Telephone & Telegraph Company, is the choice of a majority of the directors of the telephone company for the presidency, to succeed the late President Hudson. The choice is said to lie between Mr. Fish and President Cutler, of the New York Telephone Company. Mr. Fish has a very large and lucrative practice, and would need considerable inducement to relinquish the profession of which he is one of the most brilliant and uniformly successful members.

SPENCER TRASK & CO. have issued an admirable little compilation of financial data, including statistics of railroad stocks and bonds, street railway and miscellaneous securities, industrial stocks and bonds, with special data as to preferred. The range of quotations is given, and the pamphlet is in every respect full of valuable information for the investor.

AMERICAN TELEPHONE.—It is rumored that there will be a new issue of telephone stock in the spring upon which valuable rights will accure to stockholders. The recent buying of the stock is believed to be based on this fact.

LIGHTING CONSOLIDATION IN NEW JERSEY.—The United Electric Company of New Jersey, with a capital of $20,000,000 has combined all the electric light companies of Hudson and Essex Counties, and several outside these counties. It now controls and operates the properties of 21 once distinct corporations, which have now all been merged into the one organization. These companies are: Jersey City Electric Light Company, Newark Electric Light & Power Company, Central Power Company, Thomson-Houston Electric Company, Newark-Schuyler Electric Company, Essex County Electric Company, Montclair Light & Power Company, Excelsior Electric Company, Kearney Electric Light & Power Company, Hudson County Electric Company, People's Light, Heat & Power Company, Consumers' Electric Light & Power Company, Suburban Electric Light & Power Company, Edison Electric Light & Power Company, Hudson Electric Light Company, North Hudson Light, Heat & Power Company, Suburban Electric Company, Union County Electric Company, Elizabeth-Schuyler Electric Company, Consumers' Light, Heat & Power Company and Morris County Electric Company. The various electric light companies of Hudson County and vicinity were absorbed by the People's Light, Heat & Power Company last March, and the Consumers' Light Company and the other companies which were finally merged into the United Electric recently, had, prior to this action, absorbed smaller companies in their respective vicinities. For some time the United Electric has owned nearly all the capital stock of the People's, North Hudson, Consumers' Light, and Morris County companies. The President of the United Electric Company is A. B. Carlton, Comptroller of Elizabeth, N. J. Louis Lillie, treasurer of the United Gas Improvement Company of Philadelphia is treasurer, and Thomas J. George is secretary.

ERIE TELEGRAPH & TELEPHONE.—At the stockholders' meeting of the Erie Telegraph & Telephone, it was voted to reduce the number of directors from 25 to 15 and adopt by-laws providing that one-third in number of the directors shall be elected annually, and that the term of office of directors after the present year shall be three years, and that the date of the annual meeting of the stockholders be changed from the second Tuesday in June to the Thursday in January next preceding the first day of February in each year. The following board was elected: Nordon Abbott, Walter Abbott, A. B. Chandler, Frank A. Cutting, Philip Dexter, Wm. Endicott, Jr., Frederick A. Farrar, Reginald Foster, Chas. J. Glidden, Francis R. Hart, Wm. J. Latta, Frank M. Riter, James J. Storrow, Chas. S. Tuckerman and Henry R. Wilson.

CHICAGO TELEPHONE.—The directors of the Chicago Telephone Company will issue $1,000,000 worth of new stock in April next. This will make the total outstanding stock $8,000,000. It is likely that another million dollars of stock will be issued in October The proceeds of the new shares will be devoted to payments for extensions and improvements.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.—A special meeting of the New York & New Jersey Telephone Company will be held in Brooklyn, N. Y., March 1, to consider an increase in the company's capital stock from $8,000,000 to $15,000,000, the increase to be used from time to time for new construction.

CHICAGO CITY RAILWAY stockholders have unanimously voted in favor of authorizing the issuance of $5,000,000 new stock. The stock shall go to the stockholders at par. Retiring directors were re-elected. The annual statement shows a considerably smaller percentage earned on the stock, but the surplus decreases only $55,000.

MINNEAPOLIS GENERAL ELECTRIC.—The first mortgage 5 per cent gold bonds of the Minneapolis General Electric Company are now being offered in the New York market. These bonds are dated January, 1899, and run 30 years.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a larger volume of business, on the whole, the relatively best reports coming from the West and South. In the leading Eastern markets, however, the reports were not so favorable, and the aggregate business did not equal expectations. Trade collections, as a whole, are fair, the only complaints coming from sections where the mild weather has interfered with the distribution of heavy goods. In contemplating the general trade situation, *Bradstreet's* says: Measured by the earnings of railroads, the volume of the country's business is certainly in excess of a year ago, while bank clearings, though of course swelled by heavy stock speculation, show immense gains, and, in fact, exceed all records for the first month of the year. Among manufacturing industries rather more irregularity is to be noted. Foundry iron is weaker, while some finished steel products are higher. Woolens are slow of sale, and the squeeze in raw cotton, though temporary, has not helped converters, who have to pay more for their material but get no more for their finished products. Heavy cuts in rubber goods point to coming sharp competition in this industry. Export trade in crude forms of iron is lifeless, but in finished lines a good business is still doing in railway material. Shipments of locomotives to France, steel rails to Mexico and South Africa, and steel billets to England are reported. Favorable crop reports and larger Northwest receipts have slightly weakened the prices of wheat; corn is also slightly lower on heavy increases in the visible supply. The gross earnings of 60 railways for the first three weeks of January show a net gain of 8.7 per cent over the same period last year. *Bradstreet's* reports the number of failures last week as 238, compared with 281 the week previous, 171 the same week last year, 207 in 1899, 285 in 1898, and 305 in 1897 Copper is quiet, and official prices are kept at 17 cents for Lake and 16⅝ cents for electrolytic and casting stock. Large producers are adhering to these quotations, which are nominal, but it is understood that these prices can be shaded considerably.

THE FIRM OF ROSSITER, MACGOVERN & COMPANY has been in existence a matter of some seven years in New York City, during which time it has built up not only an excellent reputation but an immense business. It has gone to the front very rapidly and established a place for itself among the leading business houses in the electrical industry, under the active management of Mr. Frank MacGovern, who is so well known throughout the trade and who devotes his time personally to the purchasing of electrical and steam equipment and disposing of it throughout the country. The firm has recently closed one of the largest deals with the Pan-American Exposition Company that the latter concern has entered into. It has sold to the Buffalo Railway Company the equipment which has been called for on account of the anticipated rush of business during the Exposition, to the extent of 2500-hp generators and the necessary engines to drive them, together with the belts, fittings, etc., the generators including one 500-kw General Electric direct-connected generator, one 400-kw General Electric generator direct-connected to a Hamilton-Corliss engine, two 400-kw belt-driven General Electric generators with one 1100-hp Hamilton-Corliss engine to drive them It has also sold to the same company boilers to the amount of about 1000 horse-power, and likewise 100 street cars. To the Pan-American Exposition it has sold three 350-hp Armington & Sims engines for driving the Westinghouse Electric & Manufacturing Company dynamos for use in lighting the Exposition The business of the company is rapidly spreading to embrace a number of other lines, and preliminary arrangements have already been made to open a London office. Mr. MacGovern, in conjunction with some prominent gentlemen from the Argentine Republic (notably Mr. Benigno Ocampo) has recently closed a contract with the Electric Vehicle Company to form a licensee company to operate its vehicles in the Argentine Republic and other sections of South America.

SUBMARINE BOATS.—Work is progressing rapidly on four submarine boats of the Holland type now under construction at Lewis Nixon's Crescent shipyards, at Elizabethport, and the vessels, it is said, will certainly be delivered to the United States Government at the time specified Mr Nixon is also building a similar boat for the Holland Torpedo Boat Company, to take the place of the Plunger, and, according to the contract, this boat is to be delivered in eight months. The four boats for the Government are counterparts of the Holland, except that they are slightly larger and certain safety appliances not in the Holland will be introduced. Their increased size will afford more room for the crew and for larger engine power, which will give them a greater steaming radius. In a recent letter to George E. Foss, chairman of the House Committee on Naval Affairs, Mr. Nixon asserts that the performances of the Holland leave no room for discussion as to the efficacy of this type of warship, and writes in part as follows: "From my long experience in designing and constructing war vessels for the Government I have no doubt whatever of the endurance, habitability, durability and reliability of these boats. No type of boat in the navy has received such crucial tests as the Holland. The submarine boat to-day is further advanced in its development than any type of naval vessel that I am aware of. I desire to say that in my opinion, the Holland, without any improvements, is to-day the greatest vessel for harbor and coast defense ever known."

MR. JAMES TATLOW, chief engineer of the mechanical department of the Lancashire & Yorkshire Railway, one of the big North of England roads, accompanied by Chief Civil Engineer Worthington and Goods Traffic Manager Hauxwell, of the same system, are now in this country for the purpose of looking into the question of cost in running the various electric roads in the United States. The directors of the English line are considering the advisability of adapting electric motive power with a view to handling their suburban traffic, particularly between Bolton and Manchester, a distance of 12 miles. The English engineers will inspect the several electric systems in Philadelphia, Baltimore, Pittsburg, Chicago, Milwaukee, St. Paul, Buffalo and Boston, and expect to return to New York about Feb. 20.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Jan. 23: Antwerp—18 cases electrical material, $2,535. Argentine Republic—64 packages electrical material, $5,410; 5 cases electrical machinery, $344. Barcelona—1 automobile, $800; 10 cases electrical material, $20. Birkenhead—2 cases electrical material, $338. Brazil—150 packages electrical material, $11,843. Bremen—50 cases electrical material, $510; 12 cases electrical machinery, $1,156. British Australia—471 packages electrical material, $40,563; 5 motor vehicles, $2,000; 94 packages electrical machinery, $2,375; 32 reels cable, $13,029. British East Indies—82 packages electrical material, $9,316; 78 cases electrical material, $8,718. Basle—21 boxes electrical material, $1,104. British West Indies—41 cases electrical material, $1,675. Berlin—8 cases electrical material, $748. Chili—32 packages electrical material, $1,200. Cuba—146 packages electrical material, $3,540. Central America—132 packages electrical material, $1,755. Dunkirk—22 cases electrical material, $4,027. Dutch West Indies—22 packages electrical material, $474. Ecuador—211 packages electrical material, $879. Frankfort—1 package electrical material, $70. Glasgow—212 cases electrical material, $4,634. Hamburg—4 packages electrical machinery, $857; 9 packages electrical material, $681. Havre—163 cases electrical material, $24,577; 4 cases electrical machinery, $152. Leeds—26 packages electrical material, $1,502. Liverpool—31 packages electrical machinery, $3,148; 65 packages electrical material, $4,272. London—94 packages electrical machinery, $2,167; 353 packages electrical material, $12,357; 1 reel electric cable, $297. Mexico—198 packages electrical material, $5,596; 15 cases electrical machinery, $1,825. Manchester—138 cases electrical material, $18,323. Peru—131 packages electrical material, $1,282. Preston—107 packages electrical material, $17,400. Riga—5 cases electrical material, $255. San Domingo—19 packages electrical material, $327; 1 case electrical machinery, $74. Southampton—58 packages electrical material, $2,429. U. S. Colombia—33 packages electrical material, $1,241. Uruguay—18 packages electrical material, $500. Venezuela—4 cases electrical material, $113.

RATING OF MACHINERY.—Mr. F. V. Henshaw, under date of Feb. 1, writes to the New York *Sun* as follows: "In the very interesting article from Berlin in to-day's *Sun* in regard to the market in Germany for American manufactures, I notice a statement referring to the practice of American manufacturers of electrical machinery, which is absolutely untrue, and is undoubtedly the result of misinformation on the part of your correspondent. In drawing attention to the importance when competing in a foreign market, of a thorough understanding of the differences in practice and standards which exist in the different countries, an incident in illustration of the result of overlooking such differences in practice is given, wherein a German buyer ordered an American dynamo of a certain horse power, which upon being put in operation was found to be too small for the specified output, and it is explained that the German buyer had not been deceived, because "under American practice electrical machinery is rated as a rule up to its maximum capacity, and not, as in Germany, by its normal daily performance." Now, the facts are, that all reputable American manufacturers of electrical machinery rate their machines at the output they will give continuously, and the standard practice is to specify also that the machines will carry their rated load continuously without rising in temperature more than a specified number of degrees, and in addition to guarantee that they will for short periods carry a certain percentage overload. From the wording of your correspondent's article, I am inclined to think that in the case he cites, the difficulty may have been due to a confusion of volts with horse-power; but his explanation as it stands, is distinctly injurious and unfair to American manufacturers."

SIR WEETMAN D. PEARSON, president of the well-known British contracting firm of S. Pearson & Son, Limited, who last week passed through New York en route to the City of Mexico, stated in the course of an interview that his concern had secured a franchise for the conversion of the existing mule tramways in the city of Vera Cruz into electrical power. It will be recalled that mention was made in these columns at the time the project was first discussed. The present mule track is 15 miles in length. There is also a steam tramway which will be electrically equipped. This road is 5 miles long and runs to one of the principal suburbs of the Mexican port. The power house will consist of two 300-kw generators, two 400-hp engines and the same number of boilers of a like horse-power. On beginning operations, 15 double motor cars will be utilized. It is estimated that nearly a quarter of a million dollars will be expended before the new system is an accomplished fact. Construction on the contemplated road will not begin for about three months, as the streets are now being torn up by drainage work. In the meantime, however, Mr. F. Stuart Williamson, consulting engineer, of 257 Broadway, has been instructed to secure bids for the supply of equipment, etc. Sir Weetman has also decided to change the Terminal Railway Company's road from steam into electric motive power. The road, which was built by the Pearson people, runs from the harbor of Vera Cruz. Its length is about 14 miles. This enterprise will, of course, mean additional purchases of rolling stock and machinery.

PLACER MINE PLANT ON THE KLONDIKE.—It is safe to say that the electric light and power plant at Dawson, on the Klondike River, is the only electric power plant in the world furnishing power for a number of different placer mines over a placer mining district. This plant is the property of J. A. Williams, and is operated by the Dawson Light & Power Company, of which Capt. Donald B. Olson is manager. About 3000 lights are connected in Dawson, while on the small placer mine claims scattered up the creeks along the river there are about 1500 lights and 30 motors driving centrifugal pumps for working placer mines. The power house contains a 200-kw 3-phase General Electric generator, giving 2300 volts, at which pressure the distribution around the town and district is made. Wagner transformers are used and Westinghouse motors. A 300-hp Ideal engine and a 300-hp water-tube boiler, made by the Standard Boiler Manufacturing Company, of Harvey, Ill., complete the equipment. The plant is probably the most northerly electric light and power plant in the world. The Northwest Fixture Company, of Seattle, was contractor for the installation.

A NEW DEPARTURE IN MAGNETIC CONCENTRATION.—Witherbee, Sherman & Company, of Port Henry, N. Y., have decided, says the *Iron Age,* to undertake some very interesting experiments in the concentration of the famous magnetic ores which they mine. It is proposed to handle some of the high grade "Old Bed" ore, which runs about 61 per cent in iron. This ore, as it comes from the mine, contains a considerable quantity of fines which are to be screened from the coarse ore over a grizzley. These fines are to be subjected to crushing, and magnetic separation, the idea being to carry them up in grade and subsequently work up the tailings so as to secure a high phosphorus product suitable for the fertilizer trade. An effort will also be made to separate the zirconium. At the same time the coarse ore is increased in value through the separation from it of the fines, and the concentrates will have an increased value owing to the fact that it is expected that they will run about 68 per cent in metallic iron, and that the phosphorus will be reduced to near the Bessemer limit.

HARBOR SEARCHLIGHTS.—The Fortifications bill, as reported to the House of Representatives at Washington, carries $150,000 for electric searchlights for New York Harbor. Brig.-Gen. John M. Wilson, chief of engineers, proposes to locate the lights at Forts Wadsworth and Newton, Fort Hamilton, Fort Hancock, Norton's Point and Ward Point. Forts Wadsworth and Newton are to have seven battery lights, a detecting light and an extra power light, the system to cost $35,000. Six battery lights are planned for Fort Hamilton, one detecting light and one extra power light, at an expense of $25,000. For Fort Hancock, seven battery lights are planned, one detecting light and one extra power light, at a cost of $25,000. Three battery lights, one detecting light and one extra power light, for $15,000, and planned for Norton's Point, while two battery lights and one detecting light are to be installed at Ward Point for $10,000.

THESE WINDY, DRY WINTER MORNINGS, with their accompanying clouds of street refuse blowing all over one's clothes and penetrating into one's eyes, ears and even lungs, make one long for the days when the horse will disappear from our streets and be replaced by the mechanically propelled vehicle which will not contribute materially to this street refuse for which the horse is so largely responsible.

THE AMERICAN BRIDGE COMPANY has closed a contract with the Crown Agents for the Colonies of Great Britain to furnish and erect on the line of the Uganda Railway, in Africa, 27 viaducts. This will require about 6000 tons of steel work. These viaducts consist of plate girders spanned on towers. The highest tower will be 112 ft. Sir A. M. Rendel & Company, of London, are the engineers for the Crown Agents.

BARBADOS, the British West Indian island, is to have an electric road which will be the first system of its kind in that part of the world. A concession has been obtained by New York parties for the building and operating of the road. It will be an overhead trolley line, 15 miles in length, and will entail an initial expenditure of no less than $1,500,000. The construction of the track will begin inside of two months, when the contracts as to equipment, etc., will be decided upon.

THE SOUTHPORT TRAMWAYS COMPANY, England, which operates the trolley road running in that Lancashire summer resort, is about to be extended. Present advices do not state what the proposed extension will be, but specifications are now being prepared on the other side and will be issued inside of a fortnight.

THE JOHN STEPHENSON CAR COMPANY, of Elizabeth, N. J., has secured an order for eight double-deck trolley cars, which are intended for utilization by the Cheltenham (England) Tramways Company.

W. F. GREENWOOD, general manager and chief engineer of the Havana Electric Company, is at present in New York. He can be found at the offices of his company, 52 Broadway.

General News.

THE TELEPHONE.

NEW LOUISVILLE, ARK.—A franchise has been granted to a new telephone company of this place.

SOUTH BEND, IND.—The City Council has decided to order telephone and telegraph wires under ground.

BOSTON, MASS.—The Puritan Telephone Company has been incorporated here with a capital stock of $300,000.

MINNEAPOLIS, MINN.—The Albert Lea Telephone Company has been incorporated with a capital stock of $15,000.

INDIANAPOLIS, IND.—The Board of Public Safety is advertising for bids to construct the new fire alarm system.

JACKSON, MICH.—The United States Telephone Company has been granted a franchise to build a toll line through this place.

WINCHESTER, TENN.—The Dixie Telephone Company proposes to reduce its rates for telephone service throughout the county.

DOVER, DEL.—The Diamond State Telephone Company has purchased the telephone lines between Hepbron Station, Still Pond and Betteron.

GRANITE CITY, ILL.—The management of the Kinloch Telephone Company has secured all the switchboards and other apparatus for its central office.

ASHLEY, OHIO.—The Ashley Telephone Company has been organized and will install an independent exchange in this place. Capital stock, $5,000.

GREENCASTLE, IND.—Putnam County men have asked the Council for the privilege of erecting poles and wires in this city for a free telephone system.

WINONA, OHIO.—The Winona Central Telephone Company has been organized to install an independent exchange in this place. Capital stock, $10,000.

BALTIMORE, MD.—The Garrett County Telephone Company has begun work on an extension of its line from Eagle's Mills to the Cove, about three miles long.

CLIFTON, OHIO.—The Central Union Telephone Company has secured about 50 subscribers in this vicinity and will open an exchange with toll lines to Springfield.

SAN FRANCISCO, CALIF.—Quite an extensive system of barbed-wire fence telephone lines has been developed by the farmers in the country surrounding Stockton, Calif.

ALBANY, N. Y.—The New Berlin Telephone Company of New Berlin has been incorporated; capital, $3,000. Directors: I. L. Richer, E. G. White and A. H. Phelps, New Berlin.

TOLEDO, OHIO.—The Lucas County Commissioners are considering the advisability of securing a lighting plant for the court house, jail and grounds. Estimates are being prepared.

LOGANSPORT, IND.—The Central Union Telephone Company is soliciting among the farmers of this county, with a view of extending its service through the prosperous rural districts.

KEITHSBURG, ILL.—The Tom A. Marshall Telephone Company of Keithsburg has been incorporated; capital, $50,000. Incorporators: Tom A. Marshall, Frederick P. Burgett and David Adelsdorf.

GREAT BARRINGTON, MASS.—A fire on Jan. 29 destroyed the principal business block in this city. It included the telegraph and telephone offices, and all communication by these means was entirely cut off.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is installing a number of toll stations in all parts of the city and vicinity. Toll boxes manufactured by the American Toll Telephone Company, Cleveland, are used.

WAUSEON, OHIO.—At a meeting on Feb. 8 the Northwestern Ohio Telephone Company's stockholders will vote on a proposition to increase the capital stock of the company to $40,000. A number of improvements have been proposed.

TWO RIVERS, WIS.—The first fence-wire telephone line to be placed in operation in this section is being built from Sandy Bay to Kewaunee, a distance of eight miles. Connections will be made at Kewaunee with the Wisconsin Telephone system.

LA GRANGE, IND.—The Northern Indiana & Southern Michigan Telephone Company has been organized in this city with a capital stock of $50,000. It has purchased the local plant of the Johnston Bros. and will make all the circuits metallic. The local plant has 700 subscribers.

HAMILTON, OHIO.—The Lawton-Beattie Company of Cincinnati has just completed the installation of a complete telephone plant in the establishment of the Niles Tool Works Company. The instruments were furnished by the Simplex Interior Telephone Company of Cincinnati.

ASHLAND, OHIO.—The Star Telephone Company has elected the following officers: G. A. Ullman, president; S. H. Grabill, vice-president; E. J. Grosscup, treasurer; Howard Schwartz, secretary and superintendent. Directors are the above, with J. R. Schwartz, T. G. Stence, J. N. Brown and W. P. Ullman.

CLEVELAND, OHIO.—The United States Telephone Company's long-distance line from Toledo to Adrian, Jackson, Lansing, Owasso and Saginaw, Mich., will be completed within the next 60 days, when nearly all the independent exchanges in the Michigan association will be given long-distance connection.

ELKHART, IND.—At the annual meeting of the Home Telephone Company of Elkhart County the following officers were elected: President, C. W. Miller; vice-president, I. O. Wood, both of Goshen; H. B. Sikes and G. H. Fister, both of Elkhart, treasurer and secretary, respectively. A full board of directors was also elected.

MEMPHIS, TENN.—The Memphis Telephone Company has been chartered with a capital stock of $2,000,000. The incorporators are William P. Curtis, S. P. Walmsey, William P. Richardson, C. B. Galloway, Jeptha M. Fowlkes, Bolton Smith, Thomas R. Reddick, Leon Hunt, James S. Warren and William A. Percy. The company obtained a franchise about two years ago.

CORYDON, IND.—The plans which have been quietly taking shape between Louisville and Cleveland parties for a telephone service for this (Harrison) county have, it is said, been consummated. This service will have long distance connections through the Kinloch Company, of St. Louis, the new Indianapolis company and the United States Company at Cleveland.

ST. LOUIS, MO.—The annual meeting of the Kinloch Telephone Company was held Jan. 28. The books showed that a successful business had been done. The company has raised its rates on residence telephones to $48 per year, unlimited service. There are now 6500 telephones installed and others have been ordered but cannot be supplied until the pole and cable capacity has been increased

SALEM, OHIO.—The Columbiana County Telephone Company has completed traffic arrangements for interchange of service with the Phoenix Telephone Company, operating exchanges in Steubenville, New Cumberland, Mingoe, Toronto, Wellsburg and other points in that vicinity. The Phœnix Telephone Company will also have long distance service through the lines of the United States Telephone Company.

WARREN, OHIO.—The directors of the Warren & Niles Telephone Company have elected the following officers: Washington Hyde, president; Jules Vautrout, Jr., vice-president; J. J McClean, secretary and treasurer; E. G. Miller, general manager. The company is putting up 3000 ft. of cable in Warren and 2000 ft. at Niles; eventually the entire system in both places will be cabled. A 200-drop section of switchboard is being prepared for use at Warren.

DALLAS, TEX.—Conferences between organized labor bodies and the Board of Aldermen are being held, with a view to having granted to a company composed of laboring men a franchise for an independent telephone system in Dallas. The labor organizations of Texas are supporting a strike of union electrical workers in the State against the Southwestern Telephone Company, and this movement for a rival organization is enlisting keen general interest.

ST. LOUIS, MO.—A bill has been introduced in the Missouri Legislature providing that the following rates shall be charged in transmitting messages over telephone wires and for the use of telephone receivers and transmitters For 24 words or less a distance of 100 miles or less, 10 cents; for every 24 words or more 100 miles or more, 1 cent for each word or figure; for the use of telephone receivers and transmitters, not to exceed 75 cents per message. Violations of the law are made punishable by a fine of not less than $25 nor more than $200 for each offense.

KOKOMO, IND.—Competition has stimulated the telephone business in this city. Last September, before the new company started business, only 225 telephones were in use; but after a three months' fight between the competing companies, there are 1300 instruments in use. The war is still on, and the struggle is extending into the country and near-by villages. The Bell Company has cut the resident rate to fifty cents per month, but the new company successfully maintains its original rate of $1.25 for residents and $2 for business houses. The new system has 850 subscribers and the old one 450.

TELEPHONE RENTALS.—The Indiana Appellate Court decided the appeal of the Rushville Co-Operative Telephone Company against Irwin adversely to the latter. Irwin claimed the company owed him some money and refused to pay the company's bill for service until it should settle with him. The company therefore cut off his service. The Court held that Irwin had no right to set off a debt against his telephone bill; that a telephone company cannot be required to stop and adjudicate claims against it when collecting rental, and that the company was justifiable in cutting off the service and liable to no penalties.

BOSTON, MASS.—The American Telephone instrument statement for the month ended Jan. 20 shows:

	1901.	1900.	1899.	1898.
Gross output	66,048	58,853	46,548	25,861
Returned	25,766	18,966	14,719	10,041
Net output	40,282	39,887	31,829	15,820
Total outstanding	1,993,098	1,620,392	1,157,075	938,073

ELECTRIC LIGHT AND POWER.

HAGERSTOWN, IND.—This town will at once begin the construction of a $14,000 municipal electric lighting plant.

CAMBRIDGE, OHIO.—The City Council of Cambridge has just renewed the contract for lighting the streets for ten years at $70 per light.

RICHMOND, IND.—The City Council and Mayor closed the contract with the Varney Construction Company for a new municipal lighting plant.

DEFIANCE, OHIO.—The General Electric Company has just completed the electric equipment in the works of the Defiance Milling Machine Company.

HARTFORD, CONN.—The directors of the Hartford Electric Light Company have declared a semi-annual dividend of 3½ per cent., payable Feb. 15.

JACKSON, TENN.—The City of Jackson has decided to install an electric light plant of its own. The Council has everything in readiness to advertise for bids.

KEWANEE, ILL.—The Kewanee Light & Power Company has announced that hereafter it will pay all employees the same per cent on their salaries as given to shareholders as dividends.

MIDDLETOWN, OHIO.—The installation of a complete electric plant has just been finished in the new works of the American Rolling Mill Company. Officials expect to be turning out sheet steel by the middle of February.

SPENCERVILLE, OHIO.—The new electric light service, consisting of 36 arcs and a commercial circuit has just been completed under the supervision of the Lawton-Beattie Company of Cincinnati. The Fort Wayne Electric Company furnished the machines.

BINGHAMTON, N. Y.—The Norwich Electric Company has purchased the electric light plant in Norwich and will furnish the village with light in the future. The company, which has a capital stock of $1,000,000, will also furnish gas for fuel and domestic purposes.

CONNECTICUT.—The United Gas Improvement Company proposes to operate the several plants of the Connecticut Railway & Lighting Company by power generated on the Housatonic River and transmitted at high voltage to various stations in the system. The company owns the entire stock of the Housatonic Power Company.

ST. LOUIS, MO.—At the annual meeting of the St. Louis Electrical Exchange recently the following officers were elected: E. T. Cook, president; F. B. Adams, vice-president; Wm. Wurdack, secretary; F. E. Newberry, treasurer; C. J. Luther, sergeant-at-arms. Board of Directors—Wm. Corrao, C. F. Smith, A. C. Wolfram, A. Boes Chen Stein, F. E. Briner and F. B. Adams.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company is erecting two E. P. Allis cross-compound condensing engines of 2000 horse-power each. The engines are direct connected to a 1000-kw three-phase alternator, a 900-kw 150-volt direct-current generator and a 1000-kw 300-volt direct-current generator. The company is also erecting six Babcock & Wilcox boilers of 800-hp rated capacity each.

ATLANTA, GA.—It is stated that strong pressure is being brought to bear on the Electric Lights Committee of this city to report favorably on the petition of the Atlanta Railway & Power Compay for an electric lighting franchise. A petition has been sent to the committee, alleging that the Georgia Electric Light Company is endeavoring to force consumers to sign long-term contracts or bear heavy expenses for new wiring, motors and service connection.

PANA, ILL.—The Pana Electric Light Company has brought suit against Robert Johns, former owner of the plant, for $50,000 for alleged obstruction of business. Johns sold the plant to the present owners a year ago, taking in part payment 25,000 acres of land in Virginia. The land, he alleges, proves to be rocky and worthless. A few days ago when the company endeavored to move a dynamo Johns had issued an attachment preventing the removal, hence the suit.

CLEVELAND, OHIO.—George S. Rider, a well-known electrical engineer, is preparing plans for a power house for the W. S. Tyler Wire Works, Cleveland. Engines and boilers of about 500-hp capacity each and a generator of about 250-kw capacity will be required. Mr. Rider is also designing an addition to the power plant of the Cleveland Twist Drill Company and has placed contracts for a 400-hp Ball & Wood engine, 400-hp Babcock & Wilcox water-tube boilers with automatic stokers, and a 250-kw two-phase Westinghouse generator.

SOUTH MILWAUKEE, WIS.—The Common Council has passed the 50-year street car franchise asked for by the Milwaukee Light, Heat & Traction Company, which carries with it a contract to light the streets of the city for a period of 10 years at $80 a lamp-year for light up to 1 o'clock, and $90 a lamp-year for light all night. The lighting business was formerly done by the South Milwaukee Light & Power Company, but the city has had no lights for several months. The city offered to buy the plant, but the Mayor would not place his signature and this caused the shutting down of the plant and the Mayor to be deposed from office. Now the whole matter has been cleared up by the new franchise.

THE ELECTRIC RAILWAY.

QUEBEC, QUE.—The Levis Electric Railway Company of Levis, Que., is seeking incorporation.

BUCYRUS, OHIO.—Cleveland promoters are securing right of way for a line from Bucyrus to Shelby.

ELKHART LAKE, WIS.—An interurban electric road between this city and Sheboygan is talked of. M. M. Gottfried, of this place, is interested.

DELAWARE, OHIO.—The Union Electric Railway Company, with a capital stock of $300,000, has been incorporated in New Jersey by Eastern capitalists.

CLEVELAND, OHIO.—The promoters of the Cleveland, Ashland & Mansfield Railway Company, recently organized, have decided on the route for the road.

CLEVELAND OHIO.—At the annual meeting of the stockholders of the Cleveland Electric Railway Company the old directors and officers were re-elected.

EAST LIVERPOOL, OHIO.—Residents of Hookstown have offered a bonus to the East Liverpool & Rock Springs Railway Company to extend its line to Hookstown.

TOLEDO, OHIO.—The Toledo, Bowling Green & Fremont Railway Company is securing right of way with a view of extending its line from the present terminus at Jerry City to Fostoria.

CLEVELAND, OHIO.—At the recent annual meeting of the stockholders of the Cleveland, Painesville & Eastern Railway Company the present directors and officers were re-elected.

BLANCHESTER, OHIO.—The Clinton County Commissioners and the Blanchester Council have granted twenty-five-year franchises to the Cincinnati, Dayton & Maysville Railway Company.

TOLEDO, OHIO.—The Toledo, Napoleon & Defiance Railroad Company has been incorporated by Charles E. Sutton, Richard Hattersley, H. C. Webster and John F. Kumler. Capital stock, $25,000.

DAYTON, OHIO.—The directors of the Dayton, Springfield & Urbana Railway Company have decided to build a branch line from Osborn to Xenia by the way of Fairfield, Byron and Yellow Springs.

BELOIT, WIS.—Two applications were made for electric railway franchises by the Rock River Electric Railway through its president, J. F. Barber, of Eau Claire, and by H. H. Clough, of Elyria, Ohio.

AKRON, OHIO.—The Northern Ohio Traction Company is securing right of way between Kent and Ravenna with a view to extending the recently acquired Rapid Transit Company's line to Kent, on to Ravenna.

CINCINNATI, OHIO.—The Hamilton, Glendale & Cincinnati Traction Company has been incorporated by W. P. McCarty, Wm. S. Mundsell, George Kelly, Claude Ashbrook and Fred Munderhelman. Capital stock, $250,000.

TOLEDO, OHIO.—The Toledo, Waterville & Southern Railway Company has been incorporated by Harry E. King, Thomas H. Tracey, Harry W. Lloyd, Frank W. Coughling and James R. Murphy. Capital stock, $25,000.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has offered Milwaukee County $40,000 for property adjoining its power house. This property is needed for the new power house to be built this year.

TOLEDO, OHIO.—The stockholders of the Toledo, Bowling Green & Fremont Electric Railway have elected the following directors: L. Black, J. A. Hutson, M. I. Wilcox, C. S. Schenck, George Breymann, R. Hamlin.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company is preparing to make some extensive improvements on its system. The Wellsville line will be double tracked and improved. About $75,000 will be spent in improvements.

ELKHART LAKE, WIS.—Application has been made to the village board by J. M. Seaman, of Sheboygan, and P. P. Brickbauer for a seventy-five-year franchise to build and operate a street car line in this village, connecting with the Sheboygan interurban line.

YOUNGSTOWN, OHIO.—The promoters of the Youngstown & Sharon Railway Company have applied for a charter in Pennsylvania for a company to be known as the New Castle & Sharon Electric Railway Company, which means the extension of the road to New Castle.

CLEVELAND, OHIO.—The Cleveland & Eastern Railway Company has elected officers as follows: H. P. McIntosh, president; H. A. Sherwin, vice-president; E. G. Tillotson, secretary-treasurer. Directors: E. G. Tillotson, H. Clark Ford, W. H. Lamprecht, R. A. Harman, H. A. Sherwin, Howard White, W. N. Gates and H. P. McIntosh.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company has been incorporated by Justin A. Moore, J. S. Paisley, J. M. Powers, C. P. McFadden and B. J. C. Armstrong. Capital stock, $50,000. The company will build an electric railway from Steubenville to Toronto and will furnish light in both places; also in intermediate towns.

MILWAUKEE, WIS.—The annual report of the Milwaukee Electric Railway & Light Company and the Milwaukee Heat, Light & Traction Company shows dividends paid on the capital stock of the street railway company of $224,586, and on the traction company of $8,701.40. It also shows the total number of miles of track of the street railway company to be 175.99.

CLEVELAND, OHIO.—At the meeting of the stockholders of the Cleveland City Railway Company, held a few days ago, the old directors and officers were re-elected. The net receipts for the year were nearly $1,500,000, an increase of $28,000 over last year. The proposition to increase the capital stock from $8,000,000 to $9,000,000 was not discussed and will not be brought up again for some time.

TROY, OHIO.—The Miami Valley Railway Company, which operates a road from this place to Piqua, has secured right of way for the extension of the road to Minister, to connect there with the Western Ohio Electric Railway Company's road now being built from Lima. With the completion of these and other roads now building there will be a complete electric line from Cincinnati to Toledo.

LIVERPOOL.—The proposed electric express railway between Manchester and Liverpool appears to be in a fair way to be realized. It will be recalled that a scheme was defeated at the last session of Parliament, but the plans have been so altered as to meet the principal objections against the previous bill, and now have the approval of practically all of the local authorities of the places through which the proposed line will pass.

CLEVELAND, OHIO.—The Cleveland, Medina & Southern Electric Railway Company and the Cleveland, Elyria & Western Railway Company, rivals for a road from Cleveland to Medina and Wooster, have combined interests and have organized a new company, known as the Cleveland & Southern. The temporary capital stock is $10,000, which will be increased later to $1,000,000. Incorporators: A. H. Pomeroy, W. H. Lamprecht, A. E. Akins and U. G. Walker.

COLUMBUS, OHIO.—Levi D. York, of Portsmouth, who has been promoting a road from Columbus to Portsmouth, has joined forces with the Columbus & Southern Railway Company, which proposes to build over a portion of the same route. The company has reorganized, with the following officers: J. M. Wilson, president; Z. F. Downs, vice-president; W. E. Hoffman, treasurer; Smiley Caldwell, secretary. The capital stock has been increased to $1,000,000.

CIRCLEVILLE, OHIO.—In order to decide between rival lines the City Council advertised for propositions for a franchise through this place. The Scioto Valley Traction Company offered the following rates of fare: Cash fare, 5 cents; 6 tickets, 25 cents; 13 tickets, 50 cents; 27 tickets, $1. The company gave a certified check of $1,000 and offered a bond of $5,000. The Columbus & Southern Railway Company offered to carry passengers free of charge inside the city limits and to pay $100 per year for each car operated. President Wilson of the latter company stated that the through traffic between Chillicothe and Columbus would make this rather surprising proposition a profitable one. The matter is under consideration.

MILWAUKEE, WIS.—An electric railway to be built from this city to Lake Geneva is being promoted by some Eastern capitalists. It is proposed to run the line through the counties of Waukesha and Walworth, touching Beloit and several smaller towns. There is also a possibility of branches running to towns not too far from the main line. In Milwaukee the road would be elevated, but outside of the city it would be on the surface, the third rail system being employed throughout. It is estimated that outside of Milwaukee it will cost to build the road between $15,000 and $20,000 a mile, and that the completion of the enterprise will represent an expenditure of between $4,000,000 and $5,000,000. The distance between Lake Geneva and Milwaukee, as the road will run, is about 60 miles. The business of the road will be both freight and passenger.

YOUNGSTOWN, OHIO.—At the annual meeting of the Mahoning Valley Railway Company, held a few days ago, it was decided to practically rebuild the entire system. This will include tracks, rolling stock and power house, and the expenditure will be close to $1,000,000. Officers and directors for the following roads controlled by the Mahoning Valley Company were chosen: Mahoning Valley Street Railway Company, Struthers & State Line Railway Company, Mahoning Valley Southeastern Railway Company, Trumbull Electric Railway Company, Mineral Ridge & Niles Traction Company. A. A. Anderson is treasurer and general manager of the entire system. The officers include James Parmelee, Myron T. Herrick, Harry Dixon, B. F. Miles, J. W. Crawford of Cleveland, and A. L. Rowland, M. A. Verner, J. G. Butler and C. F. Clapp of Youngstown.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL ENGINEERING & DEVELOPING COMPANY, of New York City, has been organized; capital, $10,000. Directors: H. S. Cooper, Ithaca; W. S. Gurnsey, 3d, New York City; B. Y. Frost, Nyack.

THE H. KRANTZ MANUFACTURING COMPANY, of Brooklyn, has been incorporated, to deal in switchboards and electrical appliances; capital, $150,000. Directors: H. Krantz, A. N. Nielsen and W. M. Moore, Brooklyn.

LEGAL.

TELEPHONE DAMAGE CASE.—Last April Rev. O. B. Wilson, of Tuscaloosa, Ala., was struck by lightning and killed while he had a telephone to his ear. Suit was brought against the Southern Bell Telephone & Telegraph Company for $25,000, but the case was recently settled by the executors accepting $1,800 from the company.

CLAIMS AIR ABOVE HIS LAND.—Rufus W. Smith of Elmer, N. J., in a bill filed in the New Jersey Chancery Court, seeks to enjoin the Delaware & Atlantic Telephone Company from running wires across his land. The poles supporting the wires are not on his ground, but are on adjacent land, where they were placed with the consent of the land owners. Mr. Smith's contention is that he owns the air as high as he chooses to go, and that the exercise of the right by any one else without his consent is a trespass.

OBITUARY.

MR. JOSEPH GILLET NOYES, secretary and general manager of the National Electrical Manufacturing Company, of Milford, Conn., died at his home in that village on Jan. 15 after an illness of only a week, death being due to a complication of pneumonia and Bright's disease, with the throat trouble which first attacked him. Mr. Noyes was only 40 years of age and had been active in the management of this company since its organization in 1890. He had a large circle of business acquaintances in this city and throughout the East.

PERSONAL.

MR. JOSEPH BATTLES, president of the Lawrence Machine Company, Lawrence, Mass., was a visitor to New York last week.

MR. C. J. TOERRING, of Philadelphia, maker of the Toerring 250-hour enclosed arc lamp, was a visitor to New York the early part of this week.

MR. L. ROBINSON, who has been manager of the Montreal Park & Island Railway for the past four years, has retired to accept a post with the Compagnie de Traction of Paris, France.

MR. CHAS. A. MOORE, of Manning, Maxwell & Moore, who was lately made a member of the French Legion of Honor, has just been elected president of the American Tariff League.

MR. J. H. VAIL, the electrical engineer, has removed his office in Philadelphia from 1107 Walnut Street to 715-18 Hale Building, 1328 Chestnut Street. He has been engaged lately on several important installations.

MR. W. S. BROWN has resigned his position with the Sprague Electric Company and taken the management of the Eastern sales department of the Richmondt Electric Wire Conduit Company, with New York headquarters at 39-41 Cortlandt Street.

COL. J. W. RUTHERFORD and Mr. H. A. Douglas were in general charge of the erection of the independent telephone exchange at Atlanta, Ga., recently described in these pages. They represented the Atlanta Telephone Construction Company, of which Mr. Otto C. Wolf is treasurer and manager.

MR. E. D. LATTA, president and treasurer of the Charlotte (N. C.) Electric Railway, Light & Power Company, was in New York City last week. Legislation is being attempted in the genial State of North Carolina to force vestibules on the street cars, and Mr. Latta could not help noticing that even here in New York the motormen get along without them.

MR. THOS. H. McLEAN, the well-known vice-president and general manager of the Toledo Traction Company, informs us that there is nothing in the rumor that he is to go to Chicago to take hold of one of the big systems there. He is back in harness again at Toledo, after his indisposition, and finds himself very much benefited in health by his vacation.

MR. THOMAS DIXON, who has been associated with Manager T. J. Ryan of the Fort Wayne Electric Works' Cincinnati office for a year or more, has taken charge of the company's St. Louis office and in future will direct the work of that territory. Mr. Dixon, prior to his connection with the Fort Wayne company, represented the General Electric Company, traveling through Ohio for six years.

MR. W. T. GENTRY.—At a meeting of directors of the Southern Bell Telephone & Telegraph Company, W. T. Gentry of Atlanta, Ga., was appointed general manager of that company, with headquarters at Atlanta. Mr. Gentry succeeds Charles H. Wilson, who resigns to accept the position of general superintendent of the American Telephone & Telegraph Company, with headquarters at New York.

MR. T. F. RYAN, of this city, who for 15 years has been William C. Whitney's closest business associate and personal friend, has bought the Oak Ridge estate on the Southern Railway, in Nelson County, Virginia, just north of Charlottesville. He has also purchased 4000 acres additional adjoining this property. Mr. Ryan was born in Nelson County, within a few miles of Oak Ridge, which is one of the finest of the old estates of Virginia.

MR. H. G. CARLETON, the well-known dramatist and inventor, president of the Carleton Electric Company, has had a stroke of apoplexy due to overwork, but is now recovering. He was to have attended the recent dinner of the American Institute of Electrical Engineers, but was taken with grip, the graver symptoms supervening. He is now on the road to recovery and the doctors assure complete restoration, news which his many friends hear with great pleasure.

HON. C. STANHOPE, who acts as chief adviser to the well-known London financial house of Wernher, Beit & Company in relation to its electrical enterprises in Mexico and South Africa, has just arrived from Europe en route to the City of Mexico. Mr. Stanhope, who has been stopping at the Albemarle Hotel, Broadway and Twenty-fourth Street, is president of the City of Mexico Tramways Company, which concern operates the first electric road that was established in that part of the globe.

MR. R. H. KLAUDER.—The Electric Storage Battery Company of Philadelphia, manufacturer of the "Chloride Accumulator," announces that owing to the very large increase in its business in the middle Western States, it has established a branch office at St. Louis, Mo. This office has been placed in charge of Mr. R. H. Klauder, formerly of the Philadelphia staff, and will be located in the Wainwright Building. Mr. Klauder's extensive experience, gained during his connection with the electric storage battery, has made him thoroughly familiar with up-to-date practice.

MR. A. WILFORD ZAHM, secretary and general manager of the Manhattan Light, Heat & Power Company, and manager of the Manhattan Building, St. Paul, has resigned his position to accept a position as general manager of the Light, Heat, Transit & Public Service Company at St. Cloud, Minn. This company is a new organization, being a consolidation of the Benton Power & Traction Company and the Hertig Light & Heat Company, and it operates the St. Cloud & Sauk Rapids Street Railway Company, in addition to which it is operating an underground steam heating system and electric lighting plant for furnishing light in both St. Cloud and Sauk Rapids.

Trade Notes.

THE EASTERN ELECTRIC COMPANY, Middleton, Mass., has moved its business to Lynn, Mass. The company manufacturers incandescent lamps and expects to double its output in the Lynn plant.

OIL FILTERS IN GUATEMALA.—The Burt Manufacturing Company, Akron, Ohio, has just equipped a large electric light plant at Huehuetenango, Guatemala, Central America, with Cross oil filters.

THE NORTH ELECTRIC COMPANY, of Cleveland, Ohio, has opened an office for its telephone trade in the West, at 1511 Monadnock Block, Chicago. Mr. George W. Conover is in charge of this new department.

THE ELECTRIC APPLIANCE COMPANY is out with a new hotel telephone which it claims has many points of advantage. It is sending descriptions of this instrument to dealers and contractors throughout the country.

ELLWOOD-IVINS MILLS, at Oak Lane Station, Philadelphia, Pa., make a specialty of fine tubing for electrical purposes. They make seamless tubes in steel, copper, aluminum, etc. They make, it is claimed, 90 per cent of all the pointer tubes for voltmeters in aluminum tubes of small diameters and very thin walls.

THE TABER PUMP COMPANY, Buffalo, N. Y., is distributing a very useful and practical addition to one's desk, and one which will be much appreciated. It is a four-year dater and is at one and the same time a date-making and time-saving device. On the top of the handle the user is informed as to the kinds of pumps the Taber Company makes.

DISSOLUTION OF PARTNERSHIP.—The partnership known as the Palmer Electrical Instrument Company, 51 North Tenth Street, Philadelphia, Pa., was dissolved on Dec. 31 last by mutual consent. The former partners in the business were C. W. Swoope, S. M. Palmer and A. P. Palmer. The business will be continued and extended by Mr. C. W. Swoope individually under the old name.

PLATINUM.—As a result of a brief interview with Mr. C. O. Baker, of Baker & Company, relative to the situation of the platinum market, we learn that platinum has never been so high as at the present time, this notwithstanding the fact that the demand has never been greater. All indications, as a result of this condition, point to an early and substantial increase in the present quotations.

H. J. LINDER & COMPANY.—The co-partnership doing business under the firm name of H. J. Linder & Company, at 123 Liberty Street, New York, was, on Jan. 31, dissolved by mutual consent. The firm consisted of James W. Sturges and Herbert J. Linder. Mr. Sturges will continue the business of supplying complete power and electrical appliances under the name of James W. Sturges, at the old address.

THE MacKAY ENGINEERING COMPANY has opened offices in the Singer Building, 149 Broadway, New York, as manufacturers' agent for the Reilly patent pump. This pump is made for low and high pressure, circulating, distributing and condensing, air compression, etc. Aside from the usual types, special pumps are made for acid works, sugar refineries, refrigerating machines, mining, hydraulic elevators, etc.

STEAM TURBINES.—The Westinghouse Electric & Manufacturing Company has just published a pamphlet giving a reprint of the paper read by Mr. Francis Hodgkinson on "Steam Turbines" before the Engineers' Society of Western Pennsylvania last November. This paper was published in three parts in the ELECTRICAL WORLD AND ENGINEER, Dec. 22, Dec. 29 and Jan. 5 last. The pamphlet contains many illustrations, diagrams and curves.

GOOD GREEN GOODS.—Smith & Hemenway Company, of 296 Broadway, the well-known cutlery and hardware specialty house, has just issued a very neat little "Green Book" of hardware specialties in the size of a pocket edition. With it goes a "Green Book" pocket diary and reminder that everybody will find useful. The firm says: "If you accuse us of having a slight streak of good old Irish blood in our veins we shall not feel the least bit incommoded."

SERIES-PARALLEL SYSTEM OF CONTROL.—The C & C Electric Company of New York, in Bulletin No. 138, very completely describes and illustrates its series-parallel system of control for electric motors. The bulletin contains a reprint of the article in the issue of Electrical World and Engineer of Jan. 5 last, on this system as applied to the presses of the Philadelphia *Evening Telegraph*. It contains several excellent illustrations of the apparatus used in this system.

CIRCUIT BREAKERS.—The property of certain oils to destroy alternating arcs, or rather to prevent their formation, has led to the development of switching apparatus of the oil type. Messrs. S. B. Condit, Jr., & Company, 63 Oliver Street, Boston, Mass., are manufacturing a line of high and low tension circuit breakers and switches of this class, which instruments are described and illustrated in a neat catalogue just issued by the firm. The firm gives special attention to designing and building high tension switchboards.

SERIES ALTERNATING SYSTEM.—The General Electric Company's series alternating system in practical operation is the subject of a sixteen-page pamphlet of recent issue. This system provides for street lighting by means of alternating current generators, automatically regulating transformers, and inclosed arc lamps connected in series. The pamphlet contains extracts from letters received from central station managers using this system. These letters indicate that in practical operation the system is thoroughly satisfactory.

THE GREGORY ELECTRIC COMPANY, of Chicago, has secured an enviable reputation through the thorough and systematic manner in which it overhauls all second-hand apparatus, a machine after having gone through its regular process being practically equal to new. This company makes a specialty of this business is thoroughly equipped for this kind of work, employing a large number of men who are experts in their several departments. Its repair department has assumed large proportions, the product being shipped to every State in the Union.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports an unusual amount of business in small machines, both generators and motors, particularly in domestic orders. A recent sale was of a 100-kw direct current generator for the Garretson Hotel, Sioux City, Ia. Another is for an 80-kw belt-driven machine for the Murray Milling Company, Murray, Ky., and another for two 50-hp motors for the Eagle White Lead Company of Cincinnati. The Triumph Company has just shipped a 200-kw generator to W. F. Grower of Chicago, to be used in a large office building.

HUBBARD, HALL & COMPANY, 213 West Fourth Street, Cincinnati, Ohio, have been in business just one year. The company is a dealer in electrical and kindred supplies of all kinds, making a specialty of supplying everything in the electrical line. Its first year's business has far exceeded its expectations when it started, and it is now well established and pushing to the front. Manufacturers and dealers who have new electrical devices to place on the market would find it to their advantage to correspond with this firm, as it is energetic and active and will push a new device with vim and to probable success.

ART AND PHILOSOPHY IN A CALENDAR.—Messrs. N. W. Ayer & Son, Philadelphia, show much taste and originality in the design of their 1901 calendar. It is mounted on a striking design in clay modeling, executed in two delicate tones, with the firm's motto standing out in relief. The figures are large enough to be easily distinguishable at quite a distance, while the spaces are occupied by reproductions in colors of a number of striking modern posters and by advertising philosophy as well. The cost of the production and the demand for this calendar are so great that the firm has found it necessary to charge a nominal price for it.

THE ELECTRICAL POWER STORAGE COMPANY of London, England, is distributing a handsome desk pad blotter, which is highly appreciated by the recipients. Across the top are twelve strips forming calendars for the year, one of which is removed each month, leaving the calendar for the current month exposed to view. At the left-hand side is a diary for the entire year, with blotting paper interleaved between the pages; discount tables, foreign moneys and their English equivalents, etc., are also given. A novel feature in the calendar is that the cover of the diary is an accident insurance policy, which has to be signed by the recipient, and is then good for $2,500 in case of death by railway accident, with graduated amounts for minor catastrophes.

"STANDARD WIRING" HAND-BOOK.—The 1901 edition of the handbook, "Standard Wiring" for electric light and power, by H. C. Cushing, Jr., of New York, is now ready for delivery. This valuable little book has been entirely revised to date, and has been greatly added to in the way of new and useful tables, formulæ and data. The "general wiring formulæ" on pages 101 to 115, for all systems of wiring, is one of the most complete and valuable additions, and will be of inestimable value to central station men, engineers and firemen. All wiring and constructing done in accordance with the suggestions contained in this book will be passed by fire underwriters' inspectors throughout the United States. This work has been adopted by the Fire Underwriters of the United States.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has sold to the Rupert Brewing Company of New York City two 60-kw engine type generators with switchboard and all auxiliary apparatus, costing approximately $16,000. It has also sold to the Government, for dry dock No. 3 at the Brooklyn Navy Yard, three 450-hp and two 120-hp motors to be used in connection with a pumping outfit. This contract includes complete switchboard and apparatus. The Bullock Company has also placed an additional order from the Prudential Life Insurance Company, of Newark, N. J., for 20 motors to be used in running printing presses. It has also sold to a prominent concern in Tasmania two 250-kw generators and several motors, including one of 90 horse-power, as part of a large power installation.

GLAZE FILLED INSULATORS.—Mr. J. S. Sapp, of the firm of Fred M. Locke, Victor, N. Y., favors us with the following: "My attention has been called to an article in your issue of Dec. 29, 1900, entitled, 'Glaze Filled Porcelain Insulators.' In view of the fact that some of your subscribers who are not familiar with the status of the case therein mentioned may be misled thereby, I beg leave to call attention to the fact that the decision cited in no way affects the insulators made by us. The patent mentioned as granted to Boch being a process patent, only relating to one method of glazing insulators made entirely of porcelain. The litigation in no way affected the Locke patent of Dec. 15, 1896, covering high voltage insulators, claim three of which reads as follows: 'An insulator comprising two members respectively composed of insulating materials having different degrees of puncturability and having various degrees of surface resistance connected together and adapted to be supported substantially as shown and described as a means for insulating currents of very high voltage.' "

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 29, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

666,655. ELECTRIC MOTOR CONTROLLER FRAME AND METHOD OF CONSTRUCTING SAME; T. W. Eaton, Chicago, Ill. App. filed Oct. 8, 1900. The invention is directed to the construction of control frames so that when the several parts thereof are made in quantities and assembled they will occupy a definite relation to each other, thus decreasing the cost of manufacture.

666,656. MOUNTING FOR ELECTRIC MOTORS; T. W. Eaton, Chicago, Ill. App. filed Oct. 8, 1900. The exterior cylindrical surface of the motor is adapted to fit into a supporting ring which is concentric with the armature shaft.

666,675. TELEPHONE; G. L. Hogan, New York. App. filed March 9, 1900. (See Current New and Notes.)

666,677. MICROPHONE; A. G. Holcombe, Southampton, Mass. App. filed May 16, 1900. (See Current News and Notes.)

666,691. ELECTRIC MOTOR; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Feb. 2, 1900. A motor especially adapted for dental and similar purposes and to be suspended over the place of use, and having a universal movement permitting the operator to work in the most convenient manner.

666,698. TELEPHONE-EXCHANGE CIRCUIT AND SIGNALING APPARATUS; M. C. Rorty, Dedham, Mass. App. filed Oct. 4, 1900. Concerns the signaling appliance and operations employed in connections made by means of trunk conductors between sub-station circuits normally connecting with different central stations.

666,699. ELECTRIC ELEVATOR; H. Rowntree, Chicago, Ill. App. filed Feb. 17, 1900. A signaling system by which an attendant located at the motor can be signaled from the different floors, whereupon he will adjust the controller to stop the car at the floor from which the signal is received.

666,706. SELECTIVE SIGNALING AND REGISTERING APPARATUS CIRCUIT; H. E. Shreeve, Dedham, Mass. App. filed Sept. 18, 1900. Details.

666,731. ELECTRO-MEDICAL EYE-GLASSES; P. Balme, Izieux, France. App. filed March 26, 1900. The frame is composed of copper and zinc so adjusted as to send a current through the nose when the eye-glasses are used.

666,737. BURGLAR ALARM SYSTEM; Clyde Coleman, Chicago, Ill. App. filed May 6, 1899. A thermo-electric pole, selenium cell or photo-electric impulsive cell within a safe or vault controls an alarm circuit.

666,744. TERMINAL FOR ELECTRIC CONDUCTORS; A. L. Ellis, Chicago, Ill. App. filed Feb. 12, 1900. The terminal consists of a socket having an oblique wall between which and the end of the conductor a wedge can be forced.

666,764. ELECTRIC CIRCUIT CONTROLLER; N. O. Lindstrom and A. Cowperthwait, New York, N. Y. App. filed July 6, 1900. A push-button which controls its own circuit, so that when the button is pushed inward it will remain in this position until the circuit is broken at another point.

666,831. DEVICE FOR INDICATING DISARRANGEMENT OF ARMATURES OF ELECTRIC MOTORS OR GENERATORS; J. T. Watson, Philadelphia, Pa. App. filed Aug. 16, 1900. An indicator to show when the bands on the armature become displaced.

666,849. DYNAMO ELECTRIC MACHINE; A. E. Jenney, Boston, Mass. App. filed May 5, 1898. The dynamos used in telephone systems are provided with peculiarly shaped pole pieces intended to prevent the whistling or humming sometimes heard in the telephone receivers.

666,861. PRINTING TELEGRAPH INSTRUMENT; L. M. Cassella, London, Eng. App. filed Oct. 20, 1899. Details.

666,874. ARRANGEMENT OF SWITCHING APPLIANCES IN CONNECTION WITH TELEPHONES; P. Rabbidge, Sydney, New South Wales. App. filed Feb. 26, 1900. Details.

666,883. COMMUNICATING SYSTEM; I. Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1896. For telephoning and telegraphing simultaneously over the same circuit there are provided one or more sending and one or more receiving stations, a local source of current of rapidly alternating impulses connected through one terminal with the ground and through the other, with the interposition of a sending key and condenser, to the telephonic circuit.

666,900. AUTOMOTOR TROLLEY FOR ELECTRIC CURRENTS; L. Lombard-Gerin, Lyons, France. App. filed Nov. 10, 1900. This is a self-driven trolley adapted to run on the three wires of a tri-phase circuit.

666,912. SHIP'S TELEGRAPH; Leon S. Thompson, Washington, D. C. App. filed May 25, 1899. The receiver consists of a series of solenoids arranged circularly and having a core with a plurality of armatures in excess of the number of solenoids in a set. At the transmitter are contacts having electrical connections with the respective solenoids.

666,920. AUTOMATIC CUT-OUT DEVICE FOR USE IN CONNECTION WITH ELECTRICAL GENERATORS; M. S. Clawson, Weehawken, N. J. App. filed May 21, 1900. A cut-out device acting to disconnect the storage battery from the charging dynamo whenever the voltage of the dynamo falls below that of the battery.

666,933. ELECTRIC BELT; J. Moore and J. Murray, Providence, R. I. App. filed June 30, 1900. Details.

666,940. STATIC ELECTRIC MACHINE; J. Sorenson, Grand Rapids, Mich. App. filed Jan. 19, 1900. The passing current can be changed from a spark to a spray and the tensity of the current can be altered without altering the motion of the machine.

666,954. RELAY; S. G. Brown, Bournemouth, Eng. App. filed March 15, 1899. A device included in the relay circuit and suspended in the field of an alternating current magnet, is moved by the signaling currents received from the line, so as to induce alternating relay currents.

666,956. ELECTRIC CONNECTING HANDLE FOR AUTOMOBILES; E. N. Dickerson, Stovall, N. C. App. filed Nov. 5, 1900. The controlling circuit is held closed so long as the hand of the operator remains upon a controlling lever.

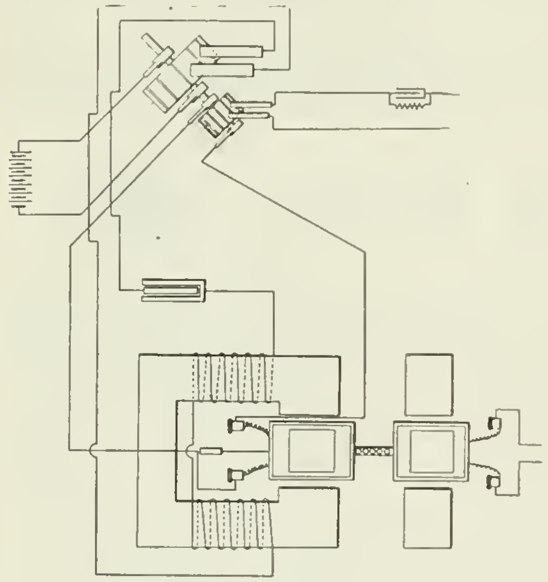
666,958. SELECTIVE SIGNALING; F. C. Ewing, Acadia, Va. App. filed Feb. 8, 1900. Details.

666,960. CABLE SUPPORTING CLIP; F. P. Fuller, New York, N. Y. App. filed Dec. 13, 1900. A strap and fastener for supporting one cable from another.

667,016. AUTOMATIC CORRECTOR FOR STEP BY STEP MECHANISM; C. O. Janney, St. Louis, Mo. App. filed Dec. 26, 1899. Details of a synchronizing apparatus.

667,028. ELECTRIC METER; A. D. Lunt, Schenectady, N. Y. App. filed Oct. 31, 1900. A field created by the measured current flowing through a certain winding is caused to rotate and the rotations are counted.

667,079. TRAVELING CONTACT FOR UNDERGROUND ELECTRIC RAILWAYS; J. Floyd, Washington, D. C. App. filed April 27, 1900. A flexible arrangement of the plough whereby contact with the conductor is maintained when the car passes over irregularities in the roadway.


666,954.—Relay.

667,095. ELECTRICAL TRACTION ON CLOSED CONDUIT SYSTEMS; H. Lane, Birmingham, Eng. App. filed Aug. 18, 1900. Relates to a system in which a magnet on the car lifts a flexible conductor in a closed conduit against contact plugs from which the car derives the current.

667,099. METHOD OF TREATING AND UTILIZING CHLORIN GAS; E. C. Paramore, Philadelphia, Pa. App. filed Feb. 21, 1900. The gas is passed through a chamber in which it is electrolyzed to nullify the odor and enhance its bleaching power.

667,100. APPARATUS FOR TREATING CHLORIN GAS; E. C. Paramore, Philadelphia, Pa. App. filed March 27, 1900. Relates to the preceding method.

667,103. INSULATOR; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 31, 1900. The wire passes through a metallic loop, the ends of which are locked inside of an insulator.

667,106. ELECTRIC ARC LAMP; E. Thomson, Swampscott, and C. E. Harthan, Lynn, Mass. App. filed Oct. 19, 1897. A magnet core consisting of a solid body having its exterior formed of thin sheet metal and its interior with lengthwise partitions of sheet metal and wires filling the compartment formed by the partitions.

667,107. ELECTRIC ARC LAMP; E. Thomson, Swampscott, and C. E. Harthan, Lynn, Mass. App. filed Nov. 4, 1897. Details in the construction of an inner globe and holder.

667,110. ELECTRIC RAILWAY; G. T. Woods, New York, N. Y. App. filed Sept. 29, 1897. Two sets of sectional conductors arranged in two distinct lines, a connection from one conductor in one line to one in the other, both sets being adapted to take current constantly from the feeding circuit and deliver the same in multiple to the car motor or motors as the car moves along, the conductors of both sets being normally dead, a normally open pick-up circuit including a source of electrical energy carried by the car, and a car-controlling switch mechanism whereby, when the car is being brought to rest, said pick-up circuit is closed.

667,113. SAFETY DEVICE FOR DYNAMO-ELECTRIC MACHINES; H. W. Buck, Schenectady, N. Y. App. filed March 11, 1899. (See Current News and Notes.)

667,114. MEANS FOR PREVENTING HUNTING OF DYNAMO ELECTRIC MACHINES; H. W. Buck, Schenectady, N. Y. App. filed April 28, 1900. (See Current News and Notes.)

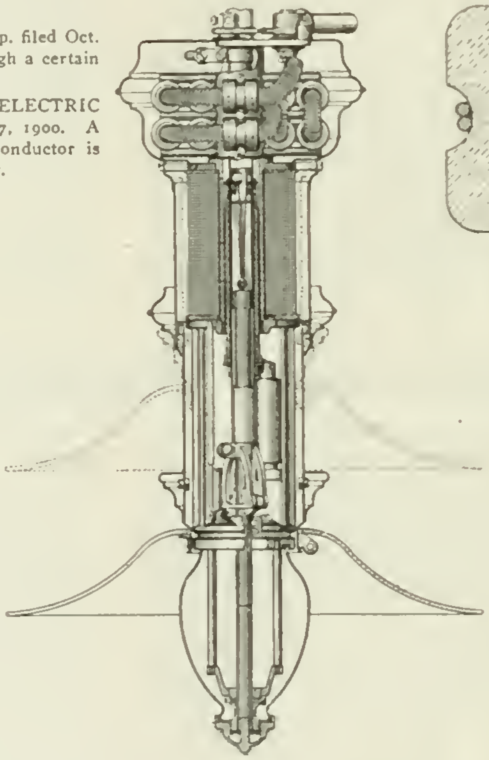
667,115. BURGLAR ALARM SYSTEM; C. Coleman, Chicago, Ill. App. filed July 12, 1898. A number of barriers are inserted between the alarm apparatus and the exterior of the structure protected, the destruction of which must be effected before the alarm can be tampered with.

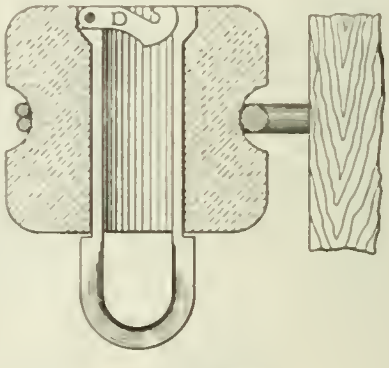
667,119. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed Aug. 29, 1898. Details.

667,120. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed Nov. 9, 1898. A magnet is used to assist the release of the clutch each time the clutch is tripped.

667,121. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed March 2, 1899. The pull of the armature is rendered uniform by utilizing the reactance introduced into the circuit of the solenoid by the changed position of the armature with respect to the coil.

667,122. ELECTRIC ARC LAMP; R. Fleming, Swampscott, Mass. App. filed Nov. 12, 1900. In an alternating current lamp a spool contains two windings in inductive relation to each other, which windings are included in the circuit at the same time.


667,119.—Electric Arc Lamp.



667,103.—Insulator.

667,123. ELECTRIC PROTECTIVE SYSTEM; H. F. Freed, Harrisburg, Pa. App. filed Aug. 31, 1900. When the alarm is once sounded, it continues and can only be stopped by a person having the keys to a switchbox.

667,124. SIGNAL BOX; H. F. Freed, Harrisburg, Pa. App. filed Aug. 31, 1900. The box is provided with a cover having openings to emit the sound of a signal therein and other openings to show a light.

667,125. ELECTRICAL CONNECTOR; H. F. Freed, Harrisburg, Pa. App. filed Sept. 27, 1900. Details of a circuit closer for burglar alarm systems.

667,128. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed July 27, 1898. Relates to the ornamental features of the casing.

667,129. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed Oct. 2, 1899. Details intended to improve and simplify the construction of focusing lamps.

667,130. LOAD-EQUALIZING APPARATUS FOR DYNAMO-ELECTRIC MACHINES; Edward M. Hewlett and Hermann F. T. Erben, Schenectady, N. Y. App. filed March 27, 1900. Brush adjusting arrangement for machines with two commutators. The brushes of each machine may be simultaneously or separately adjusted.

667,133. PNEUMATICALLY CONTROLLED TROLLEY; J. B. Linn, Schnectady, N. Y. App. filed Nov. 13, 1899. An air cylinder is mounted upon the turn-table of a trolley pole and its piston is connected to the pole, so as to control its vertical movement.

667,144. STATIC ELECTRIC MACHINE; C. H. Cook, Indianapolis, Ind. App. filed Jan. 2, 1900. Means are provided for generating a powerful supply of electricity immediately after the start, and without the aid of an exciter.

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AUTOMOBILES FOR HIRE.

The development of the electric automobile hire system has been quite rapid, and is the cause of considerable activity, as our recent article showed, in regard to the new plant or stable of the Electric Vehicle Transportation Company in this city. At the present time of one electric make alone there are in use in the various cities, plying for hire, the following number of vehicles, as nearly as can be ascertained: New York City, 360; Boston, 230; Newport, R. I., 60; Philadelphia, 55; Chicago, 115; Washington, 110; Atlantic City, N. J., 25; Mexico City, 30. There are also a considerable number of the same make in St. Louis, San Francisco and Detroit, as well as in Paris, London, Brussels and Berlin.

Such a showing is most laudable. It represents courageous investment and an infinite amount of hard work and ingenuity, and, of course, does not include any of the work done in introducing and operating private electric vehicles, of which there are already a great many also all over this country. The service given by all these vehicles this winter has been excellent, and the electrics have been able to show their qualities in more than one snowstorm or slippery frost. The expense of operation is still higher than one likes to see it, but will never be higher, tending, on the contrary, to diminish steadily with improvements, just as in every other branch of electrical development. It is true that the electric has not got the "radius" that will enable the owner to run it from New York to Buffalo, as, we are told, can be done with the steams and gasolines. But if any such trips are being made just now, either for fun or business, we have altogether missed the reports of them in the newspapers, although we have seen a Supreme Court decision to the effect that steam vehicles must all have an "avant guard" to warn the public they are coming while afar off. Such legislation is stupid and ought to be repealed if decisions can be given under it, but we are inclined to think that steam is going to have a pretty hard time of it, anyhow. There are so many practical objections to its use, despite its "radius," and perhaps because of it. Meantime, electric automobiles are quietly making headway.

FASTER MAIL SERVICE.

It is remarkable that at this late day so little should be done to improve the speed of mail delivery. The chief opportunity under present conditions is at the terminals, for the railway trip between New York and Chicago and San Francisco can be cut but an hour or two, while in the cities the collection and transportation of mail is still relatively very slow, because subject to all the delays of the street traffic, weather, etc. Yet even where the pneumatic tube system has been introduced and used with fair success it has the amazing opposition of many men in Congress, who do not seem able to look forward to the time, sure to arrive, when all city mail will be dispatched by tube, probably with electric motive power as an economical substitute for compressed air, and cheaper. Dr. Norvin Green, of the Western Union Telegraph Company, long ago expressed his belief in such electric methods, and we see nothing that can long stand in their way.

It would indeed be interesting to know to what extent the telephone has interfered with letter writing, but there is no difficulty in computing the interference of the telegraph. It amounts to about one message, or letter, per head of the population. In other words, if there were no telegraphs, people might write 80,000,000 more letters a year. This very statement is in itself a terrible condemnation of the undeveloped state of the telegraph. Why, after 60 years of growth, should it not carry hundreds of millions of the communications now sent by mail, with infinite gain in speed and general convenience, and the closer knitting together of the whole social fabric? We are unfortunately still in the primeval day of the Morse key. The telegraph companies still must earn about 30 cents a message. An operator to a circuit is still the standard. There is no patronage of any general system that will transmit a message faster than the operator can take it down. And the net result is that the telegraph is virually at a standstill, when it ought to be doing more business in a year than it has hitherto done in all its existence. Is it to be wondered at that telegraph stocks throughout an era of buoyant prosperity have either been stagnant or have declined?

Only a few months ago Prof. Pupin, before the American Institute of Electrical Engineers, showed how to increase the efficiency of telephone land circuits. His beautiful invention—at first a pure mathematical creation—has been bought on generous terms and is already going into use. That is but one example of the manner in which telephony is being developed, and handsome as the reward of the inventor may have been, it is after all small compared with the impetus given to the art and to further invention of means which are already enabling the American people to exchange some 2,500,000,000 to 3,000,000,000 conversations a year. But why should not something analogous be done in the equally promising field of telegraphy? The neglect and contumely heaped on fast machine telegraphy is one of the deepest reproaches against telegraph management in this country. One of these days the companies may wake up to find the government with a system of its own chiefly for sending letters. To-day to send a special delivery letter costs 12 cents, at which rate, we are convinced, a big and profitable business could be built up between all our large cities in machine telegraph work. And these telegraph letters would not be purely of business origin. There is a very large volume of social correspondence that could be and would be expedited in the same manner. How long are we to wait before the telegraph is brought up to the level of these opportunities, cheapened, accelerated and made once again the profitable branch of electrical industry it once was?

ELECTROLYSIS IN THE DISTRICT OF COLUMBIA.

The article appearing in this issue on the subject of electrolysis in the neighborhood of Washington, D. C., is a local reflection of what is taking place generally in the neighborhood of many large cities. The electric railway is spreading rapidly and reaching out into the open country in many directions, which, until lately, only knew the hippo-mobile and the bicycle. With the increase in the strength and transmission radius of electric currents goes increased liability to electrolytic corrosion and destruction of iron gas pipes and water pipes. On the other hand, however, the increased capital expenditure and engineering facilities enable a greater degree of care and protection to be exercised so that with ordinary precautions and engineering skill there is no necessity to dread electrolytic action in the future. It is only when watchfulness is relaxed and careless management exists that this danger tends to become serious.

It has been argued that if alternating currents could be satisfactorily employed in electric traction systems the dangers of electrolysis would entirely disappear, but this has been proved to be at least a partial fallacy. Feeble alternating currents are perhaps less likely to effect electrolytic destruction than feeble direct currents, but a strong surface density of alternating current is known to effect corrosion and this corrosion occurs at both electrodes, whereas, in the case of the direct current the electrolytic destruction only occurs at the surface of the buried anode or intermediate mass of iron acting locally as an anode on part of its surface. Consequently, it is not to the alternating current that engineers can look for complete immunity from metallic corrosion in cities. The conduit system with a completely insulated metallic circuit is undoubtedly a complete protection so long as the insulation of the circuit remains practically perfect, and even if, as in many cases, the insulation of one of the two conductors in a conduit is imperfect, the chance of stray currents effecting electrolytic damage must usually be limited. This solution of the difficulty is satisfactory in the case of large and populous cities where the heavy expenditure on the conduit system is warranted by the prospective heavy traffic. Such expenditure cannot, however, be made with a prospect of commercial returns either in small towns, or in the suburban districts of larger cities.

The double-trolley system is less expensive than the conduit system, but the double-trolley overhead system is very cumbersome, and is more than twice as unsightly, darksome and mechanically dangerous as the single-trolley overhead system. It has been fairly successful in some cases and very troublesome in others. In spite of every precaution, the chance of a short-circuit between the two sides of the system is necessarily much greater in the double-trolley than in the single trolley system, and considering the danger of a heavy short-circuit, we doubt whether it can ever come into general favor. The practical remedy for electrolytic troubles lies, however, in the proper expenditure upon the ground-return circuit, whereby the local dangers of electrolysis can be so far minimized as to be practically obviated. Every city has the right to insist upon such means being adopted by the electric traction companies as shall protect the underground pipes of other corporate bodies, but they have no right to insist upon any unnecessary and superfluous expenditure in this direction. It is possible to be so virtuous as to incur criticism for sanity, and it is likewise possible to spend money in the morbid dread of electrolysis in a manner which intelligent persons fully appreciating the situation would contemplate with dismay.

UNITED STATES GOVERNMENT MAGNETIC OBSERVATIONS.

From the report of the superintendent of the United States Naval Observatory at Georgetown, near Washington, D. C., it would appear that the electric trolley roads are responsible for rendering useless the only two magnetic observatories which the United States possesses. While this is undoubtedly a matter for regret, yet it is something for which it would seem that no one can be held responsible, since the sites of these observatories were selected long before there seemed any possibility of magntic interference by traction currents. We know, however, that the advantage of rapid traction to the community considerably outweighs the importance of maintaining these particular magneto-graphic records. We also understand that two or three new magnetic observatories are either planned, or in actual course of erection, by the United States Coast and Geodetic Survey, which are sufficiently remote from large centers as to be beyond the probable range of the deadly trolley for at least many years to come.

In the passage of the superintendent's report quoted, it would appear that considerations of gain have been allowed to outweigh considerations of scientific observation. The fact is, however, that such gains as the traction companies operating the offending system may be enabled to accumulate, are but a small fraction of the total gain to the district employing the trolley, and of the community inhabiting the district. The comparison is, therefore, not between the revenue of a corporaion and the maintenance of a continuous photographic record of the magnetic elements, but actually between the transportation service to a community occupying a certain territory, and the maintenance of the record. On this point there can be, we believe, but one opinion. Since the expense to the traction company of stopping the magnetic disturbance would probably be extremely heavy, the reasonable procedure is to carry the automatically recording instruments farther afield. A proposition inimical to the transportation service of the Washington community comes with little grace from the United States Naval Observatory, in view of the insignificance of its services to the sciences it purports to represent. Though magnificently equipped and splendidly endowed by the Government, its lack of scientific standing among the observatories of the world is no less than a national humiliation—a situation, moreover, which will continue until the incubus of its present naval management is removed.

Some Electrical Hypotheses.

We do not desire to serve as self-appointed censors of electrical theories, nor do we wish to repress that free play of the scientific imagination which leads the mind through serious battles to new realms of knowledge. But we do earnestly wish that some great, clear-headed, conservative investigator like Kelvin or Rayleigh or Poincare, would take up and pass in careful review some of the curious ultra-atomic hypotheses of electrical action which are befogging the pathway of science with an intolerable cloud of indefiniteness. When new hypotheses really clear up phenomena which have been mysterious, they are welcome, but when they merely define the doubtful in terms of the unknown, they become of questionabl value as means of investigation. It is a little difficult to see how the doctrine of charged corpuscles, in itself innocuous and useful enough in explaining certain occult phenomena of the electrical discharge in gases, has risen to the prominence of an esoteric cult with such surprising rapidity, and it is high time that the fundamental matters to which it relates were subjected to searching investigation. We suspect that the basic facts on which the elements of the doctrine were cautiously formed by a few good investigators, have been forgotten by some of their less deliberate followers, and that the thesis-grinder has done the rest. The thesis-grinder is a singular creature well known in the higher academic circles. He plunges eagerly into the pursuit of any branch of science that promises a degree in the minimum length of time and follows it with feverish energy. In due season he is turned loose upon "original work," and the borderland of new and strange theories is his favorite browsing ground. We are far from wishing to cast aspersions upon the young man in science. Far from it—some of the very best work of the century has been done by men in the twenties, but the thesis-grinder is numerous, and he is not always a genius. If he can twist a new hypothesis to fit assorted facts, or the facts to fit the hypothesis, he rushes into print as soon as the thesis has served its chief end. To such we would commend the prudent and conscientious spirit of a certain young man named Newton, who was not willing to publish a theory which he had formulated regarding the attraction of bodies in general until the accumulated data of years had shown that it was correct.

The experimental basis of these recent hypotheses may in some instances be sound enough, but while keeping our minds open in that agnostic spirit which holds final truth to be of greater moment than temporary complacency, we desire to call attention to certain objections to these tendencies of recent writers upon electrical science. The chief among these objections is the more or less metaphysical one that the corpuscular gentlemen do not vouchsafe an explanation that explains anything. To say that a molecule, atom, or corpuscle has an electric charge is a statement that may or may not be capable of complete experimental proof; but it certainly fails to explain the mechanism of electrical action in just the same sense that the old two-fluid theory of electricity failed. A molecular or atomic charge differs from a molar charge simply in magnitude, and the electric stresses between corpuscles, electrons or ions are just as difficult to explain as those larger stresses which they are put forward to elucidate. To say that chemical affinity is due to atomic charge is just as logical and satisfactory as to allege that all so-called electrification is due to the chemical stresses between the atoms; and so far as added knowledge goes one is equally benefited by either hypothesis, and would know quite as much if he were told that each atom was the houseboat of an active family of Maxwell's demons, paddled in the etheric stream by sculling with the valences; in fact, the conception of hurrying files of demons rushing growlers of positive and negative "juice" from house to house is rather attractive to the imagination, and as it expresses the facts as well as any other, is worthy of consideration by our friends the thesis-grinders. The fact is that any so-called explanation of scientific value must not be in terms of quantities just too small for experimental verification. Nor must it avoid one evident difficulty by involving two others to take its place. The whole business is suggestive of the epicycles of the old astronomers, and it is by no means impossible that it may prove to be of similar significance.

Another very serious difficulty in the way of such investigations lies in the fact that most physical quantities are interlinked in a very intimate and intricate way. The mere atomic weight of an element connotes now a vast amount of more or less accurate detail as to its physical and chemical nature. Some say all this will appear in its true significance, but at present it is a source of some confusion. For if a theory, however far-fetched, be continued to fit neatly one particular set of relations, it inevitably will also within experimental errors automatically fit a considerable variety of other relations, so that the theory at once assumes an apparent importance perhaps never intended by its authors. Even mathematical investigations are not altogether safe from similar sources of error. One never can get out of his equations fundamental truth when his original assumptions are erroneous, but unfortunately he can obtain by perfectly rigorous processes results which are in form the same whether correctly based or not. Thus, the main electrical equations are the general equations of fluent quantities, and their development has no relation whatever to the physical entities of the flux. So far as the general theory goes it might be satisfied equally well by half a dozen hypotheses which all might be grossly incorrect, and it is only the most careful investigation in the light of experiment that can discriminate between them. The general theory of light was pretty well developed a century before the idea of streaming corpuscles completely disappeared, and up to a certain point this emission theory fitted the facts as well as any other. So it behooves us to be a bit cautious in accepting general conclusions merely because they are in accordance with certain facts. The law of inverse squares fits the conditions of radiation from a point, but we are not justified in saying that brickbats are being radiated because certain assumptions as to their weight and number would harmonize the energy received with that much-abused law. There is no subject that needs investigation more than the nature of electrical energy, and every new fact is a possible clue to the mystery. But it needs rare judgment to interpret the facts correctly, and we may perhaps be forgiven for saying that just now the interpreter is badly needed.

Prof. Elihu Thomson on Electricity.

An admirable series of articles by leading authorities is now being published in the New York *Sun* on the various advances and developments of the nineteenth century in the whole round of human thought and endeavor. The eighth paper in the series is by Prof. Elihu Thomson on Electricity, occupying nearly 12 columns of the issue of Feb. 10, and covering the subject broadly. Each branch of the art receives attention, and is discussed in the clear, sane, attractive manner long since made familiar in all that Prof. Thomson says and does. Facts that are well known are grouped with skill and made fresh again, so that even those who have studied the subject can enjoy with the public this review of the "Electrical Century," although Prof. Thomson notes that only in its latter half can real utilization of electricity be said to have been effected.

As to electrical theory, we may quote Prof. Thomson as follows: "Has science any answer to make to the question, What is electricity? We think not, nor has it any answer to make to the question, What is energy? The most that science can possibly expect to do is to extend our horizon and permit us to acquire a deeper knowledge of the intimate relations of things. We speak of the ether as the electrical medium, and we acquire more and more knowledge of its properties and actions as the years go by. Facts are gradually being accumulated by workers in all departments of science, and there must follow generalizations which will bring into harmony the present discordancies where they appear. It will probably be found that the electrical properties of the ether are the fundamental ones on which the universe is built and that the properties of matter which we speak of as mass, weight, inertia, cohesion and elasticity, etc., are dependent upon or have their origin in the ether properties. Perhaps, just as light and radiant heat have been shown to be electrical vibrations, gravitation and the other properties may follow. True it is that electrical laws are most simple, most definite. Electrical measurements can be made with the utmost accuracy and delicacy. Indications these are of its fundamental and universal character.

"In order to account for the passage of light, radiant heat, magnetism and other forces through space, science has need of what is called the ether, a medium filling all space and propagating waves of heat and light, as well as magnetic disturbances and gravitation. The sun radiates to the earth luminous waves and heat waves. Moreover, it has been shown that whenever there is a great cyclonic storm upon the sun, the earth sympathizes or receives influences which disturb the compass needle. There is reason to believe that the 11-year sun spot periods find their expression upon the earth in the greater frequency of displays of aurora borealis, magnetic storms and even thunderstorms following the more active storm period of the sun, when the sun spots are most numerous.

"What, then, is the nature of this ether of space? To this question no complete answer can as yet be given, except to say that it is the electro-magnetic medium. * * * The renewed study of effects of electric discharge in vacuum tubes has already, in the work of such investigators as Lenard, J. J. Thomson and others, apparently carried the sub-division of matter far beyond the time-honored chemical atom, and has gone far toward showing the essential unity of all the chemical elements. It is as unlikely that the mystery of the material universe will ever be completely solved as it is that we can gain an adequate conception of infinite space or time. But we can at least extend the range of our mental vision of the processes of nature as we do our real vision into space depths by the telescope and the spectroscope. There can now be no question that electric conditions and actions are more fundamental than many hitherto so regarded.

"The nineteenth century closes with many important problems in electrical science as yet unsolved. What great or far-reaching discoveries are yet in store, who can tell? What valuable practical developments are to come, who can predict? The electrical progress has been great—very great—but after all only a part of that grander advance in so many other fields. The hands of man are strengthened by the control of mighty forces. His electric lines traverse the mountain passes as well as the plains. His electric railway scales the Jungfrau. But he still spends his best effort, and has always done so, in the construction and equipment of his engines of destruction, and now exhausts the mines of the world of valuable metals for ships of war, whose ultimate goal is the bottom of the sea. In this also electricity is made to play an increasingly important part. It trains the guns, loads them, fires them. It works the signals and searchlights. It ventilates the ship, blows the fires and lights the dark spaces. Perhaps all this is necessary now, and if so, well. But if a fraction of the vast expenditure entailed were turned to the encouragement of advance in the arts and employments of peace in the coming century, can it be doubted that, at the close, the nineteenth century might come to be regarded, in spite of its achievements, as a rather wasteful, semi-barbarous transition period?"

The Institute Nominations.

The nomination blanks whereby the American Institute of Electrical Engineers invites its members to select candidates for the annual election of officers have just been issued, and this has at once stimulated interest in the choice of a president to succeed Mr. Hering, who has positively declined to stand for re-election. Owing to the fact that so far only a dozen members out of some twelve to fourteen hundred have reached the chair in the 17 years of Institute life, there is an abundance of excellent presidential timber, and several well-known men are already mentioned by their friends and supporters. The list includes the names of C. P. Steinmetz, Prof. M. I. Pupin, C. S. Bradley, C. F. Scott, William Stanley, C. O. Mailloux and L. B. Stillwell, all of whom stand high in the esteem of their professional brethren, and would serve most creditably. It would hardly be fair, however, to say that the lists were closed.

Control of Enclosed Arc Patents.

It is understood, and the fact is officially confirmed this week, that the General Electric Company has secured control of the enclosed arc patents of the Marks Enclosed Arc Light Company. For some time past the General Electric Company had fought these patents, and had presented a very complete case for the defence, the litigation being in this respect one of the most interesting and important of recent years, in view of the universal vogue and popularity now enjoyed by arcs of the enclosed type. It would appear, however, that the General Electric Company, after the taking of the evidence, decided that the Marks patent had validity and value; and not caring to become merely a licensee, has now virtually absorbed the Marks Company, and abandoned its defence. The price paid is not known, but is said to reach in the aggregate several hundred thousand dollars and to be quite satisfactory to all directly concerned. The General Electric Company has already appointed new officers to represent its interests in the Marks Company, in whose name of course litigation against alleged infringers will be pushed. There are several enclosed arc manufacturers in the field, some of whom hold licenses under the Marks patents. The others are fighting the patents or disregard them as not covering the type of lamps they make. The old licenses are not affected by the changed conditions, but continue. It is reported that suit has been commenced in this city against a manufacturer not licensed who is putting in some enclosed arcs in a large dry goods store.

The Automobile Club of America.

The club announces that the formal opening of its new clubrooms, 753 Fifth Avenue, New York City, will take place on Saturday, Feb. 16. Each member may be accompanied by one guest.

The Board of Governors has issued and called special attention to the following, asking that all members will respect such regulations:

Resolved, That driving automobiles by members of this club at an excessive rate of speed on the public highways in disregard of the comfort and safety of other users of the common roads, be and the same is hereby strongly disapproved by this club, as an injury to the sport and to a great industry; and that when members driving their automobiles meet the driver of a horse or horses which shall be restive or frightened shall, on request or signal from such driver, in all cases stop and use every effort and precaution to avoid the possibility of accident.

Resolved, further, That any member of this club who shall be found, after a fair hearing, to be guilty of driving at said dangerous and excessive speed on the public highways, and who shall have disregarded the comfort and safety of other users of the same by failure to stop when requested by the driver of frightened horse or horses, or who has been guilty of such conduct in the use of an automobile on the highways as shall tend to bring odium and reproach on this organization shall be duly warned and suspended, and upon repetition of such offence shall be expelled from this club.

The New Middletown Drawbridge.

By H. G. Tyrrell.

THE new highway bridge across the Connecticut River at Middletown, Conn., is 1300 ft. long, with a 26-ft. roadway, and provision for two 6-ft. sidewalks. Beside the street traffic it carries a line of electric railway, connecting Middletown with Portland. It consists of two fixed spans, 200 ft.; two of 225 ft., and a draw span of 450 ft. Up to the time of building the bridge in 1896 communication between the two towns had been kept up by means of ferries. The amount of travel seemed to warrant the construction of a bridge, so that the Middletown & Portland Bridge Company was formed to build and maintain a toll bridge. The location selected was about on the line of ferry, running from the foot of Ferry Street, Portland, to a point on Bridge Street, Middletown, about one-sixth of a mile above the railroad depot. It is 850 ft. up stream from the railroad bridge and 300 ft. below the end of Willow Island. The position of the island, with the channel on the west side, required the draw span to be about in the center of the river, thus making a symmetrical arrangement for the span. The Government required two clear waterways of 200 ft. each, which fixed the length of draw at 450 ft. This is believed to be the longest highway drawbridge in the world. The comparison table given below does not include a number of long-span railroad draw bridges that have a highway attached:

Middletown Bridge	450 ft. long.	
Macomb's Dam "	412 " "	
Third Avenue "	300 " "	
Harlem Canal "	270 " "	
Cleveland "	279 " "	in two spans.
Charlestown "	240 " "	

Notwithstanding its being 30 miles from the sea, there is a tide of 2½ ft., and the highest known water mark is 25 ft. above low water. The floor of the bridge was placed 6 ft. above the last elevation, making the distance from floor to low water 31 ft. At low tide the depth of water in the channel is 16 ft.

The width of bridge selected is that required for two lines of carriage travel, and one line of electric cars. This requires 26 ft. center to center of trusses. Provision is made on the floor beams for connecting sidewalk brackets in the future. The bridge floor is designed to carry a live load of 100 lbs. per square ft., 14-ton electric cars or a 10-ton wagon. The trusses are proportioned for a live load per foot of bridge of 1500 lbs. for chords and 2000 lbs. for web. The material used was iron for eye bars and lateral rods, and the rest excepting machinery is medium steel.

The turntable is entirely rim bearing. Eight loading beams transfer the weight to 16 points on the drum, which is 4 ft. deep, and 31 ft. diameter. This stands on 64 cast steel wheels 8 by 16 in., which run between cast steel beveled treads 2 in. thick at centre. The lower tread rests on wrought steel plates bolted to the masonry. This arrangement of turntable makes a simple construction, and is believed to be as effective for a highway draw, as some of the more elaborate combinations of rim and center bearing turntables, which depend on their adjustment for an even distribution of load. The drum and wheels are secured in place to a center casting by means of the usual radial braces and spider frame. This center casting is set down 6 in. into the stone pier, and secured to it by means of 8 bolts 1½ in. diameter and 6 ft. long, built solid into the pier. This casting has a hollow center for the passage of wires up to the bridge.

New Electric Drawbridge Over Connecticut River.

The draw is operated by three 25-hp electric motors of the railway type, one for turning and the others for blocking up the ends. Besides these there is a fourth motor, and a duplicate set of turning machinery, all in place, which can be used in case of unbalanced wind pressure, or a break in the other machinery. Those two sets can be worked independently, or together at the will of the operator. Power is taken from the Middletown street wires, and a cable is laid on the river bottom, and brought up on the center pier. This passes in a groove under the wheel track and up through the center casting. The operating house stands on an overhead platform in the center tower. It has large windows on four sides, and an overhanging sunshade eave. The walls and floor are double thick, and it is provided with electric heat for cold weather. The platform is reached by means of a ladder from the bridge floor. It was originally intended that the closing of the gates should be done by the operator in the tower, and, in fact, the author of this article made a complete design for electrically worked steel safety gates. While these would cost $950 for the two gates, they would do away with the services of two gate operators. But on account of an accident to the substructure involving extra expense the steel gates and some other machinery were omitted.

This last was an arrangment for closing the space between the rail ends, where the draw and fixed span join. In cold weather this opening is liable to be two inches or more. As this would cause a serious jar to cars and possibly a derailment, the author had designed machinery to close this space, while the toggles were tightening. There is also a lifting steel apron plate, to cover the curved openings in the floor at the end of draw, to lift up before the bridge is opened. Instead of the moving rail, an ordinary split rail is used that can be adjusted occasionally with the changing seasons, and instead of the safety gates a pair of temporary wood ones are now in use.

As already stated, the blocking up of the ends is done by two separate motors at the ends of the draw, placed under the floor. It is not infrequent to bring power from the center by means of a shaft, but the writer's experience shows that for long draw spans, this method is not satisfactory, as too much power is lost by friction in the boxes. The calculated deflection of the ends was 3¾ in., and after the bridge was completed and levels taken the actual deflection was found to be 3⅞ in.

Blocking up the ends is done by means of a pair of toggles at each corner. These are drawn together by two bronze nuts working on a right and left-hand screw, that is turned by bevel gears from the motor. To prevent these nuts from jambing, there are electric signals that tell the operator when to shut off his power. As a general rule, it is intended to simply block the ends up tight. This requires but very little power. But as there is always the liability of the blocks becoming tight from change of temperature or other causes, the end machinery was proportioned to lift 50 tons at each corner 1½ in. in 10 seconds. This required 10 hp, but it was thought best to use the same kind of motor as at the turntable giving interchangeable parts. To provide for expansion the end toggles rest on cast steel rockers of 17½ in. radius, which in turn bear on cast iron pier plates, blocked up to the right elevation with shims. The floor of the fixed span and draw were made to level up by notching the joist.

The latch is an extra heavy swinging gravity latch, to which is attached a line of No. 10 wire passing over pulleys to the center and connected by means of bell cranks with the operator's house.

To open by electric power takes 30 seconds, and the power required to overcome an unbalanced wind pressure of 5 lbs. on one-half of the bridge is 30 hp. Ordinarily, however, in calm weather 5 hp is sufficient to turn. It was necessary to use about four times the amount of resistance, ordinarily used on street-car work with the same motors. The reason for this is evident when the relative weight of bridge and car is considered. Both the center and end sets of machinery are provided with clutches, which can be thrown out of gear, and the operation performed by hand power. Working on 10-ft. levers the bridge is turned by four men in eight minutes. There is a friction brake applied to a drum on the highest speed turning shaft. This and the other turning machinery, including the motor, are placed on the outside of the drum beneath the floor in a machinery frame that can be sheathed in and protected from snow and ice. The whole bridge is well lighted with incandescent lamps, and has also the usual signal lights required by the Government.

Electric Vehicles in Berlin.

United States Consul Hughes, at Coburg, states that Dr. M. Kallmann's report on the competition of electrically propelled vehicles in Berlin is highly instructive. The battery taking the first honors weighed only 121 pounds per kilowatt hour, while the heaviest weighed 286 pounds per kilowatt hour. The mean weight of the thirteen vehicles taking part in the competition was 165 pounds. Upon the assumption of a yearly total mileage of 9500 miles, he calculates the annual maintenance cost of a battery at only 48d., or, say, a cent per mile. The smallest consumption of energy per ton mile at the mean speed amounted to 91 watt hours for a passenger car, a far better performance than previous records are able to show. At the highest speed, the consumption increased to 135 watt hours. However, in the majority of cases, the demand did not vary greatly with the speed, which leads to the conclusion that, in order to obtain the greatest commercial economy of energy, the electrically propelled car should be driven at the highest speed consistent with public safety. By the high speed, the consumption of energy per car mile is not considerably increased, while the number of passengers which may be transported in a given time naturally increases with the speed.

The Development of the Nernst Principle.

By A. E. Fay, M. S.

It seems that the earliest experiment having any bearing upon the recent invention of Prof. Nernst was made by one "Mr. Lane," who observed that "when electric shocks passed over the surface of a piece of marble—the part over which the fire had passed, was luminous and retained that appearance for some time," and after further experiments came to the conclusion that "all calcerous substances, whether animal or mineral, and especially when burnt into lime," as well as tiles and bricks, exhibited this property. This discovery was first announced by Priestley in his "History and Present State of Electricity," which was published in 1767. The earliest attempt to put this electrical limelight* to a practical use was made with some success by W. E. Staite in 1846, but, as far as the present subject is concerned, he added nothing to Lane's discovery.

Although this experiment was probably the first one relating to the production of light by electrically heating a refractory substance, the history of Prof. Nernst's idea really began with Sir Humphrey Davy's announcement that "the conducting power of metallic bodies varied with the temperature, and was lower in some inverse ratios as the temperature was higher" (Phil. Trans., 1821), for this was the first observation of the effect of heat on conducting power.

The next discovery in this line, and the one of supreme importance, was announced by Ohm in 1844; it was that the conductivity of certain salts was *increased* by a rise in temperature. In the 50's similar results were described in Poggendorff's and Liebig's Annalen by Kohlrausch, Buff, Nippoldt, Grotrian, Hittorf and others. The halogen compounds of silver, the sulphides of silver, copper, lead and iron, and the oxides of several metals were found to have this property, and Matthiessen discovered that the conductivity of carbon was increased by heat, though not to such an extent as in the case of some poorer conductors.

As is well known, the first to apply these discoveries to lighting was Jablochkoff, who, in describing his famous "candle" in 1877, says that in general, substances which are insulators when cold, become sensibly better conductors when heated to incandescence or even to redness, and afterward describes the use of a high-tension current from an induction coil, saying: "The body becomes a better conductor on all the points where the spark touches it, and at the end of several seconds the current passes easily where it could not pass before," the surface along the path of the spark becoming incandescent at the same time. Another means for heating the "colombin," or refractory material, to give it conductivity, which was proposed by him, was to connect the electrodes by a thin carbon strip or "igniter," on the surface of the "colombin." This being heated to incandescence by the current soon burned away, leaving a conducting surface on the refractory substance. He proposed plaster of paris, brickdust, glass, porcelain, lime, chalk, kaolin, magnesia, zirconia, etc., for the "colombin," which left little for others to do in the way of suggesting materials, but it may be of some interest to note a few applications of the principle which have been made.

Edison made one invention in this line in 1878, but went no further than to mix an iron or other metallic oxide, which would act as a conductor when heated, with iridium, for an incandescent filament, an idea that was followed by Hickley several years later, who mixed glass and a carbonized vegetable fibre. American inventors, however, were working in different and seemingly more important lines at this time, and the French Jablochkoff candle, "sun lamp," and the like, did not receive much of their attention. Three of the French inventions made between 1881 and 1884, however, deserve attention in this connection.

An electrical company patented a lamp in which a wedge-shaped piece of "magnesia, or other body, which is a non-conductor when cold and a conductor when heated," was employed to furnish the light. A platinum wire passed up one side and down the other, and was made of smaller cross section at the edge of the wedge, so as to heat the magnesia more at that point. The result was as stated, that after the magnesia was once heated at the edge to incandescence, most of the current passed up the thicker portion of the wire on one side, then through the incandescent part of the magnesia and out through the thick portion of the wire on the other side.

In Tihon's lamp two carbons were placed in a refractory substance not quite parallel, with their points approaching so that the

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*The first account of Capt. Drummond's lime light was published in the "Philosophic Transactions" of the Royal Society in 1826.

"colombin" would not waste away so rapidly as its conductivity increased with the rise in temperature.

Beck patented a lamp which, in the language of his claim, consisted of "a permanent electrode, a carbon electrode arranged to rest thereon, a plate of porcelain or other equivalent material arranged in contact with said electrodes, and means whereby, after the establishment of a current sufficient to develop the conducting power of said plate by heat, the said carbon electrode is maintained in contact with said plate, at a substantially constant distance from said permanent electrode."

One of the most remarkable of the old inventions, however, in view of recent developments, is contained in a British patent taken out in 1878 by W. S. Scott, an engineer, of Wolverhampton, England. He claimed a "mode of largely reducing the resistance of electro-calcic burner by employing a large metallic reflector," presumably surrounding the burner or filament, except on one side, and reflecting the rays back upon it to assist in heating it. The device is not clearly described nor explained in the patent.

In 1888, Rudolph Langhaus, an Austrian, rediscovered that the metallic oxides were conductors at high voltages, and in 1896 several Swiss scholars found that a mixture of graphite coal tar and an infusible metallic oxide was suitable for use on 100-volt circuits.

Electrical Illuminations in Mexico.

A visit paid recently by President Diaz, of Mexico, to the city of Pueblo for the purpose of dedicating the French and Mexican Soldiers' Monument and other new buildings, afforded an opportunity for electrical illumination which was promptly availed of by the Pueblo Electric Light Company. This concern was one of the first fruits of the export trade in electrical apparatus, and has now been in existence 10 years or more. It is equipped with General Electric machinery; has 7500 incandescents and 250 arcs, and always has some American in charge of the electrical department.

Two features of the illumination are shown herewith. The fine arch was built by the company for itself, and rose to a height of 45 ft., with a width of 26 ft. It was lit up by no fewer than 700 lamps and 3 arcs. On one side were the letters, "P. D.," for Porfirio Diaz; and on the other, "Paz," or "peace." The other illustration shows the decorations of the Spanish colony in the Zaragoza Street. This beautiful piece was elaborately floral and contained 800 lamps. There were also 100 lamps in their Casino. Such displays are very unusual in Mexico, and hitherto have been seen by very few of the natives, so that they created a tremendous effect and gave unbounded pleasure to the crowds thronging the city.

All told, the company had about 3000 extra lamps on the new palace and arches, etc., which, added to the regular lighting and the illumination in the stores, transformed old Pueblo at night into a rarely beautiful spectacle. We are indebted to Mr. H. H. Wilson, superintendent and engineer of the Pueblo Electric Light Company, for this opportunity to note an interesting and tasteful electrical display in the sister Republic.

Street Electrical Illuminations in Pueblo, Mexico.

Electrolysis in the District of Columbia.

By Grahame H. Powell.

The rapid extension of electric car lines in and about the District of Columbia, the majority of which have grounded returns, or, at best, inadequate metallic circuits, with the consequent dangers of electrolytic action to the gas and water mains of the city, as well as to the telegraph and telephone cables, has led to a recommendation on the part of the Commissioners of the District that Congress should provide more stringent penalties for failure on the part of the electric light and power companies to provide a proper metallic return for the powerful currents employed.

The recommendation of the Commissioners is embodied in an extensive report, giving the text of the legislation desired and which, it is hoped, will enable the District to compel the power companies to make adequate provision for the protection of the network of mains underlying the city of Washington.

Serious attention was first attracted to the dangers of electrolytic corrosion in the early part of 1897, the period which marked the beginning of the extension of the trolley systems about Washington. In the spring of that year the telephone companies observed that their cables were charged electrically much higher than had previously been the case. An investigation resulted in the discovery that the lead-covered cables in the conduits of the company were carrying the return currents of a large part of the supply furnished the trolley roads by the Potomac Electric Light & Power Company. The telephone company sought to remove the danger to its lines by running a zero copper wire through its conduits and bonding the cables to it; but this method was only successful after the copper wire had been connected with the negative pole of the power company's generator at the power house.

In the course of his report, the engineer officer who investigated the subject of electrolysis in the District, says that "with the large increase of late years in the use of electricity for lighting and power purposes, the damage resulting to underground metallic constructions from the use of ground or uninsulated returns has greatly increased, and the evils from such an incomplete system of distribution for electricity are beginning to be fully realized. In many cities the question of the prevention of electrolytic action on such constructions is being very seriously considered. With the absence of overhead trolley roads in the city of Washington, the question has been an unimportant one until recently. Conditions have, however, changed so markedly in the last two years that it should have immediate attention. So long as the trolley roads did not enter the city, and while each one had its independent small power plant, the return of the current to its point of generation was accomplished through the ground or otherwise without any material damage to gas and water mains, etc. Recently a large central power station has been established within the city limits from which nearly all the trolley roads in the District of Columbia, and some in Maryland and Virginia, obtain their power. This station also furnishes current for public and private lighting at various points within the District. Current so generated is constanty delivered to many points, some of which are a number of miles distant. In many instances this current has to find its way back to the station through the ground and such metallic constructions in it as offer the least resistance, no proper metallic return having been provided. Where a metallic return has been provided it is uninsulated, and only partially serves its purpose." The report then goes on to point out specific instances of damage resulting from these return currents.

One of the phases of the question is set forth in a report by Capt. C. H. Davis, United States Navy, superintendent of the Naval Observatory. Capt. Davis in the course of his report says that the observatory is situated on a spot selected by a commission appointed for the purpose. The site contains nearly 70 acres in the suburbs of the City of Washington and was purchased in 1882. The site chosen was one that was expected to remain free for all time from the disturbances due to the proximity of a city and the effects of traffic. As Capt. Davis says, the electric railway had not then been perfected. and no more desirable site could have been selected. The construction of the necessary buildings, the laying out and grading of the grounds, and the removal of the instruments from the old observatory extended over a period of ten years, and to-day the place where the astronomical observations and calculations are made by the officers of the government is one of the most picturesque about Washington.

Among the many delicate instruments installed in this supposedly out-of-the-way location are a number of magnetic instruments which are self-registering by means of photography. The impossibility of using these instruments under present conditions is the occasion of Capt. Davis's report. The magnetic instruments referred to were mounted in January, 1894. He says:

"There are two lines of electric railway passing on parallel lines in a northwesterly direction on either side of the observatory grounds, the Georgetown & Tenallytown Road, with branches which extend to distances of from 7 to 8 miles from the terminus in Georgetown, the main line passing within 1400 ft. of the magnetic observatory, being the nearest, to the west. The other road runs from Washington to Chevy Chase, passing the Observatory to the east at a distance of three-fourths of a mile.

"When the instruments were mounted it was immediately noticed that there was a disturbance of the vertical force trace during the hours when the cars were running on the Georgetown & Tenallytown road. This disturbance was not at first sufficiently serious to destroy the value of the observations. It was apparent in a widening and blurring of the line (trace), and the question was raised as to whether the disturbance was mechanical, and an experiment was undertaken to determine this, with a negative result. The disturbance remained about the same until the spring of 1897, when it gradually assumed larger proportions, and began to show itself also in the horizontal force and declination, the increase in disturbance being attendant upon a very heavy increase in the traffic of the road. It became evident that the effect of currents from the roads operated not only to blur the trace, but to increase the vertical force. * * *

"The disturbances so far noticed have been traced directly to the nearest road, the Georgetown & Tenallytown, but were traffic on this road to cease the observatory would still be within the radius of influence of the Washington & Chevy Chase road, three-fourths of a mile distant, the effects of which are obliterated in the preponderating influence of the closer road. * * *

"In addition to the disturbances which can be traced to the electric railway, there are during the night hours, at more or less regular times, small disturbances which are probably due to throwing off the current in arc light circuits in the city, these circuits having a grounded return wire.

"It thus appears that the use of powerful electric currents for commercial purposes has destroyed the usefulness of the only two magnetic observatories on the North American continent. That is, considerations of gain so far outweigh considerations of science and knowledge that the latter do not enter where questions of money prevail."

The report of Mr. Walter C. Allen, the inspector of electric lighting of the District, which accompanies the Commissioners' recommendation to Congress, contains a great deal of interesting reading and shows a careful and intelligent investigation of the subject of electrolysis.

Mr. Allen says: "This inspection of the trolley roads involved more than mere readings of the potential difference between water main and rail; it embraced a thorough examination of the feeding circuits, the size and efficiency of the return, and the general condition of the roadbeds. This ground was gone over quite thoroughly in the fall of 1895, and report made of the results. Since then several important changes have occurred to increase the danger to which the mains are exposed. The Potomac Electric Power Company, which was then just beginning to operate to any extent in the District, had its power plant in the station of the Georgetown & Tenallytown Railway Company, and confined its operations to furnishing current for a limited number of incandescent lamps, both public and private, on the alternating system, and to supplying current to the above-mentioned railroad and to the newly installed Washington & Great Falls Electric Railway. Since then it has, with commendable enterprise, extended its lines to all portions of the District, besides reaching railroads operating both in Maryland and Virginia exclusively, until now it is an important factor in the electrical engineering field. The new power house of the company, in Georgetown, contains the most modern machinery, well adapted to the service to which it is put. * * * In addition to the alternating system employed by this company, which is a complete metallic system and does not enter into the question involved in this report, it supplies current from its grounded railway generators to public arc lamps and to stationary motors, besides running several overhead trolley roads."

Mr. Allen concludes that the solution of the problem is quite simple, though legislation is necessary before the railroads can be compelled to adopt the remedy. He says the extension of the underground electric system such as is employed on the Metropolitan Railroad lines, a local corporation, is, of course, too expensive to put in operation; but its substitute, the double trolley, he believes, can be easily installed and successfully operated. Either this must be done or some other equally good metallic circuit system must be provided.

In a former report on this same subject, Mr. Allen calls attention to a case of electrolytic action. The water main was comparatively new, having been down only about 18 months, and showed no signs of damage; but the service pipe was badly corroded and was, in fact, leaking at one place where the current had eaten entirely through.

Capt. Davis, in a report written prior to the one already quoted, says:

"As these railways are now managed, it would probably be necessary to remove our magnetic instruments to a distance of at least two miles before the effects of local disturbances would cease to be felt. This would retire the observatory from the national capital, which, in view of the amount of money already spent here and the beauty and fitness of the site in all other respects, is not to be thought of. The only other alternative is to discontinue magnetic observations here. This would be a loss to science, because there are only two magnetic observatories on the continent of North America, the other one, situated at Toronto, being unfortunately in the same predicament as ourselves, owing to the close proximity of a trolley road; so that the accumulation of accurate magnetic observations, which are of incalculable value for the future solution of one of the great problems of nature, has practically ceased in North America."

The Senate committee has reported favorably on the proposed bill, the main provisions of which are as follows:

"That each and every street railway company in the District of Columbia using the overhead trolley system for the propulsion of its cars, or using any other electrical system employing an uninsulated, a grounded, or a rail-return or feeding circuit for the current, shall equip its lines with the double trolley system, or other equally good insulated metallic circuit system."

"That after the passage of this act it shall be unlawful for any person, company or corporation in the District of Columbia to furnish current for electric light, heat or power on a circuit or system, any portion of which is grounded or connected to any grounded construction, or which is not thoroughly insulated from the ground. It shall be unlawful for any person, company or corporation in the District of Columbia to use any dynamo, generator, motor or transforming device in connection with any lighting or heating apparatus for the production or utilization of electric current any pole or terminal of which is grounded or connected to the earth or any grounded construction."

A penalty of $25 a day is provided for each day's non-compliance with the provisions of the act.

A Chemical Printing Paper.

By JAMES ASHER.

MR. GREEN, of London, has recently invented a chemical paper which may be printed without ink, and without previous moistening or other preparation on the part of the printer. The chemicals are mixed with the paper pulp during manufacture. The paper can be made at as low cost as common paper, because only low-priced chemicals are necessary. The paper is white, and it is not affected in any other manner than by currents of electricity. It will last for any length of time. It gives a jet black, lasting impression, and requires neither drying nor other treatment after the printing has been effected. The printing machine is a common printing press from which the inking devices have been removed. The part which carries the paper is made of metal. Types and cuts of any design may be used.

Either a dynamo or a battery has one of its terminals electrically connected with the cylinder which bears the paper, while the other terminal is connected with the form. During the passage of the paper through the machine the current of electricity passes through the paper and causes electrolysis of the chemicals therein contained, leaving dense black stains having exactly the same form as the types. A current of 4 amperes at from 10 to 110 volts is sufficient in machines of the largest size. The power necessary to drive the machine is less than usual, because of the absence of inking machinery. The cost of the press is said to be about two-thirds that of the common press, and the cost of the electric current is only one-half the cost of ink. At Blackpool a rotary press printed at the rate of a hundred copies a minute and is claimed to be doing absolutely perfect work. Whether or not the blackening effect extends quite through the paper has not been stated. If extending quite through, it would practically prevent the use of the new method in printing newspapers or other sheets requiring words on both sides. On the other hand, if the blackening effect extends through the sheet, there may be a chance to secure the advantage of manifold printing by merely passing several superposed sheets through the machine at the same time. Currents of higher tension than usual would be necessary in manifold printing.

It seems to me that several other uses might be made of the new paper. It might be used instead of the troublesome moistened paper in automatic telegraphs which chemically record the messages. Even telegraphs which record with ink, such as Wheatstone's automatic, the Morse inkwriter, Meyer's autographic telegraph, the telautograph, and perhaps even the siphon recorder used on submarine cables could use the new paper with great advantage. In some of these the current which passes through the paper would not pass over the line, but a relay would bring a local current into action by means of which the required impressions would be recorded. Printing telegraphs such as the stock ticker, Hughes' printer and even the very rapid page printer, recently patented by Mr. Buckingham, might record their messages by electrolysis in Green's paper. Possibly it would be practicable to record the messages on several papers superposed, and so produce the desirable result of manifolding in all the telegraphs in which the paper could be used.

Manifolding on typewriters could also be done in a similar manner. A metallic cylinder, bearing the paper, would be necessary. It might even be advisable to use this paper on typewriters when printing single sheets in many large offices.

Again, a person could with a metallic pencil in an insulating holder perform the operation of writing single sheets or do manifold work. The electric wires would be connected with the top of the pencil and with a metal plate under the paper. It would be possible to considerably diminish the chances of forgery were a business man to use the chemical paper in his transactions, either with the typewriter or with the metallic pencil in the manner which I have just proposed.

Steam Heating from Central Stations.

By ALTON D. ADAMS.

STEAM may be distributed from central stations at either high or low pressure. For high-pressure distribution, or that from 20 to 100 lbs. by the gauge, the steam must usually be taken directly from the boilers where it is generated, but a reducing valve may be employed if desired to reduce the pressure in pipes below that of the boilers. In distribution at low pressures from 1 to 20 lbs. above that of the air, steam may be taken from high-pressure boilers through a reducing valve, from low-pressure boilers or from an exhaust tank for engines. In a station devoted exclusively to the distribution of steam the boilers would naturally be operated at the pressure required in the pipes. At stations that distribute both electric energy and steam, a high-pressure pipe system may be supplied directly from the boilers, or a low-pressure system from either the boilers, the exhaust steam tank, or both, according to the extent of the service and whether the engines are operated condensing.

The pressure at which steam is distributed will largely determine the uses to which it may be put. Steam at high pressure in the pipe system is suited to the production of power, by means of engines, and to all classes of cooking, laundry work and general warming, through suitable reducing valves. Low-pressure steam is available in the laundry, for some kinds of cooking and the heating of buildings. If steam is distributed simply for general warming purposes, there is little reason to deliver it to the pipes of consumers at more than 2 to 5 lbs. pressure, as this is usually enough to force it through the local heating system. The pressure necessary to force the required amount of steam through the pipes of a public distribution system is subject to much variation, depending on their design, but may readily be 5 or 10 lbs. in a low-pressure supply for heating buildings. As steam at low pressures is mostly used for general warming purposes, the demand for it is very small during four to six months of each year.

If distribution pipes are supplied with exhaust steam from engines, as is desirable at electric stations, whatever pressure is necessary in the exhaust tank acts as a back pressure in the engine cylinders. This back pressure reduces the power of the engines and lowers their efficiency. The power and efficiency of engines is also lowered by the lack of a partial vacuum that might be had if the exhaust steam were condensed. This vacuum may be 10 or 12 lbs. per square inch below atmospheric pressure. Engine power may be brought up to that possible with a condenser, by a suitable increase of the boiler pressure. If all of the exhaust steam can be used in the heating system, the drop in the efficiency of engines affects the efficiency of the combined equipment to a much smaller extent. This is evident from the fact that while the total heat of exhaust steam at atmospheric pressure is 966 heat units above that of water at 212 degs., the total heat of steam at 100.3 lbs. gauge is only 1177 units above water at 40 degs.

The distribution of steam through long pipes involves losses of two distinct kinds, a loss of pressure due to the friction of the pipes and a loss of heat from their surfaces. Both of these losses increase directly with the length of pipe through which steam is delivered. The loss of pressure increases with the square of the velocity at which steam flows through the pipe and with the friction of its surface. Heat loss by radiation and conduction also increases with the diameter and temperature of pipes, and with the radiating and conducting powers of their coverings. It will be noted from this that an increase in the diameter of pipe lowers the loss of pressure from friction, by allowing a smaller velocity of steam for a given rate of delivery. But the larger diameter and surface make the loss of heat by conduction and radiation greater. A result is that for a given rate of steam delivery, at a certain temperature, with a certain pipe covering and quality of interior surface, there is one size of pipe that involves a smaller total loss than any other. It is thus quite as possible to have a pipe too large as too small for the best economy. The combined loss in pipes of friction and condensation should not exceed 20 per cent of the total energy in steam transmitted at their maximum rate, over distances up to one-half mile. The loss of pressure in pipes one-half mile in length need not usually exceed 10 lbs. at their highest rate of delivery.

In the early development of steam distribution from central stations, two pipes were laid to the premises of each consumer, one to deliver the steam and the other to return the water of condensation to the central station. As a gravity return is not practicable for the extensive system of a central station, pumps were used to return the condensed steam. It was found that the additional expense and complication necessary for return pipes was not warranted by the value of the condensation, and such pipes have been abandoned. As now laid, the distribution system of a central heating station contains but one set of pipes, where steam is used. Service pipes from the steam mains are each supplied with a regulating valve just outside or inside of the consumer's premises, in the case of high-pressure service, so as to insure a nearly constant pressure of the desired amount. Where the steam supply is at low pressure, as 5 or 10 lbs., the regulating valve is not necessary. The hot water from steam condensed within a building becomes the property of those who buy the steam and may be used for any purpose to which it is suited. In some cases this hot water is collected in heater coils over which a supply of fresh air from out of doors is passed and warmed for ventilation.

Since a first-class boiler plant with economizers may deliver as much as 80 per cent of the contained energy of coal to water and steam, this amount less the losses in distribution mains is available at the premises of consumers. If steam pipes are so proportioned and laid that their loss of heat amounts to one-fifth, or any other definite portion, of that latent in all of the steam entering them, during periods of maximum service, the average loss must be a much larger part of the total steam used. This increase of the average per cent of loss in pipes over that for maximum service is due to the fact that the average supply of steam for heating must be much less than the maximum, while the amount of loss in heat units is nearly constant, whatever the flow of steam. With a heat loss of 20 per cent from the pipes at the maximum flow of steam, the per cent of loss would rise to about 40 for one-half and 80 per cent of latent heat for one-quarter the maximum rate of steam delivery to pipes. Experience at central heating stations has shown that the consumption of steam is at a monthly maximum during December, January, February and March, this maximum being reduced by one-one-third for November and April, and about two-thirds for May and October. From all of the data at hand it seems fair to estimate the average per cent of loss of heat from distribution pipes for low-pressure steam at one-half greater than the per cent of loss at the maximum rate of delivery. A loss of 20 per cent of the latent heat of steam during the maximum rate of delivery thus implies a loss of 30 per cent for the average rate. To change 1 lb. of water at 40 degs. to steam at 10 lbs. gauge pressure requires 1147 heat units, and on condensation at atmospheric pressure, as is nearly the condition in the radiators of consumers, 966 heat units are given up. If .3 of the steam is condensed in distribution pipes, their efficiency as to the latent heat is $(966 \times .7) \div 1147 = 59$ per cent. If the water of condensation is cooled from 212 to 40 degs. at the premises of consumers, the efficiency of distribution is $(676 + 173) \div 1147 = 74$ per cent. With boilers of 80 per cent efficiency, the low-pressure steam system has an efficiency from the fuel to consumers of $80 \times .59 = 47$ per cent for latent steam heat and $80 \times .74 = 59$ per cent if the water of condensation is cooled to 40 degs. As the pressure of steam in distribution pipes goes up their temperature and the losses by radiation also increase. Steam at a pressure of 15.3 lbs. by the gauge has a temperature of 250 degs., while at 100.3 lbs. gauge its temperature is 338 degs. The rate at which heat is radiated from the distribution pipes varies directly with the difference between their temperature and that of the surrounding air or earth. If the temperature of the air or earth about pipes is taken at 40 degs. the pipes with steam at 15.3 lbs. are 210 degs. higher in temperature, while pipes with steam at 100.3 lbs. are 292 degs. higher in temperature. The pipes at the higher pressure may therefore be expected to show a heat loss 1.4 times as great as those at the lower pressure. The high average loss from pipes for steam distribution is due in large measure to the fact that the temperature of such pipes must remain nearly constant whatever the rate at which steam is passing through them.

As the demand for steam is very light during a large part of each day in cold weather, and decreases at all times of the day as the weather grows warmer, while the loss of heat from pipes remains nearly constant at all times, there are many periods when the steam condensed in the distribution pipes is larger in amount than that delivered to consumers. Where the exhaust steam at an electric station is to be utilized for general distribution, several factors beyond those involved in supply from a simple steam heating station have to be considered. One of the most important points relates to the distribution as to time during each day of the demand for heat and the supply of exhaust steam. The maximum demand for heat usually occurs between 6 a. m. and noon, but the greatest rates of supply of exhaust steam at electric stations take place between 4 and 10 p. m. If only exhaust steam is supplied to the distribution pipes, it is evident that either the excess of exhaust at times of heavy loads in electric stations must be stored for subsequent use, or else that it must be applied to some purpose other than heating. Even at 10.3 lbs. gauge pressure, 1 lb. of steam occupies 16 cubic feet. Allowing 36 lbs. of exhaust steam for each kw-hour of electric energy delivered at the station, the necessary tank space for exhaust at 10.3 lbs. pressure corresponding to this unit output is 576 cubic ft. To store one-half of the exhaust during two hours of a station operating at 500 kw, supplying 10,000 incandescent lamps, requires therefore a tank space of 288,000 cubic ft. This space would be provided by an exhaust tank 75.5 ft. in diameter and 65 ft. high. These figures are obviously so impracticable for application that their discussion is unnecessary. Since it is not desirable to attempt to store steam because of its great volume in proportion to weight, the maximum or morning demands of a heating system must be met with much less than the greatest rate of supply of exhaust steam, if none is taken directly from the boilers. Such a condition seriously limits the extent of heating systems from electric stations.

A solution of the difficulty, so far as it limits the extent of a heating systems, is found by taking steam from boilers through a reducing valve, to supply the distribution pipes at times when the demand for heat cannot be met with the available exhaust steam. This plan leaves open the question as to what shall be done with exhaust steam, in excess of the demands for the heating system, during periods of maximum loads at the electric station. Either or both of two methods may be followed in the use of exhaust steam beyond the amount that can be distributed in the heating system at any one time.

One plan is to operate a part of the engines condensing, during times of greatest loads at electric stations, and all of the engines non-condensing on the lighter loads. This practice involves condenser capacity for most or all of the engines and their variation between condensing and non-condensing action at different times of day. Condensers are thus in use but a small part of the time and the changes in engine operation involve some extra attention, but the plan is much better than that on which any large amount of exhaust steam goes to waste.

Another plan is to use all excess of exhaust steam during periods of heavy loads at electric stations, to heat feed water for the boilers during the remainder of each day. The extent to which this method can be applied is evidently limited by the amount of heat that feed water for operation during an entire day can absorb from the exhaust steam. As is well known, the weight of exhaust steam rejected from engine cylinders is materially less than the weight of live steam entering them. This result is due to cylinder condensation, and an average value for the portion of the total steam consumption leaving cylinders as water may be taken at 20 per cent. On this basis the 36 lbs. of exhaust steam rejected by engine cylinders per kw-hour of output at electric stations, implies a consumption of 45 lbs. of feed water by boilers for each delivered unit of electrical energy. To heat 1 lb. of water from 40 to 212 degs. F. requires 173 heat units, but if the exhaust steam is only 80 per cent by weight of the steam entering the engine, 216 heat units must be supplied by each pound of exhaust steam to heat the 1.25 lbs. of feed water entering the boiler. At atmospheric pressure 1 lb. of steam contains 966 units of latent heat, so that 22 per cent of this can be absorbed to heat 1.25 lbs. of feed water.

Considering the total production of exhaust steam at an electric station during each 24 hours, it is thus evident that not more than 22 per cent of its weight can be condensed to heat the supply of feed water for the entire day. If, therefore, the excess of exhaust steam over the demands of a heating system, during the hours of heavy load is more than 22 per cent of the exhaust for the day, a part of this excess must be consumed in condensers or otherwise, or else wasted. To store the latent heat of 22 per cent of the total production of exhaust steam during each 24 hours in feed water will require a large tank, but its size is warranted by the saving to be effected.

To illustrate the size of feed water tank that would be necessary to store the latent heat of 22 per cent of the exhaust steam at an electric station of moderate capacity, during 24 hours, take the following case: Let the total daily output at an electrical station be 5000 kw-hours, the exhaust steam corresponding to 22 per cent of which is to have its heat stored. Then the steam whose heat is to be stored is that produced with 1100 kw-hours, or at 36 lbs. of exhaust steam per electrical unit, 39,600 lbs. As water heated from 40 to 212 degs. absorbs 173 heat units, the 966 units of latent heat in 1 lb. of steam at atmospheric pressure raises the temperature of 5.6 lbs. of water through this range. The 39,600 lbs. of steam whose heat is to be stored, therefore, require 221,760 lbs. of water, which, at 59.8 lbs. per cubic foot occupies a space of 3708.36 cubic feet. A round tank. 15.5 ft. in diameter and 20 ft. high, holds this amount of water. If feed water for the entire 24 hours at an electric station is heated to 212 degs. by the excess of exhaust steam during the period of heavy load, over the demands of the heating system, the heat of the flue gases can be utilized to still further raise the temperature of the feed water. As steam at a gauge pressure of 100.3 lbs. has a temperature of 338 degs., 128.6 heat units may be added to each pound of boiler feed water after it reaches the temperature of 212 degs., if boilers are operated at the pressure named. This use of flue gases to raise the temperature of feed water above 212 degs. will absorb a large per cent of their heat and enable rapid changes to be made in the steam output of boilers. To determine the efficiency of a combined electric and steam heating station, in the generation and distribution of energy from coal, it is necessary to take account of both the heat and electricity delivered to consumers.

The reasonable assumptions previously made show that for each electrical unit or kw-hour delivered by the station with 10 lbs. back pressure on the engine, the boilers must supply 45 lbs. of steam, of which 36 lbs. will come from the engine cylinders as exhaust steam and 9 lbs. as water. Forty-five lbs. of steam at 100 lbs. gauge and 10 lbs. back pressure per kw-hour is about equivalent to 40 lbs. per kw-hour at the same gauge and 2 lbs. back pressure. The 36 lbs. of exhaust, when reduced to atmospheric pressure, yield $966 \times 36 = 34{,}776$ heat units for the pipe system. If a part of this heat is stored in feed water, and then subsequently taken from the boilers, through a reducing valve, into the distribution pipes, the result is the same. The 45 lbs. of steam, at 100 lbs. gauge pressure, per kw-hour of electric energy, absorbs $1177 \times 45 = 52{,}965$ units of heat above feed water at 40 degs. temperature. Exhaust steam from engines driving dynamos may, therefore, deliver for the heating system $34.776 \div 52{,}965 =$ 66 per cent of the heat taken from the boilers by engines. The average efficiency of the steam distribution pipes has been found to be 59 per cent where only the latent heat of steam is used and 74 per cent where the heat can be extracted from the water of condensation down to a temperature of 40 degs. Considering only the latent heat of exhaust steam, consumers may, therefore, receive $80 \times .66 \times .59 = 31$ per cent of the energy of the fuel, consumed under boilers of 80 per cent efficiency, to drive engines for electric stations. If the heat equivalent of 1 kw-hour, or 3412 heat units is reduced to a per cent of the fuel energy it becomes $(3412 \div 52{,}965)\ .80 = 6.4$ per cent. The combined heat and electric energy supplied to consumers is thus $31 + 6.4 = 37.4$ of that taken from fuel, where the condensed exhaust is wasted. Where the temperature of the condensed exhaust can be reduced to 40 degs. by indirect heating coils, the efficiency of distribution becomes 74 per cent, and the portion of fuel energy delivered by the exhaust steam is $80 \times .66 \times .74 = 39$ per cent. The total efficiency in this last case is $39 + 6.4 = 45.4$ per cent. As the simple steam heating system has an efficiency of 47 per cent, the coal that an electric station must burn in order to distribute a given amount of heat with exhaust steam is therefore $47 \div 31 = 1.5$ times the amount necessary at an independent heating station for the same heat distribution. When steam at an electric station is taken from the boilers for the heating system, either through reducing valves or from boilers operated at low pressure, about the same efficiency as to heat distribution can be had with this steam as would be possible at a simple heating station.

The supply of the steam distribution system of an electric station in part directly from the boilers, makes it practicable to store the latent heat of more than 22 per cent of the exhaust steam in feed water, because in this case all of the feed water does not enter the engines as steam. For electric stations that can use a weight of steam for heating at least equal to their total amount of exhaust with simple engines, there is little or no advantage in the operation of compound engines. The pressure of 10 to 15 lbs. above the atmosphere, that must be maintained in the distribution pipes for steam heating from a central station, operates to reduce engine power in nearly the proportion of the total back pressure to the mean effective pressure of boiler steam in a simple engine. Where a compound engine is used this back pressure operates against the piston in the low-pressure cylinder, and as this piston may have an area 2.5 to 3 times as great as the piston in a simple engine of equal power, the advantage of the compound engine over the simple as to steam consumption for a given power may be more than offset, even where the total exhaust is not used for heating.

Elements of Illumination—XX.

By Dr. Louis Bell.

THE ELECTRIC ARC.

The electric arc is the most intense artificial illuminant and the chief commercial source of very powerful light. A full account of it would make a treatise by itself, so that we can here treat only the phases of the subject which bear directly on its place as a practical illuminant. First observed probably by Volta himself, the arc was brought to general notice by Davy in 1808 in the course of his experiments with the great battery of the Royal Institution. If one slowly separates at any point an electric circuit carrying considerable current at a fair voltage the current does not cease flowing when the conductor becomes discontinuous, but current follows across the break with the evolution of great heat and a vivid light. If the separation is at the terminals of two carbon rods the light is enormously brilliant and by proper mechanism can be maintained tolerably constant. The passage of the current is accompanied with immense heat, and the tips of the carbon rods grow white hot, and serve as the source of light. In an ordinary arc lamp the upper carbon is the positive pole of the circuit, and is fed slowly downward, so as to keep the arc uniform as the carbon is consumed. The main consumption of energy appears to be at the tip of this positive carbon, which is by far the most brilliant part of the arc, at which the carbon fairly boils away into vapor, producing a slight hollow at the center of the upper carbon, known as the "crater." The carbon outside the crater takes the shape of a blunt point, while the lower carbon is rather evenly and more sharply pointed, and tends, if the arc is short, to build up accretions of carbon into somewhat of a mushroom shape. Fig. 1 shows the shape of these tips much enlarged, as they would appear in looking at the arc through a very

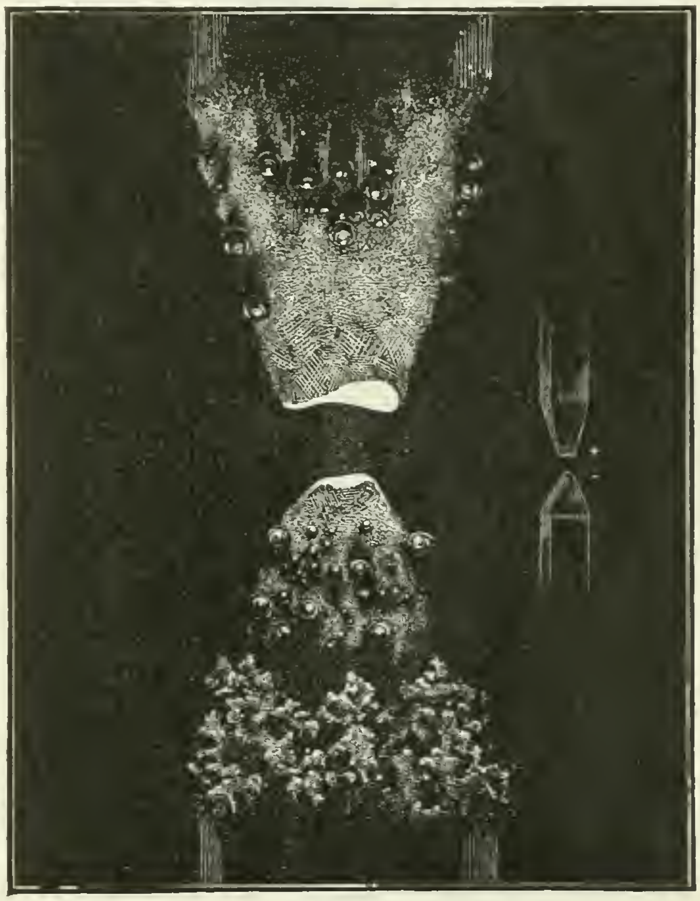


FIG. 1.—ENLARGED VIEW OF CARBON TIPS

dark glass. Under such circumstances the light from the arc between the carbon points seems quite insignificant, and it is readily seen that the crater is by far the hottest and most brilliant feature. In point of fact the crater is at a temperature of probably 3500 degs. to 4000 degs. F., and gives about 50,000 cp per square inch of surface —sometimes even more.

It is tolerably obvious that the more energy spent in this crater the more heat and light will be evolved, and that the concentration of much energy in a small crater means a tremendously powerful arc. It is not surprising therefore to find that the larger the current crowded through a small carbon tip, in other words, the higher the current density in the arc the more intense the luminous effects and the more efficient the arc. Fig. 2 shows this fact graphically, giving the relation between current density and light in an arc maintained at uniform current and voltage. The change in density of current was obtained by varying the diameter of the carbons employed, the smallest being about 5-16 in. in diameter, the largest ¾ in. The current was 6.29 amperes, and the voltage about 43.5. The efficiency of the arc appears from these experiments to be almost directly proportional to the current density. But if the carbon is too small it wastes away with inconvenient rapidity, while if it be too large the arc does not hold its place steadily and the carbon gets in the way of the light.

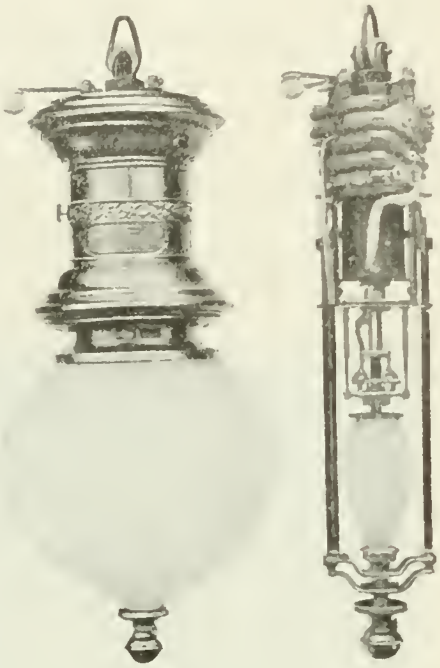


FIG. 3.—TYPICAL ENCLOSED ARC LAMP.

The higher the voltage the longer the arc that can be successfully worked, but here again there are serious limitations. With an arc too short the carbons are in the way of the light, and the lower carbon tends to form mushroom growths, which interfere with the formation of a proper arc. In arcs worked in the open air the arc is ordinarily about 3-16 in. long. If the voltage is raised above the 40 to 45 volts at the arc commonly employed for open arcs, the crater temperature seems to fall off and the arc gets bluish in color from the relatively larger proportion of light radiated by the glowing vapor between the carbon poles.

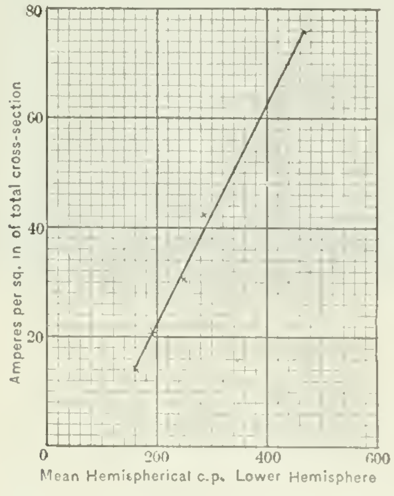


FIG. 2.—RELATION BETWEEN CURRENT DENSITY AND LIGHT.

So it comes about that commercial arcs worked in the open air generally run at from 35 to 50 volts, and from 6 to 10 amperes. The softer and finer the carbons the lower the voltage required to maintain an arc of good efficiency and proper length, so that arcs can be worked successfully at 25 or 30 volts with proper carbons, and with very high efficiency, but at the cost of burning up the carbons rather too rapidly. Abroad, where both high-grade carbons and labor are cheaper than in this country, such low voltage arcs are freely used with excellent results, and a greatly increased efficiency.

Sometimes three are burned in series across 110-volt mains, where in American practice one or at most two arc lamps would be used in series with a resistance coil, the same amount of energy being used in each case. The upper carbon burns away about twice as fast as the lower, and the rate of consumption is ordinarily from 1 to 2 inches per hour, according to the diameter and hardness of the carbons.

The carbons themselves are generally about ½ in. in diameter, and one or both are often cored, i. e., provided with a central core perhaps 1-16 in. in diameter of carbon considerably softer than the rest. This tends to hold the arc centrally between the carbons and also steadies it by the greater mass of carbon vapor provided by the softer portion. Generally it is found sufficient to use one cored and one solid carbon in each arc, although in this country arcs burning in the open air usually are provided with solid carbons only.

In this country such open arcs are very rapidly passing out of use, and are being replaced by the so-called enclosed arcs. During the past three or four years these have gone into use in immense numbers until at the present time the open arc is very rarely installed, and illuminating companies are discarding them as rapidly as they find it convenient to purchase equipment for the enclosed arcs.

The principle of the enclosed arc is very simple. It merely consists in fitting around the lower carbon holder a thin elongated vessel of refractory glass with a snugly fitting metallic cap through which the upper carbon is fed, the fit being as close as permits of proper feeding. The result is that the oxygen is rapidly burned out of the globe, and the rapid oxidation of the carbon ceases, the heated gas within checking all access of fresh air save for the small amount that works in by diffusion through the crevices. The carbon wastes away at the rate of only something like ⅛ in. per hour under favorable circumstances, and the lamp only requires trimming once in six or eight full nights of burning, instead of each night. For all-night lighting it used to be necessary to employ a double carbon lamp in which were placed two pairs of carbons, so that when the first pair was consumed the second pair would automatically go into action and finish out the night. The enclosed lamp burns 100 hours or more with a single trimming. Even much longer burning than this has been obtained from a 12-in. carbon, such as is customarily used, but one cannot safely reckon on a better performance without very unusual care. Fig. 3 shows a typical enclosed arc lamp, both with and without its outer globe and case, of the description often used on 110-volt circuits. The nature of the inner globe is at once apparent, but it should also be noted that the clutch by which the carbon is fed acts, as in many recent lamps, directly upon the carbon, thereby saving the extra length of lamp required by the use of a feeding rod attached to the carbon. Finally, at the top of the lamp is seen a coil of spirally wound resistance wire. The purpose of this is to take up the difference between 110 volts, which is the pressure at the mains, and that voltage which it is desired to use at the arc and in the lamp mechanism.

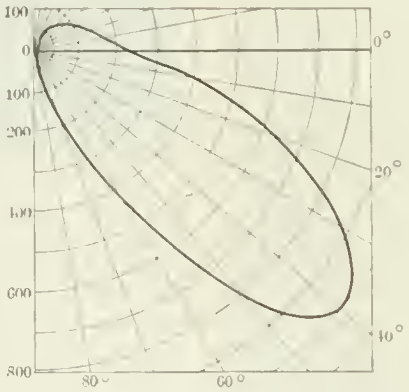


FIG. 4.—AVERAGE DISTRIBUTION OF LIGHT.

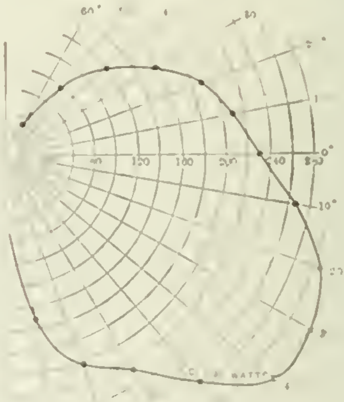


FIG. 5.—COMPOSITE DISTRIBUTION CURVE.

Such a resistance evidently involves a considerable waste of energy, but in the enclosed arc the voltage at the arc itself is rather high of necessity, 70 to 75 volts, so that the waste is less than it would otherwise be.

It has been found that when burning in an inner globe without access of air, the lower or negative carbon begins to act badly, and build up a mushroom tip when the voltage falls below about 65 volts.

Hence it is necessary to the successful working of the scheme that the arc should be nearly twice as long as when the carbons are burning in open air. This has a double effect, in part beneficial, in part harmful. With the increased length the crater practically disappears, and the light is radiated very freely without being blocked by the carbons. Hence the distribution of light from the enclosed arc is much better than from an open arc. On the other hand, there is no point of the carbon at anything like the temperature of the typical open arc "crater," and the intrinsic efficiency is thereby lowered. Also if the enclosed arc is to take the same energy as a given open arc the current in the former must be reduced in proportion to the increased voltage, hence, other things being equal, the current density is lowered, which also lowers the efficiency.

The compensation is found in the lessened care and the lessened annual cost for carbons. The carbons themselves have to be of a special grade, and are about two and a half times the cost of plain solid carbons, but the number used is so small that the total cost is low. There is some extra expense on account of breakage of the inner globes, but the saving in labor and carbons far outweighs this. Moreover, the light, albeit somewhat bluish white, is much steadier than that of the ordinary open arc, and the inner globe has material value in diffusing the light, being very often of opal glass, so that the effect is much less dazzling than that of an open arc, and the light is far better distributed.

In outdoor lighting the greater proportion of horizontal rays from the enclosed arc is of considerable benefit, while in buildings the same property increases the useful diffusion of light, as will be presently shown. Of course, when enclosed arcs are operated in series as in street lighting the resistance of Fig. 3 is reduced to a trivial amount or abolished, so that the extra voltage required with the enclosed arc is the only thing to be considered. The enclosed arc used in this way is very materially better as an illuminant than an open arc taking the same current, and experience shows that it may be substituted for an open arc taking the same energy with general improvement to the illumination.

The weak point of the open arc is its very bad distribution of light, which hinders its proper utilization. The fact that most of the light is delivered from the crater in the upper carbon tends to throw the light downward rather than outwards, and much of it is interrupted by the lower carbon. Fig. 4 gives from Wybauw's experiments the average distribution of light from 26 different arc lamps, representing the principal American and European manufacturers. The radii of the curve give the intensities of the light in various angles of a vertical plane. The distribution of light in space would be nearly represented by revolving this curve about a vertical axis passing through its origin, although at any particular moment the distribution of light from an arc may be far from equal on the two sides. The shape of the curve is approximately a long ellipse with its major axis inclined 40 degs. below the horizontal. The presence of globes on the lamps may modify this curve somewhat, but in ordinary open arcs it always preserves the general form shown. The small portion of the curve above the horizontal plane shows the light derived from the lower carbon and the arc itself, while the major axis of the curve measures the light derived from the crater. The tendency then of the open arc is to throw a ring of brilliant light downward at an angle of 40 degs. below the horizontal, so that within that ring the light is comparatively weak and without it there is also considerable deficiency. Hence the open arc, if used out of doors, fails to throw a strong light out along the street while it is dazzling when near the lamp. For the same reason the open arc is at a disadvantage in interior lighting for the reason that most of the light being thrown downwards, falls upon things and surfaces far less effective for diffusion than the ordinary walls and ceiling. Hence one of the very best ways of using arcs for interior lighting is to make the lower carbon positive instead of the upper, and to cut off all the downward light by a reflector placed under the lamp. Then practically all the light is sent upward and outward to be diffused by walls and ceiling.

The enclosed arc, on the other hand, gives a much rounder, fuller curve of distribution, the light being thrown well out toward the horizontal and there being a pretty strong illumination above the horizontal. For the same energy the maximum illumination is little more than half the maximum derived from an open arc, but the result in distribution is such as to fully compensate for this difference if one considers the lamps as illuminants and not merely as devices for transforming electrical into luminous energy.

Fig. 5 shows a composite distribution curve from ten or a dozen enclosed arc lamps, such as are used on constant potential circuits, including various makes. Most of them were lamps taking about 5 amperes, and therefore using nearly 400 watts at the arc, besides the energy taken up in the resistance and the mechanism. Figs. 4 and 5 afford a striking contrast in distribution, and it is at once obvious that the lamps represented by the latter have a great advantage as general illuminants either indoors or outside. These figures include the inner globe, of course, which is generally of opal glass, which is of material benefit in correcting the bluish tinge produced by the long arc. After a few hours burning a slight film collects on the inner globe, which tends to the same effect. For interior lighting, outer globes of opal or ground glass are generally added, so that the color question is practically eliminated. As ordinarily employed, enclosed arc lamps take from 5 to 7 amperes, although now and then 3 or 4 ampere lamps are used. These smaller sizes are less satisfactory in the matter of color of the light, and are not widely used. Abroad open arcs taking as little as 2.5 amperes are sometimes used. The carbons in this case are very slender and of particularly fine quality, and these tiny lamps can be made to give a brilliant and steady light. Outside of America the enclosed arc is little used, for abroad labor is much cheaper than here, and carbons of a grade costly or quite unattainable here are there reasonably cheap, so that the somewhat higher efficiency of the open arc compensates for the extra labor and carbons.

At its best the electric arc has about three times the efficiency of a first-class incandescent lamp, but this advantage is somewhat reduced by the need of diffusing globes to keep down the dazzling effect of the arc, and to correct the distribution of the light. Taking these into account, and also reckoning the energy wasted in the resistances in case of arc lamps worked from constant potential circuits, the gain in efficiency is considerably reduced, and if one also figures the better illumiation obtained by using the distributed lights usual in incandescent lighting, the arc lamp has a smaller advantage than is generally supposed. Many experiments bearing on this matter have been made, and a study of the results is highly instructive.

Transmission System of the Bay Counties Power Company, California.

ONE of the largest transmission undertakings in California has been carried on very quietly, so that it has by no means attracted the attention its size and importance deserves. The company now has power houses of an aggregate capacity of 16,000 hp, with room for enlargement, and in addition to supplying power to towns and mining districts in Yuba and Nevada Counties, northeast of Oakland, is now completing a double 140-mile pole line to deliver power to Oakland and the eastern shores of San Francisco Bay. The transmission line and apparatus is designed for 60,000 volts line pressure.

The Bay Counties Power Company is the result of a consolidation of two companies, which previously owned power plants and supplied power in Yuba and Nevada Counties, viz., the Yuba Electric Power Company and the Nevada County Electric Power Company.

The Bay Counties Power Company now has three power houses. The largest of these is at Colgate on the North Yuba River, which was originally started in September, 1899. It has been enlarged until, when machinery now contracted for is installed, it will have a capacity of 15,000 hp. There will be allowance made for extending this plant still further. The water is supplied by a flume 7.6 miles long, 7 ft. wide and 6 ft. deep, with a drop of 13 ft. to the mile. This flume terminates at a point on the hillside 700 ft. above the power house. Five pipe lines will take the water to the power house. These are cast iron at the bottom and steel at the top, 30 in. inside diameter. In the power house there will be three units of 3000 hp and four units of 1500 hp. Risdon Iron Works impulse water wheels direct-connected to Stanley three-phase generators and governed by Lombard type F governors are adopted for all the units. The large units will run 285 r. p. m., and the small units run 400 r. p. m. The generator voltage is 2400, and this is raised at present writing by transformers connected delta fashion to 24,000 volts for transmission. This will presently be changed to star connection, and consequently 40,000 volts. The new transformers for the 140-mile line to Oakland will give 60,000 volts, and will be connected star-fashion with grounded neutral. They will have three different connections, so that 40,000, 50,000 or 60,000 volts may be obtained. The start will be made at 40,000 volts, and according to the plans this will be raised to 50.000 and 60,000 when the line loss due to increasing load exceeds 10 per cent. Oil switches are to be put in on all the 2400-volt generator circuits at the power house.

What is known as the Old Yuba power house is 10 miles from the Colgate power house. It operates under a 300-ft head of water supplied by a pipe line 42 in. in diameter. It has three Pelton waterwheels direct-connected to two-phase Stanley generators, giving 2400 volts pressure. This is stepped up to 16,000 volts, three-phase, and is run in parallel with one of the circuits of the Colgate plant not before mentioned.

The South Yuba power house, 5 miles from Nevada City, formerly owned by the Nevada County Electric Power Company, is unique in having two different sources of water and necessarily operating under two different heads. Most of the time it is run by water supplied by a flume, and the head is 290 ft. When this water is low the supply is pieced out with water from a storage reservoir under an 800-ft. head. To accommodate these two different heads each generator has two Pelton wheels direct-connected on its shaft, one for high and one for low head. This plant has four 500-kw Stanley two-phase generators generating at 5000 volts.

Grass Valley, Nevada City, Oroville, Marysville and neighboring mining districts are now being supplied, besides a part of the Sacramento Electric Gas & Railway Company load. A maximum of 800 to 900 hp is being supplied to placer mining dredges alone.

The 140-mile transmission line to Oakland consists of two pole lines side by side, 25 ft. apart. Each pole line carries one three-phase circuit transposed every mile, and a telephone circuit 5 ft. below the power circuit. One circuit is of No. 00 medium hard-drawn copper, and the other of stranded aluminum cable of equal conductivity. It was considered that while aluminum is considerably cheaper it is still an experiment for use on transmission lines, and that the company could not afford to experiment on more than one line for the sake of the saving in first cost. The poles are round Oregon cedar, 35 ft. long, are spaced 132 ft. apart, and were painted with hot carbolinium avenarius around the ground line. The insulators (made by Locke) are porcelain with a very wide lip fastened by a sulphur joint onto a glass insulator with a very long petticoat. This is placed on a high wooden pin. This insulator is the result of experiments by R. H. Sterling, superintendent of the Bay division, who has charge of the construction of the transmission line, and sub-stations at the Oakland end of the line.

The line passes through and will supply Woodland, population 8000; Dickson, 4000; Vallejo, 7000; and other smaller towns. A branch of 12 miles will be run to Napa, 12,000 population. The main business will be in supplying power around the eastern side of San Francisco Bay to smelters, reduction works, powder works, etc. The Oakland Transit Company is also to be supplied with power. The latter sub-station will have three 450-kw motor generator sets, with G. E. 60-cycle synchronous motors driving railway generators. There will be there three 500-kw G. E. transformers in use, and one of the same size in reserve. Each side of the crossing of the Straits of Carquinez, north of Oakland, a 1500-kw sub-station, is being put in where transformers will be placed for 5000-volt distribution. Each sub-station is to have three transformers in use, connected star on primary and delta on secondary, and one in reserve, and all transformers have regulating heads on the secondaries for varying the voltage.

One of the most novel and interesting features of the transmission aside from the high voltage is the crossing of the Straits of Carquinez with the transmission line. This is to be done with a span 4700 ft. long. Four 7/8-in. Roeblings steel cables, three in use and one in reserve, will make the enormous span. Steel towers were built by the Pacific Bridge Company on high ground, each side of the Straits, over which the cables pass. There will be 12 tons strain on each cable, and the design of 60,000-volt insulators for taking the strain and also for sustaining the weight was a nice problem. The weight is taken by porcelain insulators ,and the strain insulators depend on micanite to withstand the heavy pressure.

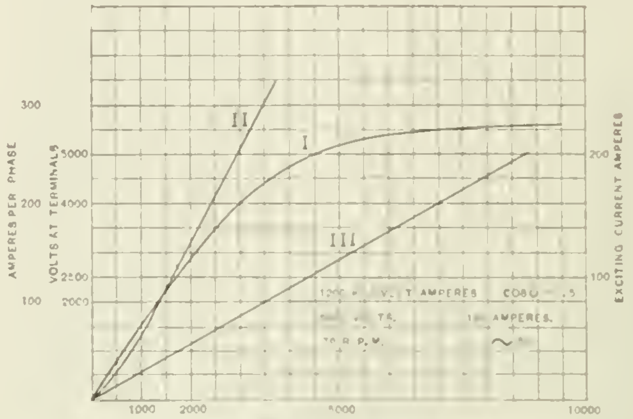
The officers of the Bay Counties Power Company are E. J. De Sabla, president and general manager; W. H. Pierson, vice-president, and C. R. Grow, secretary. R. H. Sterling is superintendent of the Bay division; T. E. Theberath superintendent of the Yuba division, and L. M. Hancock superintendent of the Nevada division. The work of these engineers is of unusual interest and importance, as the above account will indicate. It is not a little remarkable that California should have become in this manner the center of power transmission work on such a large scale, transcending in distance anything else of the kind in the world up to date.

European Types of High-Tension Alternators—V.

By C. F. Guilbert.

LABOUR ALTERNATOR.

One of the alternators of the Société Eclairage Electrique shown at the Paris Exposition (Figs. 46, 47, 47a and 50), where it was direct-connected to a horizontal tandem-compound Dujarin engine, presented a particular interest on account of the smallness of the power factor as stated by the makers, namely, .5 and from the very small drop. The second feature is still more interesting on account of the high voltage for which the machine was constructed—30,000 volts. A feature worthy to be noted with reference to the construction of this alternator is the manner in which the laminations are secured, indicated on the accompanying illustrations, and which has for an effect to increase the rate of the cooling of the armature, with a consequent reduction in the weight of iron employed.

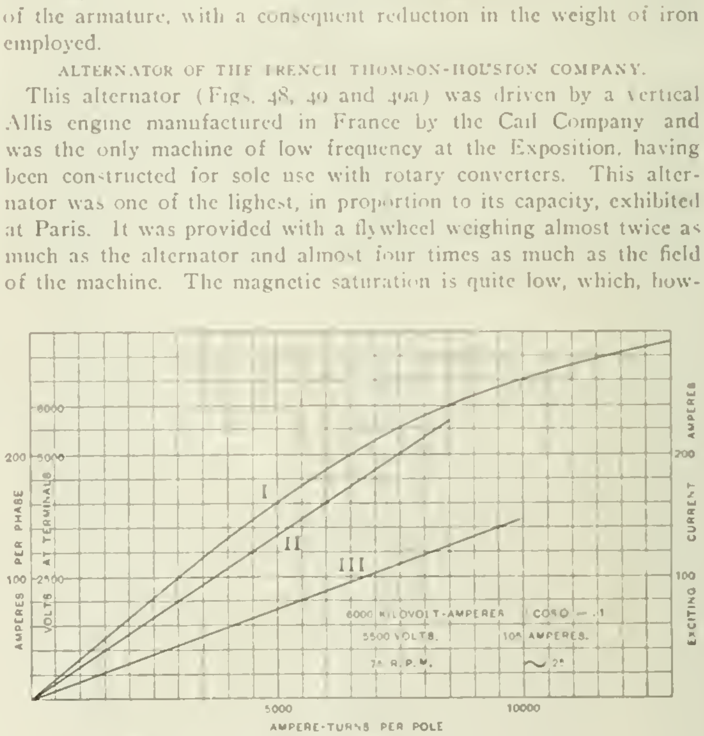


I.—No load Characteristic. II.—Short circuit Characteristic.
III.—Excitation line.

FIG. 47A.—CHARACTERISTICS OF LABOUR ALTERNATOR

ALTERNATOR OF THE FRENCH THOMSON-HOUSTON COMPANY.

This alternator (Figs. 48, 49 and 49a) was driven by a vertical Allis engine manufactured in France by the Cail Company and was the only machine of low frequency at the Exposition, having been constructed for sole use with rotary converters. This alternator was one of the lighest, in proportion to its capacity, exhibited at Paris. It was provided with a flywheel weighing almost twice as much as the alternator and almost four times as much as the field of the machine. The magnetic saturation is quite low, which, however, in this case is little with respect to drop, the power factor remaining practically at unity on account of the regulating effect on a circuit of rotary converters.

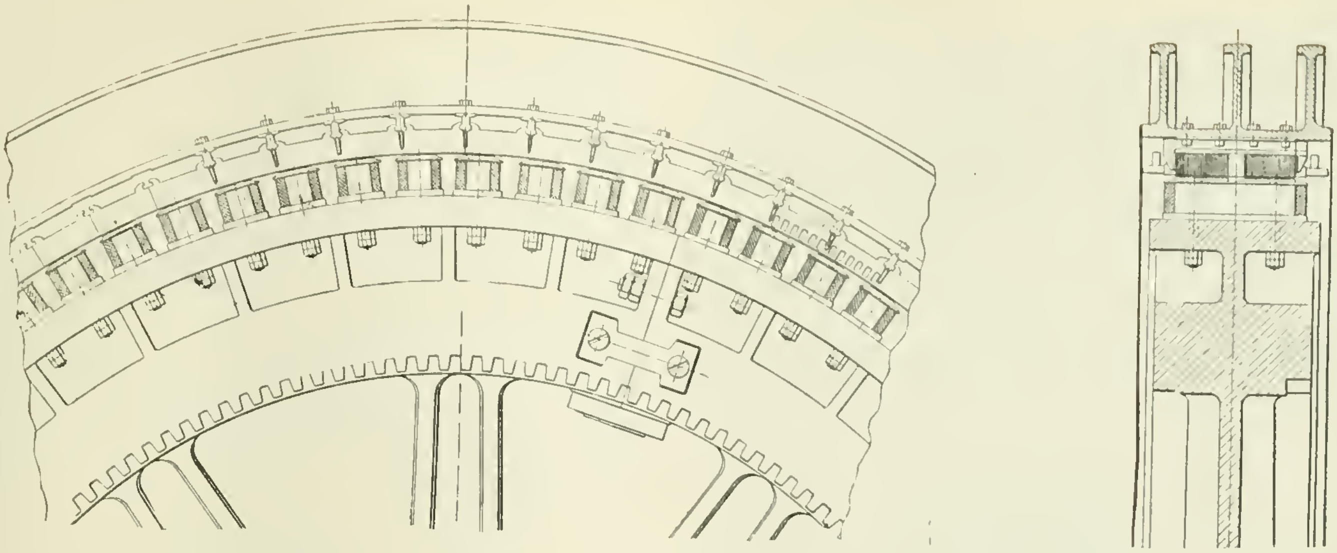


I.—No-load Characteristic. II.—Short-circuit Characteristic.
III.—Excitation line.

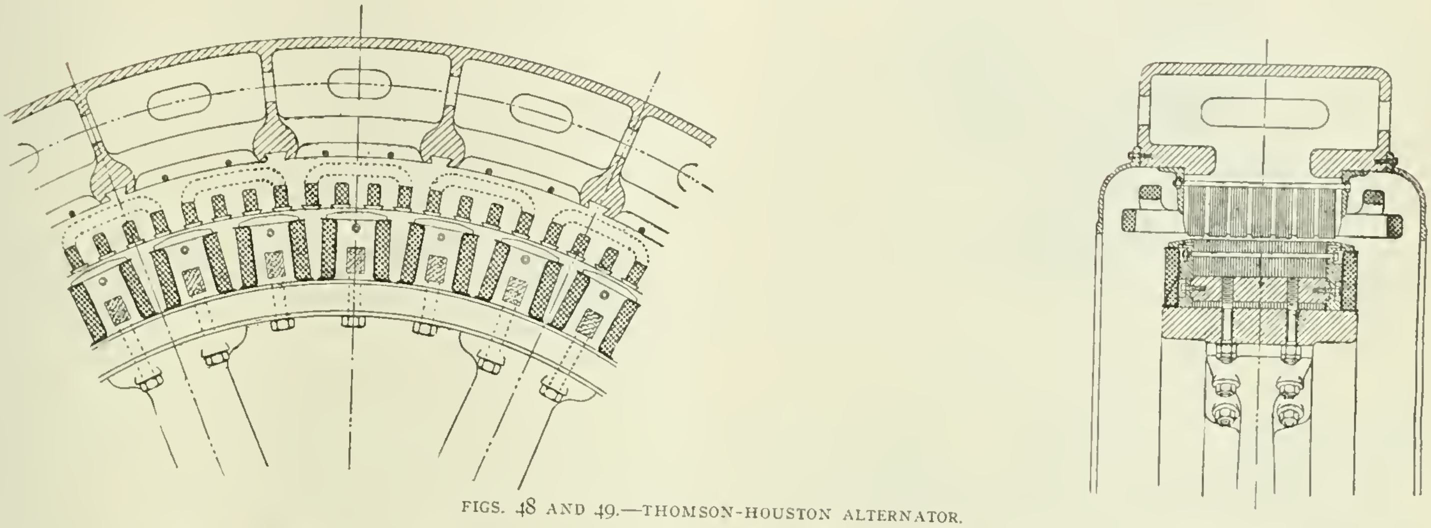
FIG. 49A.—CHARACTERISTICS OF THOMSON-HOUSTON ALTERNATOR.

FARCOT ALTERNATOR.

The Farcot alternator exhibited at Paris (Figs. 51 and 52) was direct-connected to an engine from the same works, and is a two-phase inductor machine. Two features are to be noted in connection with this machine, both with respect to its electrical design—the separation of the two phases, the machine in this respect resembling



FIGS. 46 AND 47.—LABOUR ALTERNATOR.



FIGS. 48 AND 49.—THOMSON-HOUSTON ALTERNATOR.

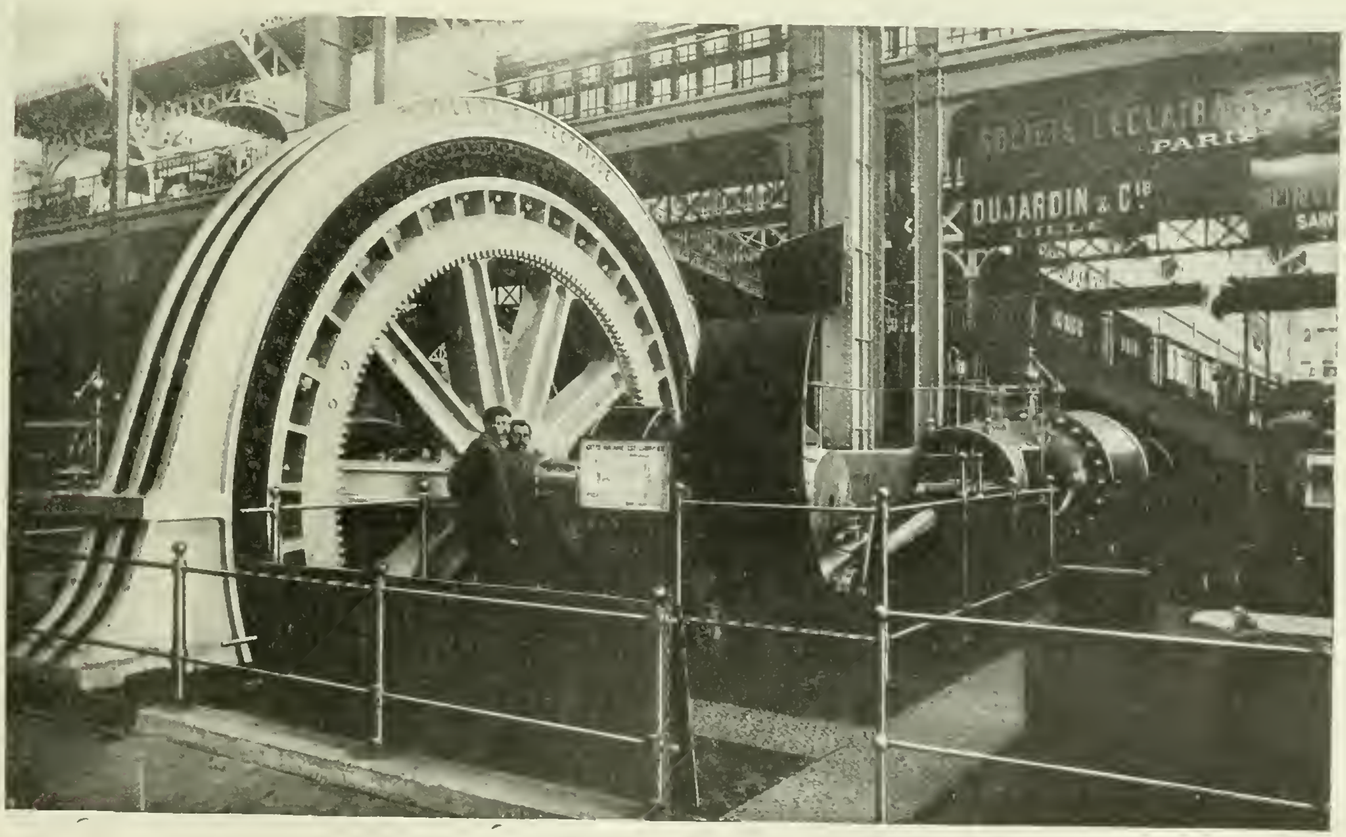
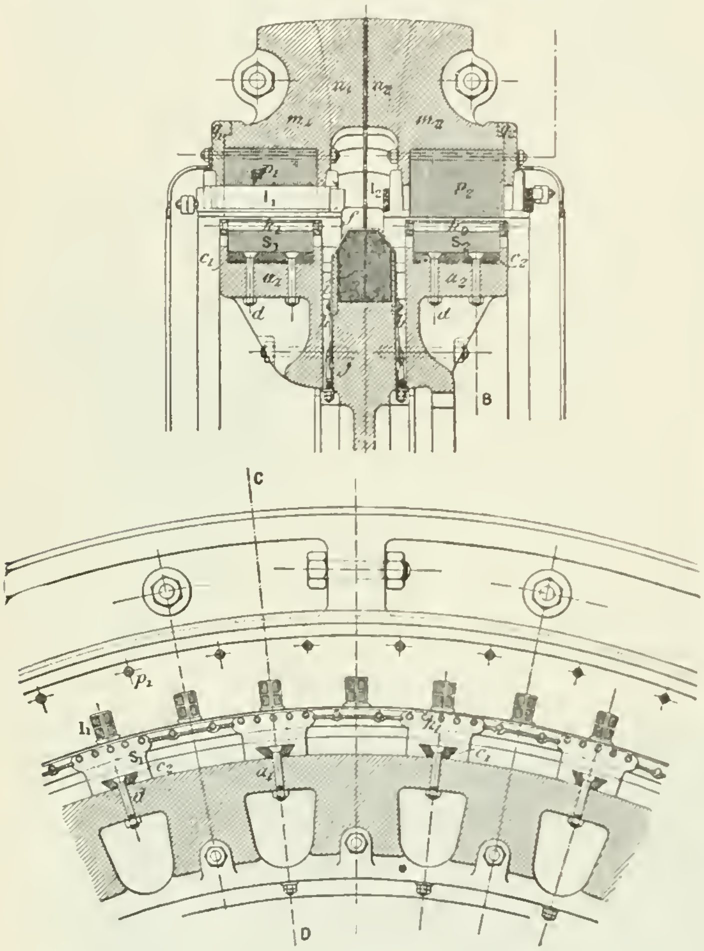


FIG. 50.—PERSPECTIVE VIEW OF LABOUR ALTERNATOR.

the American Stanley alternator; and the employment of the Hutin & Leblanc amortisseur to lessen the armature reaction flux and to facilitate operation in parallel.

The Hutin & Leblanc amortisseur consists of a cylindrical cage formed of copper rods axially arranged, there being 5 rods per pole, and two between each pole—riveted to two copper rings, thus forming a squirrel-cage construction identical with that of polyphase motor armatures. The principle of action is as follows:

In polyphase machines the flux due to the currents in the armature is constant and turns in space with the same velocity as the field flux and in the same direction. It is thus stationary with respect to the amortisseur circuits which, consequently, are not acted upon. In single-phase armatures—which classification includes the Farcot armatures—the flux due to the armature current is, on the contrary, an alternating flux, which can, as the MM. Hutin and Leblanc have shown, be decomposed into two fluxes both revolving with a velocity equal to that of synchronism, but in contrary directions. We can thus consider the ampere-turns of the armature as a resultant of two constant magnetomotive forces, each having a value one-half the maximum value of the alternating ampere-turns into the factor 4π nearly; and turning, one in the same sense as the field and with its speed, and the other in the opposite direction. The first is thus fixed with respect to the field and consequently with respect to the amortisseur circuits, and the flux which it produces will thus induce no e. m. f. in these circuits which consequently are not affected by this component. The second, on the contrary, is displaced with respect to the amortisseur circuits with a speed double that of synchronism and tends to produce a flux in the circuit giving rise to an e. m. f. of double the frequency of that furnished by the alternator, thus producing currents giving rise to a number of ampere-turns practically equal to and opposed to those of the second magnetomotive force considered. In reality, the part corresponding to the armature flux will be practically nullified, for there will pass through the amortisseur circuits only the flux necessary to produce the e. m. f. lost in their ohmic resistance, and thus can be made as small as may be. The field ampere-turns, aside from the production of the flux necessary to give rise to the no-load voltage in the armature, will thus only be required to counterbalance the ampere-turns of the first rotating field mentioned, neglecting magnetic leakage.



FIGS. 51 AND 52.—FARCOT ALTERNATOR.

The preceding explanation applies to all the types of single-phase armatures—separate pole and inductor. It may, however, be objected in the case of the latter machines, that the reactive flux of the armature will traverse the solid mass of the armature frame and consequently diminish the effect of the amortisseur; but this objection will only apply to the case of an alternator furnishing wattless current.

Prof. Blondel has lately shown the great value, from the point of view of the theory of alternators, to be derived from the resolution of the armature current into two components—one in phase with induced e. m. f. and the other in quadrature with it. This resolution applied to the armature flux shows that only the *direct* flux due to a wattless current—a maximum when the poles of the field are opposite the induced coils—follows the same path as the field flux. The *transverse* flux, which is of much more importance with respect to a machine, as in this case, with a high-power factor, is, on the contrary, a maximum when the field poles are opposite the slots of the armature, and is consequently half destroyed solely by the action of the amortisseur circuits.

Train Lighting in Germany.

At a recent session of the German Parliament the Offenbach railway disaster, which occurred on Nov. 8, 1900, through which 12 persons lost their lives and which shocked the entire population of Germany, was taken up for discussion. The question before the Government was as follows: What precautionary measures have the authorities taken, or what measures do they intend to take to prevent similar catastrophies in the future? The Minister of Public Works, Von Thielen, declared himself ready to reply at once, but the floor was given to Repr. Funck, whose remarks may be summed up as follows:

He briefly related the details of the collision, and then expressed a doubt as to whether the results would have been as disastrous if it had not been for the presence of the gas retorts. The lighting of railway cars has been considerably improved since the gas has been mixed with acetylene, but the latter also increases the danger of explosions. The postal cars are already equipped with electric lights. Cannot such a system be introduced on the entire train? In other countries electric-light equipments have been introduced with gratifying results. Eventually the authorities will be forced to introduce the electric light, certainly on passenger trains. In America the work is being pushed vigorously, and in their own country equipments are continuously being made along this line. Even without propelling the cars electrically, electric lighting may be introduced. It affords greater safety, and the danger of short circuits is not to be entertained in view of the low voltages employed. If the authorities desired to wait until an absolutely perfect system has been invented, the Prussian railway cars would never be lighted electrically. Did the other municipalities wait so long? The members of the Elektrotechnische Gesellschaft, of Berlin, have offered to equip trains electrically. The State engineers certainly are equally capable. Why do the authorities hesitate? They fear the expense! Is this always the correct businesslike standpoint? Would any private undertaking be content with such a one-sided point of view? The speaker then referred to the inadequate signal system in use in that section of the country and the small force of men employed at the various signal stations. The system of economy, said he, plays too important a part in their railway system.

The Minister of Public Works, Von Thielen, then replied by referring to his personal regret and sorrow over the awful accident. He defended the Government by denying the false economy attributed to it, and referred to the large sums of money which had been spent within recent years for railway safety devices. The responsibilities of his important office are not as burdensome, stated the Minister, as the daily care and anxiety which is the outcome of the fact that about 6,000,000 people are daily transported over the Government railways. In 1897 26,000 trains were dispatched during 24 hours, which number has grown during the past three years. Every morning and evening the thought is foremost in his anxious mind whether these 26,000 or 30,000 trains will all arrive safely at their destinations. Economy is certainly a virtue, but economy in railway management is only a virtue in theory and not in practice. He then referred to the improvements in track and roadbed construction and the complete renovation of all switches, making them all work automatically. The steam locomotives have been greatly improved. The passenger cars are equal to those in any other country, and the freight cars undoubtedly superior. The employees are receiving higher salaries and their hours of labor have been shortened. In this respect he claimed the German Government to be considerably in the lead. Ministers and Consuls are in constant touch with engineers, and keep the Government informed of the latest improvements in the railway field, and they frequently send their engineers to such places as might be referred to, in order to find out for themselves whether the improvements are suited for German conditions. During the last 10 years they have introduced the electric block signals more extensively than any other country or railroad company. The Minister then laid particular stress on the fact that every employee of the system must be exonerated, and that any damage suits which may be brought against the Government will receive prompt and careful consideration.

By means of photographs taken of the wreck and by relating what was considered by the Government to be the real cause and manner of the accident, the Minister endeavored to show that the gas which leaked out of the punctured gas retorts did not explode. This was said to be substantiated by the fact that the retorts were found intact after the fire had been extinguished. Then followed a detailed description of that section of the road on which the collision occurred and a description of the block signal system employed. The Minister then defended the cars, known as D-cars, and which had the doors at the two ends, by stating that they were far stronger than the old-fashioned cars which were weakened by a large number of side doors.

"In regard to the gas mixture," continued the Minister, "which we employ for the illumination of the cars, i. e., an oil gas with acetylene, I wish to state that it is not explosive under any circumstances. Extensive experiments have shown this to be a fact. It simply cannot be brought to the point of explosion. About 105,000 cars are equipped with this mixed gas and 8000 with electricity. Even in America, only a small proportion of the 135,000 cars are lighted by electricity, and in that country, as well as in England, the mixed gas industry, as referred to above, makes rapid progress. The postal authorities have introduced the electric light, because the men employed on the postal cars have to work at tables and have to move the lamps around constantly. For this purpose the electric light is far more practicable. In the future we shall also introduce electric train lighting, but electrical engineers are not prepared at the present day to offer a thoroughly practical electric railway lighting system which will meet all conditions. The use of accumulators is also not to be recommended, especially in this country, as new cars have to be switched in and out at nearly every large station. The charge has been made against me that I object to the cost of electric equipments. To this I plead guilty, and I consider it my duty to tell you of the cost, because a system must be well perfected before we ought to expend 50,000,000 marks for its introduction. Again, I wish to state that the Offenbach disaster was not caused by the explosion of gas retorts. The latter cannot be placed on top of the cars, as has been suggested, as the weight ought only to be increased toward the bottom."

Representative Sanger then made some pithy remarks on the subject of block signaling, and condemned the small railway station at Offenbach. It may be true, continued the speaker, that there was no gas explosion, but the fire would not have spread so rapidly if it had not been for the gas which leaked out of the retorts. This burns, as is well known, at a temperature of about 1200 degs The charred woman might have been saved had not the gas escaped and had there been danger exits. Electric lighting is certainly the safer of the two systems. The electric lights might also be attached to the side walls and thus give a better light for reading purposes. If the Government's methods were pursued by a private company and they should hesitate so long before they introduced improvements, the Government would soon force them to adopt different tactics.

The discussion was continued on Jan. 24, when Repr. Macco replied to Minister von Thielen. He expressed the opinion that the Minister's idea of the engineering progress made in the German railway department was too optimistic. "Our railway system," he continued, "should stand at the head of all systems, and we should not permit other countries to surpass us. Our engineers are certainly doing splendid work, but they are not in a position to advise us properly as to how to use their inventions in actual practice. We are largely dependent upon the progress made in other countries." The speaker proved this assertion by a number of references to track construction, rail material, car construction, locomotive building and electric haulage on canals as practiced in Germany and foreign countries. He mentioned the Wannsee road as a triumph for private companies and claimed that the Government deserved no credit for its successful operation. He further approved the Government's methods of obtaining information on technical matters through its consuls, but urged the necessity of appropriating funds for this purpose. He attributed the Offenbach disaster mainly to the fact that the block signal was inoperative during the fog.

Hereupon Minister von Thielen again mounted the platform to reply to the previous speakers. He claimed to be willing at all times to take the responsibility for disasters occurring on the German railway system. He stated that the wages of employees have been increased 80,000,000 marks yearly during the past 10 years. Speaking of improvements on the railway system he mentioned the unsuccessful attempt to adopt a serviceable coupler for cars. He spoke of the introduction of electricity on trunk lines, saying that the large companies are still experimenting in that respect. He expressed himself in favor of electric haulage on canals.

The next speaker was Repr. Fritzen, who expressed the hope that electric lighting would soon be introduced on German railways, saying that he would gladly sacrifice light-giving power for safety. Repr. Felisch plainly stated that if the gas retorts could not be placed in a position where they would not explode or be punctured, then electricity should be introduced, and if this is not feasible, then one ought to go back to the oil lamps. Rather safety than brilliant illumination.

On Jan. 18 the *Frankfurter Zeitung* replied to the remarks of Minister von Thielen, reaching the conclusion that the Government is opposed to the electric lighting of trains, cynically summing up its remarks as follows: On account of the great expense to be incurred in case it were decided to introduce electricity the mixed gas appears brighter and safer, for that reason the acetylene gas is harmless; for that reason the fires in motorcars due to short circuits are pointed out; for that reason all foreign and local post office or car electric light installations count for naught; for that reason the remark that there was no gas explosion, but simply a leakage of gas. As if death due to an explosion were not to be preferred to being slowly roasted to death.

German Canal Bill.

The text of the new Canal Bill before the Reichstag embodies an extension of the scheme of 1899, which proposes to connect the Rhine with the Elbe by means of a canal navigable for vessels of considerable tonnage and to canalize the Weser from Bremen to Minden, where the canal would cross it. Among the many objections brought against this plan was the charge that it would benefit only the western half of Prussia. The poorer agricultural provinces to the east of the Elbe would, it was urged, actually suffer from the creation of a cheap means of transport which would lessen the price of foreign agricultural produce on the Berlin market. The Government now has expanded the original bill into a measure providing for the extension of the canal system in all parts of the kingdom. This will, of course, involve a much greater expenditure. It contains seven different schemes, embodying considerable electrical work, of which the total cost to the State is estimated at $100,000,000. These include the Rhine-Elbe Canal; a ship canal between Berlin and Stettin; a waterway connecting the Oder and the Vistula, with a channel rendering the Warthe navigable for ships from Posen to the junction of the Netze, and a canal connecting the province of Silesia with the canal joining the Oder to the Spree.

Motor Vehicles in Holland.

Consul Frank D. Hill, of Amsterdam, reports that the use of motor vehicles in Holland is becoming general, and that the prospects for American machines are good. Machines intended for Holland should be made narrower than is customary in America, because the roads are too narrow to permit two machines of 4 ft. 8 in. in width to pass each other. Carriages may not be charged higher than 2200 lbs. per wheel.

Engineering in Brazil.

We have received from Mr. Adolpho Aschoff, of Rio Janeiro, a handsome pamphlet of nearly 300 pages, being the special number of the *Revista de Engenharia*, issued by the Engineering Club. It is devoted to the proceedings of the Engineering Congress held in December, presided over by Mr. Ozorio de Almeida, one of the best Brazilian engineers.

A Polyphase Power Distributing Plant for Grain Elevators.

The Great Northern Elevator Company has now in service for its two elevators in West Superior, Wis., a complete three-phase power plant, which is soon to be greatly enlarged in order to drive the apparatus of a new elevator now being erected. The elevators are owned by the same company that operates a large steel elevator in Buffalo, driven by Niagara power, this elevator being the first to be equipped with electric motors. The more recent equipment in West Superior is of interest owing to the improvements which have been adopted over the arrangements in Buffalo. In the West Superior plant the power is generated in an engine-driven isolated plant, leaving the frequency to be determined by the needs of the motors, whereas in Buffalo the frequency is necessarily, as it is supplied by the Niagara system, 25 cycles. A frequency of 60 cycles per second has been adopted at West Superior. The pressure of the motors is the same in both cases, viz., 440 volts, and the number of phases is also the same, viz., three. In Buffalo all the starting switches and fuses are located in one room, to which signals for starting and stopping the motors are sent from those in charge of the apparatus driven. This is to avoid the danger of arcing or severe sparking in the extremely dusty and combustible locations of an elevator. In West Superior the switches and fuses are located near the motors, and are enclosed in dust-proof cast-iron boxes, each switch having an extended shaft coming through the casing of the box and furnished with a hand wheel by which it is thrown from the off to the starting or to the running position. The switches are of the usual auto-starting type of the Westinghouse Company, this company having built the entire electrical equipment.

The Great Northern Elevator Company at present operates two elevators in West Superior, one with a capacity of 1,800,000 bushels and the other with a capacity of about 1,500,000 bushels. Both of these are wooden buildings. A new steel elevator with a capacity of some 3,000,000 bushels is now under construction The two existing elevators were originally driven by their own steam plants, each having an engine of sufficient size to drive the whole equipment; this engine being, of course, underloaded at all times when only part of the elevator was in operation. On account of the fire risk of this class of buildings, they are necessarily located at some distance from each other, so that it is impracticable to drive several of them from one power plant with any other than electrical means. The electrical drive, concentrating several elevators in one plant, permits the use of larger engines with a better load factor, and allows the power plant to be removed a sufficient distance from any of the elevators to prevent the spread of fire from it to them, whereas with mechanical drives, each power house is usually adjacent to an elevator. The sparkless operation of the polyphase motor and its starting arrangements is essential in such dusty and combustible surroundings as the interior of a grain elevator where a direct-current motor, even if enclosed, would, on account of its starter, be a serious risk.

The present elevators in West Superior require when in full operation about 900 hp; the new one will call for about twice that amount of power. The present plant includes a 300-kw, 60-cycle, three-phase alternator, direct-coupled to a Buckeye cross-compound horizontal engine running at 130 r. p. m. The installation is laid out with unusual thoroughness for an isolated plant. For instance, the engine room is served by an overhead traveling crane, and a central condensing equipment and air pump is installed. The generator is of the revolving-armature type, with overhanging teeth and a bar winding, connected up as a continuous or a two-path wave winding, tapped for the three phases at three points situated 120 degs. apart from each other around the armature. The new generating unit which is now being installed will have a 410-kw alternator direct-connected to a single-crank tandem-compound Allis-Corliss horizontal engine, running at 100 r. p. m. These machines will be worked in parallel with each other and, later when the new elevator is finished, with larger units of possibly other speeds and crank arrangements, illustrating the variety of types of engines which are now installed for parallel service, even with 60-cycle machines.

The motors for the old elevators are 22 in number, all of the induction type, and are adapted to the apparatus originally built for mechanical driving. In elevator A 11 75-hp motors with 10 poles, and hence making about 690 r. p. m. at full load, drive the elevator legs, i. e., the long vertical belts with buckets which raise the grain from the lower to the upper floors of the elevator. Each motor is connected by a rope drive to the usual speed-reducing gears which were used when the elevator was mechanically driven. The other five motors in elevator A drive shovel rigs, cleaners and conveyors. All dust and refuse from the cleaners, which is too poor to be sold as screenings, is drawn by means of motor-driven centrifugal fans into a conveying system, by means of which it is carried to the power house. There it passes through a centrifugal separator which extracts it from the blast which conveys it, and delivers it to the storage bin, from which it passes through chutes into furnaces which are especially constructed for burning it. In this way a considerable saving is made in the item of fuel.

In the new elevator there will be 18 75-hp motors for the elevator legs, 9 15-hp motors for 8 cleaner legs and 1 screening leg. 2 25-hp motors for transfer belts, 3 30-hp and 1 15-hp motors for exhaust fans of the dust-conveying system, 4 50-hp motors for 8 groups of cleaners, 1 50-hp motor for the shovel rigs, 1 100-hp for a car haul and 1 20-hp for a transfer table. There will also be a motor-driven passenger elevator, and a complete lighting system. The present elevators are lighted by means of two-phase 110-volt lines obtaining their power from the three-phase 440-volt system by means of two transformers Scott connected. The speeds of most elevator machinery are, as a rule, so low that a double reduction of some kind is usually necessary from the high speeds of induction motors. The reduction which has been tried in the old plant, and which will be generally adopted in the new one, is a rawhide pinion on the motor shaft, meshing with a cut steel gear, which in turn delivers the power to a rope drive or belt.

The work at West Superior is in charge of Mr. A. D. Bellinger, general superintendent of elevators for the company, to whom is due credit for the working out of many of the special mechanical problems in the application of the electric drive, as well as for many structural and other improvements which have been adopted in the new elevator. The electrical work is in charge of Mr. G Willius, Jr., electrical engineer of the company.

Equalizer System for Compound Wound Dynamos.

By Charles Brandeis.

The following is a description of a new compound dynamo equalizing scheme devised by the writer, which may be found of interest. The accompanying sketch indicates the main features. Two or more sets of compound dynamos working on two or more sets of positive and negative bus-bars at equal or at different voltages can work on a common equalizer bus. Moreover, the equalizing current between machines of one set will not interfere with any other set, and the equalizing currents of different sets occurring simultaneously will be superimposed in the common conductor without interference. The advantages of this method are its simplicity and the saving in copper involved.

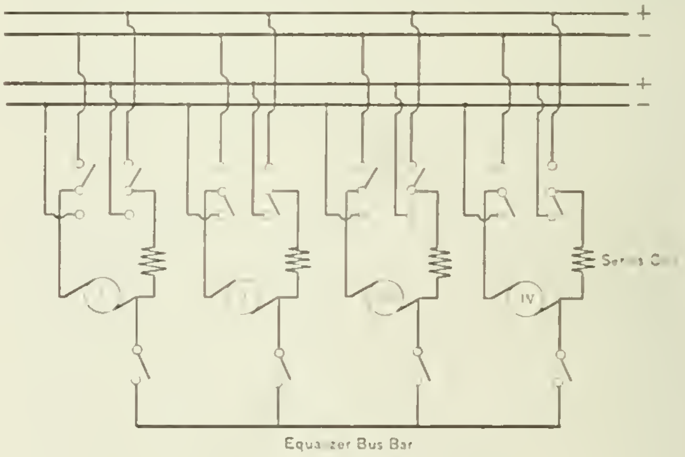


DIAGRAM OF EQUALIZING SYSTEM.

The method is particularly applicable in the case of exciters working on separate bus-bars, which are enabled to excite separate sets of alternators at different voltages. For example, in the plant of the New York Metropolitan Street Railway Company, as described in these columns (page 699, May 12, 1900), it will be seen that the equalizing switches are double-throw, and there are two sets of equalizing buses or cables. With such large units, this means considerable expense. Greater simplicity is introduced by the method here described, as the equalizing switches can remain closed whether the machines are running or not, and to whatever sets of bus-bars the other switches my be changed over to; and the switchboard attendant has only to change the positive and negative switches on the switchboard. With the Metropolitan plant the equalizing switches are placed next to the exciters, and if the switchboard attendant changes over the positive and negative switches on the switchboard and forgets to run to his machine and change over his equalizer switch first, a disaster might result. A patent is being applied for on this method.

CURRENT NEWS AND NOTES.

GOVERNMENT WIRELESS TELEGRAPH.—Prof. Fessenden and his corps of assistants sent out by the Government to establish wireless telegraph stations down the coast have completed the first installation off Roanoke Island, N. C. The station is not far from Cape Hatteras.

PARIS AUTOMOBILE SHOW.—Never before in the history of automobilism in France has there been such a complete show of horseless vehicles made as may be seen in the Grand Palais, Paris, which is thronged every day with a large attendance. There is no doubt that this exhibition will prove of tremendous benefit to the manufacturers of automobiles.

SEARCH LIGHTS.—With regard to a recent item in our columns, Schuckert & Co. write us that they exhibited a search light projector at Paris as large as two meters. They had also two of 1.5 meter diameter, corresponding to their Chicago exhibit in 1893. They do not agree with the statement that in war metal mirrors are preferable to glass parabolic ones. "As a matter of fact, metal reflectors are more sensitive than those made of glass as regards destructive influences, and are only kept in good condition with difficulty."

DR WILLIAM GILBERT.—Commenting on the scheme of erecting a memorial to Dr. William Gilbert, who, more than 300 years ago, laid the foundations of the science of magneto-electricity, the London *Lancet* says: "We congratulate the medical men of Colchester upon their desire to do honor to their great townsman, while the incident may surely give us all cause for serious thought when we consider how very few memorials, whether statues, medallions or pictures, of our great scientific heroes are to be found in this country." The same thing might well be said in America.

GASOLINE LAMPS PROHIBITED IN OHIO.—State Oil Inspectors Frank L. Baird, of Toledo, and John R. Mallow, of Columbus, have issued a positive mandate that all manufacturers of gasoline lamps in the State must discontinue such manufacture and use at once. There are several large factories in Ohio, and many thousand users. It is intended to serve notice on all at first, and if the order is not obeyed in reasonable time radical measures will be taken. It is expected that the manufacturers will fight the matter through the courts. The statutes of Ohio are very positive on the subject, but have never been made effective by former State oil inspectors.

FREE TELEPHONE SERVICE GIVEN.—Huntington, W. Va., is one of three cities in the United States where telephone service is had by the public absolutely free of charge. In that town the Bell and a home company are fighting each other tooth and nail, and three years ago the Bell company created a sensation by announcing that, until further notice, its service would be given all subscribers free. This was expected to crush the home company, but, contrary to expectations, it has thrived; its rates have not been cut, and its number of telephones has increased. Of course, there has been an active demand for the free Bell telephones, but the home company is owned largely by local residents. New Philadelphia, Ohio, near Wheeling, is another town where the Bell gives an absolutely free service, owing to the competition of a home company.

WIRELESS IN A SNOWSTORM.—In the midst of a Channel snowstorm the Belgian mail steamer Clementine crossed from Ostend to Dover recently and the final official trial of the Marconi system of wireless telegraphy took place with complete success. A dozen Belgian Government officials were on board to witness the trial, before recommending the system for adoption on all the Belgian Channel packet boats, which are operated by the Belgian Government. They were quite satisfied with the day's achievements. In spite of the storm, messages were regularly exchanged between the Clementine and Ostend until the boat drew alongside Dover pier. The result will be the installation of the system on the Belgian boats. It is said that the British authorities have prohibited the use of the Marconi system on the English boats. Mr. Marconi now contemplates establishing stations all round the English coast, to enable vessels at any distance up to 60 miles from land to communicate with the shore.

SPLIT FIELD POLYPHASE PATENT.—A decision was rendered last week in the Western Division of the United States Circuit Courts of the Southern District of Ohio enjoining a fan motor company from infringing the first claim of patent 401,520, issued to Nikola Tesla April 16, 1889, on an application filed Feb. 18 of the same year, covering what is generally known as the "split phase" method of starting synchronous motors. This method consists in separating at starting the field into two parts, one of which is fed by a current in phase with that of the line, and the other by a current shifted in phase through the action of inductances contained within this circuit. After the motor has been brought up to speed through the effect of the rotary field produced by the above arrangement, a switch is shifted and the motor then proceeds to act as a purely synchronous motor. One part of the defence lay in the contention that the device of the patent at issue did not constitute an invention, since it merely involved a change in the connections, which was such a simple thing to do as to involve no exercise of the creative faculty of invention. Another part of the defence was based upon patent 407,844, issued July 30, 1889, to Elihu Thomson, on an application filed Nov. 17, 1888, but the Court decided that although in this case the patentee had the question before him of "suitable devices" for "bringing the armature up to full speed or a speed almost synchronous with the rate of alternation speed," he did not accomplish what was accomplished by the patent in suit.

SCRIBNER TELEPHONE PATENTS.—Four patents were granted Feb. 5 to Charles E. Scribner on telephone exchange apparatus. The earliest in date of application (Sept. 25, 1896), relates to a system of signals to permit a calling subscriber to indicate by a visible device the group or office in which the required correspondent may be found, thus obviating the necessity of bringing an operator into communication with the subscriber to obtain that information. For instance, in an exchange system comprising a number of different devices, the subscriber whose lines terminate in one office may indicate to the distributing operator in charge of his line, the office with which he requires connection, and the line having been extended by means of a trunk circuit to the designated office, the required connection may be completed at the latter office with a minimum expenditure of labor and time. The specific invention involved consists in the combination with a metallic line circuit, of a signal in a branch from each line conductor; a key at the sub-station controlling each of the signals, and a third key at the same point adapted to cause the display of both signals simultaneously. This device enables the subscribers to give three different signals through the agency of the three keys and two signal-indicating appliances. Preference is given to a source of current at the central office for the line conductors, and the use of small incandescent lamps for visible signals. The second patent in date of application (Jan 9, 1897), relates to the mechanism associated with telephone lines in a switchboard for signaling to the attendant and indicating the use or disuse of the appliances at the station. It also concerns the use of incandescent lamps as secondary signals, controlled by suitable devices directly responsible to signal currents to the lines. The interruption of service by the breaking of this signal lamp is guarded against, and means are provided for setting a general signal before any operator to indicate a call from any of the subscribers under her care, or to serve as a night signal. The third application filed March 9, 1898, is on the construction of small incandescent lamps for use as secondary signals in telephone switchboards, and relates to certain details of structure whereby increased durability together with improved operation is attained. The fourth patent (application filed June 7, 1899), applies to telephone lines equipped with supervisory signals at the telephone switchboard serving to indicate the condition of the apparatus at the sub-stations. The purpose of the invention is to cause the supervisory signals of two united lines to act independently at certain stages during the connection between the lines, and jointly at other times.

PARIS SURFACE CONTACT ROADS, recently installed, are said to be giving trouble from short circuits, due in some instances from the use of salt after snow to keep the contact buttons and tracks clear. "The street looked like a battlefield. Men and horses were falling everywhere. The authorities ordered traffic stopped and investigated. Fearing wholesale danger, they talked of forbidding the continuance of the system. The railway company threatened to sue the city for damages if prevented from running, so the restrictions were removed, the authorities simply warning the company against putting salt on the rails."

WHAT HATH GOD WROUGHT?—Mr. W. A. Bole, as retiring president of the Engineers' Society of Western Pennsylvania, said recently: "The first message ever flashed across the Atlantic cable was from the good Queen Victoria to our President Buchanan, and the words were these: 'What hath God wrought?' In summing up the results of a century's progress in electrical matters, what more fitting words can be employed than these of the gentle sovereign of our mother country?" Well, that first message was rather dubious, anyhow, but now the good old Queen is dead, some one ought to arise and defend her from this funny charge of plagiarism.

PATENTS IN ENGLAND.—The number of patents taken out in England seems to be falling off. The number of applications last year was 23,909. It is the lowest mark reached since 1891. But there is the consolation that 1897 produced 30,936 applications, the biggest number on record. A corresponding falling-off occurred during 1900 in the number of readers at the Patent Office Library. There were 94,864, as compared with 113,397 in 1896. Of the 23,909 applications made last year probably half will be abandoned before next Christmas. Three-fourths of the remainder having become patents will inevitably collapse during 1902, and by 1914 possibly only a meagre remnant of 5 per cent will remain.

U. S. PATENT OFFICE ANNUAL REPORT.—The report of the Commissioner of Patents for 1900 shows that during the year there were received 39,673 applications for patents, 2225 applications for designs, 82 applications for re-issues, 2099 applications for registration of trade marks, 943 applications for registration of labels, and 127 applications for registration of prints. There were 26,418 patents granted, including designs, 81 patents reissued, 1721 trade marks registered, and 737 labels and 93 prints. The number of patents that expired was 21,196. The number of allowed applications that were forfeited for non-payment of the final fees was 4215. The total expenditures were $1,200,019. The receipts over expenditures were $90,808. The total balance to the credit of the Patent Office in the Treasury of the United States on Jan. 1, 1901, was $5,177,458.

TELEPHONE TRANSMITTER.—A patent was granted Feb. 5 to T. Lidberg on a telephone transmitter claimed to possess all of the resonant and sensitive qualifications of the transmitter of the Blake type, combined with the durability and practical features of the transmitter of the Hunning type. A movable carbon electrode secured to the vibrating diaphragm is enclosed in a cylindrical case, the stationary carbon electrode being within the other end of the same case, and the space between the two filled with granulated carbon. The construction is such that the entire movable system of electrodes is attached to the vibrating diaphragm. The moveable carbon button is attached to a small mica diaphragm, which is permanently secured to one end of the enclosing case. Two diametrically opposite springs bear on the vibrating diaphragm, the pressure or stress thus exerted being claimed to increase the sensitiveness.

SIGNAL FOR TRUNK LINES.—A patent was issued Dec. 5 on an application filed Jan. 11, 1897, to F. R. McBerty and J. L. McQuarrie on a signal for trunk lines whereby each of the operators may be apprised of the acts performed by the other and by the subscriber. Means are provided for automatically operating the signals, which latter comprises a lamp before the toll operator controlled by a relay responsive to currents in the subscriber's line, determined by the position of the telephone switch at the subscriber's station; and a lamp before the subscriber's operator which is displayed when the plug is withdrawn from the terminal socket of the trunk line at the toll board. A repeating coil is provided to sever connection between the subscriber's line and the toll line; also a switch for removing the repeating coil from the circuit in special cases, and a device operated by that switch to prevent the display of the signal controlled by the relay when the latter is thus rendered inoperative.

ROENTGEN RAY SURGERY.—Prince Kropotkin, discussing recent science in an English magazine, says: "In the hands of an able surgeon—as Prof. E. Bergmann illustrated before the Association of German Naturalists and Physicians in 1899—the X-rays become a most precious means of exploration. Many limbs were saved during the last Greek-Turkish war by Nasse and Küttner continually resorting to radiography. So also in the Soudan war. In fractures of the kneecap the Röntgen rays have proved simply invaluable. But perhaps the best service they have rendered was to demonstrate that in many cases it was far preferable to leave pellets of lead, small revolver bullets, and even Peabody-Martini bullets where they were lodged in the tissues instead of trying to get them out. In fact, Dr. Bergmann's radiograms prove that a bullet may sometimes remain even in the lungs without occasioning any trouble. Such was the case of a German soldier who had carried a bullet in his lungs for 29 years, since 1871, without knowing it."

NO MUNICIPAL LIGHT IN MONTREAL.—A few months ago a special committee was appointed by the City Council of Montreal to report upon the best course to adopt in regard to the electric lighting of the city, upon the expiration of the present lighting contract with the Royal Electric Company of that city. The committee did not favor municipal ownership, but recommended that public tenders for the new lighting contract be called for, and that the specifications contain certain conditions which do not apply to the existing contracts. The following objections to muncipal ownership were given: That it would cost the city an immense sum to purchase such a plant; that the city would find it costly to operate it by steam power; that there was an unfavorable outlook of getting water power, without purchasing it from the companies, on account of so many water power companies operating water plants in the vicinity of Montreal; that if water power was bought, it would cost the city as much to manufacture electricity as if produced by coal; and, finally, under these conditions, it would be better to give the lighting out by contract and to have the keenest private competition for the service.

CHARLESTON EXPOSITION.—The South Carolina Inter-State and West Indian Exposition will be held in Charleston, S. C., opening Dec. 1, 1901, and closing June 1, 1902. The work of constructing the building is now in active progress, contracts having already been made for four of the principal structures, of which there will be 11. The Exposition Company has its agents actively at work in different parts of the country, and it is expected that the Exposition at Charleston will be one of the completest and most attractive that has ever been given in the Southern States. The recent development of several water powers in the South has introduced a new and progressive factor in determining the placing of manufacturing plants. The demand for electrical appliances has grown steadily, and the most advanced methods are being called into play in arranging the details of the modern cotton mills throughout the South. The field is as yet but sparsely occupied, and electricity is destined to revolutionize methods of obtaining and distributing power through the South. It is thought that the Exposition will afford a good opportunity for the display of electrical apparatus to possible purchasers.

PHONOGRAPH ATTACHMENT FOR TELEPHONE CIRCUITS.—A phonograph attachment to a telephone circuit which will transmit messages—such as advertising matter, news matter, etc.—to different subscribers, from a central station without interfering with the conversation between subscribers or operation of the line by operators at the central station, is the subject of a patent granted Feb. 5 to A. B. Clark, of Nashville, Tenn. Means are provided for automatically causing the transmission of phonographic messages to a subscriber on a telephone circuit, independently of any act of the central operator while the subscriber is waiting to be connected with a given line through the central station, and means for cutting off the phonograph circuit at the same time that the operator at the central station connects the subscriber with central or with the line asked for by the subscriber. At the central station is a plug adapted to be inserted in the switchboard, so as to release the spring jacks of a subscriber's line, thereby breaking the connection between the subscriber and phonograph circuit. At the same time the subscriber will be connected with central or with another subscriber through central. A single movement of the operator at the central station thus disconnects the phonograph from a given subscriber when the latter is connected with a given line.

LONG DISTANCE WIRELESS TELEGRAPHY.—A special cable dispatch from London of Feb. 12 says: "Prof. John A. Fleming, lecturing at Liverpool to-day, said that he had Signor Marconi's permission to make the first mention of the fact that on the first day of the reign of King Edward VII. Marconi accomplished the feat of sending wireless messages between St. Catherine's, Isle of Wight, and the Lizard, 200 miles. Perfect communication between the two points has since been established .

ACETYLENE GAS VS. PETROLEUM IN GERMANY.—Consul Hughes, of Coburg, under date of Dec. 18, 1900, writes as follows: "Up to the present time, Germany has imported each year from $25,000,000 to $30,000,000 worth of American petroleum. This industry, however, seems to be threatened somewhat by the introduction of acetylene as an illuminant, in a convenient and safe form, for house, store and other uses. This has resulted from the low price at which calcium carbide is being produced here, and also from the rise in the cost of petroleum in the German markets."

THE ELECTRO-CHEMIST AND METALLURGIST.—The first number of a monthly journal devoted to electro-chemistry and metallurgy has been issued by Sherard, Cowper-Cowles & Co., Limited. 82 Victoria Street, London, England, the subscription price being 6 shillings per year. If we may judge from the first number, just received, it promises to be a valuable addition to the scant periodic literature on electro-chemistry and metallurgy published in the English language. Although there are at present about a half dozen journals devoted exclusively to electro-chemical subjects, yet all but one are in foreign languages. There is therefore a good field for a well edited journal on this branch of the science of electricity in the English language. The name of Cowper-Cowles is already well known to those who have followed the current electro-chemical literature of recent years, and gives assurance that the journal will be intelligently edited. The present number contains the beginning of a serial on recent progress in electro-chemistry, an article by Hutton on the less well-known carbides, borides and silicides, a long illustrated article on electro-chemistry at the Paris Exposition, an article of a theoretical nature on the deposition of metals from mixed electrolytes by Lethfeldt, and an article on the present and future of accumulators by Wade. One of the most interesting and valuable features is a department like our Digest, except that it is limited to electro-chemical subjects, and that the abstracts are as a rule longer but less numerous, and therefore less complete, than in the corresponding department of our Digest. This part of the paper seems to be very well and intelligently edited by Dr. Garrard. The last part of the journal is devoted to illustrated abstracts of the patents of the previous month bearing on electro-chemical subjects. The journal has our best wishes for success.

LETTERS TO THE EDITORS.

The Tunneled Armature Winding.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of Dec. 29, 1900, I notice a paragraph entitled "Tunneled Armatures vs. Slotted Armatures," in which the common mistake is made that Mr. Wenstrom was the inventor of the tunnel winding.

Now, Wenstrom invented not a tunnel winding, but one in which the teeth nearly met over the grooves; that is to say, his was the intermediate step between the slot and the hole winding. That he did not think of employing entirely closed holes is quite clear from the wording of his patent, in which he distinctly states that the slits between the teeth shall be filled with some *non-magnetic* material.

The matter is, of course, not of much importance at the present time, but as I have found many people under the same mistaken impression, I thought I would draw your attention to this inaccuracy.

Baden, Switzerland. C. E. L. Brown.

[Mr. Brown is correct with regard to the disclosures in the issued Wenstrom patents. However, the Wenstrom machines that were built in Baltimore were constructed with closed tunnels and not with partially closed slots. We also learn that Wenstrom applied for a patent about 1888, in which tunnels of various shapes in cross section were shown, but the patent did not issue for a reason, we are informed, that did not relate to the merits of the invention.—Eds.]

The Oscillograph and Oscillographic Curves.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to the latter of Mr. André Blondel in your issue of Feb. 2, I beg to state:

First, that in my experience the vibrations of the mechanism of an alternating-current arc lamp cannot be relied upon to diminish the amount of steadying resistance under any circumstances. During the period of regulation the vibration of the mechanism at various frequencies produces entirely different results, so that lamp designers aim to keep vibrations out of the regulating mechanism instead of relying upon them. At the feeding point the effect of vibrations is therefore eliminated.

Second, the apparent lag in the alternating arc and the effect of cored and solid carbons upon the arc were known before Prof. Blondel published a description of the oscillograph in 1893. The results of his own work with alternating-current arcs previous to 1893, his modification of the Joubert method are described in *La Lumiere Electrique*, Vol. XLII., page 551, 1891. He corroborated in a brilliant manner with the oscillograph the results of contemporaneous investigations as well as of his own, adding many new and interesting points.

The following references will illustrate the above: *a.*—Tobey and Walbridge's paper on the Stanley alternating-current arc dynamo, *Proceedings* of the American Institute of Electrical Engineers, 1890, Vol. XVII., No. 11. This paper contains the first curves of the current and e. m. f. of an alternating-current arc. *b.*—Heubach on watt consumption and power factor of an alternating-current arc with different carbons. *Elektrotechnische Zeitschrift*, 1892, page 460. *c.*—Steinmetz, discussion of above papers, *Elektrotechnische Zeitschrift*, 1892, page 567. *d.*—Prof. Ayrton writes in 1891 in the London *Electrician*, page 736: "If the arc be quite steady and only give out the rhythmic hum that accompanies a good arc such as can be obtained with cored carbons of proper quality, the arc appears to act practically as a simple resistance, and M. Joubert's law does not hold. But if the arc be maintained between uncored carbons of poor quality and be hissing, there is considerable difference in phase between the current and the P. D. between the terminals; further the experiments show that the current is very far from being a sine function of the time, although produced by a dynamo, whose e. m. f. normally follows a harmonic law." *e.*—Froelich arrived through his method (*Elektrotechnische Zeitschrift*, page 65, 1887; *ibid*, 1889, page 210; demonstrated at the Frankfort Exposition, 1891), at the result, that the alternating-current arc does not change the phase of current and e. m. f. See *Elektrotchnische Zeitschrift*, 1892, page 568.

It appears therefore that the principal features of the physics of the alternating-current arc were established before Prof. Blondel communicated his paper on "Alternating-Current Arc Curves" to the Chicago Electrical Congress of 1893.

The writer was not aware that these curves were obtained with the oscillograph. He referred to Messrs. Duddell & Marchant's paper, as it contained the first curves of the enclosed alternating-current arc, and this paper was highly commented on by Prof. Ayrton, S. P. Thomas at the Institution of Electrical Engineers, London.

Very few of Prof. Blondel's papers are published in this country or in Germany. The writer was, therefore, not aware of the scope of Mr. Blondel's work. He hopes that by calling attention to the oscillograph, the instrument will find a place in all laboratories and shops and facilitate the study of the many intricate problems of alternating-current work. C. Wiler.

Chicago, Ill.

The South Norwalk Municipal Plant.

To the Editors of Electrical World and Engineer:

Sirs:—Mr. M. J. Francisco's characteristic article in your issue of Feb. 2, relating to the last report of the South Norwalk municipal electric light plant, has been read by me. I am not surprised to note how he resorts as usual to distortion of figures and perversion of facts, adding or subtracting with the abandon of one hardened to a pernicious habit of long practice, and again attempts to tarnish the splendid reputation that this plant has earned as an acknowledged success and a shining example of the possibilities of municipal ownership.

I deny what he assumes to prove by the methods outlined above, and deem it unnecessary to point out in detail what he as well as I know are his own misrepresentations. If there is any just person who may know so little as to credit his assertions, I will guarantee that a visit of investigation to this plant will make him its friend, whatever he may have been before.

He deplores the absence of a sinking fund, but note how he covers up the fact that only last year this plant reduced its debt by $2,500 from its profits. Then, again, he adds interest on a part of the investment that is not due yet. To this he adds cost of water, when the plant does not have to buy water. Not satisfied, he adds taxes, when the plant, by operating the fire-alarm system of the city without any charge to the city, makes ample return in lieu of taxes. All this effort to prove that more than $60 per year per arc light for 1.30 a. m. service was paid. He takes no account of the fact that a part of the expense that he tries to saddle onto the cost of the arc lighting belonged to the commercial service which is self-sustaining and profit-bearing.

If the facts are as Mr. Francisco would have them appear, would the Government Statistician, who made a personal investigation of this plant, have made a report not only gratifying to it but most encouraging to the cause of municipal ownership?

Some little time ago the city of South Norwalk by a unanimous vote refused to listen to an offer of a private corporation to buy this plant at a price equal to twice its cost, which I believe is ready to make the same formal offer to-day. It knew what it was about, as it had a corps of accountants, engineers and lawyers investigating the plant for several days previous to taking any decided step. If this plant was a burden to them, would the citizens have voted not to listen to any offer to rid themselves of it at a good price? And would the private corporation unasked have been so anxious to possess it?

Possibly we may learn sometime who is paying Mr. Francisco for the harm he thinks he is doing the cause of municipal ownership. But not questioning his ability as an oracle on the management of central stations, it might be of interest to some people to know something of what used to be his Rutland plant, and how he came to let it slip away. But I will refrain from further questions in this line and only ask if one who could not seem to keep his own private plant from insolvency, is a proper person to contradict the results of a successful municipal plant?

Will not such men as this be more likely to harm the cause they advocate and their masters than the cause of municipal ownership? Are they influencing public opinion in their favor? If so, how is it that municipal light plants have increased in this country alone in the last two years or so from 300 to about 500? Two new ones per week seems to be the present record, and the "fad" will continue so long as private corporations in public service do not properly compensate the people for the valuable franchises that give them life. Municipal ownership is but a remedy for the wrongs that have been heaped upon the public in the past, and it must continue until private corporations created by legislative action realize that the people, their creators, not themselves, are the masters.

South Norwalk, Conn. A. E. Winchester.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

REFERENCES.

Winding Coils.—Claussen.—A communication referring to the article of Loewit, noticed in the Digest, Nov. 17. He shows that the same method which Loewit used for the determination of the diameter of a wire for given dimensions of the spool, can also be applied for the determination of the length of the spool, as in the case of designing a dynamo.—*Elek. Zeit.*, Dec. 13. A translation in abstract of Loewit's paper in *Jour. of Elec.*, Dec.

General Transformer Diagrams.—Quite a number of communications by Heubach, Behrend, Grob, Emde, and Ossanna, in which the long discussion in this journal on general transformer and induction motor diagrams is continued and concluded.—*Elek. Zeit.*, Dec. 27, Jan. 24.

Direct-Current Motors and Synchronous Alternating-Current Motors.—A clear comparison of these two types of motors, the difference of their action and the reasons to which it is due. It seems to contain nothing new.—*Jour. of Elec.*, Dec.

Large Alternators.—Several communications, by Meyer, Schueler, Rohde and the United Electric Company, of Vienna, criticizing some points in the paper of Heyland, noticed in the Digest, Jan. 5, 12. It is claimed that the use of a high saturation of the poles is not new.—*Elek. Zeit.*, Jan. 3.

Lights and Lighting.

REFERENCES.

Train Lighting.—A reprint in full of a very extended topical discussion on the introduction of electric lighting on railway cars, in the Electrotechnical Society, of Berlin; also a long abstract of a paper, by May, read before the Electrotechnical Society, of Frankfurt, on the same subject.—*Elek. Zeit.*, Jan. 3.

Arc Lamps.—Almert.—A paper, read before the Chicago Elec. Ass'n, on "Arc lamp standardization." It deals mainly with photometric tests of arc lamps and with the different lights tandards in use.—*West. Elec.*, Feb. 2.

Power

Electric Power in Factories.—Philippi.—A long and well illustrated description of the electric power and lighting installation of the Hartmann Machine Works in Chemnitz, Germany. There are four steam-driven alternators, generating three-phase currents at 500 volts. All the motors in the shops are three-phase induction motors. All the stationary motors are supplied with current at 500 volts, while the movable motors of the cranes, etc., are supplied with three-phase current at 120 volts from transformers, for the sake of safety, on account of the bare conductors. For the lighting of the shops, three-phase currents at 120 volts are used, as the central station of that city also supplies three-phase currents at 120 volts, so that this current may be used as reserve. For the lighting of the office building, direct current at 120 volts is used, which is supplied by a 40-kw motor generator, in combination with a battery of 1150 ampere-hour capacity. There are at present in use 60 motors of together 1700 hp. The installation is said to be highly successful and the following advantages are mentioned. There have been no accidents with the electric motors so far, and the cost of repairs was practically zero. There is a saving in wages, as fewer attendants are required. There is a great saving in fuel, etc. If 5 per cent are assumed for interest on the whole plant, 5 per cent for amortization of the power house and 3.5 per cent for amortization of the other plant, the cost of 1 kw-hour measured at the bus-bars of the primary switchboard, is 1 cent, and measured at the shaft of the machines, 1.37 cents. There is also a considerable saving of floor space.—*Elek. Zeit.*, Jan. 3.

Refuse Destructors.—Watson.—An article on "The disposal of refuse in the twentieth century." A refuse destructor properly designed and constructed is at present the only known means of disposal which satisfies both sanitary and economical requirements He gives some notes on their proper design. Regarding the most important by-product of the destructor, mainly the waste heat, he says that town refuse varies far more in different towns than does coal in different collieries. "It will, however, be safe to generalize to this extent, that in all districts in the neighborhood of coalfields from 1 lb. to 1¼ lbs. of steam may be counted upon as available for external use for every pound of refuse burned in an efficient destructor, and that in residential districts remote from cheap coal, from ¾ lb. to 1 lb. of steam may be counted upon with equal certainty." He warns, however, against generalizations of results obtained in special cases. —Lond. *Elec. Rev.*, Jan. 25.

Traction.

Sag and Strain in Trolley Wires.—B. Hopkinson.—A short article in which he calls attention to an ambiguity in Dawson's electric traction pocketbook, in which tables are given for the sag of a trolley wire at different temperatures. From those data, it would follow that the wires so strung would become dangerously tight if the temperature should fall below freezing, and as in practice such wires are almost always put up tighter than according to that data, and do not break, there must be a discrepancy. This, the present writer thinks, is due to a neglect of the consideration of the elastic extension of the wire. He develops formulas in which this is included, and gives a short table of data for hard-drawn copper wire 0.4 in. diameter and 120 ft. span. The results are based on a test made by Prof. Ewing. The table shows that if the sag is 6 in. at 60 degs. F., the wire would never in that country (England) be stretched beyond its limit of elasticity. The table also shows that at 170 degs. F. the sag would be only 9 in. A wire hung so that the sag is 12 in. at 50 degs. F. will at 90 degs. F. drop down to 18 in., which is excessive.—Lond. *Elec.*, Jan. 25.

Electric Traction in Great Britain in 1900.—A very large table, in the form of a supplement, giving a large amount of information regarding electric railways and tramways in the United Kingdom in 1900. In 1899 there were 42 lines in operation, 28 in process of construction, and 111 projected tramways and railways, making a total of 181. In 1900 there were 62 lines in operation, 31 in progress and 127 projected, giving a total of 220. Concurrently with the rapid development of electric traction there is also a growth of several species of opposition, the chief of which relates to electrolysis, to magnetic disturbances of observatories and to vibration. A matter of serious moment is the vibration and consequent nuisance and injury to property, which is alleged to be set up by the Central London Railway. It is probable that this vibration originates in the use of heavy locomotives, in which the greater part of the weight is unsupported by springs, but, on the contrary, is imposed directly on the axles of the driving wheels. The remedy lies in either using spring-suspended and geared motors on the locomotives, or else in abandoning the use of separate locomotives and distributing the motive power throughout the train.—Lond. *Elec.*, Jan. 25.

Storage Batteries in Traction Stations.—Booth.—An article in which he shows the advantages that can be obtained in traction stations by means of storage batteries. The engine should be of such power as to perform the mean duty required. The mean load is determined by the number of cars at work and their average speed, "and we will not vary much from 10 to 12 amperes per car for 28-ft. cars in ordinary English practice." From German experience he says that a battery has been found sufficient, if it provides the maximum discharge for one hour. Thus if the maximum current be 300 amperes the battery capacity would be provided to yield a steady 300 amperes for one hour. For small tramway systems the economy will be undoubted if suitable and liberal batteries are provided, but the larger systems do not require batteries, because where load factors of 70 and 80 per cent can be secured, the battery losses must more than outweigh the economy. At the same time, with large load factors, it must not be overlooked that the output of the battery will be comparatively small, as quite a small battery will be competent to "rub off the spokes of the load diagram."—Lond. *Elec. Rev.*, Jan. 25.

High-Capacity Storage Battery for Automobiles.—Fabre.—An illustrated description of the Lacroix accumulator. Both plates consist of thin wires, each being formed of two metals. The core of each wire is antimoniate of lead, or any lead alloy not subjected to formation, the diameter of the core being 0.05 to 0.6 mm. Around this core there is a layer of lead in ring form, of about 0.2 mm thickness. For a battery of 120 ampere-hours one electrode consists of 300 such wires of 200-mm length. It is claimed that in this way a battery can be constructed giving 25 ampere-hours per kilogram of total weight, and that the life of this battery is sufficiently long to use it in practice.—*L'Eclairage Elec.*, Jan. 5.

REFERENCES.

Third-Rail System.—Washington.—An illustrated description of the Murphy third-rail system, to be used by the Baltimore & Ohio Railway in Baltimore.—*West. Elec.*, Feb. 2.

Jungfrau Railway.—A long illustrated description of the Jungfrau polyphase electric railway, which was described in these columns May 12, 1900, in an article by the constructing engineer.—*Elec. Rev.*, Feb. 2.

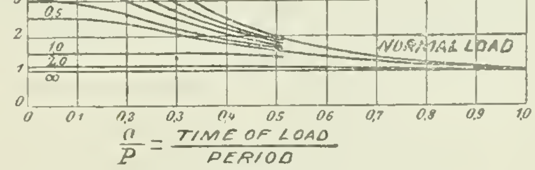
Aerial Electric Traction.—Adams.—A brief article on electric traction systems which may be used over deep and comparatively narrow gullies or valleys, at large excavations and embankments for engineering works, for the movement of canalboats, etc.—*Cassier's Mag.*, Feb.

Installations, Systems and Appliances.

Capacity in Alternating-Current Working.—Mordey.—The conclusion of his illustrated paper, the first part of which was abstracted in the Digest, Feb. 9. He gives a description of the choking coil which he has used. He remarks that "there is something very disproportionate and anomalous about the two classes of loss in the dielectric—the insignificant losses due to leakage, and the large apparent and actual losses due to capacity and hysteresis. Let me take for illustration a 10,000-volt cable having one-third microfared capacity per mile, and working at 50 periods. Its insulation is, say, 2500 megohms (it may be only a few megohms without affecting the argument). The dielectric has several functions. It acts as a nearly perfect non-conductor. But it does conduct a little. It allows 1-250,000 ampere to pass through it, equals 0.04 watt per mile. Then there is the electrostatic action. * * * The capacity current is 1.05 amperes, the apparent watts 10,500, and the real watts 1296 or 32,400 times the watts lost by conduction. This is an interesting state of things. Both dielectric conduction and dielectric hysteresis waste energy in the same way—by heating the dielectric. We use an insulator which reduces the leakage energy loss to 0.04 watt per mile, but allows another energy loss 32,400 times as great. So far as loss of energy is concerned we should be just as well off, or as badly, with an insulation resistance of $10,000/1.05 = 9524$ ohms, instead of 2,500,000,000. The energy spent on our dielectric would be just the same, and I suppose we should have no wattless current at all. I point this out to illustrate an anomaly, not to make a practical suggestion. It may be that no low resistance insulator can be found capable of resisting breakdown under such conditions." The paper is concluded by a description in detail of an alternating-current wattmeter for such tests. In the discussion which followed, Ayrton questioned whether Mordey has sufficiently tested either the cable or the Thomson recording wattmeter, to feel sure that the low power factor he was dealing with was read correctly. Mordey replied that the power factor had been determined with the greatest care.—Lond. *Elec.*, Jan. 25.

Mather.—A communication referring to Mordey's paper. He suggests measuring dielectric hysteresis loss by putting the dielectric of the cable in series with a suitable choking coil without iron, and arranging matters so that the current through them is approximately in phase with the P. D. of the alternator. An ordinary wattmeter would then measure the power spent in cable and choker with fair accuracy. The watts spent in this ironless choker can be determined by the product of the square of the current and the resistance, and deducted from the wattmeter reading.—Lond. *Elec.*, Jan. 25.

Calculation of Resistances, Motors, Etc., for Discontinuous Service.—Oelschlaeger.—Resistances, motors, etc., built for continuous operation, are of too large a size when used for frequently interrupted service, as, for instance, in the operation of lifting apparatus. He shows how to calculate a resistance for discontinuous service. The results can, of course, also be applied to motors, generators and transformers. He gives a series of characteristic curves which indicate how many times greater the load can be made for interrupted service, than for continuous service, without surpassing the limit of increase of temperature, allowed for normal load. These curves are based upon one constant, the "time constant," which can be found either by calculation or by an experiment. For the exact determination of the kind of discontinuous service the knowledge of the ratio of the time of load and of the period is required, also the absolute value of the time of load. This series of characteristic curves is shown in the adjoining diagram. The ordinates represent the ratio of time, *a*, of load, and the whole period, *P*, this period, *P*, being the sum of the time of load and the time of rest. It is evident that the



CHARACTERISTIC CURVES.

ratio a/P must therefore be smaller than unity. It becomes unity for continuous service. The ordinates of the diagram give the ratio of the load with interrupted service and of the load with continuous service, the increase in temperature being the same in both cases. The different curves are plotted for different values of a/T, i. e., the ratio of the time, a, of load and the "time constant," T. This time constant is the only constant that must be known, in order to determine the behavior of a given resistance in a discontinuous service. To calculate this time constant for a certain resistance, it is required to determine the temperature limit which it finally reaches with a continuous load of, Q, watts. Let t be the difference of this temperature limit and of the temperature of the surrounding air. If the weight of the resistance in grams is G, and the specific heat s, (t and s being given in the same thermometric scale), then the time constant T in seconds is the product, $4.16\ G\ s\ t$, divided by Q. As the method appears to be of practical value, a numerical example may be given; say, a resistance can stand continuously 1000 watts, its time constant was bound to be 150 seconds equals 2.5 minutes. The time of load in the regularly discontinuous service may be $a = 0.5$ minute, and the time of rest equals 0.5 minute, therefore the period $P = 1$ minute, so that $a/P = 0.5$ and $a/T = 0.2$. For the curve, $a/T = 0.2$ in the diagram, the abscissas 0.5 corresponds to the ordinate, 1.85; i. e., if in such a discontinuous service of 0.5 minute with 0.5 minute rest, that resistance is loaded with 1850 watts, it does not become warmer than if it is loaded in continuous service with 1000 watts. It is evident that for $a/P = 1$, the service is continuous, and therefore all the curves must have the ordinate unity for this abscissa, that is, for continuous service. It will also be seen that the load in discontinuous service may be chosen the greater, the smaller the time of load, compared with the period, and compared with the time constant.—*Elek. Zeit.*, Dec. 20.

Calculation of Resistances for Dissipating Energy.—GIRAULT.—A short article in which he develops the formulas for accurately calculating a resistance for dissipating energy under the following assumptions. The resistance material is to be in the form of a metallic band of constant thickness, but different widths, the length of which is varied by cutting out parts of it for regulation. It is for constant potential circuits and is supposed to be in series with a fixed constant resistance. The basis of the calculation is that the density of the current should remain constant in the variable resistance. This gives the maximum degree of utilization of the material and of the resistance. The formulas are too complicated to give here. He draws the following conclusions. For the same value of the specific cooling surface the volume of metal is independent of the resistivity of the metal used, depending only on the specific cooling surface. The widths of the bands are directly proportional, and the lengths inversely proportional to the square root of the resistivity, for the same value of the total resistance. The less resisting metals therefore correspond to the smaller widths and the greatest lengths of the resisting band, all else being the same.—*L'Ind. Elec.*, Dec. 10.

Southport.—The first part of a long illustrated description of the electric plant of this British town. The high-pressure alternating-current system is used, with sub-stations. The present capacity is 1150 kw for lighting purposes, with an additional plant of 600 kw for traction. A new plant is in course of erection, providing accommodation for a generating plant of 3000 kw.—Lond. *Elec. Rev.*, Jan. 25.

WIRES, WIRING AND CONDUITS.

Saving of Copper in Transmission Lines.—BESSO.—A communication referring to the system of Bedell of combined transmission of alternating and direct current, and to the article of Spielmann abstracted in the Digest, Dec. 29. He remarks that with the scheme of Bedell, the e. m. f.'s against the earth become quite different. In the most favorable case the maximum alternating-current e. m. f. is increased by half the direct-current e. m. f. With the new maximum e. m. f., however, the sole use of nothing but direct current is more economical. The system of Bedell and a similar one of Troucone, cannot be more economical than pure direct current for the same maximum e. m. f. between a conductor and earth.—*Elek. Zeit.*, Dec. 20.

REFERENCES.

Cable Breakdowns.—HANAPPE.—A long mathematical paper, referring to the paper by Kapp, abstracted in the Digest, Jan. 20, 1900. By a graphical method he shows that a very simple calculation may be used for the determination of the maximum tension between the outer conductor and the earth, and that the graphical method may be generalized for plotting the tension curves. He considers a circuit with self-induction and capacity in two particular cases. The first case deals with constant e. m. f. and self-induction and with variable capacity. The second case relates to the secondary of a transformer in short circuit with a constant capacity, the primary being supplied under constant pressure. He applies the results obtained in these cases to a study of the capacity effects dealt with by Kapp.—*L'Eclairage Elec.*, Dec. 29.

Inductance of Long Transmission Lines.—*Sartori.*—A mathematical paper. He studied the transmission of power by three-phase currents over a distance of 24 miles. He gives the formulas obtained by him for calculating the inductance of such lines.—*L'Elettricista*, March, 1900; abstracted in *L'Eclairage Elec.*, Dec. 29.

Cables.—A brief illustrated description of different kinds of electric cables used in the British Navy.—Lond. *Elec. Rev.*, Jan. 25.

ELECTRO-PHYSICS AND MAGNETISM.

Stratified Discharge.—RIECKE.—He thinks that the explanation of the stratified discharge must not be sought in the analogy of any wave motion like Kundt's dust figures, but rather in the analogy of a fluid jet which periodically expands and contracts as its distance from the orifice increases. Cathode rays, proceeding as they do by projection from the cathode, may behave substantially like a jet, as they leave the cathode with a definite initial velocity. He attempts a mathematical investigation from which it follows that the curve of velocities becomes a periodic one, and consists of an exponential curve and a sine curve of increasing amplitude superimposed. When there is no viscosity, the periodicity disappears. The same thing happens if the initial velocity is very small.—*Phys. Zeit.*, Jan. 12; abstracted in Lond. *Elec.*, Jan. 25.

Cathode Ray Tubes.—ROLLINS.—A continuation of his long illustrated serial. He describes a method by which he has found that cathodes lost in weight, some losing more than others, with the same amount of electricity. He also describes a cathode of radio-active substance and a "seehear" containing two principles which are new in stethoscopes, one a sound chamber, the other a fluorescent screen in connection with a sound chamber. There is certainly an advantage in hearing the sounds in the chest of a patient while the organs are under inspection by Röntgen rays.—*Elec. Rev.*, Feb. 2.

Magnetic Hysteresis.—KROGH and RIKLI.—An article illustrated by diagrams, on "Magnetic inertia," i. e., that property of soft iron by which its magnetic flux is unable to follow immediately too rapid variations of the e. m. f. This property causes an increase of the hysteresis loop for the same maximum induction with increasing frequency, also a lag of the maximum induction behind the maximum of m. m. f., also a decrease of the permeability. They have investigated the influence of the frequency upon the magnetic inertia with constant maximum induction. The frequencies used by them varied between 10 and 100 p. p. s. The results are given in diagrams. Among other things they found that the hysteresis loss depends upon the wave form, it is greater for pointed e. m. f. waves than for flat e. m. f. curves. They also found a distinct decrease of the permeability with increasing frequency.—*Elek. Zeit.*, Dec. 27.

Torsional Magnetostriction.—BARUS.—A paper on "Apparent hysteresis in torsional magnetostriction and its relation to viscosity." He describes a series of phenomena bearing on the permanence of torsional magnetostriction in iron and nickel magnetized by circular and by longitudinal fields. The phenomena are evoked by purely magnetic action. They are obtained by twisting the wire alternately back and forth over a definite angle within the elastic limits and examining the change of rigidity produced by circular or by longitudinal magnetization immediately after each new twist and after several repetitions of the magnetization. The first magnetization succeeding any twist, operates on the magnetic configurations surviving from the preceding twist and magnetizations; the remaining magnetizations (current alternately made and broken) for the same twist operate on the new configurations produced by the twist in question and the first magnetization applied to it. The results are very different, the former are viscous (temporary), the latter elastic (permanent) in character. He uses Maxwell's theory of viscosity, in which any deformation due to molecular instability is a viscous deformation. When the breakdown is gradual in character, which it must be if dependent on temporary local intensities in the distribution of heat motion, the deformation will be gradual as actually observed in ordinary viscous phenomena. If, however, the breakdown is instantaneous, due, for instance, to the molecular shake-up accompanying magnetization or its withdrawal, then viscosity is instantaneously a minimum, the deformation sudden, and the phenomenon "static."—*Am. Jour. of Sc.*, Feb.

REFERENCES.

Effective Value of Alternating Waves.—Brisse.—A mathematical article illustrated by diagram. The effective value of an alternating wave is in close relation with the time integral of the square of the instantaneous values. He describes a graphical method for calculating this integral and determining the relation between the effective value and the maximum instantaneous value, if the wave form is given graphically. The integral is represented by a volume. He applies his method to the following cases: Sinusoidal currents, pulsating currents, a wave form represented by a series of teeth.—*L'Eclairage Elec.*, Dec. 29.

Electric Oscillations.—Fleming.—A reprint in full, with illustrations, of the first of his series of Cantor lectures on "Electrical oscillations and electrical waves."—Lond. *Elec.*, Jan. 25.

ELECTRO-CHEMISTRY AND BATTERIES.

Potassium Chromate in the Electrolysis of Alkalies.—Mueller.—Not long ago there appeared an article in which the advantages were pointed out of adding a small amount of potassium chromate to the alkalies during their electrolysis. It was shown that the addition of this salt was very beneficial. In the present article the nature of the action of this salt is discussed at some length, chiefly from a theoretical standpoint, and the results of experiments are given, which he believes suffice to show that the action of the chromium salt is somewhat like that of a diaphragm, and that its catalytic action is questionable. He believes that electrolyses, with the chromium salt is one of the most ideal diaphragm processes that could be imagined.—*Zeit. f. Elektrochemie*, Jan. 3.

Carbides, Borides and Silicides.—Hutton.—An article in which he says that the discovery of the production of calcium carbide and carborundum in the electric furnace, followed by their rapid technical application, has to a very great extent been the cause of withholding attention from some of the other products of a similar kind, which have been studied especially by Moissan and seem destined to become of industrial application in future. The metallic carbides are decomposed by water, whilst those of the metalloids are not. The carbides of tungsten, vanadium chromium and iron form an intermediate group. Carbides of the alkalies and alkaline earths give acetylene. Carbides of aluminum and beryllium give pure methane. Manganese carbides react with water, giving equal volumes of hydrogen and methane. The carbides of the rare earths, cerium, etc., give mixtures of acetylene, methane and ethylene. The carbides possess another important property in being most powerful metallurgical reducing agents. Reference is made to the application of carbides for the production of artificial graphite in the electric furnace. The silicides and borides which are prepared in the electric furnace are amongst the most stable substances known. They have the valuable property of great hardness, and consequently find application in cutting, grinding and polishing. Silicium carbides or carborundum is now made in large quantities. The borides are also very stable compounds. Even those of the alkaline earths, such as calcium boride, are not attacked by water.—*The Electrochem. and Met.*, Jan.

REFERENCES.

Transference Numbers.—Noyes.—A long paper in which he describes a modification of the usual method of determining transference numbers, and gives an account of an investigation of the influence of the concentration on their values in the case of some tri-ionic salts. —*Phys. Rev.*, Jan.

Estimating Free Alkalies.—Von Huber.—A paper describing a method for estimating the percentage of free alkalies, when hypochlorites, chlorates and chromates are present.—*Zeit. f. Elektrochemie*, Jan. 3.

Electro-Chemistry in 1900.—Krueger.—The first part of an article giving brief descriptions of new inventions and improvements in electro-chemistry in 1900. This part deals with the theory of electrochemistry.—*Elektrochem. Zeit.*, Jan.

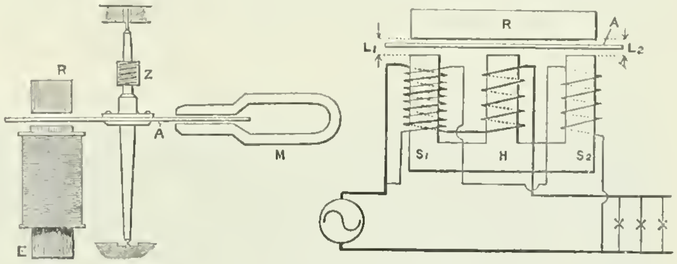
Progress in Electro-Chemistry.—The first part of a review of "some recent progress in electro-chemistry." Improvements or new processes are briefly described. This part deals with the electric methods of manufacturing aluminum, zinc, copper, iron, gold, chlorates and hypochlorites.—*The Electrochem. and Met.*, Jan.

Electrolytic Preparation of Phosphorus.—A brief description of the Dile appartus, recently patented in Germany. It is claimed to work continuously and to require no other manipulation than that of introducing a fresh quantity of material after each batch is exhausted. Phosphoric acid mixed with coke or charcoal is used.—*Sc. Amer.*, Feb. 2.

Solutions in Liquid Ammonia.—Legrand.—A long illustrated account of an experimental investigation of the electric conductivity of certain salts and of sodium, dissolved in liquid ammonia.—*L'Eclairage Elec.*, Jan. 19.

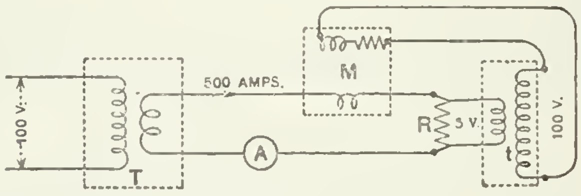
UNITS. MEASUREMENTS AND INSTRUMENTS.

Alternating-Current Meter.—An illustrated description of a watt-hour meter for alternating-current lighting circuits of the General Electric Company, of Berlin. The meter is of small size, the diameter being less than 9 in., and its weight 11 lbs. Its price is low, and it is claimed that by its introduction the meter rent paid by consumers will be reduced to one-half its present amount. It is illustrated in the adjoining diagrams. There is a revolving disk, *A*, subjected to the action of two alternating magnetic fields differing in phase, which, owing to their special disposition, impress a comparatively large driving force on the disk. The pressure bobbins S_1 and S_2, as well as the main current bobbin, *H*, are placed at one side of the disk, the three cores of the bobbins being connected to a single yoke, *E*, and the magnetic circuit being completed by a single armature, *R*. The two shunt bobbins, S_1 S_2 impart alone, that is, without the main current, a fairly strong torque to the disk, either when the air spaces, L_1 L_2 of the two pressure cores are unequal, or when the magnetic force of the two pressure bobbins is different. This torque would cause the meter to run when no current was flowing, and it must be reduced to an amount which is just sufficient to overcome the friction of the apparatus. This can be done by varying the number of turns or the air space. In the present instrument the latter is made adjustable. If the main current is now turned on a mutual action takes place between the magnetic flux of the main current and the eddy currents generated in the disk by the shunt bobbins on the one hand and between the magnetic flux of the shunt bobbins and the eddy currents generated by the main current bobbin, on the other hand. The result is that the disk, *A*, is set in rotation. The field of the main current bobbin acts upon the fields of the shunt bobbins so as to reduce one and increase the other. The core of one of these bobbins would thus reach the saturation point much sooner than that of the other, and the proportionality would be disturbed. To prevent this, a part of the main current circuit is wound about one of the shunt cores, to compensate for this inequality in the field. If the same effect were produced by winding different numbers of turns on the two shunt bobbins, then, as stated above, the meter would run when the main current was not turned on, which is an insuperable objection to this method of compensation. The magnet, *M*, acts as a brake to the disk. The rotation of the disk is transmitted to a counting mechanism by worm gear.—*Zeit. f. Beleucht*, Jan. 10; Lond. *Elec. Rev.*, Jan. 25.



FIGS. 1 AND 2.—ALTERNATING-CURRENT METER.

Obtaining Alternating Currents and Voltages in the Same Phase for Fictitious Loads.—Campbell.—When testing instruments for the measurement of large amounts of electrical power or energy, it is usually desirable to do so by means of fictitious loads, *i. e.*, by applying to the instrument under test current and e. m. f. representing the required load, but not actually producing the load. To obtain a fictitious non-inductive load with alternating currents the current and e. m. f. must be in phase with each other, although they do not belong to the same part of the circuit. He has found the following arrangement convenient for this purpose. Suppose the fictitious load required is 500 amperes at 100 volts. In the adjoining figure, *T* is a transformer with its primary on 100 volts, its secondary giving out 500 amperes at 5 volts or 6 volts. Connected in series on the secondary circuit are the series coil of the instrument under test, an ammeter A and a non-inductive resistance R, to take 500 amperes at about 5 volts. Across suitable points of this resistance is connected the low-pressure coil of a closed iron-circuit transformer t, of ratio 1 : 20, such as is commonly used for transforming, say, 1 kilowatt from 100 volts to 2000 volts. The high-pressure coil of this transformer furnishes the 100 volts required for the shunt coil of the instrument. "It will be found that the e. m. f. is practically in phase with the current of 500 amperes."—Lond. *Elec.*, Jan. 25.



ALTERNATING CURRENTS AND VOLTAGES IN SAME PHASE.

Determining the Frequency.—Kempf-Hartmann.—A long, illustrated description of an instrument of Hartmann & Braun for measuring the frequency. It is based upon the principle of the electromagnetically excited tuning fork; it begins to vibrate when the frequency to which it is tuned corresponds to the frequency of the alternating current supplied to the coil of the electromagnet, which attracts one arm of the tuning fork. Instead of a tuning fork he uses a reed of steel. In the actual instrument 32 steel reeds, corresponding to frequencies between 79 and 110, are arranged erect in a circle, the upper ends being free and capable of vibrating. By turning a button they can be moved before the poles of an electromagnet excited by the current the frequency of which is to be measured. When a reed begins to tune, the corresponding frequency is read off directly. The instrument is evidently independent of variations of voltage.—*Elek. Zeit.*, Jan. 3.

Magnetic Observatories and Traction Disturbances.—Wedmore.—A communication in which he criticizes the arguments of Glazebrook (Digest, Feb. 2). He says that the stray currents observed are evidently due to some traction system or systems, while all such systems are at a considerable distance from Kew. According to Edler's formula, there should already be a considerable vertical disturbance at Kew, and this should be augmented by the presence of the bonded rail in the immediate neighborhood.—Lond. *Elec.*, Jan. 18.

REFERENCES.

Slide Wire Resistance.—Edelmann.—An illustrated description of a slide wire resistance devised by him and consisting of a series of resistance coils, with five levers for making contact with five circular contact pieces. It can be used so that the whole length of the resistance corresponds to 1 or 10 or 100 or 1000 or 10,000 ohms.—*Elek. Zeit.*, Dec. 20.

High Tension Electrometer.—Schwartz.—A communication referring to the article of Baeumler (Digest, Dec. 29), and giving some results of tests of the Ebert-Hoffmann high tension electrometer.—*Elek. Zeit.*, Dec. 20.

Telegraphy, Telephony and Signals.

REFERENCES.

Telephone Receiver for Space Telegraphy.—Popoff and Ducretet.—A description of a receiver which dispenses with a relay and a decohering device, the messages being read by means of a telephone receiver. The coherer is filled with grains of hard carbon or other substance. The air wire need only be a couple of feet long. A good earth connection is required. The apparatus is said to be exceedingly sensitive.—*Comptes Rendus*, Dec. 31; abstracted with an illustration in Lond. *Elec.*, Jan. 25.

Multiple Switchboard.—An illustrated description of the multiple switchboard of Mix & Genest for telephone exchanges of small and medium size.—*Elek. Zeit.*, Dec. 20.

Long-Distance Cable Telegraphy.—Breisig.—A mathematical paper in which he describes a method for determining the influence of the transmitting and receiving apparatus at the ends of a long cable, upon the telegraphic signals.—*Elec. Zeit.*, Dec. 13.

Insulated Telephone Wires.—A reply to the criticism of West (Digest, Dec. 29), by the company which makes the Hackethal telephone wire (Digest, Nov. 24).—*Elek. Zeit.*, Dec. 13.

Miscellaneous.

REFERENCES.

Paris Exposition.—Montpellier.—An illustrated description of galvanometers exhibited by Hartmann & Braun.—*L'Elec.*, Jan. 19.

Armagnat.—An illustrated description of various induction coils and interrupters which were exhibited.—*L'Eclairage Elec.*, Jan. 5.

Reyval.—An illustrated description of arc lamps exhibited by Thury and by Koerting & Mathiessen.—*L'Eclairage Elec.*, Jan. 5.

Reyval.—Illustrated descriptions of a 1200-kilovolt ampere three-phase, delta-wound alternator of Ganz & Company, the voltage being 2200, the power factor 0.7, the number of poles 48, the speed 125 r. p. m., the frequency 50; and of a similar machine of the same firm, differing from the former only in the number of poles and frequency, which are 40 and 42, respectively.—*L'Eclairage Elec.*, Jan. 12.

Armagnat.—An illustrated description of some measuring instruments in the Hungarion, Swiss and Italian sections.—*L'Eclairage Elec.*, Jan. 19.

Reyval.—An illustrated description in detail of the installation for electric lighting of the Eiffel Tower.—*L'Eclairage Elec.*, Jan. 19.

Horner.—A well-illustrated description of different electric cranes exhibited.—*Cassier's Mag.*, Feb.

Richards.—A Franklin Institute paper on aluminum exhibits.—*Jour. Frank. Inst.*, Feb.

New Books.

An Introduction to Modern Scientific Chemistry. By Dr. Lassar-Cohn. Translated by M. M. Patteson-Muir, M. A. New York: D. Van Nostrand Company. 348 pages, 58 illustrations. Price, $2.00.

This book does not contain, as some might think from its title, an exposition of the modern theories of solution, electrolysis, etc, but is devoted to the theories that were known as "The new chemistry" a quarter of a century ago. That is, the ordinary chemistry of today. The book is very elementary in character and evidently intended for beginners, who will find it within the limitations above pointed out, interesting and instructive.

National Electric Light Association. Report of Twenty-third Convention. By order of the Executive Committee. The James Kempster Printing Company. 455 pages, 10 illustrations, 43 diagrams. Cloth.

This is an excellent addition to the long series of volumes now issued by the Association during its useful career, and embodies many important papers and discussions. The papers include those of President Cahoon on uniform accounting; W. L. Abbott on central station economics, H. J. Frith on utilization of exhaust, Prof. Robb on series enclosed alternating arcs, H. L. Doherty on rates, H. G. Reist on alternating current generators, E. A. Sperry on automobile revenue, R. S. Feicht on combination plants. There are also valuable reports on the photometric values of arc lamps by Profs. Matthews and Goldsborough, and on grounded circuits by Capt. Brophy. The volume has been put through the press in excellent shape by Miss Billings, the assistant secretary. It has as a frontispiece a portrait of Past President Carnes, and as an appendix the Institute or joint report on standardization of electrical apparatus.

The Coal and Metal Miners' Pocketbook. Principles, Rules and Tables. Sixth edition, revised and enlarged. Scranton: The Colliery Engineer Company. 637 pages, illustrated.

The first thing that one notices in examining this book is that there is not given, on the title page or elsewhere, the name of the author, editor or compiler of the contents of the volume. This, however, should not be taken as evidence that those responsible for the work were ashamed, or had reason to be ashamed of the book, for, as a whole, it compares well with the average pocketbook. There are, besides the usual tables of logarithms, etc., many useful articles which, when extracted from original papers, are credited to their respective authors.

A mining engineer in the course of his regular professional work finds use for knowledge on a wide variety of subjects, and this is kept in view in the make-up of the book. For example, no up-to-date mining engineer can get along without some knowledge of electric machinery, and the book devotes 33 pages to electrical subjects.

A good part of the book is devoted to mechanical engineering, and there are notes on a variety of things that may prove useful at times, such as the treatment of injured persons. The greater part of the book is, as it should be, devoted to mining engineering proper—that is, prospecting, working of mines, mining machinery, etc.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 17-20, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, New York, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., Sept. 4, 1901.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Next meeting, Houston, Tex., May, 1901.

The Automobile Show at Philadelphia.

It has become quite the fashion for each large city to have an automobile show, and indeed the fashion is already more or less of a nuisance to the manufacturers, for not even the largest of them can stand such a constant strain on their resources. The tendency is, therefore, to patronize only the best shows in a few of the largest centers of population, and even there to leave the matter to local agents. At the show in Philadelphia last week, evidences of the attitude of indifference of manufacturers toward shows in general were seen, and under such circumstances, the Pennsylvania Automobile Club is to be congratulated upon the result of its maiden effort. The list of exhibitors numbered 66, and it is said that over 300 vehicles were grouped within the building.

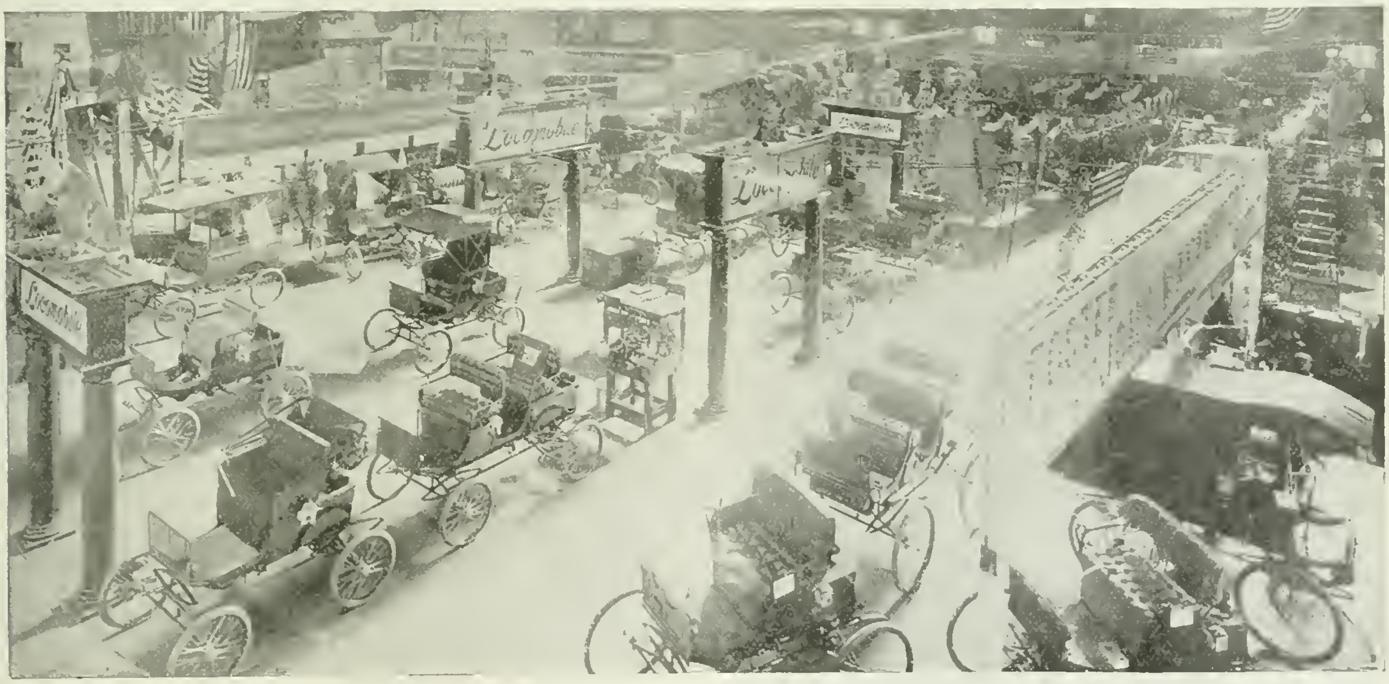


FIG. 1.—GENERAL VIEW PHILADELPHIA'S FIRST AUTOMOBILE SHOW.

For the purposes of the show, which lasted the whole week with afternoon and evening sessions, the Second Regiment Armory Building was taken—a big, ugly stone barn of a place, well out from the City Hall, but by means of bunting and decoration it was made quite attractive interiorly. The now familiar plan was adopted of a central exposition space with a surrounding wide track, an outer pocket for track vehicles, and a fringe of miscellaneous exhibitors on the outer edge of the track. To such a plan Madison Square Garden lends itself admirably, but the armory served very well, except that the 18-ft. track being short and almost circular, caused the wheels to bind a good deal and rather took it out of the tires. Access to the exhibit space in the middle was obtained by means of a four-way footbridge crossing over the track at a safe altitude. One serious objection to the armory on the part of visitors was the fact that there was no sitting accommodation, while others spending hours there complained of the absence of a refreshment bar. On the other hand, outside lay one of the finest asphalted avenues in Philadelphia, giving a splendid opportunity for a straightaway spin with a prospective customer.

There were practically only four electric automobile exhibitors, and only two of these made any serious attempt at an exhibit, the Electric Vehicle Company and the Woods Motor Vehicle Company, both of whom had fine displays and attracted a considerable amount of attention from the visitors, of whom there were large crowds every evening. There were also many callers in the afternoon of those who meant business, as a large part of the evening being given over to track contests of one kind and another, it was hardly possible to discuss such matters seriously at the evening sessions. In general, the exhibits may be noted as follows: Locomobiles, by the Locomobile Company of America; Mobile, Mobile Company of America; Columbia electric, Columbia gasoline, Pennsylvania Electric Vehicle Company; Foster steam (Foster Automobile Company), Orient motor cycle, Orient carriage, John Wanamaker; De Dion Bouton, Marlboro, Century, Maurice Loeb; Winton, Reading steam carriage, Wharton & Wright; Victor, Overman Automobile Company; Fanning electric, Manufacturers' Supplies Company; the Wall, R. C. Wall Manufacturing Company; the Schwarz, Charles L. Schwarz; the Skene, Skene American Automobile Company; National electric automobile, Boston automobile, the gasmobile, Motor Carriage Company; Thornycroft, Thoryncroft Steam Wagon Company; electric ambulance, Fulton & Walker; Union motor truck, Union Motor Truck Company; Woods electric, Woods Motor Vehicle Company; Grout Bros.' automobile, Grout Bros.; Standard, Standard Motor Vehicle Company. The sundries and accessories were: Sundries, R. C. Wall & Co.; lamps (Gray & Davies), bells (Bevin Bell Company), pumps (Gleason-Peters Pump Company), Maurice Loeb; lamps, Rose Manufacturing Company; bells, Liberty Bell Company; tires, Diamond Rubber Company; tires, Consolidated Tire Company; Glasses, Rothchild & Co.; motors and running gears, Motor Vehicle Power Company; engines (gasoline), Philadelphia Gas & Gasoline Engine Company; tires, Pennsylvania Rubber Company; Philadelphia automobile station, Hinchman & Hawkins; Motsinger dynamo sparker, Motor Carriage Company; boilers and tubing, Janney & Steinmetz; tires, New York Belting & Packing Company; motors, Palmer Motor Company; electric charging, Diamond Electric Company; tires (Goodyear), Davie & Co.; tires and automobile coats, Delaware Rubber Company; mechanical engineer and repairs, William F. Rudolph; batteries and dynamos, Dow Portable Electric Assistant Company; graphite, Dixon Crucible Company; automobile trimmings, Keyser & Rogers; tires, Hartford Rubber Works; automobile robes, Jensen & Grossman; lubricants, Columbia Lubricants Company; tubing, A. L. Smith & Co.; lamps, R. E. Dietz & Co.

The exhibit of the Electric Vehicle Company occupied a large triangular space tastefully draped and decorated, and surrounded at night by lamps with large shades in automobile reds. The exhibit included an electric delivery wagon, a surrey, a cabriolet, a runabout, a Victoria, a phaeton and a new type hansom cab. On the track there was a Mark VIII. gasoline runabout, which drew considerable attention, and Mr. Entz and others took frequent spins in the electrics. A noteworthy point was that in the literature handed out, the miles of radius per charge of the vehicle were all marked up from 25 and 30 miles to 40, the batteries supplied now being able to give this increase of distance.

The Woods Motor Vehicle Company had so large an exhibit two spaces were necessary, one within the central space and one outside. The exhibit was in the competent hands of Mr. E. W. Curtis, Jr., and included an extension brougham, brougham cab, hansom cab, top road wagon, game trap (new), a Queen Victoria (new), a 12-passenger wagonette, a "Germantown" (new), a Victoria, a Stanhope and a runabout—all electric. The Queen Victoria is a very handsome and stately type of vehicle, as shown in the accompanying cut. It weighs about 2600 lbs., has two $2\frac{1}{2}$-hp motors, and 40 cells of battery, and has a radius of 35 miles. It may be added, that at the recent bicycle show in Philadelphia under the auspices of the Philadelphia Board of Trade, Mrs. Curtis, with the Woods stanhope carrying its rumble, took a first prize silver loving cup in the floral parade, the vehicle being decked with smilax and carnations.

The exhibit of the De Dion-Bouton Motorette Company, of Brooklyn, included quadricycles and tricycles, etc. The New York type, a two-passenger vehicle, weighs only 450 lbs. The Brooklyn type, weighing 750 lbs., with a capacity for three passengers, came in for much praise, and was kept continuously on the track. A skeleton carriage showed the mechanical construction used by the De Dion-Bouton Company, was always surrounded by a circle of spectators listening to the explanations of those in charge of the exhibit. The American type quad for two passengers was also much appreciated.

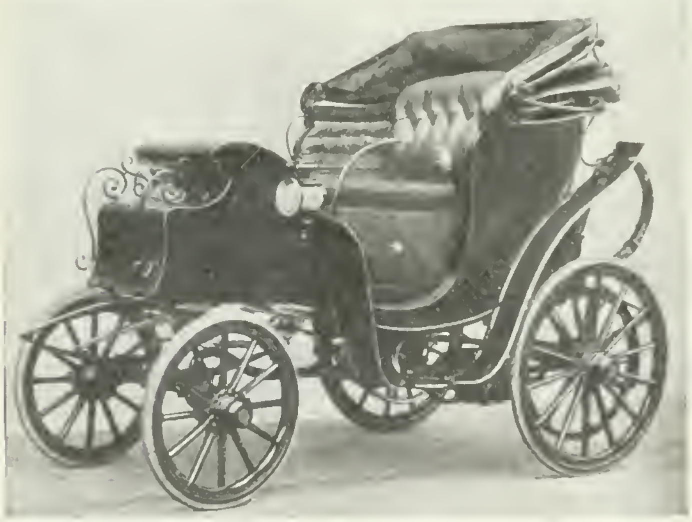


FIG. 2.—NEW TYPE ELECTRIC AUTOMOBILE "QUEEN VICTORIA."

The show was remarkably brilliant at night with electric light signs. Outside, the makers of the "Neverout" oil lamp had cleverly taken large models and put arc lamps within them. The finest interior display was that of the local Diamond Electric Light Company, which had run in its circuits, and which, in addition to some fine incandescent lighting signs and displays, had several charging outfits, and a General Electric "Electrant." One outfit, under the management of Mr. C. A. Bragg, was a Westinghouse 5-kw rotary, on 100-110 two-phase, and delivering direct with a range of from 90 to 150 volts, charging two vehicles at a time. This is the first of these Westinghouse equipments to be shown. In addition there was a Wagner single-phase 5-hp motor generator outfit, and a Wagner single-phase motor belted to a small General Electric generator.

FIG. 3.—VIEW OF TRACK AND ELECTRIC VEHICLE COMPANY'S EXHIBIT.

The officers of the Automobile Club, which is to be congratulated on the success of its show, are Dr. F. L. Sweany, president; Julian Haugwitz, first vice-president; C. S. King, second vice-president; H. J. Johnson, secretary; W. H. Hinchman, treasurer; R. P. McCurdy, captain; J. K. Wharton and G. E. Gossler, lieutenants; G. E. Gossler, C. L. Klauder, S. R. Weaver, Maurice Loeb and W. F. Rudolph, board of governors.

Muffler for Gas Automobiles.

The device illustrated herewith is designed to eliminate the noise of exhaust of hydrocarbon motors used on automobiles. It is constructed of aluminum and asbestos, both materials being capable of taking care of vibrations resulting from the exhaust. The exhaust is cushioned upon itself, and it is then expanded twice in the small mufflers and three times in the large mufflers. Between each expansion apparatus is placed to change the gas to a stream, and upon its final expansion into the atmosphere it is still further changed in its nature to a practically steady stream. Various sizes of these mufflers are now in practical operation, and it is stated that the results are very satisfactory, the noise of expansion being very greatly reduced.

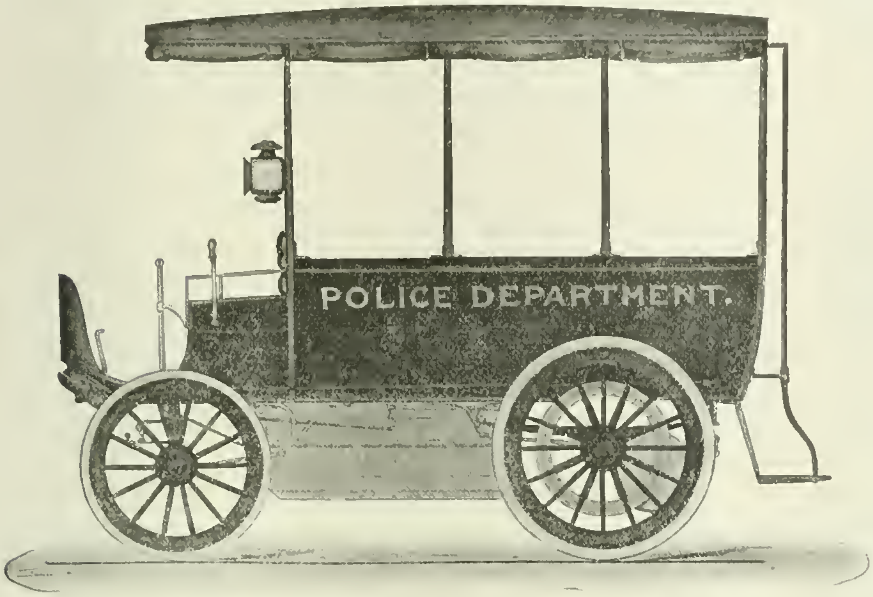
MUFFLER FOR GAS AUTOMOBILES.

This muffler is manufactured by the Loomis Automobile Company, Westfield, Mass., and can be supplied for any size of exhaust pipe. They are readily attachable, being simply screwed on.

An Electric Police Patrol Automobile.

The electric patrol wagon, for which the Hartford, Conn., Police Commissioners have signed a contract with the Electric Vehicle Company, has several novel features which have never been adopted in horse-drawn conveyances of this kind. In compartments under the driver's seat will be kept medical and surgical appliances necessary in emergencies, and within the wagon there will be two stretchers. Thus the vehicle can, in cases of emergency, be made to serve the purpose of an ambulance. The tires will be of heavy rubber, permitting the removal of an injured person or a patient without jolting. Another feature is the manner in which the two seats, running the entire length on the inside, are to be constructed. These seats can be dropped against the sides at will, leaving the inside space entirely free. Thus the carrying capacity of the vehicle can be largely increased. The body of the wagon is modeled after standard horse patrol wagons in New York, and in construction is similar except that the parts supporting the weight of the battery will be heavier. A charging station will be placed in the Police Headquarters station. Extra sets of batteries will be provided, and exhausted batteries can be charged while one set is in use. In this manner the wagon will be constantly supplied with power, the change from an exhausted to a fresh set of batteries requiring only a few minutes.

Wire screens will be provided for the sides and across the front, and upon these screens will be stretched curtains which can be lowered or raised at will. An electric light fixed on a flexible cord can be removed about the wagon. The woodwork of the body of the vehicle will be of white pine, coloring, finish and lettering being left to the Police Commissioners. Heavy brass railings will be provided about the driver's seat and along the back to the step at the rear.



POLICE PATROL AUTOMOBILE.

The wagon will have a capacity of 25 miles on one charge of the batteries and a speed of 11 miles per hour. It is to cost $3000, and to be ready for service in three months.

New Type of Combination Trolley Car for Brooklyn, N. Y.

Thanks to the efforts and ingenuity of Mr. Eugene Chamberlain, superintendent of equipment, a new type of combination trolley car for summer and winter use has been introduced on the lines of the Brooklyn Heights Railroad, much to the pleasure and satisfaction of the patrons of that system.

The change from winter to summer style is effected by removing the windows, leaving the sides of the car practically entirely open. The windows, each made of one large piece of plate glass, cannot be lowered when in place, but are held firmly to the window posts by iron strips on the outside, the sash being rubber lined to prevent rattling. These strips are secured by three set screws, which pass through the posts from the inside. To remove the windows, therefore, all that is necessary is to take out these three screws from each post, remove the iron strips from the outside, and take the sash out; after which the iron strips are replaced. This operation can be performed in about 40 minutes for each car. The length of the car over bumpers is 37 ft., ¾ in., and the body over corner posts, 28 ft.; the platforms are 4 ft. 7 in. The width over all at grip rails is 8 ft. 1½ in;. at sills 7 ft., and at steps 7 ft. 4 in. From the head of the rail to the top of the trolley board is 11 ft. 5 in., and the height of the car from sill to trolley board is 9 ft. 1 in. The distance between the bolster centers is 18 ft. 11 in. The window openings are 40 in. by 31 in. The curtains, which remain in place for both summer and winter use, are fitted with patent fasteners, and run in diagonal slots in the side posts, which slope outward from the top down. At the bottom these slots reach almost to the outer edge of the window sill, and a flap about 4 in. wide is provided, which extends completely over the sill and makes an efficient watershed. This gives the car a great advantage over the ordinary type of open car, as it is as dry in rainy weather as a closed car would be. There can be no drifting in of the rain on the passengers or empty seats.

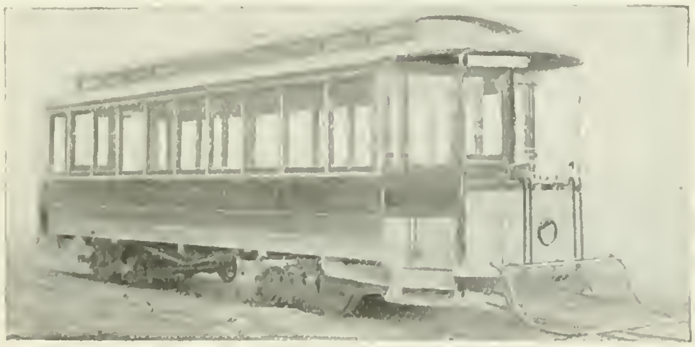


FIG. 1.—COMBINATION CAR.

The seats are of a peculiar revolving type, covered with dark green pantasote, and arranged in pairs, one seat of each pair being slightly in advance of the other, although the bases of the two opposite pairs are in the same transverse line. This gives the seats a staggered appearance, and allows the greatest amount of room for the passengers' feet; it also provides ample space for the standing passengers, and it is found that a conductor on a crowded car is enabled in collecting fares to work his way in and out among the seats with much greater facility than where the ordinary longitudinal type of seat is used. Pressure on a pedal under the seats enables them to be turned through a half revolution, and thus face the other way. No locking device is employed, so that the passengers can sit facing each other where a party of friends so desire. The seating capacity of the car is 40, there being nine double revolving seats on each side, and a fixed sofa seat at the ends. The doors are placed at the side of the platform, as shown in the front view of the car, so that ample room is provided for the sofa seat. The total capacity compares favorably with the standard cars on the road, but the comfort of both seated and standing passengers is greatly increased.

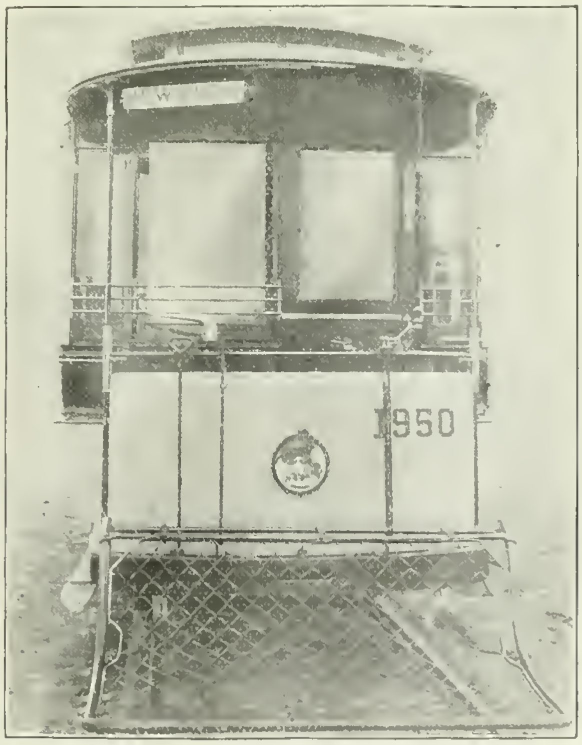


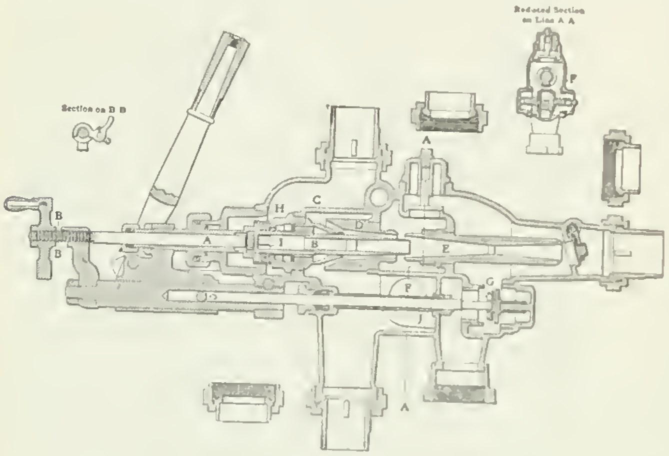
FIG. 2.—FRONT VIEW OF COMBINATION CAR.

The car is furnished with Brill maximum traction trucks, and two Westinghouse type 68 motors of 40 hp each. K-11 controllers, circuit breakers, lightning arresters, etc., complete the electrical equipment. The lighting consists of three center clusters and five single incandescent lamps on each side of the car. These give practically a half again more light than is customary. There is also a lamp under each platform hood, and electric headlights are used. Electric push buttons on a line with the lower window sill and conveniently placed at the hands of the passengers are provided for signaling the conductor. The car is heated by electric heaters, made by the Consolidated Car Heating Company, of Albany, N. Y. There are 11 of these heaters ranged along the side, a short distance above the floor.

The interior woodwork is of natural cherry, having a flat finish, and the headlinings are of quartered oak. The Brooklyn Heights Railroad Company operates parlor cars on certain lines, in which an extra charge is made, and many passengers on entering the new combination cars think that they have made the mistake of boarding a parlor car.

An Improved Injector.

The injector shown in the accompanying illustration has a number of features which make it differ from like devices now on the market. By pulling the lever slightly the steam valve *H* is withdrawn from its seat and steam is admitted to the lifting steam jet *C* through the annular space around the movable steam tube *B*. The steam flowing into the water lifting tube *B* forms a vacuum in the water supply pipe and the water is "lifted" and passes out through the check valve *A* and the delivery tube *E*, past the overflow valve *G*, to the atmosphere. Drawing the handle farther back opens the ports *I I* in movable steam tube *B*, thus admitting steam to the interior of said tube, which forces the water through the combining tube *E* past the line check to the boiler, due to the closing of overflow valve *G* by the withdrawal of the rod *J*. The principal feature in this machine is that the regulation of the water is accomplished by the movement of the movable steam tube *B*, the amount of which is controlled by the crank handle at the end of the machine. On this account it differs from all other forms of injectors, inasmuch as, in cutting down the discharge of water, the steam consumption is reduced in direct proportion. In other forms of injectors the steam supply remains constant, while the water supply alone is reduced.

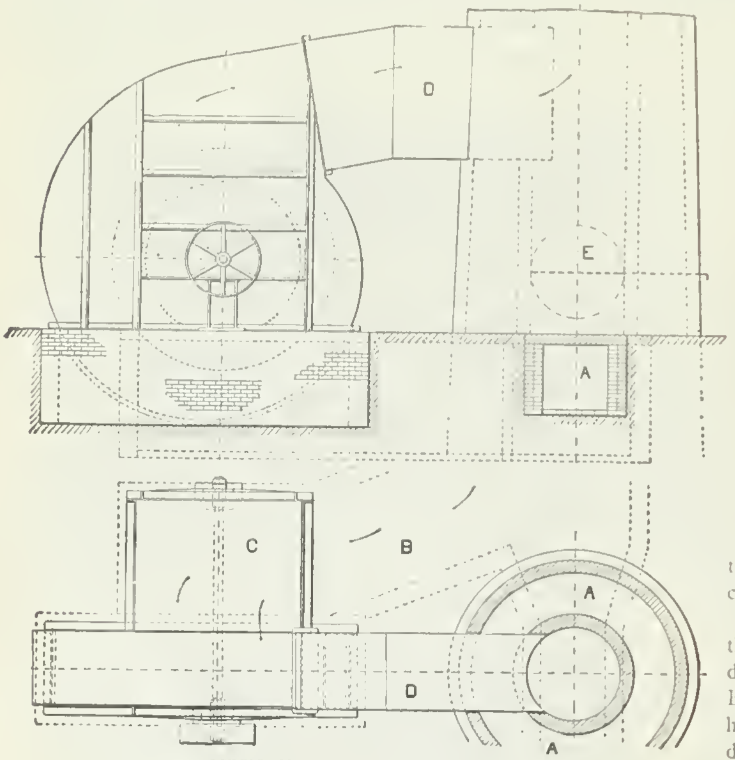


SECTION OF INJECTOR

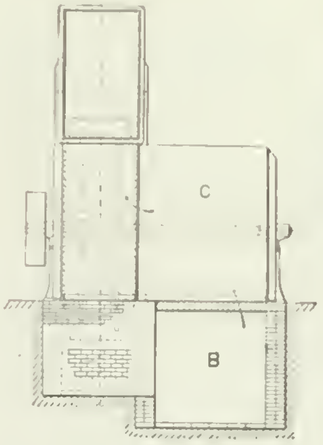
The manufacturer, the Lunkenheimer Company, Cincinnati, Ohio, claims that this injector will start promptly under most all conditions and can be depended upon to work reliably at all steam pressures from 25 lbs. to 300 lbs. and higher.

Mechanical Boiler Draft.

The illustration given below shows the manner in which an induced draft fan may be applied to perform the work of a chimney which has proved itself inadequate. The boiler plant in this case had been increased from 1200 to 2000 hp. The original course of the gases was through the underground flues, *A A*, into the base of the chimney. With the increase in the boiler plant, a fan was installed instead of building another chimney, which would otherwise have been necessary, while the existing chimney was used merely as a discharge pipe from the fan. When in operation the fan draws the gases through the branch duct, *B*, into the chamber, *C*, whence they pass to the fan and under its positive action are discharged through *D* to the chimney. A damper, *E*, serves, when closed, to prevent passage of gases to the chimney through the old duct, *A A*. Under this condition the old chimney with damper, *E*, wide open meets the requirements for steam raising before the mill is started, but during working hours the fan is necessary to maintain the required output. Under the circumstances it is therefore perfectly feasible to drive the fan by belt and operate it only during these hours. The plant illustrated was installed by the B. F. Sturtevant Company, Boston, for the Wampanoag Mills, Fall River, Mass.



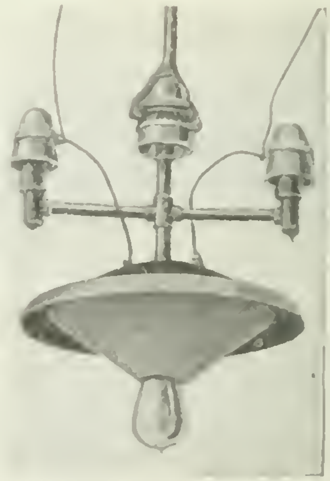
MECHANICAL BOILER DRAFT.



High Potential Street Incandescent Hood.

By G. N. Tho.

In carrying out a change in a municipal street incandescent lighting system from direct current 1200 volts, to alternating at 3200 volts, the writer encountered a serious problem in securing a suitable incandescent street hood at Chester, Pa.



INCANDESCENT LAMP HOOD.

In many locations the hoods were to be placed on iron poles, and there seemed to be no hood on the market which was satisfactory under these severe conditions. Consequently, in conjunction with Electrician Clinton Shain, the writer designed the hood illustrated herewith, which will explain itself. The insulator is of the ordinary double petticoat type, and the supporting fixture is of gray cast iron, made at a cost of something like 3 cents each.

The hoods have now been in constant service for two years under the worst climatic conditions, and we have yet to report the first failure. The same idea has, under Mr. Shain, been used in many ways, and in general central station practice should meet a variety of needs where a reliable insulating device is needed.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Rates for money closed at 3@3½ per cent for 30 to 60 days. Call money closed at 2 per cent, and the rates for commercial paper were quoted at the close of the week at 3½@3¾ per cent for prime double names. Up to Thursday the stock market was very active, heavy transactions and large advances being recorded, due to the purchase of the Southern Pacific by the Union Pacific road, and the anticipated successful outcome of the negotiations for the purchase of the controlling interest in the Carnegie Steel Company. Industrial stocks materially advanced as a result of the latter situation. On Thursday, however, reports of an obstruction to the Carnegie negotiations depressed the market, which at the end of the week exhibited an unsettled feeling. The electric and traction securities, with one exception, closed the week with better prices than were last recorded here. General Electric made the largest advance of this list—6½ points. The week's range of prices was between 191 and 198, the sales being 4100. Western Union closed with a net gain of 2¾, and Brooklyn Rapid Transit 1⅜. Metropolitan Street Railway was the only exception in the list, closing with a net loss of 1 point. Trading in outside securities was of satisfactory proportions, and business was fairly well distributed. General Carriage was active but very irregular. The following are the closing quotations at the New York, Boston, Philadelphia and Chicago exchanges:

NEW YORK.

	Feb. 2.	Feb. 9.		Feb. 2.	Feb. 9.
Gen. Electric	190½	197	Elec. Veh	15	16
Bklyn Rap. Tran	77	78⅜	Elec. Veh., pfd	30	30
Met. St. Ry	163½	162½	Gen. Car	2⅞	2⅜
Am. Tel. & C	—	96	Ill. Elec. Veh. Tran	¾	¾
West. Un. Tel	83¾	86½	Hud. Riv. Tel	117	117
Am. Dist. Tel	—	35	N. E. Elec. Veh. Tran	2⅞	3
Com. Cable	—	—	N. Y. Elec. Veh. Tran	4¼	4¾
Elec. Boat	27	27	Tel. & Tel. Co. of Am	4	4
Elec. Boat, pfd	53	51	N. Y. & N. J. Tel	174	174

BOSTON.

	Feb. 2.	Feb. 9.		Feb. 2.	Feb. 9.
New Eng. Tel	—	—	Erie Tel	58½	63
Mex. Tel	2½	2¼	Gen. Elec., pfd	*162	—
Westing. Elec	55	—	Am. Tel. & Tel	163	163
Westing. Elec., pfd	—	—	Boston Elec. Light	—	210

PHILADELPHIA.

	Feb. 2.	Feb. 9.		Feb. 2.	Feb. 9.
Elec. Stor. Bat	72	75	Phil. Elec	7⅜	7⅝
Elec. Stor. Bat., pfd	72	75	Pa. Elec. Veh	2	—
Elec. Co. of Am	8¾	8⅛	Pa. Elec. Veh., pfd	1	—
Gen. Elec. Auto	—	—	Am. Rys	32½	33

CHICAGO.

	Feb. 2.	Feb. 9.		Feb. 2.	Feb. 9.
Chicago Edison	150	150	Chicago Telep. Co	255	260
Chic. City Ry	255	255	Union Traction	11¾	12
Nat'l Carbon	15½	16	Union Traction, pfd	49½	53½
Nat'l Carbon, pfd	84	83	Northwest. Elev. Com	*31	34

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* Asked.

NASSAU ELECTRIC GOLD BONDS.—The Guaranty Trust Company, of New York, and Harvey Fisk & Sons offer at 97½ and interest, and recommend to investors $9,500,000 Nassau Electric Railroad Company consolidated mortgage 4 per cent gold bonds, due Jan. 1, 1951, principal and interest guaranteed by the Brooklyn Heights Railroad Company, through which the Brooklyn Rapid Transit Company controls the properties of the Nassau Electric. The announcement is accompanied by a letter to the bankers from C. L. Rossiter, president of the Nassau Electric Railroad Company and of the Brooklyn Rapid Transit Company, containing exhaustive information regarding the property. In April, 1899, all the railroad properties and franchises of the Nassau Electric Railroad Company were leased to the Brooklyn Heights Railroad Company for 999 years, which company owns all of the common and preferred stock of the Nassau Electric Railroad Company, excepting $448,000 par value, and, besides, the Brooklyn Heights Railroad Company, the operating company for the Brooklyn Rapid Transit Company, controls by lease or ownership all the properties embraced in the Nassau Electric Company's system. For the year ending June 30, 1898, the net earnings of the Nassau's system largely exceeded the present entire interest charge upon the same. The net earnings of the Brooklyn Heights Railroad Company for the year ending Dec. 31, 1900, were $4,333,968, and after deducting all interest and rentals of leased companies, there was left a surplus of $529,101, to which there is to be added interest and rentals derived from holdings of stocks and bonds of the companies controlled by the Brooklyn Rapid Transit Company, amounting to $701,688, making the aggregate surplus income of that company $1,230,789. It is estimated that the Nassau system contributed at least $935,000 to the net earnings of the entire Brooklyn Rapid Transit Company, which were $4,333,968.

METROPOLITAN OF CHICAGO.—The directors of the Metropolitan West Side "L" have declared a dividend of 1½ per cent on the preferred stock, payable Feb. 28. This action has caused much disappointment, as a payment of 2 per cent was promised and generally expected. The declaration was made on the advice of prominent directors, while a number of others favored 2 per cent. It is the opinion in some quarters that the next semi-annual declaration will be 2½ per cent, to make 4 per cent for the year.

TELEGRAPH RUMORS.—The advance in Western Union has revived the rumor of a combinaton of telegraph companies as a means of reducing expenses and obtaining better results. There has been considerable figuring on the saving that would be effected by doing away with competitive offices of Western Union and the Postal companies in different cities. It is said that there could be a saving of $100,000 a year in New York City alone, with a saving over the country that would have a very sensible effect on dividends.

BOSTON LIGHTING CONSOLIDATION.—The project of a consolidation of the Edison Illuminating Company and the Boston Electric Light Company has been entirely abandoned and the offer of a lease guaranteeing 10 per cent by the Edison Company has been rejected.

INTERNATIONAL STEAM PUMP COMPANY.—Trading in the common stock of this company has become more active lately, upon expectations that it will be placed upon a dividend basis in May, possibly 4 per cent, although it is stated that this has not been decided upon.

HUDSON RIVER TELEPHONE.—Stockholders of the Hudson River Telephone Company will hold a special meeting on March 7 and vote on the question of increasing the capital stock from $3,000,000 to $4,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—In the main, trade developments last week were favorable. Several lines of trade and some staples show irregularity, but this condition is not unusual at this season. The situation therefore is, on the whole, satisfactory and normal. The growth of the spring demand in distributive jobbing lines in the South and Southwest, *Bradstreet's* reports, was a feature of the week's development, and better advices as to the trade outlook come from the Northwest. Reports from the Pacific Coast are no less encouraging. Clearings undoubtedly reflect speculation in the enormous totals reported, but the gains outside the metropolis, in the country at large, indorse the reports from a number of cities of a total trade larger than a year ago. Railway earnings likewise point to a substantial gain over January a year ago, which marked the highest point reached up to that time in this branch of industry. Gross railway earnings of 78 roads for the month of January aggregate $48,641,000, a gain of 8 per cent over January a year ago. Southern and Southwestern lines show greatest relative gains, but increases on the granger and Central Western roads are also liberal. Iron and steel have been quiet but steady, and even strong as to price, with finished product, particularly structural material, in active inquiry. The business failures of the week, as reported by *Bradstreet's*, aggregated 245, against 238 the week previous, 231 the corresponding week last year, 193 in 1899, 278 in 1898 and 301 in 1897. In the metal market copper was quiet, transactions in small lots only being reported. The official quotations are 17c. for lake and 16⅝c. for electrolytic and casting stock.

LIGHTING IN MANILA.—Negotiations are now stated to be all but completed for the purpose of consolidating the interests of the Manila Electric Light Company and the Mule Tramway Company in the Philippine capital. The latter concern operates the only horse road in the city of Manila, which system will, under the new régime, be converted into electrical power. The existing road is 12 miles in length. The promoters of the enterprise propose to build about 10 miles of additional track in the city. The Electric Light Company has been a success from the very start. Its capacity will soon be doubled, two 400-kw generators built by the General Electric Company, also boilers from the Aultman-Taylor shops at Mansfield, Ohio, engines from the Buckeye Engine Company of Salem, Ohio, and pumps from the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio, have just been shipped for service in the main plant. Bagnall & Hilles of Yokohama, Singapore and Manila, installed the original plant, which is of American equipment throughout. Mr. A. L. Bagnall, who, it will be recalled, is at present on a visit to the United States and can be found at the offices of the New York Insulated Wire Company, of 15 Cortlandt Street, states that he had been trying to bring about a merger in the two companies for the last 10 years. The delay has been caused by the long franchise that the horse road secured and the fact that the principal stockholders, who are resident in Spain, finding the road a most remunerative investment under present conditions, were loath to sanction a change. Now, however, that the Electric Light Company is doubling its plant and power can be produced much cheaper than heretofore, it is anticipated that the companies will shortly be in a position to place contracts for material, equipment, etc., rendered necessary by a change in the tramway system.

BULLOCK SALES.—The following sales have been entered by the Bullock Electric Manufacturing Company, Cincinnati, Ohio, for the week ending Feb. 2: Joseph Joseph, Cincinnati, Ohio, one 50-kw engine type generator; Manning, Maxwell & Moore, New York, one 180-kw engine type generator, one 35-hp, one 50-hp and one 65-hp motor; Pittsburg Engineering Company, Pittsburg, Pa., one 30-kw engine type; American Sugar Refining Company, New York, one 50-hp motor; John L. Thomson Estate, Baltimore, Md., one 100-kw engine type; the New Schuyler Apartments, one 50-kw and one 25-kw engine type; Fore River Engine Company, Quincy, Mass., fourteen motors of miscellaneous sizes; this makes about forty Bullock motors in all which this company has purchased; U. S. Finishing Company, Greenwich, Conn., one 75-hp motor; Mosler Safe Company, Hamilton, Ohio, one 35-hp motor; Pacific Coast Borax Company, Bayonne, N. J., one 15-hp motor; this makes about twenty Bullock motors now in operation by this company; Wolf Process Leather Company, Summerdale, Pa., one machine, 80-kw engine type; Jacob Ruppert, New York, two machines, 60-kw, and switchboard, together with several small motors; National Enameling & Stamping Company, Baltimore, Md., one 65-hp motor; Christian College, Columbia, Mo., one 17½-kw engine type generator; Bergtheil & Young, London, Eng., one 225-kw type H generator and two 60-hp teaser equipment for operating newspaper press; Brown Hoisting & Conveying Company, Cleveland, Ohio, one 25-hp motor; Columbia Chemical Company, Barberton, Ohio, one 42½-kw engine type generator.

THE STANDARD UNDERGROUND CABLE COMPANY announces that it has organized a new department, known as the Eastern and Northeastern Sales Department, of which Mr. Charles J. Marsh, for many years and until now officially associated with the electric lighting companies of New York City, is the general manager, with offices at 56 Liberty Street, New York City. Mr. George L. Wiley continues as manager of the Eastern Sales Department, with offices at 56 Liberty Street, New York City. With these changes, increased facilities and division of territory, Mr. Wiley will give closer attention to the trade throughout the territory reserved by the Eastern Sales Department, which includes the State of New Jersey north of the city of Trenton, the entire State of New York, the States of Connecticut and Massachusetts west of longitude 72½ degs., Vermont, and the Canadian provinces of Quebec and Ontario east of and including Toronto; also the West Indies. Mr. Atlee B. Saurman, formerly assistant manager of the Eastern Sales Department at New York, will be manager of the Northeastern Sales Department, with offices at Boston, Mass., to be opened on or about March 1. The Northeastern Sales Department will include the States of Massachusetts and Connecticut east of longitude 72½ degs., Rhode Island, New Hampshire, Maine, and the maritime provinces of Canada.

SOUTH AFRICA.—Contracts are about to be placed in this market for the furnishing of a large water power plant which is to be erected in South Africa. The plant is intended to begin operations by developing about 12,000 horse power, which will entail an expenditure in the neighborhood of $500,000. The greatest secrecy is being pursued by the interested parties, who are believed to be well-known London capitalists. They have sent an engineer here and he will remain until the machinery is shipped. It is stated by local parties who have been invited to figure on the contracts that so far no information has been given them as to the exact purposes and location of the plant.

McINTOSH, SEYMOUR & COMPANY, of Auburn, N. Y. and New York City, have secured a contract for the furnishing of two 150-hp horizontal compound condensing engines for shipment to the Imperial Government Railways of Japan. The engines, which are to be utilized for electric light and power purposes, were ordered through the Japanese house of Mitsui & Company, whose New York offices are located at 445-7 Broome Street. This concern is buying considerable electrical machinery for various Japanese plants. The McIntosh-Seymour people are about to make shipment of three 750-hp horizontal compound condensing engines, which are to be utilized in the central generating station of the Compañia Carril de Ferro de Lisbon, the Portuguese title of the Lisbon Tramways.

THE BUFFALO, ROCHESTER & PITTSBURG RAILROAD has just closed various contracts for the furnishing of electrical equipment required for its new shops at Du Bois, Pa. The Westinghouse Electric & Manufacturing Company obtained the contract for the supply of one 150-kw direct current engine type generator, two alternating current generators and a number of motors for electric power transmission through the shops. Westinghouse, Church, Kerr & Company, New York City, secured an order for a 250-hp compound engine and two simple engines of 113 horse-power each. The Stirling Boiler Company of Chicago took the boiler contract, which calls for water tube boilers aggregating 600 horse-power.

PURCHASES FOR JAPAN.—Extensive purchases of electrical machinery, according to private advices from Japan, will soon be made in this country on account of various concerns which are interested in gold dust enterprises in the River Pechiri, Kitami Province, Hokkaido, Northern Japan. The services of a number of American experts will, it is reported, be also enlisted. Isaac & Company, Sale & Company and the American Trading Company of Yokohama are stated to be behind the schemes. On inquiries being made at the local offices of the latter company in the Johnson Building, Broad Street, it was said that no instructions had yet been received on the subject, but that they were expected by the next mail.

THE DIESEL ENGINE.—The Diesel Engine Company, Ltd., has commenced operations in England, its present offices being at 171 Queen Victoria Street, London. This company has acquired from Mr. R. Diesel the patent rights for Great Britain, the colonies and certain other countries for his internal combustion engine. Up to now the engine has been mainly developed to work with oil, but at the same time very successful results have been obtained with other fuels. These engines are now in course of construction in England and will shortly be placed upon the market.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Youngstown & Sharon Street Railway Company, of Youngstown, Ohio, for the installation of two batteries of "Chloride Accumulators," to be used on its lines. Each battery, consisting of 288 cells, will have a capacity of 191 kilowatt-hours and will be operated in connection with differential boosters of 200 amperes capacity at the railway company's rotary transformer sub-stations, located 2 and 12 miles, respectively, from the power house.

THE SAO PAULO TRAMWAY, LIGHT & POWER COMPANY is about to extend its operations. Fred. S. Pearson, consulting engineer of the Metropolitan Street Railway, who is the leading spirit in the Brazilian concern, is now in Sao Paulo with a view to determine exactly what is to be done as to the company's further exploitation. He is expected to return inside of six weeks, when specifications will be drawn up for the furnishing of whatever is necessary by way of additional equipment, etc.

MR. W. B. ROMMEL, the chief engineer and general manager of the Lisbon Tramways Company, is expected in this country within the next few weeks with a view to placing additional contracts for equipment, etc. The Lisbon road, which is the first electric traction system in Portugal, is operated by the Portuguese Improvement Company of Bishopsgate Street Within, London, E. C. Wernher, Beit & Company, the London financiers, capitalized the company.

MR. C. ICHIKAWA, chief electrician of the Hokkaido Coal Mining & Railway Company of Japan, is now on a sojourn in America for the purpose of placing important contracts for electrical machinery to be used for lighting and operating the extensive coal mines of his company. Mr. Ichikawa, who is at present in Pittsburg, is expected to arrive in New York the latter part of this week.

MESSRS. ROBERT W. BLACKWELL & COMPANY, the well-known merchants and contractors of London, Eng., announce from their New York office that they have acquired the business of Messrs. Schiff, Jordan & Company, which will be carried on by them under the personal direction of Mr. L. E. Frorup as sales manager at 232 Greenwich Street, New York.

BALL ENGINE ORDERS.—The United Electric Plant, Baltimore, Md., has recently installed one 300-hp cross compound self-oiling engine, which was furnished by the Ball Engine Company, Erie, Pa. The Center Star Mining Company, Rossland, British Columbia, has recently installed a 150-hp self-oiling cross compound engine, built by the Ball Engine Company.

AN ELECTRIC LIGHT PLANT is about to be erected at Live Oak, Fla. Mr. C. Y. Byrd, whose address is care of Blackwell & Johnson, attorneys, located in the Florida town, will make the necessary purchases of the equipment, etc. The services are desired of a competent electrical engineer to superintend the erecting of the plant.

BRITISH TRACTION EQUIPMENT.—There have been some very important inquiries received in New York within the past few days for material, equipment, etc., required by various British electric traction companies. One inquiry alone calls for figures for the supply of no less than 2000 trucks.

TELPHERAGE.—The Consolidated Telpherage Company, Broad Street, New York, has closed a contract to put a small equipment in the Singer Sewing Machine factory at Elizabethport, N. J., for transferring parts from one section to another.

BATTERIES WANTED.—Mr. C. G. Wilcox, general manager of the De Pere (Wis.) Electric Light & Power Company, writes us that it will be in the market for a storage battery equipment.

THE SCRANTON TRACTION COMPANY of Scranton, Pa., is in the market for an engine for direct connection to a 1000-kw generator.

General News.

THE TELEPHONE.

TARPON SPRINGS, FLA.—A co-operative telephone company has been formed here.

HARTSELLE, ALA.—Mr. J. C. Rogers has sold his local telephone interests to S. L. Sherrill and L. O. Waldsmith.

ST. PETERSBURG, FLA.—The St. Petersburg Telephone Company is making arrangements to build a line to Tampa.

ST. JOSEPH, MICH.—The Twin City Telephone Company of St. Joseph and Benton Harbor has declared its twelfth dividend.

KOKOMO, IND.—The Jay Brothers, of this city, have purchased an interest in the Kokomo Independent Telephone plant. When completed it will cost $50,000.

WORTHINGTON, OHIO.—The Citizens' Telephone Company of Columbus will install a sub-exchange in this place. About fifty local subscribers have been obtained.

JEFFERSON CITY, MO.—The Daviess County Telephone Company of Gallatin has been incorporated by C. J. Bain, J. W. P. Love and M. L. Bain. The capital stock is $5,000.

UTICA, N. Y.—The West Canada Telephone Company has sold its interests to the Remsen & West Canada Creek Telephone Company, which latter concern will conduct the service in the districts of the two separate companies.

INDIANAPOLIS, IND.—The Indiana Supreme Court has decided that laying telephone wires under the sidewalk in front of a city lot is not a use of the street for which the owner of the lot is entitled to either damages or an injunction.

AUSTIN, TEX.—The Austin Telephone Company has been incorporated with a capital stock of $1,000,000. The incorporators are J. E. Boynton, J. B. Earle of Waco, C. H. Rose of Columbus, Ohio, J. S. Bailey of Wauseon, Ohio, and G. H. Baker of Defiance, Ohio.

RAVENNA, OHIO.—The Ravenna Home Telephone Company proposes to extend its lines to Sandy Lake and Windham. The company is using Eureka, Swedish-American and North instruments. Its switchboard, having an ultimate capacity of 500 drops, is of the Eureka Company's make.

ANDERSON, IND.—Fifty physicians of this city have decided to order out the Central Union telephones and agreed to use only those of the local company. They claim to pay $4,500 a year for telephones and think they can save half this amount by agreeing among themselves to use but one system.

ROCHESTER, N. Y.—The Rochester Telephone Company has opened an exchange at Brockport, N. Y., with 210 local subscribers and toll connections with this city. The rate for five-minute conversations has been placed at 20 cents. The company is also giving long distance service to other places in this vicinity.

HARTFORD CITY, IND.—The Central Union Telephone Company announces that it will enter the Hartford City field for local business. Heretofore it has contented itself with long-distance business, but the independent company, which has a large number of patrons here, has been making inroads on long-distance business.

ELYRIA, OHIO.—At the annual meeting of the stockholders of the Elyria Telephone Company, held a few days ago, the following officers were elected: W. E. Brooks, president; F. H. Sudro, vice-president; J. A. Dake, secretary and treasurer. The above, with Charles Savage, E. K. Mussey and S. B. Rawson, constitute the board of directors.

BOSTON, MASS.—At the annual meeting of the Southern New England Telephone Company the following directors were elected: M. F. Tyler, W. E. Downs, James English, S. E. Merwin, A. H. Robertson and J. W. Alling, all of New Haven; L. B. Jewell of Hartford and Thomas Sherwin and Alexander Cochran of Boston. The annual report showed net earnings for the year of $167,660, of which $150,660 was paid in dividends.

TOLEDO, OHIO.—The stockholders of the recently incorporated Toledo Telephone, Telegraph & Messenger Company have elected the following officers: J. H. Bellows, president; C. F. Watts, vice-president; H. A. Merrill, secretary; A. H. Hough, treasurer. An ordinance asking for a franchise will be presented to the City Council in two weeks. There will be a large main exchange in the centre of the city, with sub-exchanges in East Toledo, Air Line Junction, North Toledo and Auburndale.

WASHINGTON, D. C.—The Telephone Company of America which was recently incorporated under the laws of Delaware, will manufacture apparatus on the Frost central energy system. In introducing this system the company requires all local companies to place a telephone in every house and place of business. The company will supply its combination telephones and switchboards to local companies. It is stated that this system can be operated much cheaper than other systems. The line construction, it is claimed, is equally reduced in cost. It is also claimed that the Frost system can be installed for one-fifth the cost of the other systems, and each telephone will earn as much percentage of profit as each of the old-style instruments does now. Mr. T. W. Tryrer is secretary of the new company and Mr. E. F. Frost chief electrician.

ELECTRIC LIGHT AND POWER.

HENRIETTA, TEX.—A contract for an electric light plant was closed Feb. 4 with E. B. Carver.

CLEBURNE, TEX.—The plant of the Cleburne Electric Light & Power Company was recently damaged by fire.

OTTAWA, ONT.—The water power of the Pen Dóreille River, in British Columbia, is about to be utilized by a New York company.

YARMOUTH, N. S.—A special committee of the Town Council has recommended the installation of a municipal electric light plant.

BROWNSVILLE, TENN.—The electric light plant here was totally destroyed by fire Feb. 2. It was valued at $8,000 and will be rebuilt at once.

HARTFORD, CONN.—The Hartford Electric Light Company is installing a 3000-hp steam turbine made by the Westinghouse Machine Company.

FARGO, N. D.—Stern Bros. has purchased the outside interests in the Fargo Edison Company, organized several months ago, from the Hughes Electric Company.

PARIS, ONT.—The ratepayers will vote on a by-law to raise the sum of $15,000 by debentures to purchase the electric light plant and operate the same under municipal ownership.

OTTAWA, ONT.—A company has been formed at the town of Bic, Quebec, with a view to purchasing the water power of Mr. Alf. Bouillion for the purpose of developing it electrically.

VINCENNES, IND.—E. J. Julian has been appointed receiver for the newly established electric light plant of Vincennes on complaint of the Consolidated Light & Water Company of Chicago.

WEIR CITY, KAN.—At a special meeting of the City Council, held Feb. 2, it was decided to ask the Legislature for permission to vote $60,000 municipal bonds to put in a light and water plant.

MONTREAL, QUE.—At the next session of the Quebec Legislature a number of Montreal citizens will make application to establish an electric plant near Riviere des Prairies, in Quebec Province.

CHERUBUSCO, IND.—The Seckner Contracting Company, of Chicago, to which the Town Council delivered the electric light and water works plant, will operate the same until a purchaser can be found.

LOUISVILLE, KY.—Between 16,000 and 17,000 incandescent lamps will be used in the street arches that will form part of the special decorations here on the occasion of the annual conclave of the Knights Templar.

PHILADELPHIA, PA.—Plans are being completed for a large power house to be erected at Conshohocken, Pa., for the Conshohocken Electric & Power Company. It will be modern in its construction and equipment.

OTTAWA, ONT.—The Keewatin Power Company and the Lac du Bonnet Power Company of Manitoba are said to have made propositions to transmit electric power to the city of Winnipeg. The distance from Keewatin to Winnipeg is about 130 miles.

ELKHART, IND.—Articles of incorporation have been filed by the Elkhart Electric Company; capital, $100,000. The company has absorbed the Home Electric Light & Power Company and will assist in developing the power of the St. Joseph River.

LIVERMORE, CALIF., is now without electric lights, the creditors of the promoter of the electric light system having dismantled the generating plant. It is supposed that the Livermore Water & Power Company will install a lighting plant in the near future.

OTTAWA, ONT.—The Maitland River Power Company of Goderich, Ont., has made a proposition to operate the water works and electric light plant of the town. The company has in view the development of the water power of the Maitland River at an estimated cost of $100,000.

MOUNT VERNON, ILL.—Owing to the transfer of the electric light plant, Mount Vernon has been in darkness for the past month, but the lights are now burning. With the change in location the control of the plant passes from the Mount Vernon Electric Light Company to the city.

BANGOR, MAINE.—A hydraulic-electric power plant is to be established at Sangerville, this State. Water privileges have been obtained on Carleton stream and an electric lighting plant will be established. A new dam will be constructed, also a power house. The estimated cost of the plant is $10,000.

CINCINNATI, OHIO.—The Fort Wayne Electric Works have closed a contract through the Cincinnati office with the Water Works Board at Leipsic, Ohio, for a complete power outfit to drive the deep well pumps in the new plant. The Gould Manufacturing Company will install the pumps, each to be driven by a 5-hp motor.

MANCHESTER, N. H.—A bill has been introduced in the Legislature to change the name of the consolidated electric interests in this city to the Manchester Traction, Light & Power Company. The company controls nine electrical companies, five of which are actively doing business under the general head of the Manchester Electric Company.

MINNEAPOLIS, MINN.—The Guaranty Building is to have a new lighting plant within the next 60 days. The contract calls for two 125-hp Corliss engines, direct connected to direct-current generators of 80-kw each. The Twin City Iron Works will build the engines and the Electric Machinery Company of Minneapolis will install the generators and switchboards.

HUDSON, WIS.—The annual meeting of the St. Croix Power Company was held here on Jan. 28. Messrs. Lathrop, Baker and Crawley were elected directors. Officers were chosen as follows: President, A. P. Lathrop, St. Paul; vice-president, H. C. Baker, Hudson; secretary and treasurer, Y. P. Crawley, St. Paul. The company has power developed on the Apple River, in this county, and transmits electricity to St. Paul for lighting the city.

SEATTLE, WASH.—The Seattle Electric Company has inaugurated a new schedule of rates based upon the two-rate principle. The rates are 20 cents per kilowatt-hour for the first hour's average use of lamps, 8 cents for the next four hours, and 4 cents for all use in excess of five hours. A discount of 10 per cent will be granted for prompt payment of bills. The company is also offering to replace, free of charge, burned-out or blackened lamps for all meter customers.

OTTAWA, ONT.—Another large electric company is being formed at Ottawa, provided a charter can be obtained from the City Council. Mr. J. W. McRae, late managing director of the Ottawa Electric Company, is the chief promoter of the scheme. The new company is to be called the Consumers' Electric Company, and by its charter will have the power to carry on its business in Ottawa and elsewhere, for the purpose of producing and supplying electric current for electric light, heat and power.

SAN FRANCISCO, CALIF.—The Consumers' Electrical Association of San Francisco is installing an elaborate and extensive electric plant at the new seaside cottage of Hugh Tevis on the bay, in Monterey. The generator will be direct connected to a large gasoline engine. A Willard storage battery plant of sufficient capacity to supply 500 incandescent lights will be installed. The plant will also be used as a charging station for electric automobiles and a 40-ft. electric launch, which was recently purchased by Mr. Tevis. A direct connected electric hoist will lift the launch out of the water whenever it is necessary.

OTTAWA, ONT.—The annual meeting of the shareholders of the Ottawa Electric Railway Company was held at Ottawa on Jan. 30. The annual report and financial statement for the year ending Dec. 31, 1900, showed a most satisfactory year's business. Four quarterly dividends of 2 per cent each were paid, and a substantial balance carried to the credit of profit and loss. The following directors were elected: Messrs. T. Ahearn, Geo. P. Brophy, C. E.; Peter Whelen, Warren Y. Soper, Thos. Workman, A. Lumsden and Hon. Senator Cox. Mr. T. Ahearn was elected president, Peter Whelen vice-president, and James D. Fraser secretary-treasurer.

THE ELECTRIC RAILWAY.

PORTLAND, MAINE.—The Westbrook, Windham & Naples Railway Company has been sold to the Portland Railroad Company.

GAINESVILLE, GA.—There is talk of an electric railway here. It is said that Mr. Montgomery, of the Pacolet Cotton Mills, is interested.

SACRED HEART, MINN.—This village proposes to have an electric railway. Bonds have been voted for the same by the Farmers' Mill Company.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company of St. Paul and Minneapolis contemplates expending about $500,000 for improvements in the two cities.

CHESTERTOWN, MD.—The Chestertown Light, Power & Railway Company has been granted the use of the streets and will construct an electric railway in the near future.

ANDERSON, IND.—The Union Traction Company has voluntarily increased the wages of 200 conductors and motormen and made eleven and one-half hours a day's work.

BALTIMORE, MD.—A franchise has been granted the Baltimore, Halethorpe & St. Denis Railway Company to construct an electric railway on Wilkins and Beachfield avenues.

INDIANAPOLIS, IND.—Plans are formulating to connect this city and Cincinnati, Ohio, by a chain of interurban lines. Companies have been organized to build each of the links.

DETROIT, MICH.—The steam railway between Paw Paw Lake and Coloma has been purchased by the South Haven & Paw Paw Railroad Company and will be transformed into an electric road.

BALTIMORE, MD.—The Kent County Commissioners have granted right of way to the electric light and power company at Chestertown to run an electric railway from Chestertown to Tolchester and Rock Hall.

HUNTINGTON, IND.—W. S. Reed, manager of the Fort Wayne & Southwestern Traction Company, has contracted for the machinery for the company's power house, to be located in this city. The orders aggregate $60,000.

CINCINNATI, OHIO.—Powel Crosley and C. T. McRae have received from the Hamilton Traction Company $10,000 for their option on the Cincinnati & Southwestern Railroad, which has been taken over by the electric traction interests.

BUFFALO, N. Y.—It is stated that the Niagara Falls, St. Catharines & Toronto Electric Railway Company has completed arrangements with the International Traction Company which will give direct service between Buffalo and Toronto.

BOSTON, MASS.—The Berkshire Street Railway, of Pittsfield, Mass., has been incorporated with a capital stock of $1,100,000, to build an electric railway from Adams to the Connecticut State line. Among those interested are R. D. Gellett of Pittsfield.

PITTSBURG, PA.—The management of the Consolidated Traction Company, of this city, is contemplating a number of improvements in the equipment, the rolling stock and the operation of the entire system. Among other things the company will order 100 new cars.

MANITOWOC, WIS.—Surveys are in progress for an electric railway from this city to Two Rivers, a distance of about 6 miles. The surveys are being made in the interest of Thomas Higgins, who owns an electric railroad at Marinette, and who is said to intend extend the line to Mishicotte and Green Bay.

GREEN BAY, WIS.—It is reported that an option on the street railway system and all the property of the Fox River Electric Railway & Power Company of this city has been given to representatives of New York capitalists, who are back of a plant to establish an electric railway between Green Bay and Manitowoc.

DANVILLE, IND.—J. V. Edwards and others have petitioned the County Commissioners for a franchise for an electric railway to Rockville. The Western Indiana Railway Company has petitioned the commissioners for a franchise for an electric line from this city to North Salem, Lodago and Crawfordsville.

MANKATO, MINN.—The Mankato Electric Street Railway, Lighting & Power Company is about to be transferred to an Eastern company. The consideration is $10,000 for the franchise and rights. The electric road has been surveyed and plans drawn. The company plans to run an electric line between Mankato and Le Queen Centre. A line will also be built to Eagle Lake, St. Clair and Elmer City, Minn.

CINCINNATI, OHIO.—Promoters of the scheme to substitute electric service on the Miami & Erie Canal between Dayton and Cincinnati are strongly censured in the annual report of the Ohio Canal Commission. The protest is made after a conference with the chief engineer and State Board of Public Works, and is expected to cause considerable trouble. T. N. Fordyce has the lease to the berme bank of the canal and has already begun preparations for the change.

DETROIT, MICH.—The Detroit & Chicago Traction Company was incorporated recently by P. H. Flynn, John McCarthy and F. C. Cocheu, of New York; Isaac W. MacClay, Yonkers, N. Y.; George J. Carr, of Montclair, N. J.; W. A. Boland, of Grass Lake, Mich., and W. A. Foote, of Jackson, Mich. The company has an authorized capital of $4,000,000. Its object is to build an electric railway from Detroit to Chicago, as well as lines in the various cities and towns in Michigan and Illinois.

BROOKLYN RAPID TRANSIT CAR HOUSE BURNED.—On the night of Feb. 8 fire destroyed the Flatbush car sheds and several cars of the Brooklyn Rapid Transit Company, entailing a loss estimated at $250,000. The building, which had a frontage of 125 ft. on Flatbush Avenue, extended back 600 ft. It served as headquarters for the Flatbush, Nostrand Avenue and Lorimer Street lines, all of which were tied up for three hours as a result of the fire. There were 150 cars in the building at the time and only 40 of these were saved intact, it is said. Many of the cars destroyed were open cars, and some were entirely new.

THE AUTOMOBILE.

INDIANAPOLIS, IND.—C. Koehring & Bro. have purchased and succeeded to the automobile business of Carl G. Fisher, in this city. Mr. Fisher announces that he will associate himself with others for the purpose of manufacturing automobiles.

A FRENCH AUTOMOBILE FOR MRS. MACKAY.—A Paris dispatch states that an order has been received there by cable from Mr. Clarence Mackay for an automobile for his wife. The dispatch adds that this machine will beat anything of the kind in America. The automobile is being built by Charron, Girardot & Voight, and will cost $17,000.

COLUMBUS, OHIO.—The Post Office authorities in this city are considering a proposition made by the Columbus Auto Cab & Vehicle Company to carry the mail to and from the railway stations and to make those collections which are now made by wagon, at less cost than under the present system. The Auto Company also intends to run automobiles to the parks and about the city.

BOSTON AUTOMOBILE SHOW.—The projectors of the Automobile Show, which is to be held in Boston early next month, express satisfaction with the manner in which the preliminary arrangements are advancing, and are confident that there will be a large display of automobiles and accessories. The Massachusetts Automobile Club will take an active interest in the management of the show, which, there is every reason to believe, will be an entire success.

A RECORD RUN IN SAN FRANCISCO.—Mr. H. M. Sessions, manager of the Consumers' Electrical Association, San Francisco, recently made a record-breaking run with a Woods electric road wagon. He made the round trip from Montgomery Street to the ocean beach at the Cliff, a distance of about 17 miles, in 55 minutes. This was over the Point Lobos road with a two mile hill to be overcome.

AUTOMOBILES IN CANADA.—The invasion of the automobile is spreading in Canada. The recently organized Electric Cab Company, of Toronto, Ont., will have cabs and tourist brakes on the streets of Toronto as soon as they can be turned out of the factory. The company now proposes to extend its business to Ottawa and other large Canadian cities. At a meeting of the stockholders a few days ago it was decided to double the capital of the company and go into wider fields of operation.

LEGAL.

STEAM AUTOMOBILES.—A verdict has just been rendered in the Supreme Court of this State by which automobiles run by steam are placed in the same category and under the same restrictions as other steam engines using the public highways. Such engines must be preceded at an eighth of a mile by a runner whose duty it shall be to warn vehicles that it is coming. Whether this man shall carry a red flag has not yet been judicially decided. Louis W. Moore, of Watertown, has been assessed heavy damages in the Supreme Court in Saratoga County for causing a runaway which destroyed the vehicle of Dr. T. Royal Cook, of Ballston Spa, N. Y., and seriously injured a valuable horse. The case was tried before Justice Russell. The evidence showed that the defendant was running along one of the highways of Saratoga in a locomobile driven by steam. It frightened Dr. Cook's horse. Judge Russell held that a steam locomobile was bound by the law which compels its driver to send a man ahead of it, at a distance of an eighth of a mile, to warn travelers of the approach of such a vehicle. As Mr. Moore had no such protection, it was for the jury to decide whether he was not guilty of culpable negligence. The jury decided that he was, and gave a verdict for the plaintiff. This is the first case in the Supreme Court of this State in which the rights and duties of one operating a steam automobile were defined.

OBITUARY.

MR. OTTO W. MEYSENBURG, president of the Rodger Ballast Car Company, formerly president of the Siemens-Halske Electric Company of America, and ex-president of the Wells French Car Manufacturing Company, died on Feb. 11 at Alma, Calif., of typhoid fever. He was 52 years old.

MR. HENRY C. DAVIS, a well-known Philadelphian, at one time president of the Sawyer-Man Electric Company and of the old Electric Club, died at his home on Jan. 30 at the age of 62. He had many large business interests, but always took an active part in electrical matters. He was a grandson of Lucretia Mott, the abolitionist, and himself gave much of his time and money to the elevation of the negro. He leaves a wife, two daughters and a son, Mr. C. H. Davis, the electrical engineer, of this city.

MR. R. P. BROWN.—Robert Pond Brown, formerly chief engineer in charge of the electrical equipment of the Brooklyn Heights Railroad Company, died last week in New York City. He had been suffering from kidney trouble since last spring and was compelled to give up his work in Brooklyn on Dec. 15 last. He was only 35 years old, a native of Whiting, Vt. He was graduated from Tufts College as an electrical engineer in 1891, and later took charge of the construction department of the West End Railroad Company of Boston. He went to Brooklyn for the Brooklyn Heights Company eight years ago.

PERSONAL.

MR. NIKOLA TESLA has a signed article in *Collier's Weekly* on his communications with Mars.

MR. EDWARD LYNDON has become associated with the Gould Electric Car Lighting interests in New York City.

PROF. G. F. SEVER, and Mr. Henry Rustin contribute articles to the January *Pan-American Magazine* on electricity and electrical exhibits at the coming exposition.

MR. E. T. PARDEE has become associated with the Bullock Electric Manufacturing Company and will have his office as its New England representative at 70 Kilby Street, Boston.

MR. W. H. JOHNSON, second vice-president of the Electric Vehicle Company of New York, is visiting San Francisco on business connected with the local agencies of his corporation.

MR. MARTIN J. INSULL, of the General Incandescent Arc Light Company, has been suffering from the strain of overwork due to heavy business and is now recuperating for a week or two at Atlantic City.

MR. FRANCIS B. SMITH, an electrical engineer, will have the management of the office which the Bullock Electrical Manufacturing Company is opening at Buffalo. His office will be at 675 Ellicott Square.

MR. W. S. HEGER, manager of the San Francisco agency of the Westinghouse Electric & Manufacturing Company, recently returned home after an extended tour of the principal cities of the Eastern States.

PROF. ELIHU THOMSON has an admirable review of electrical development during the nineteenth century in the New York *Sun* of Feb. 10. It is several columns in length and bristles with names, dates and facts, besides being charmingly written.

MR. PAUL D. CABLE has severed his connection with the Rumsey-Sikemeier Company to take up the presidency of the Missouri Electrical Manufacturing Company of St. Louis. The object of the company is to do a general supply and jobbing business and to make certain specialties that it can handle to advantage.

CAPT. G. O. SQUIER writes from Manila, P. I., that the cable ship Burnside reached the islands on Dec. 6 in good condition and that they had been very busy since then up to the time of writing in mounting the special cable machinery on board. He was hoping to start out before the beginning of January, cable laying.

Trade Notes.

REMOVAL.—The Gordon Battery Company, New York, has moved its place of business to 13 and 15 Laight Street.

EXHAUST HEADS.—The National Steel Works recently ordered one 24-in. exhaust head from the Burt Manufacturing Company, Akron, Ohio.

THE AMERICAN BRIDGE COMPANY announces its sales during the month of January as the largest of any month since the organization, aggregating over 60,000 tons.

CHICAGO FUSE-WIRE & MANUFACTURING COMPANY.—A recent fire in the building in which the Chicago Fuse-Wire & Manufacturing Company is located caused the company some loss.

THE WESTERN ELECTRIC COMPANY, Chicago, has a large stock of pins, brackets and cross-arms which it is offering at very attractive prices at the beginning of the spring construction season.

ELECTRIC CRANES.—Messrs. Struthers, Wells & Co., of Warren, Pa., are making an addition to their machine shop. It will be used as an erecting room, and an electric crane will be installed therein.

THE NILES TOOL WORKS at Hamilton, Ohio, are installing an electric light plant, including a 500-hp compound condensing Corliss engine and a General Electric 500-hp generator. Fifteen new motors are being added to the present equipment.

THE ELECTRIC MOTOR & EQUIPMENT COMPANY, Newark, N. J., electrical engineer and contractor, is distributing a "Ten-Year Calendar" which is neatly and tastefully gotten up. It will be useful for a long period and will serve to keep constantly in mind the company who issued it.

THE AMERICAN VITRIFIED CONDUIT COMPANY is distributing a very effective paper weight in the shape of a miniature section of its underground conduit. It is safe to assume that any papers upon which this weight is used will stay there in good condition, just as the cables laid in this company's conduit stay in good condition.

THE ELECTRO-DYNAMIC COMPANY, of Philadelphia, in order to meet its increased business, has had to enlarge its factory and move its business to a more convenient location. It is now occupying 212-226 Ionic Street, and with its additional space and new equipment is better prepared than ever to promptly fill orders for its apparatus.

STORAGE BATTERIES IN RAILWAY PLANTS.—In a circular of recent issue by the Electric Storage Battery Company, Philadelphia, the storage battery plant of the Peekskill Lighting & Railroad Company is described. The advantages of the use of batteries on small roads are discussed and figures are given showing the economy of operation on this line.

COLUMBIA CALENDAR.—The Columbia Incandescent Light Company, St. Louis, Mo., is sending to central stations, isolated plants and other patrons, a calendar for the first four months of the new year. The card bearing the calendar contains illustrations of the various styles of lamps manufactured by the company, and in the centre is a picture of the company's plant in St. Louis.

LOOMIS AUTOMOBILES.—The Loomis Automobile Company, Westfield, Mass., is manufacturing a full line of gas automobiles. The company also supplies fittings to those wishing to construct their own vehicles, and is prepared to furnish such parts as running gears, bodies, carburetors, mufflers, etc. The company's muffler for reducing the noise of exhaust is described and illustrated elsewhere in this issue.

MR. GEORGE WILLIAM HOFFMAN, of Indianapolis, Ind., maker of the U. S. metal polish, reports that business is booming with him. He states that one customer who has been using his polish has just sent in an order for five barrels and ten cases, and that a number of other large orders have come in from people who have given the polish a trial, which justifies Mr. Hoffman's motto, "Once used, always used."

POLYPHASE MACHINERY.—The General Electric Company describes and illustrates in Bulletin No. 4239 its polyphase machinery. Among the views shown are various plants in which three-phase apparatus is used. The company has also issued catalogues and price lists of marine supplies, repair parts of GE-55-A railway motor and of D lever switches; also a leaflet giving illustrations and prices of GE porcelain knobs and cleats.

"SALARIED POSITIONS FOR LEARNERS" is the title of a pamphlet issued by the International Correspondence Schools, Scranton, Pa. It tells how a young man can become a mechanical or electrical engineer or architect and support himself while learning. It contains photographs of a score or more students who have obtained better positions as a result of their studies, and some specimen drawing plates showing the progress made by students.

"A LITTLE BOOK ABOUT FANS" has been issued by D. L. Bates & Bro., Dayton, Ohio. This firm manufactures ceiling fans for direct current only, and desk and bracket fans for direct and alternating currents. The fans of both classes are of various styles, to suit different tastes. The ceiling fans are made with and without electroliers. The firm also makes electrolier column fans. The desk fans are compact in design and highly efficient machines.

THE VARLEY DUPLEX MAGNET COMPANY has changed its factory address to Phillipsdale, R. I. The company believes that this change will be advantageous to its customers, and all delays in the execution of orders will be avoided. The American Electrical Works of Phillipsdale, R. I., will have the right, on and after Feb. 11, 1901, to solicit and accept orders for "Varley Windings." All orders placed through them or their agents will be accepted by the Varley Company.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has sold for installation in the steamer "Exporter," running between St. Louis and New Orleans, a complete electric plant consisting of a vertical engine with direct connected generator. The same company has sold through Thebaud Brothers, exporters, several machines to go to Merida, Mexico, one to Mexico City and one for British Honduras. The consignment to Mexico and British Honduras is intended for lighting service.

AIR COMPRESSORS.—The Clayton Air Compressor Works, New York, in a recently issued catalogue, illustrates and describes the many types of Clayton air compressors, air receivers, vacuum pumps and other lines of apparatus produced by this concern. The catalogue also contains full information relative to the transmission of compressed air and capacity lost by air compressors in operation at various altitudes. It is a very complete work of its kind, and a copy may be obtained upon application.

THE PAN-AMERICAN FOUNTAIN.—The plant for serving power for the spectacular fountain in the electric tower basin at the Pan-American Exposition consists of one Keystone generator direct connected to an engine manufactured by the Ball Engine Company, of Erie, Pa.; also a Keystone generator of the belted type, driven by a Skinner engine. The D'Olier Engineering Company, of Erie, Pa., is the general sales agent for the Keystone Electric Company. This company will install its switchboard in the plant above referred to.

INCANDESCENT LAMP TESTS.—The Western Electric Company has issued a bulletin in large folio form entitled "Comparative Incandescent Lamp Tests." The tests refer to 12 lots of lamps of different manufacture and consisted of both efficiency and life tests. Large target diagrams are given for each make of lamp, and the results are submitted to an analysis to determine their bearing from the dollars and cents standpoint. This analysis shows that in some cases the comparative lack of economy was such that had the consumer obtained the poorer lamp without charge he would yet be a loser owing to the greater consumption of energy.

DISSOLUTION AND REORGANIZATION.—The firm of the Walker Electrical Construction Company, Philadelphia, Pa., has been dissolved for the purpose of continuing the manufacture of electrical appliances under a new copartnership which has been formed under the Pennsylvania State laws with the name and style of the "Walker Electric Company, Registered." The company's headquarters will be at Eighteenth and Hamilton Streets, Philadelphia. It will conduct a business of manufacturing and selling switchboards, switches and other electrical appliances and apparatus. The company has greatly increased facilities and is prepared to fill contracts promptly. The members of the firm are Henry H. Walker, F. Dinwiddie Walker, Bennett L. Johnson and Hervey S. Walker.

VENTILATION OF RAILWAY SHOPS.—The new shops of the Colorado & Southern Railway, just completed at Denver, Colo., are noticeable for the introduction of many features conducive to the comfort and welfare of the workmen. Among these is a complete equipment for both ventilating and heating the entire plant by the blower system. Separate apparatus furnished by the B. F. Sturtevant Company of Boston, Mass., consisting of fans and heaters, are installed in the machine and car shops. Air distribution is secured through a complete system of galvanized iron piping. A clear atmosphere is also maintained in the forge shop by means of a large Sturtevant exhauster arranged to draw the smoke and gases from the 18 special down-draft forges, also furnished by the same company.

A FAN PROPOSITION.—The Emerson Electric Manufacturing Company, St. Louis, offers to send to electrical dealers or central stations of financial responsibility in the United States, on request, one sample each of such types of its 1901 desk and ceiling fan motors as may be designated on a postal card order which it supplies for the purpose. It offers to take back the samples after 30 days' trial if for any reason it should be desired to return them. The Emerson Company pays transportation charges both ways. The company carries a stock and endeavors to make prompt shipment of fans of standard voltages and alternations, both from St. Louis and New York City. It has completed arrangements with the following named firms, who will act as the company's special selling agents: H. C. Roberts Electric Supply Company, Philadelphia, Pa.; Doubleday-Hill Electric Company, Pittsburg, Pa.; Western Electrical Supply Company, St. Louis, Mo.; California Electrical Works, San Francisco, Calif. Each of these firms will be able to promptly fill orders from a large and well-assorted stock, at the company's regular schedule prices.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 5, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

667,134. FORM FOR WINDING ARMATURE COILS; J. W. Lundskog, Lynn, Mass. App. filed Nov. 12, 1900. The form is provided with a terraced edge and provided with extensible parts whereby coils of different form and size can be wound upon a single apparatus. (Issued Jan. 29.)

667,135. RHEOSTAT; G. F. Martin, Corydon, Ind. App. filed June 5, 1900. The resistance of a Leyden jar is regulated by controlling the extent to which the outer coating extends over the jar. (Issued Jan. 29.)

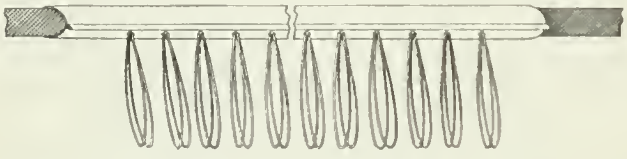
667,189. BATTERY BOX OR TRAY FOR MOTOR VEHICLES; G. Condict, New York, N. Y. App. filed Sept. 3, 1898. The tray is wedge-shaped and contacts connected with the battery are located on the outside thereof to engage with yielding contacts on the frame of the vehicle. The shape of the tray insures constant and good contact.

667,195. TELEPHONE SWITCHBOARD CONNECTION; T. V. Davis, Chicago, Ill. App. filed April 28, 1900. A device for cable connections, comprising a casing with a series of slots or indentations alone one edge to receive and hold the connections leading from the cable, and means associated with said casing for holding the edges together when the conductors are in place.

667,220. DENTAL ENGINE; W. G. Hughes, Pittsburg, Pa. App. filed March 7, 1900. On the motor shaft is a cup-shaped disk upon the outer side of which a frictional power-transmitting wheel impinges. The motor and disk can be swung bodily to alter the position of the friction wheel upon the disk and so change its speed of rotation.

667,246. ELECTROMAGNET BRAKE SHOE; F. C. Newell, Wilkinsburg, Pa. App. filed April 28, 1900. A magnetic brake shoe device having a body or core made up of a series of plates or laminations secured together and provided with wear shoes at its ends, or poles.

667,275. ELECTRIC MOTOR; G. E. Weisenburger, Sharon, Pa. App. filed Feb. 21, 1900. A motor for electric vehicles, constructed so that its field magnet and armature both rotate, one being connected to one wheel and the other to the other wheel on the same axle, thus avoiding compensating gear.



667,195.—Telephone Switchboard Connection.

666,327. TELEPHONE TRANSMITTER; T. Lidberg, Chicago, Ill. App. filed Oct. 3, 1900. (See Current News and Notes.)

667,336. TROLLEY HEAD; E. S. Reed, Hill City, Tenn. App. filed June 20, 1900. The trolley head is connected with the end of a pole so as to be capable of an axial rotation between certain limiting stops.

667,366. LIGHTNING ROD; E. J. Hansen, Atlantic, Ia. App. filed May 22, 1900. A lightning rod consisting of a heavy central spring core support, copper wires twisted together upon themselves into ropes, said ropes laid in juxtaposition upon said tempered spring central core-support, and spirally wound or twisted thereon.

667,372. ELECTRIC ARC LAMP; H. O. Swoboda, New York, N. Y. App. filed June 15, 1900. The gas cap is spring-supported upon the upper end of the inner globe.

667,374. ELECTRIC HEATER FOR LIQUIDS; J. A. G. Trudeau, Ottawa, Can. App. filed April 4, 1900. The heater is constructed to pass a current through the body of liquid to be heated.

667,421. MEANS FOR CONNECTING ELECTRODES; H. Blackman, New York, N. Y. App. filed June 6, 1899. The electrode is formed with holes at its upper end, into which extend conducting rods, and separable conducting rings surround the rods and make contact with the walls of the holes.

667,434. SIGNALING SYSTEM; W. F. Follett, New Haven, Conn. App. filed June 22, 1900. A duplex receiving instrument responding to the conjoint action of a group of signals each of which alone is insufficient to elicit a full response from the duplex instrument.

667,442. PUMP GOVERNING MECHANISM; E. R. Hill, Wilkinsburg, Pa. App. filed July 2, 1900. Fluid pressure actuated devices are adapted to open a normally closed switch, and an electromagnet which is controlled by the degree of pressure in the system, itself controls the fluid which actuates said devices.

667,448. SIGNAL FOR TRUNK LINES; F. R. McBerty, Downer's Grove, Ill., and J. L. McQuarrie, Chicago, Ill. App. filed Jan. 11, 1897. (See Current News and Notes.)

667,454. FAC-SIMILE TELEGRAPH; A. Pollak, Szentes, Austria-Hungary. App. filed Feb. 17, 1899. A fac-simile telegraph comprising a transmitting device having a series of selenium cells, means for varying the illumination of such cells in accordance with the message, and means for sending current impulses through such cells successively, whereby such impulses individually correspond with the successive points of the message, a receiving device having a vibrating member adapted to respond to such impulses to reproduce such successive points of the message, and means for so suppressing the after-vibrations of such vibratory member that its response to the current impulses may be substantially unaffected by such after-vibrations.

667,460. TELEPHONE EXCHANGE APPARATUS; C. E. Scribner, Chicago, Ill. App. filed Sept. 25, 1896. (See Current News and Notes.)

667,461. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Jan. 9, 1897. (See Current News and Notes.)

667,462. SIGNAL LAMP FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed March 9, 1898. (See Current News and Notes.)

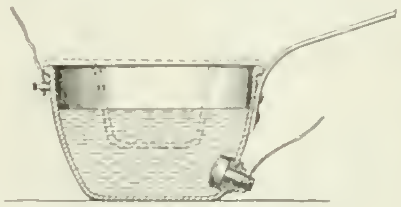
667,463. SIGNALING APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed June 7, 1899. (See Current News and Notes.)

667,484. DEVICE FOR DISINFECTING TRANSMITTERS AND RECEIVERS OF TELEPHONES; C. F. Axell, New York, N. Y. App. filed May 25, 1900. A distributor of ozone is attached to the transmitter.

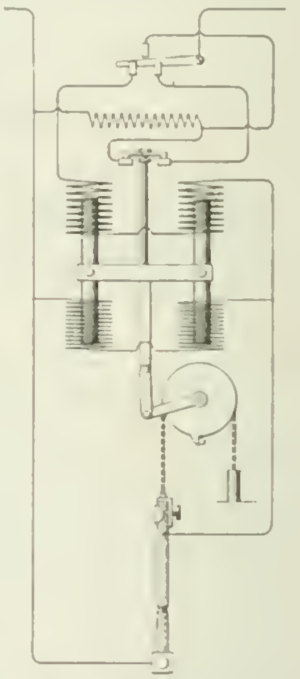
667,498. ELECTROLYZER; W. T. Chapman, Manchester, Eng. App. filed Sept. 12, 1900. Details.

667,503. PHONOGRAPH ATTACHMENT FOR TELEPHONE CIRCUITS; A. B. Clark, Nashville, Tenn. App. filed July 10, 1900. (See Current News and Notes.)

667,509. CURRENT COLLECTOR FOR ELECTRIC RAILWAYS; F. C. Esmond, New York, N. Y. App. filed Nov. 17, 1899. The collector comprises a number of metallic plates grouped together on edge and upheld from a common support to form a unitary device, but having each an independent spring support.



667,374.—Electric Heater for Liquids.



667,584.—Electric Arc Lamp.

667,519. ELECTRIC METER; J. Harris, Rensselaer, N. Y. App. filed June 2, 1900. A centrifugal governor controls the train of gear.

667,541. MUSICAL CHROMOSCOPE; J. M. Loring, St. Louis, Mo. App. filed May 12, 1900. A series of colored lamps corresponding to the keys of a musical keyboard are lighted up when the keys are played upon.

667,546. TELEPHONIC TRANSMITTER; L. Mellett, Somerville, Mass. App. filed June 14, 1900. A device to maintain the carbon grains in a loose condition.

667,567. CONDUIT FOR ELECTRIC WIRES; E. D. Page, New York, N. Y. App. filed May 14, 1900. The conduit is provided with a flexible cover so that it may be bent to insert it into undercut grooves in the walls of the conduit.

667,571. TROLLEY WIRE CROSSING; J. W. Perry, Philadelphia, Pa. App. filed May 10, 1900. Details.

667,584. ELECTRIC ARC LAMP; R. Schefbauer, Jersey City, N. J. App. filed May 1, 1900. An alternating current lamp having an inductive reactance and a switch and connections whereby the lamp can be cut out and the reactance cut in, or the lamp and reactance connected in parallel with each other.

667,585. ELECTRIC ARC LAMP; A. Schweitzer, Pittsburg, Pa. App. filed Oct. 6, 1900. Details.

667,619. CONTROLLER FOR ELECTRIC MOTORS; T. W. Eaton, Chicago, Ill. App. filed Oct. 8, 1900. This is an elevator controller in which the movable contacts are carried by the drum shaft, on which their position is adjustable.

667,625. AUTOMATIC ELECTRIC CIRCUIT BREAKER; B. Hopkinson and E. Talbot, London, Eng. App. filed July 16, 1900. The combination of a circuit-breaker, a line supplied with current both through the circuit-breaker and at some other point and an automatically operating electromagnetic mechanism for replacing the circuit breaker actuated by current drawn from the said line.

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TELEPHONIC GROWTH.

Our issue this week devotes even more space than usual to telephonic matters, this being a season when the breaking up of frost invites to new construction so that subscribers can be added and toll lines run. Any one can see from the news presented that the field is in a condition of great activity. An even better feature is the determination of the independents to improve their work and service, so that to be "as good as the Bell" no longer expresses their ambition to the full. Whatever may be the outcome of the present rivalry and activity which has surpassed anything seen hitherto in telegraphic or telephonic work, and which equals the fervor of the old trolley days, it is clear that a large amount of work remains to be done before the country is adequately supplied with telephones. While some communities may suffer from too much telephone, the great majority of the inhabitants of the United States still suffer from too little.

THE RUSSIAN TARIFF.

It is very discouraging to find that just as an excellent electrical trade with Russia was springing up, a dispute over a few poods of sugar should threaten to choke it off, with a vast amount of other American export business in products of metal. Looking over the figures given weekly in our columns of shipments through the port of New York, we find that while electrical exports to Russia in these lines were less than $7,000 in the first half of 1900, they ran up to nearly $70,000 in the second half. We know from the responses to our own efforts to push such Russian trade that it is growing rapidly this year, and it is therefore to be profoundly hoped that no check will now be imposed by the present dispute over sugar rebates. There are signs that Russian opinion favors the removal of such misunderstandings, and the maintenance of all friendly commercial relationships. As we have ventured to say before in these pages, American trade must come more and more to a basis of reciprocity, and here is a chance to put ourselves right with Russia, with whom our interchange of products ought to be much greater now than it has ever been before.

NUT CRACKING BY ELECTRICITY.

Attention has recently been called to the fact that annually in St. Louis several thousand tons of nuts are cracked electrically. We hardly see why this should excite wonder, for the great role assigned to electricity nowadays is that of cracking nuts of every kind. If there is any old or new difficulty in physics or mechanics, resort to electricity is immediately suggested, and when every other agency has failed, there is still thought to be some hope, if only the electrical inventor can be induced to turn his mind to the subject. This, indeed, must be offered as a good excuse why modern electrical inventors are generally so diffuse in their efforts and cannot be pinned down long to any one problem. Opportunities to win new triumphs present themselves so abundantly in every direction that the most enduring energy and the highest genius are in danger of dissipation without net results.

This is the reason why the public once in a while gets impatient with the inventor and says rude things; or, as the New York *Sun* puts it neatly, in defending its worthy protégé, Mr. Tesla, utters "flippant remarks of disparagement." The tide of this flippant disparagement has been rising high of late, possibly because Mr. Tesla, with the onrushing enthusiasm of a man who sees things ahead to be done and is fertile in expedients for doing them, inclines to discuss them as though they were already disposed of. With men of this stamp of intellect it will be so to the end, and it would be a prosaic world of mediocre achievement if it were otherwise. Just at present Mr. Tesla and his brilliant fellow-countryman, Dr. Pupin, have their names associated in the public mind with new means of communicating across the ocean, and the newspapers, as the popular sources of scientific information, are full of the subject—a thing we heartily prefer to seeing the same columns filled with murder cases. But it is certain, in advance, that before they get through, both Messrs. Pupin and Tesla will encounter a good deal more of "flippant disparagement." What is now being heralded as a novelty in each instance has been known to the electrical community for some time past, as we show in reproducing our articles of nearly a year ago; and probably before the goal is reached there will be several successive outbursts of sensational writing, followed by more of the "flippant disparagement." Obviously the tasks of telegraphing to Europe without wires or telephoning to Europe with a "loaded" cable are most serious problems, but the public is impatient, we fear, and does not realize that things attempted these many years past may still linger unaccomplished many years to come, without any fault on the part of the men who do not "get there," strive as they may.

In Mr. Tesla's case the injury done him by the jokes and jibes one finds in almost every paper picked up is the more severe because so much is promised in his name without his direct personal sanction. There seems no way to stop this abuse of confidence, from which Mr. Edison has also suffered to such an extent that a shotgun is his preferred reception for the average reporter. But just now Mr. Tesla holds the center of the sensational stage, and the talk about him is all the looser for the reason that it has so little that is tangible behind it as food. He has read no scientific papers before the societies for years, and since his monumental series of patents on polyphase work has taken out extremely few patents. We can recall only one or two in recent years. Hence, the gossip that always besets a great genius has little to feed upon save the wild and absurd stories to which few of the authors hesitate even at signing Mr. Tesla's own name. In this way, as all such men discover, the lot of the genius trying to crack the nuts of modern civilization is not much better than that of his predecessors treated as lunatics or witches. And this "flippant disparagement" falls hardest upon those who are not drawing-room inventors with drawing-board inventions.

The Latimer Clark Electrical Library.

Possibly the last opportunity now offers to secure for this country the magnificent library of the late Latimer Clark, and it is to be sincerely hoped that some friend or friends of the American Institute of Electrical Engineers will obtain the collection for that body. As in the case of the great Ronalds collection, now owned by the English Institution of Electrical Engineers, so much stress has been laid on the literary rarities which the Clark library contains, that its great value from a utilitarian standpoint has perhaps been overlooked. As a reference library it is almost absolutely complete in English titles up to the present period, and includes possibly every work of real reference value that has been printed in continental tongues.

Those who have occasion in this country to look up important references relating to the early days of electricity are greatly handicapped at present by the almost complete lack of access to originals or even to works of any kind printed earlier than a quarter of a century ago, and this condition is naturally reflected in our literature when it touches upon the historical side of the electrical art and science. For the past few years the American Institute of Electrical Engineers has been paying especial attention to the matter of a library. Its collection now numbers more than 1200 volumes, and as these consist largely of bound volumes of periodicals, the library has already a real importance. Were the Clark collection added the library would at once assume a standing worthy of the Institute, one which would attract to it gifts and legacies from the membership, and assure its future. We must confess to a keen desire that the present opportunity should be availed of, and venture to believe that among the Institute members to whom the growth of the science and art has brought some measure of worldly fortune, the needed generosity will be found to effect this lasting good.

State of Physical Science at the Beginning of the Century.

In our review columns will be found a notice of the recently issued report of the International Physical Congress held at Paris last year—a work which offers such a notable contribution to the literature of physical science that we desire to direct to it the especial attention of such of our readers as are conversant with the French language. Of the 80-odd papers contained in the three volumes more than 30 relate to electrical or closely allied subjects, including a collection of monographs on electrical discharges in gases, on ionization and radio-active phenomena, which will be of particular value to the reader who wishes to thoroughly inform himself concerning these comparatively recently developed branches. Aside from the authoritative character of the papers contained in these three portly volumes due to their coming from the pens, with scarcely an exception, of recognized leaders in physical science, their plan is such as to greatly heighten their value. This plan, as followed in most of the papers, is to give a résumé of the branch treated to date, followed by a discussion of its latest developments and present status, and concluding with a forecast into the future. The work thus forms an authoritative record of the state of physical science at the beginning of the century, and furnishes an admirable starting point in taking up the study of any of the branches represented in this remarkable collection of papers.

Discontinuities in Magnetic Declination.

In the Annuaire of the Bureau des Longitudes for 1901 and also in the same volume for preceding years, is a set of small charts showing the declination, inclination and horizontal magnetic force over the surface of France. The mean horizontal intensity is about one-fifth of one gauss with the isodynamics running roughly east and west, and fairly parallel to one another. The mean dip is in the neighborhood of 64 degs., and the isoclinics also run roughly east and west, also sensibly parallel to one another. The mean variation is about 15 degs. west, and the isogones run roughly north and south, parallel to each other, except in a certain region in the north of France where the lines are contorted in a pair of very sharp bends. A straight line joining Nevers on the Loire, with Dieppe on the British Channel, and passing nearly through Paris, approximately follows the course of this remarkable distortion, which might be termed a fault in the veins of magnetic declination. The magnitude of the disturbance amounts at its greatest to about half a degree, so that an observer traveling north and following an isogone would first swing suddenly about 30 miles eastward, then return suddenly to the regular course and again swing sharply 30 miles westward before resuming his steady march. This distortion is barely noticeable on the inclination and horizontal intensity charts. If a feeble vertical electric current sheet intersected the land, and pointing upwards, it might have such an effect as is indicated, but, of course, it is difficult to see by what force a vertical electric current sheet could be maintained, following this line nearly 200 miles long. The distortion is noted in the description of the charts, but no explanation for it is offered. It is stated, however, to extend northwards across the channel into England as far as Oxford. It is quite evident that there exists in this enigma a most interesting inquiry, although its source may be very deep.

The whole subject of terrestrial magnetism is still enveloped in mystery. In the year 1600, or 300 years ago, the agonic line, or line at which the magnetic needle pointed north and south, passed through Turkey and eastern Germany. Now it passes nearly through Cincinnati, Ohio; but, although this agone has apparently passed one-third of the way round the world in this time, yet its movement has been so irregular, and its position at intermedite dates so contorted, that it seems impossible to explain the change as a revolution of magnetic poles within the substance of the earth. The facts seem to suggest rather a periodic waxing and waning of polar areas or polar forces.

The Temperature Co-efficient of Resistance in Metals.

One of the most remarkable properties of metals in common is found in the temperature co-efficient of their resistivity. Thus, aluminum, copper, silver and gold have resistivities varying roughly in the respective proportions of 29, 16, 15 and 20, yet their temperature co-efficients of resistivity are all approximately 0.4 per cent per degree Centigrade reckoned upon the resistivity at zero Centigrade as standard. It is wonderful that this co-efficient should be so nearly alike in these different cases. The temperature co-efficient of copper, for example, is so nearly uniform in samples of commercial copper wire, that it forms the basis of practically determining the temperature elevation of dynamo-electric machines under load. The temperature co-efficients of tin, lead, magnesium, antimony and bismuth are all nearly the same as that of copper, and the same may be said for mercury in the solid or frozen condition. Iron forms a notable exception, being distinctly higher (0.46) while liquid mercury is only about one-fifth of that of copper, so that its change from the solid to the liquid state reduces its temperature co-efficient some five times. Carbon, having a negative co-efficient, is perhaps the most remarkable of conducting substances in this respect.

As a rough generalization, it is, therefore, fair to say that all of the solid metals, except iron, have a temperature co-efficient in the neighborhood of 0.4, and this variation appears to follow substantially a straight line law from the lowest to the highest observed temperatures. At first sight, platinum seems to constitute an exception to this rule, being usually stated at about 0.25, but the fact of the difficuly of obtaining platinum free from alloy may, perhaps, account for this discrepancy. In the face of a common property so remarkable as this, no theory of electric conduction can possibly be complete without offering a satisfactory explanation for it.

The Study of Electrical Energy.

We often wish that some of the active students of electrical theory, upon whose acutely directed activity so much of human progress depends, could be provided with a species of intellectual ball and chain to encourage contiguity with mother earth. Not that we would wish to repress theory and hypothesis with the wearying clog of things purely practical, but we would like to impress the restraining influence of every-day facts upon flights of the scientific imagination. And chiefly we wish that every man who writes papers upon electrical topics or who is tempted to that indiscretion would remember first, last and always that the thing with which the experimenter deals is in every case a manifestation of electrical energy. One of the first things taught the schoolboy in science is that "electricity is not a form of energy," a statement which in itself admits of no dispute, but which in nine cases out of ten conveys a totally wrong impression. All that we know of "electricity," however, we gather from experiments on the electrical energy of which it is an indeterminate and perhaps physically inconsequential part. Whatever we may do with mathematical symbols as a matter of convenience, the facts by which these symbols are brought into physical significance have to do with electrical energy. We need a new Joule to free electrical science from its incubus of metaphysical quantities and put the theory of electrical energy upon a sound basis. We have had plenty of Fouriers, who have accomplished splendid things in electrical theory, but never a Joule to bring their works to fruitfulness. We cannot get along without the mathematicians, but every little while in the world's work comes a time when there is bitter need of a great experimenter and scientific logician like Faraday or Joule.

When we see the high-tension line of a big transmission plant at night glowing blue with the energy that is streaming off into the dielectric and delivering perhaps a thousand kilowatts to the distant transformers, discussions as to ionic charges in a conducting medium lose their significance in face of the great fundamental fact that here is a wire no bigger than a leadpencil along which is being delivered enough energy to light a whole city. The all-important question is the relation of this particular form of energy to the mechanical energy whence it has been transmitted, and the luminous energy into which it is destined to pass. Cut that metallic thread and the spell is broken and a city plunged into sudden darkness. All the theories of electric and electromagnetic induction that have ever been formulated are as yet helpless to explain the wonderful thing that has become part and parcel of our daily life. They do not go to the root of the matter, they deal with concomitants rather than causes. It may be that the nature of electrical, and for that matter thermal, energy belongs in the category of the unknowable, but we have no right upon that assumption to neglect all investigation of the matter. Or, look at the subject on a smaller scale. Here is an electrical condenser, a little pile of mica and tinfoil, in which is stored enough energy to knock down a strong man at the touch of his fingers. To say that the plates of this condenser are charged with positive and negative electricity is utterly futile; it is merely explaining by definition. In point of fact, we know that energy has somehow been stored in that inert and harmless looking dielectric just as really as energy in another form is stored in a dynamite cartridge. That this electrical energy produces somewhat striking phenomena at the surfaces of the energized body is in nowise remarkable, although in itself interesting enough, but why these surface conditions deserve a special nomenclature, and why all the essential facts should be reduced to terms of these phenomena alone, is from a philosophical standpoint quite incomprehensible.

In some particulars, it is true, modern investigators have tried to escape from such a narrow point of view, and to consider electrical energy in its broader aspects, but they have only made a beginning. Even now nearly all the text books begin the discussion of electrical matters along the ancient line followed when a ball of brimstone and the discarded hide of a defunct tabby cat were the most formidable dispensers of the electrical fluid. The vitreous and the resinous electricities are still with us in spirit and will not down. They are the stumbling block of many a hapless student, who does not escape from their malign influence until in dealing with the tremendous agents of modern electrical engineering he finally realizes that there is a vast difference between the substance and the accidents of electrical science. We would not dispense with any part of that science, nor belittle careful investigations, however unpromising of practical results; but there is much in our present electrical theory which should be studied and perhaps rewritten from the standpoint of energy, not for its practical so much as for its theoretical value. Electrical text books in particular ought to be provided taking a broader view of the subject than those now current.

Latimer Clark Library.

We learn that the magnificent library of the late Latimer Clark is now being offered for sale in this country. The library embraces about 4000 bound volumes dealing with electricity, besides more than 2000 pamphlets and periodicals, and also many photographic and autographic albums constituting an almost complete collection of the portraits and handwriting of eminent electricians.

A man of Latimer Clark's scientific attainments and literary tastes naturally found it congenial to surround himself with all obtainable publications and other data bearing upon his own very extensive researches in the electrical field, and it is not surprising to find that his library embraces pretty much all of the reference literature touching upon the leading scientific inventions and discoveries of the nineteenth century. The prominent positions held by Mr. Clark as president of the Institution of Electrical Engineers, and as an officer in other professional and scientific bodies, during the tenure of which he gained much popularity, gave him unusual opportunities for acquiring valuable literary material as well as autographs and photographs of celebrities, which he fortunately availed of.

The value of the pamphlets, in particular, may best be judged by the fact that several of them each cost their late owner, more than 10 years ago, as much as £20, which figure at the time exceeded even the cost of his fine folio vellum copy of Martin Cortes, "Breve Compendio de la esfera y de la arte de Navagar," 1551, edition of 190 pages, one of the treasures of the collection.

In a letter to a friend in New York, and referring to Mottelay's "Chronological History of Electricity" (printed in these columns some years ago), Mr. Clark says: "It was quite a treat to me to read over the 'History,' and to see what a large proportion of the rarities I had in the original. Of course, in all the more modern works up to 1889, it is practically complete. * * * I find also that I possess in my library by far the greater number of the very ancient works which Barnalite has cited in his researches on Peregrinus, so that I had the chance of consulting the actual works as I read the references to them. In this respect my library is incomparably richer than the Ronalds library; in fact, is a far finer collection than the Ronalds. During the first 30 of the 40 years I was collecting, I secured every electrical book that was published in England (including pamphlets), besides all I could hear of that were published in foreign languages. I was so lucky, too, in digging out the old books that I can nearly boast of possessing every English work on the subject up to about 1886 or 1888, after which they became painfully numerous. I have all the few very scarce and interesting sixpenny and shilling pamphlets which appeared when the telegraph first came into existence—they are now extremely rare. I have also, I think, all the scarce old histories and treatises on the magnetic needle by English and foreign writers—some very interesting."

In the way of absolute rarities, the Clark library exceeds by far that collected by Sir Francis Ronalds, and which is now owned by the English Institution of Electrical Engineers. Among them may be enumerated, in addition to the 1551 Cortes named above, a 1473 Vincentius (Bellovacensis); the 1478 and 1490 Sacroboscos; the 1491, 1513 and 1519 Albertus; 1510 Leonardus; 1519 Glanville copy of Lord Stuart de Rothesay; 1528 Homer; 1531 Marbodeus; 1535 Stoefler; 1537 Mardus; 1541 Raimondi Lulli; 1545 Pontano; 1545 Apianus; 1546 Polandus; 1547 Proclus; the extraordinarily rare 1558 Peregrinus; half a dozen Portas; the Taisniers of 1559, 1560, 1562; the 1562 Ptolemai; the 1585 and 1592 Bororigh; 1581, 1592 and 1720 "Neuie Attractive"; Ridley's Magnetical Bodies, 1613; 1597 "Navigator's Supply"; 1613 and 1616 "Magnetical Advertisements"; all the Gilberts and the works of Cabeus, Kircher, Guericke, Newton, Volta, etc., etc., including the original and excessively rare four-page quarto pamphlet wherein Oersted announced to the world his discovery of the influence of the galvanic current upon the magnetized needle, and also the extremely rare copy of George Green's "Mathematical Analysis of the Theories of Electricity and Magnetism," issued in 1828. Of works on the sympathetic telegraph, Mr. Clark exhibited 34 different editions, at the Paris International Electrical Exposition of 1881.

The Clark collection has been valued at $20,000, but can, we learn, now be purchased for less than half that sum. It is to be hoped that some public-spirited American citizen will try and obtain it for this country, and not let it go, as it easily might, into the hands of Japanese and German representatives of electrical associations, who have, it appears, cast upon it longing glances for a long time past. Mr. Clark at one time remarked that he should like the library upon his death to come into the possession of the American Institute of Electrical Engineers, the English Institution of Electrical Engineers being the possessor of the great Ronalds collection.

Forecast of the General Electric Annual Report.

Last week witnessed one of the most phenomenal advances in electrical securities in the rise of General Electric to 217, settling at the close to 211, a net gain for the week of nearly $15 per share. The price of the stock had already gained rapidly of late and was generally regarded as high, but it is stated that the conditions are such as to warrant even these latest figures. As might be expected, Wall Street is full of rumors as to what may happen.

A well-known brokerage house, Harrison & Wyckoff, in a circular on General Electric, notes that nearly $4,000,000 of the debentures of the company have recently been exchanged for the company's common stock on a basis of $120 of debentures for $100 of stock, leaving only $1,693,100 outstanding. The fixed charges of the company are only the interest on the debentures, $84,655. The interest on the preferred stock is $178,584, so that the charges ahead of the common stock are only $263,239. Earnings last year were approximately $27,000,000, as against $22,000,000 the previous year, $15,000,000 in 1898, and $12,000,000 in 1897. The current liabilities will amount to $1,000,000, against cash on hand amounting to $1,500,000. During the past five years about $8,500,000 of patents and plants were written off and charged to operating expenses, leaving practically no obligations of this character. Orders for over a year in advance are reported to have been booked.

It has been rumored that the directors might give back to the stockholders the stock they lost when in 1899 a reduction was made of 40 per cent. The present stock outstanding is $2,551,200 preferred and $22,836,000 common; total, $25,387,200. But it is said, on the other hand, that in all probability the General Electric board will not reopen the capital account of the company in the future and there will be no stock dividend. It is more likely to choose the other method of distributing profits, viz., that of paying them in periodical dividends. This will mean very large writing off of profits made last year.

Assuming that the gross business of the company last year was $30,000,000 (against $22,379,463)—which is said to be not far out of the way—the company's earning capacity is not less than 30 per cent on the stock. But it is certain that the management of the company, remembering the terribly bitter experiences of the last hard times, will not be in a hurry to pay out all its net earnings in dividends at any such figure.

Steam and Trolley Traffic in Massachusetts.

Previous to 1893 the steam roads reporting to the Massachusetts Railroad Commission made great gains in their passenger business. From 1890 to 1893 the steam roads reported an increase of 21,000,000 passengers, and the street railways 46,000,000. With 1891 the influence of the improved trolley system began to make itself felt in stimulating street traffic. The annual reports of the Massachusetts Commission give the following comparison of the passenger traffic of the two systems for 1891 and 1900, in which it is shown that the rapid growth of the steam roads from 1891 to 1893 was lost.

The comparison is as follows:

	Steam Roads.	Street Railways.
1891	107,271,000	172,000,000
1900	108,768,000	395,000,000
Increase	1,517,000	223,000,000

Moreover, in 1891 a number of important roads that are now included in the 1900 report of the steam roads were independent railroads, in New Hampshire and Connecticut, and at that time were carrying millions of passengers that should be included in the totals of the steam roads for 1891. If these figures were accessible it would be shown that the number of passengers carried by the steam roads was decidedly smaller in 1900 than in 1891.

Again if a comparison was to be made of the growth of the surface roads that compete with the steam roads the increase in the traffic of the surface roads of Rhode Island, Connecticut and New Hampshire from 1891 to 1900 should be added to the increase of 223,000,000 shown above as the increase of the Massachusetts street roads alone since 1891.

The Independent Telephone Exchange at Rochester, N. Y.

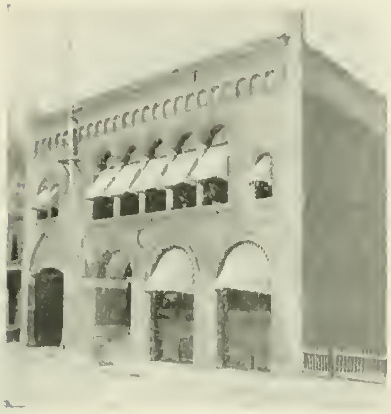


FIG. 1.—ROCHESTER TELEPHONE EXCHANGE.

ONE of the best constructed and most modern equipped telephone exchanges in this country is the independent telephone plant now in operation in Rochester, N. Y. The company is a local organization, and was organized about two years ago. It has as its stockholders some of the wealthiest and most influential business men in Rochester. The officers of the company, all having large other interests, placed the entire work of building the plant in the hands of C. E. Stinson, formerly superintendent of the Bell exchanges in that section. The construction department, the most important—especially during the time of building the plant—was placed under the charge of Mr. C. O. Harris.

The first work was to make detailed specifications of the entire system proposed, maps of the aerial and underground construction, and an estimate of all material required. This work was completed and all orders placed for the material and apparatus early in June, 1899. The exchange was completed, and the plant was started with 2500 subscribers the following May. The building shown is owned by the company, and was built especially for the company's exchange and offices. The cables enter the basement through conduits, and are terminated in fused iron terminals. In the basement of the building, beside the terminal room are located the boiler room, a large storage room and a room for shop purposes. On the ground floor are the general offices, the directors' room, superintendent's office, engineering department, the construction department with a stock room accessible from the driveway, inspector's room and the trouble department. In the rear of the ground floor is a battery and distributing room in which are placed distributing board, lightning arrester board, ringing generator, charging machines, storage-battery plant, power switchboard and necessary equipment for making tests of subscribers' instruments for lines. The entire second, or top, floor is occupied by the operating department. The operating room is lighted by large windows on all four sides and by a skylight the entire length of the switchboard.

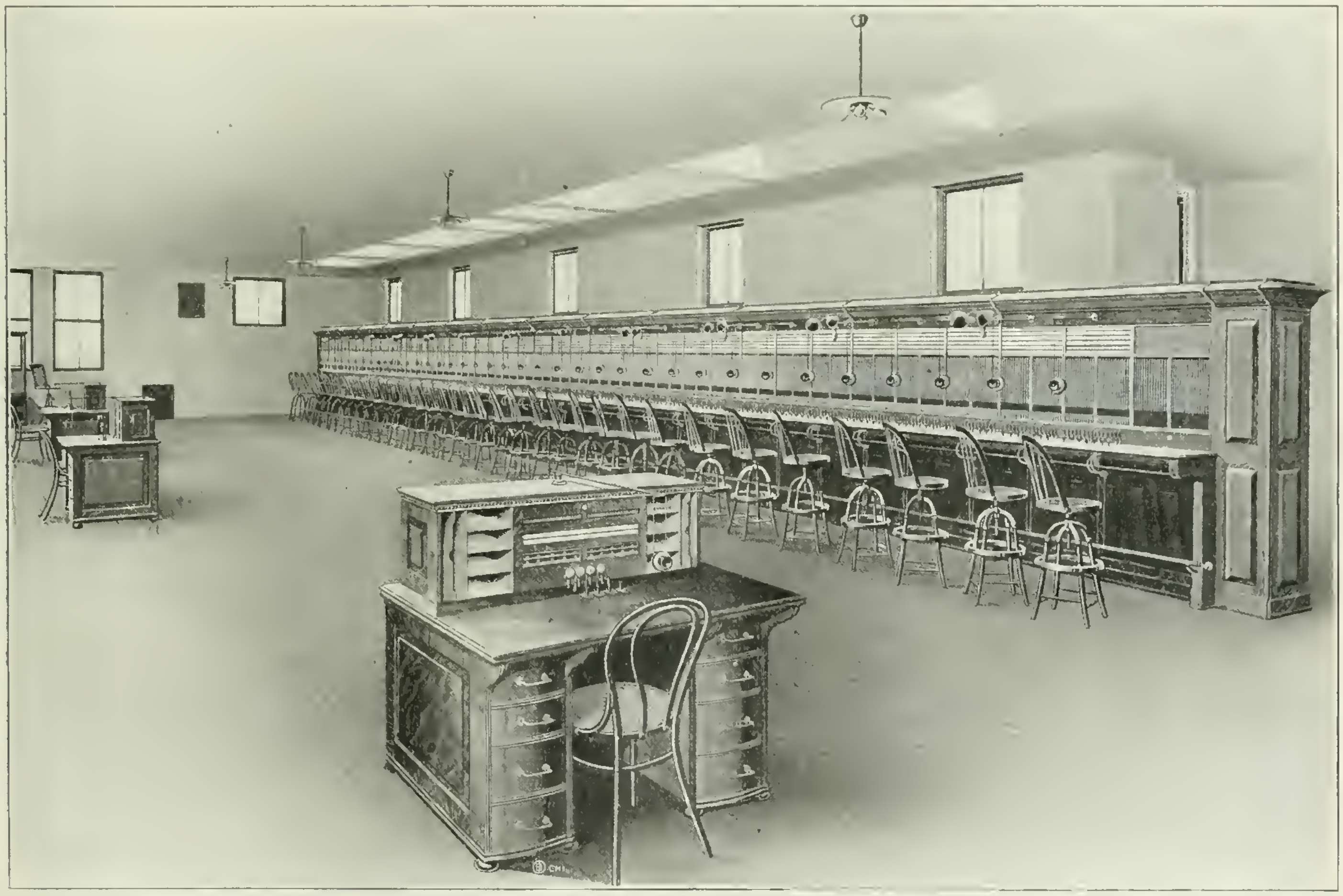


Fig. 2.—Interior View of Rochester Telephone Exchange.

The equipment was furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, and is of the "central energy" type. The switchboard is located in a straight line on one side of the operating room. It has a capacity for 3600 subscribers, and was originally equipped for 3000 lines, and later equipped to its full capacity. It is a strictly multiple board. Each operator is within reach of every subscriber's line in the exchange, and can complete the connection between any two subscribers. When the subscriber takes the receiver from the hook, a signal is automatically raised into view, showing the number of the station called. The visual signal is automatically released and restored when the operator inserts the plug to answer the call. The connection is made in the usual manner. The clearing-out lamp signal on the plug shelf between the cords is automatically shown when the subscribers replace their receivers, and disappears when the disconnection is made. All signals are made and restored electrically.

On the opposite side of the operating room are the manager's desk, monitor and supervising operator's desk. The supervising operator's desk is provided with a complete operator's telephone and three sets of miniature lamps for each operator's position of the main board, one giving a white light as pilot lamp, and is lighted when a subscriber calls "central" and remains lighted until the operator answers by inserting the plug. A red light shows when the subscribers replace their receivers and remains until the disconnection is made. When the operator rings a subscriber a green light is shown on the supervising operator's desk. This enables the supervising operator to know readily every call received at the switchboard and the time required by each operator to answer calls and make disconnection after the clearing out signal is given. The desk in the center, the monitor, is provided with a pilot lamp for each operator's position, and is connected direct with the various offices in the building. The first desk shown is the manager's desk. This desk is connected with the monitor and supervising operator's desk, superintendent office and the various departments, and also has a monitor to each operator's position.

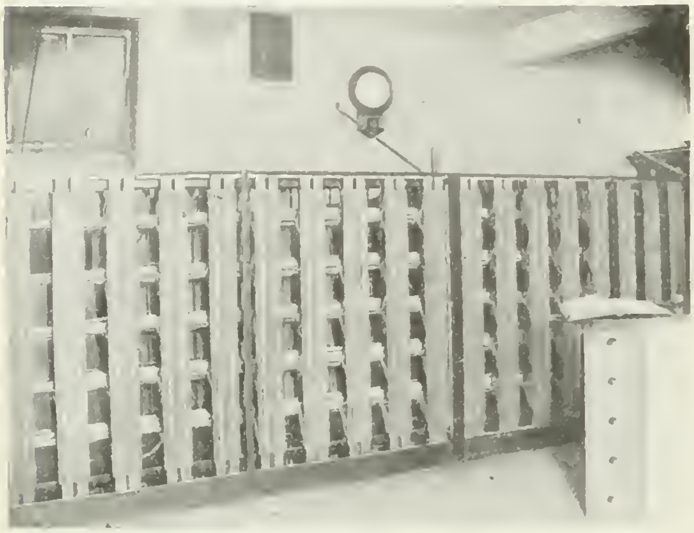


Fig. 3.—Cross [illegible]

The battery plant consists of two sets of 20 cells, 360 ampere hour storage batteries. Each set is of sufficient capacity to supply energy for the exchange for over 24 hours. In Fig. 4 are shown the power switchboard, the main and auxiliary charging machines and one of the ringing machines. On the power board are placed the ammeter and voltmeter, the bus-bars with separate fuse for each operator's position and a voltmeter switch, switch for ½-hp ringing machine with starting boxes; switches and starting boxes for the main and auxiliary charging machines, switch and starting boxes for the emergency ringing machines; the field regulators for the main and emergency charging machines, the main battery switch, which is located in the center, the emergency battery switch and the emergency ringing machine switch. The power board is of heavy marble.

The construction work of the exchange is of the highest standard, metallic circuit throughout. In outside construction for the distributing poles, a cable is led from the underground ducts to the top of the pole into an iron terminal, far above all other wires, and the circuits are distributed from a circle pole top by heavy twisted rubber covered wire to the subscribers' instruments.

The company has successfully installed without an accident nearly 200,000 ft. of underground cable through the conduit of the Rochester Gas & Electric Company, which is occupied by both high and low tension currents from 50-volt direct to 2500 alternating.

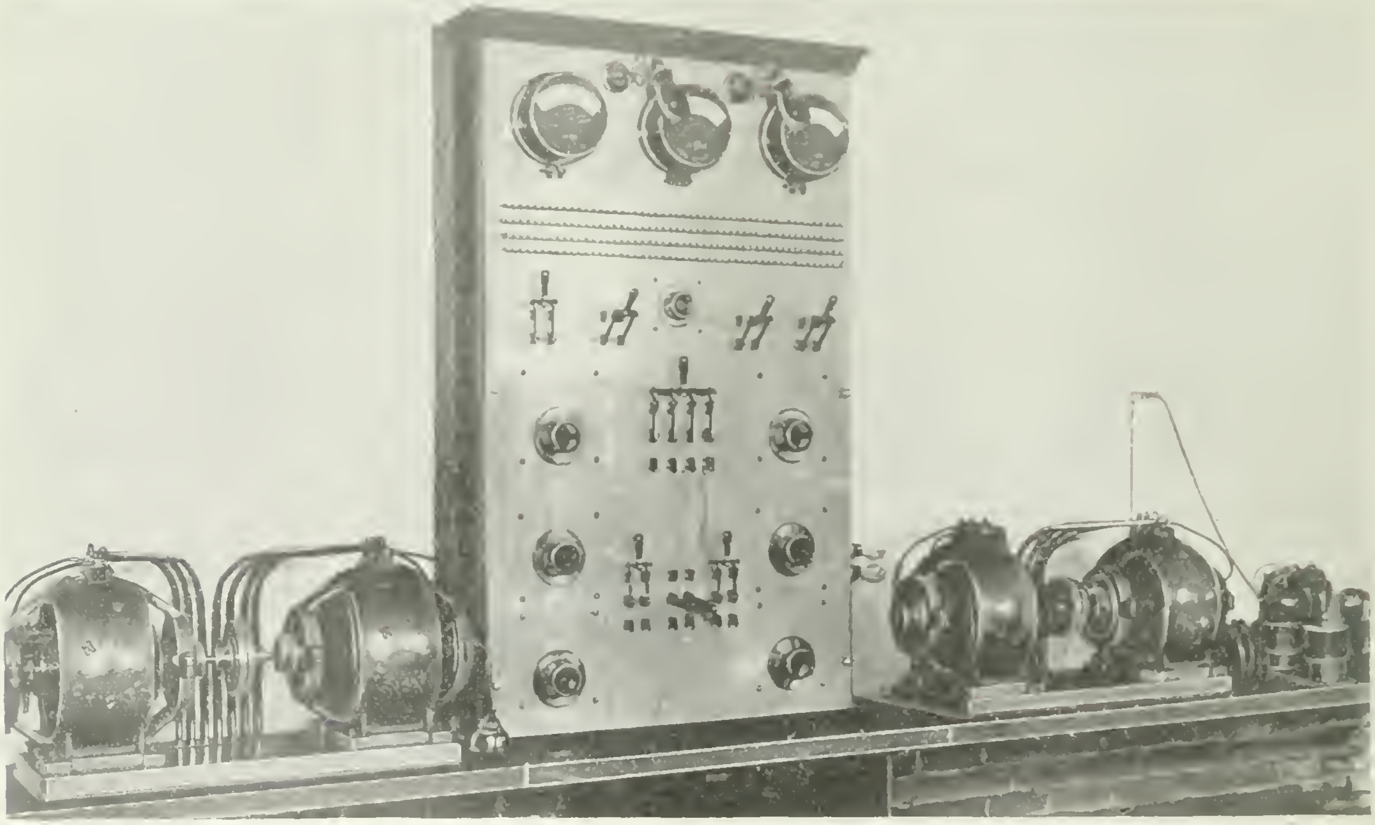


Fig. 4.—Power Switchboard, Motor Dynamos and Motor Generators, Rochester Telephone Company

European Types of High-Tension Alternators—VI.

By C. F. Guilbert

GRAMMONT ALTERNATOR.

A GRAMMONT alternator (Figs. 53, 54, 55 and 56), exhibited at Paris, direct connected to a Piguet engine, was particularly interesting on account of the special system of excitation with which it was provided, designed to maintain the voltage constant at the binding posts whatever the current output or the difference of phase between current and voltage. The exciter, the invention of M. Maurice Leblanc, is based on several interesting principles, of which the most important is the employment of rotary fields in excitation. This method of compounding may be explained quite simply as follows:

Referring to Fig. 58, let OA equal U be the difference of potential at the terminals of an alternator, and OI the direction of the current generated by the machine and differing in phase from the voltage at the terminals by the angle φ. For the sake of simplicity, assume that the magnetic circuits are so far removed from saturation that the characteristic on open circuits is a straight line; and, furthermore, assume that the apparent internal resistance of the alternator reduces itself to the inductance, ωl, and remains constant whatever the current and phase relation.

As is well known, to represent the induced e. m. f. it is merely necessary to draw from *A*, the vector, *A B* equals ωH, perpendicular to the direction of the current, and to join *OB*. The direction, *OB*, of the induced e. m. f. is independent of the output and phase relation. The vectors, *OA* and *OA'*, on the other hand, vary the one, *OA* in direction only, and the other, *OA'*, in length and direction with these two quantities, but always in such a manner that the direction of the resultant, *OB*, is unchanged.

Assuming, as has been done above, that the e. m. f.'s are proportional to the exciting current and the latter to the voltage of the terminals at the exciter, then the e. m. f. induced in the alternator will be proportional to the field flux in the exciter. If then, we can design an exciter excited not only by an ordinary field, but by two rotary fields (naturally supplied by the alternator itself), giving fluxes proportional to the two vectors, *AO* and *AO'*, and maintaining between them and with respect to the fixed vector, *OB*, the same angles as these vectors, we shall obtain a perfect compoundage of the alternator. If the exciter has the same number of poles as the alternator—bipolar, for example—it is evidently merely necessary to supply two polyphase windings of proper dimensions,* one in shunt with the alternator terminals and the other in series with the working circuit, and make them act on a common winding on the two rings carrying the polyphase winding. It remains to be seen if the difference of phase between the two fields and with respect to the vector, *OB*, can also be obtained.

Let us suppose that the exciter is mounted on the same shaft with the alternator and that the connections of the field circuits are so arranged that the field will turn in an opposite direction to the machine. These fields will become fixed in space when they turn in a direction opposite to the alternator field, and with the same speed as the latter.

The flux due to the rotary field, the winding of which is in shunt with the terminals of the alternator, will be shifted in phase by a quarter of a period with respect to the e. m. f. at the binding post, represented by $O\psi$ in Fig. 57; that due to the series winding will, on the contrary, coincide in phase with the current; and if the output of current in the two circuits corresponds, the flux corresponding to the current may be represented by the vector $O\psi'$. The vector, $O\psi$ and $O\psi'$ being proportional to *OA* and *OA'*, and perpendicular respectively to the latter, their resultant will be proportional to *OB* and perpendicular to that direction. The resulting field in the exciter will then not only be proportional to the voltage to be obtained in the alternator, and consequently, according to our hypothesis, to the exciting current to be produced in the alternator, but also will have a fixed direction in space. If these fields act on an ordinary direct-current armature, the line of commutation and consequently the position of the brushes will be fixed in space, if care be taken to annul the armature reaction, as has been proposed by M. Leblanc, by the addition of a Ryan compensating winding.

Fig. 60 represents the scheme of circuits of an exciter of this type designed by the Societe la Transmission de la Force, and shown in the Grammont exhibit. This type may be described as follows:

On the alternator shaft, *OO*, are two rings, *A* and *B*. Around the ring *A* is a polyphase winding, S_1S_1, corresponding in character to that of the alternator. These circuits are connected in series with the corresponding circuits of the alternator by means of brushes and collector rings.

On the ring, *B*, is mounted another polyphase winding also corresponding in disposition to those on the armature of the alternator and connected in shunt with the working circuit. A third and direct-current winding, *E*, covers the rings *A* and *B*, and is connected to a commutator, *CC*. From two brushes on this commutator the exciting current of the alternator is taken. The rings, *A* and *B*, are surrounded by iron cylinders, *DD* and *EE*, which furnish a path for the magnetic flux generated. The sections of these rings, *DD* and *EE*, are fixed in such a manner that the magnetic circuits along which the flux due to the ring, *A*, passes, are always far from saturation; while, on the contrary, the magnetic circuits along which the flux generated by the ring, *B*, passes, are highly saturated when the exciter is in normal operation.

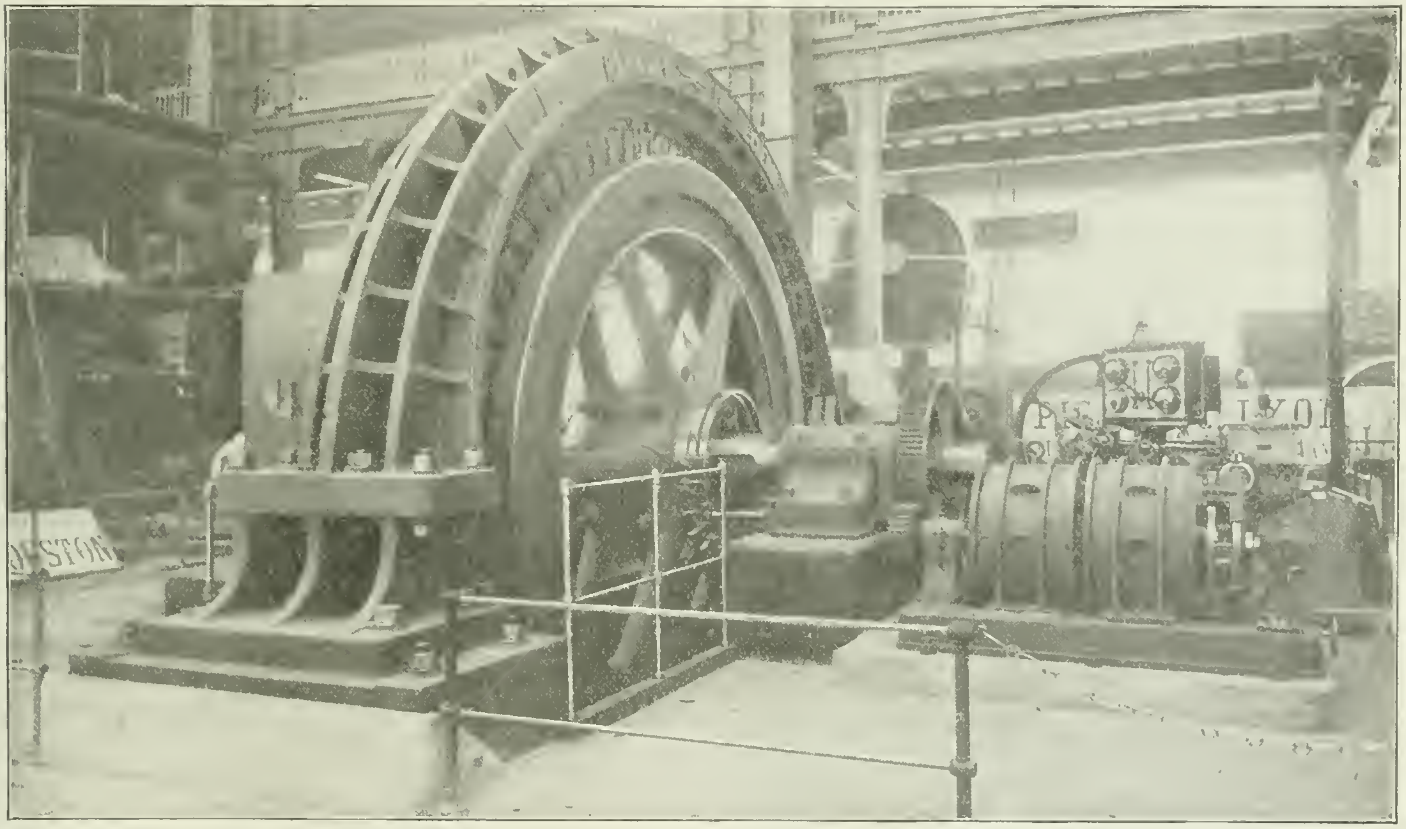


Fig. 53.—Grammont Alternator.

Finally, another circuit surrounds the rings, *DB* and *EE*. It has as many turns as the armature circuit, and is traversed by the current from the armature brushes. The current has such a direction in this winding that the magnetizing forces developed by it will always be equal to and contrary in sign to that developed by the circuit, *EE*. Under these conditions the currents which traverse the two direct-current circuits will give rise to no flux in the exciter, since each neutralizes the effect of the other.

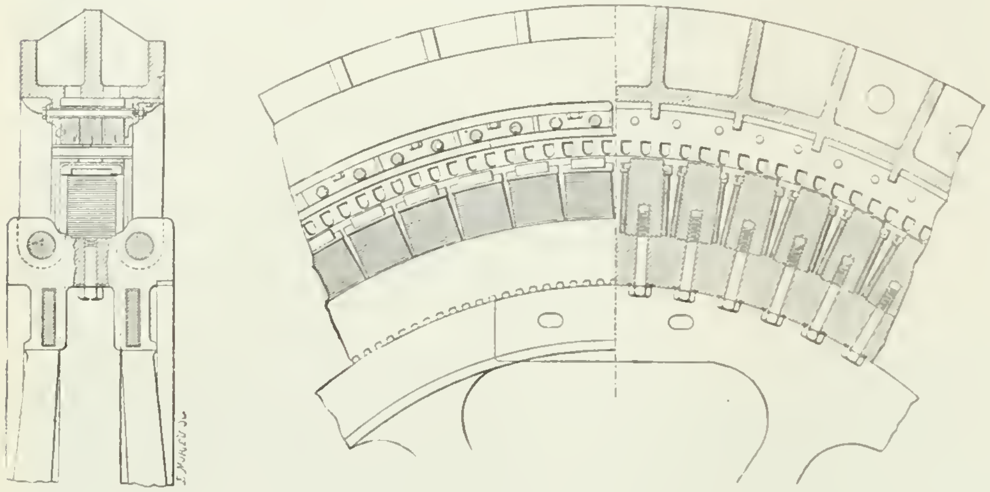
The operation will be relatively the same if the alternator and exciter have not the same number of poles, but have speeds in inverse ratio to the number of poles. In this case the exciter will be geared to the alternator.

The preceding disposition has the disadvantage, which at times may be serious, by requiring that the number of poles of the exciter and alternator to be in inverse ratio to the angular velocities. This objection can be obviated by employing a very ingenious disposition which permits of the collection with fixed brushes of a direct current from the commutator of an armature subject to the action of a field turning with respect to the armature, the field being composed, as above, of two rotary fields proportional to the terminal alternator voltage and to the e. m. f. of self-induction of the alternator. This disposition is based upon the two following considerations:

---

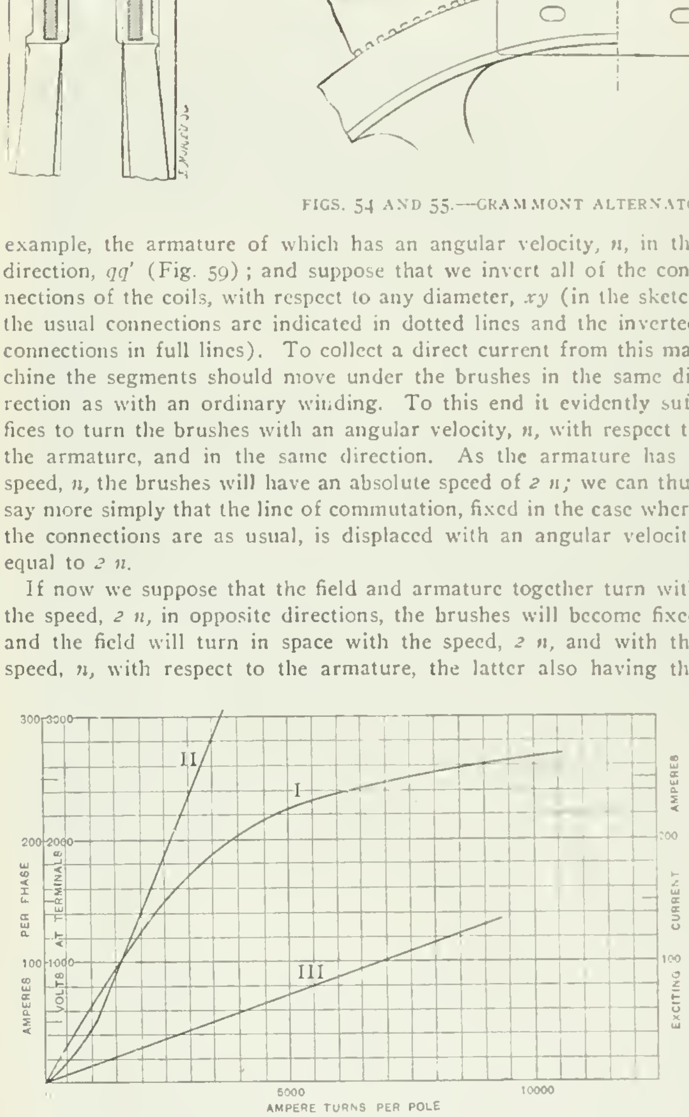
* It suffices to take $O\psi = k\,U$ and $O\psi' = k\,I\sqrt{r^2 + \left(\frac{2\pi}{T}\,l\right)^2}$.
See article by M. Leblance in *L'Eclairage Electrique*, t. xvii., p. 429.

First, consider a direct-current, bipolar Gramme ring dynamo, for example, the armature of which has an angular velocity, n, in the direction, qq' (Fig. 59); and suppose that we invert all of the connections of the coils, with respect to any diameter, xy (in the sketch the usual connections are indicated in dotted lines and the inverted connections in full lines). To collect a direct current from this machine the segments should move under the brushes in the same direction as with an ordinary winding. To this end it evidently suffices to turn the brushes with an angular velocity, n, with respect to the armature, and in the same direction. As the armature has a speed, n, the brushes will have an absolute speed of $2n$; we can thus say more simply that the line of commutation, fixed in the case where the connections are as usual, is displaced with an angular velocity equal to $2n$.



FIGS. 54 AND 55.—GRAMMONT ALTERNATOR.

If now we suppose that the field and armature together turn with the speed, $2n$, in opposite directions, the brushes will become fixed and the field will turn in space with the speed, $2n$, and with the speed, n, with respect to the armature, the latter also having the speed, n. For a machine with $2p$ poles one would evidently obtain the same results by adopting, p, axes of commutation.



I.—No-load Characteristic. II.—Short-circuit Characteristic. III.—Excitation line.

FIG. 56.—CHARACTERISTICS OF GRAMMONT ALTERNATOR.

Second, considering in the next place a multipolar direct-current dynamo with parallel winding, let $2p$ be the number of poles and $2pm$ the number of armature segments. To obtain a direct current from this machine when the armature turns with an angular speed, n, it is necessary, of course, either to cross-connect the brushes having the same potential or to employ two pairs of brushes and cross-connect the armature segments. We may also obtain a direct current if we reduce the $2pm$ armature segments to $2m$ and unite the p points having the same potential, to a single segment and cause two diametrical opposite brushes to revolve with a speed p times greater than that of the armature or pm; for in this case the number of segments which will pass under a brush during a given time will evidently remain the same.

If, as above, we give to the whole a speed of pm in a direction opposite to the rotation of the armature and of the brushes, the latter will become fixed while the armature and the field will turn in the same sense with speeds respectively equal to $(p-1)n$ and pn.

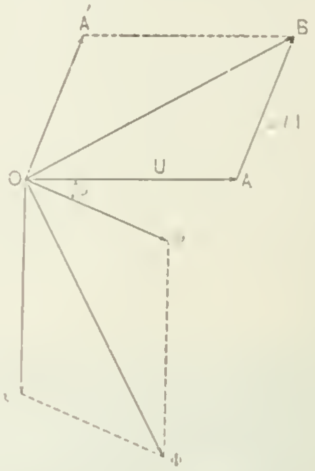


FIG 57.—DIAGRAM OF VOLTAGE, HUTIN AND LEBLANC EXCITER.

Suppose now that instead of reducing the number of segments p times we reduce it only k times, k being a divisor of p, we can then easily conceive that it will suffice to turn the brushes with a speed equal to $\frac{pn}{k}$ to obtain a direct current. In increasing the number of segments by a multiple of p—that is to say, by making k the multiple of p—we can thereby decrease the velocity, but always in the inverse ratio of k, and the speed of the brushes will then become equal to $\frac{pn}{k}$.

We will now see how we can utilize these two properties, or any one of them, to produce a direct-current exciter with fixed brushes, and a rotary field therefor by the composition of two fields, the windings of which are, one in shunt with the terminals of the alternator, and the others in series with the circuits of the alternator. Let a be the frequency of the current produced by the dynamo and $2p$ the number of poles of each of the two fields and of the armature of the exciter. The angular speed, n, of the revolving field, and consequently of the resultant field, will be given by relation, $np = a$, or $n = \frac{a}{p}$. The angular speed of the armature being n', the speed relative to the field of the exciter, admitting that the armature turns in the same sense as the field, is $\frac{a}{p} = n'$. This will also be the relative speed of the brushes with respect to the armature if there are $2p$ pairs of brushes; if this becomes $2k$ the speed of the brushes will be

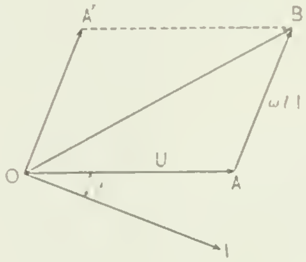


FIG. 58.—DIAGRAM OF VOLTAGE, HUTIN AND LEBLANC EXCITER.

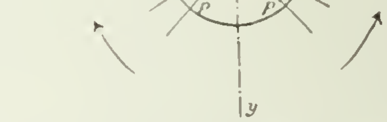
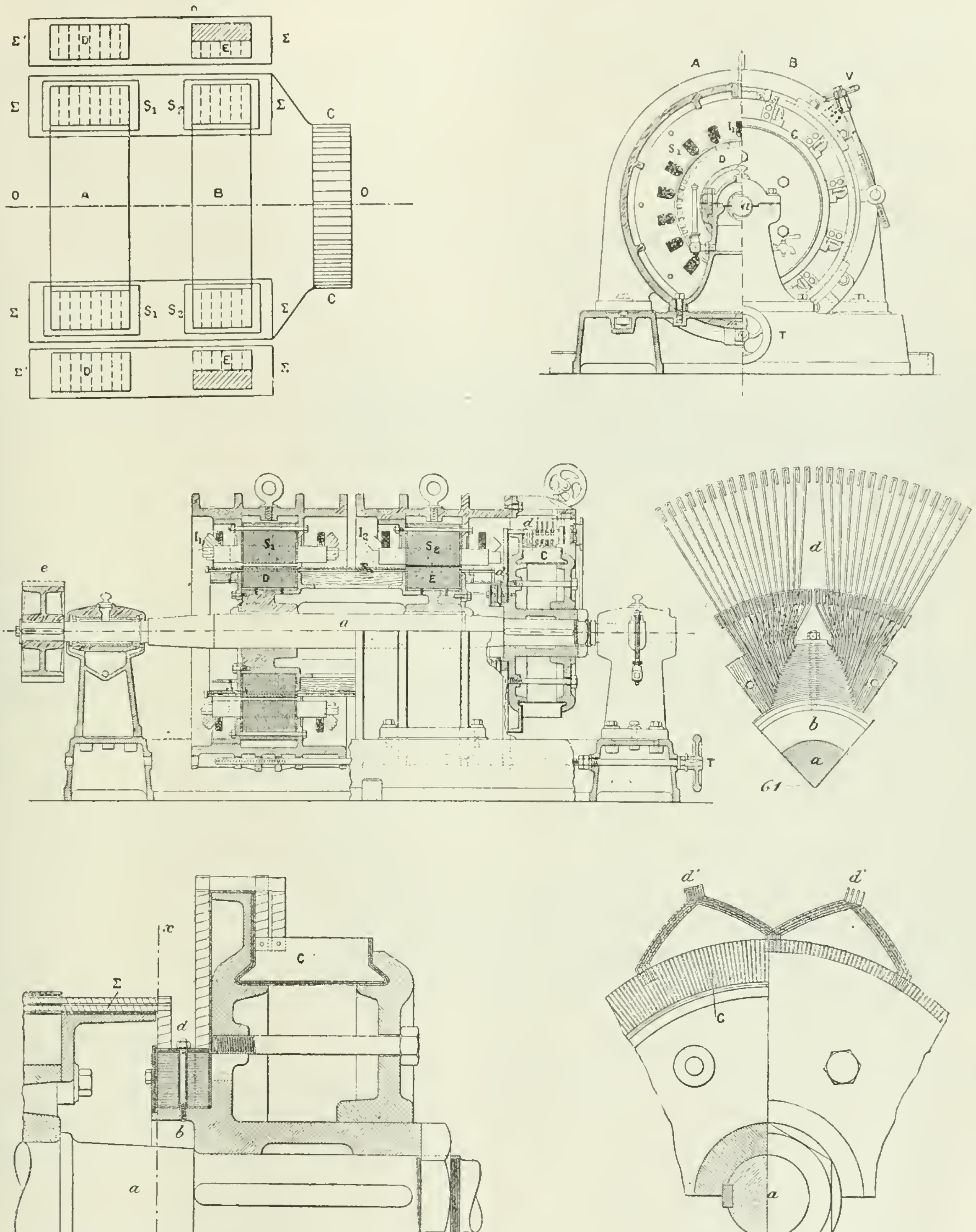


FIG. 59.—HUTIN AND LEBLANC EXCITER.



Figs. 60 to 65.—Hutin and Leblanc Exciter.

modified, as we have seen, in the ratio of $\frac{p}{k}$, and will become

$$\frac{p}{k}\left(\frac{a}{p} - n'\right)$$

Inverting now, as above shown, the connections of the armature with respect to the axes of symmetry, the brushes maintaining the same relative speed with respect to the armature, but in contrary direction from the preceding, it results that the absolute speed of the brushes will have for a value $\frac{p}{k}\left(\frac{a}{p} - n'\right) - n'$

The condition with respect to the fixed position of the brushes is thus

$$\frac{p}{k}\left(\frac{a}{p} - n\right) = n', \text{ or } p - k = \frac{a}{n'},$$

a relation in which a only is known. (We will refer later to the values of p and of k, which have been chosen in the actual design of the exciter). By causing the armature to revolve in an opposite direction from the field, we can make the brushes fixed without changing the connections of the armature. The relative speed of the armature with respect to the field is then $\frac{a}{n} + n'$, and the relative speed of the brushes with respect to the armature for $2\ k$ lines of symmetry is

$$\frac{p}{k}\left(\frac{a}{p} - n'\right)$$

The brushes turning in the same sense as the field, their absolute speed is

$$\frac{p}{k}\left(\frac{a}{p} - n'\right) - n'),$$

which gives for the condition involving fixed brushes,

$$k = p - \frac{a}{n'}.$$

These solutions require that a shall be a multiple of n', and leads to the employment of a number of brushes too large for a convenient speed, n', of the exciter. It thus has no practical value.

In an exciter having a rotary field and an armature rotating in the same sense as the field, we have in fact a true rotary converter and the driving gears impose a definite slip. The action of the fields thus tends to bring the armature to the speed $\frac{a}{p}$ in such a manner that the pinion mounted on the shaft of the armature tends to drag the shaft of the alternator. The energy borrowed by the fields of the exciter from the armature of the alternator is thus partially restored to the latter in the form of mechanical work, the part taken being transformed into direct current for excitation. The ratio thus restored to the total electrical work furnished will evidently be n' to $\frac{a}{p}$.

The exciter is represented in section and partial views by Figs. 61 to 65. The number of poles of each of the fields, S_1 and S_2 is six, the number of pairs of brushes 12; the angular speed of the armature, $n' = \frac{a}{p - k} = \frac{50 \times 60}{3 \times 6}$, is 333 r. p. m. The two stators, A and B, have each an ordinary three-phase winding disposed in 18 slots. The coils, I, of the field, S, are composed of wire of one-eighth inch diameter, there being 3 coils and 92 turns in each circuit mounted in series. The winding is of the star type. The windings, I_2, of the field, S_2, are, as in the case of the alternator armature, composed of a cable of 60.4 mm² section, with 7 turns per slot; the sections of each phase are in series with the armature circuit of the alternator. The armature, E, of the exciter, has a 6-pole drum winding

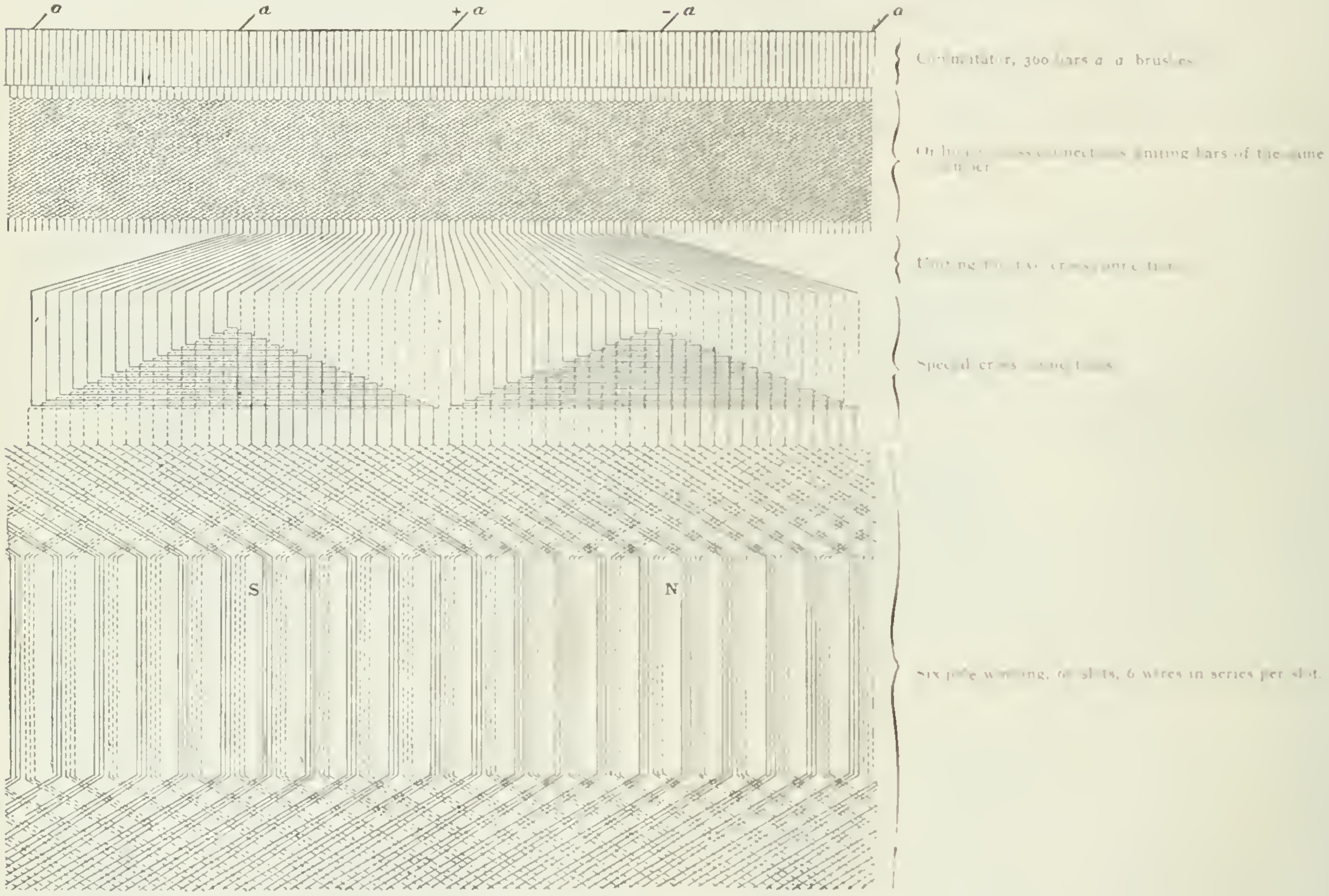

a
a
+ a
− a
a
Commutator, 360 bars a a brushes
Ordinary cross connections uniting bars of the same potential
Uniting the two cross connections
Special cross connections
S
N
Six pole winding, 60 slots, 6 wires in series per slot.

FIG. 66.—HUTIN AND LEBLANC EXCITER, SCHEME OF WINDINGS.

The inversion of the connections is made with the aid of connectors, d (Figs. 64 and 65), formed of two bands of narrow copper of different length, united on the two opposite sides with a wider band, and at the extremities with the same diagonal of these bands. All the wide bands corresponding to the interval between two poles are insulated from each other, and secured on a cylindrical support by means of bolts (Fig. 63). The connection of the sections with the commutator segments is made by means of bars connected to the long end-connectors, d, and uniting the latter to a system of connectors, d' (Fig. 65), identical with those of multiple armatures in parallel. The commutator, C, has 360 bars and a diameter of 20 ins. The brushes, to the number of 36 (3 per set), are mounted on a support which can be displaced by means of a tangent screw, V.

Fig. 66 indicates the scheme of connections of the exciter armature to the commutator segments. In order to over-compound the field, S_1 may be adjusted by means of a screw, T, the adjustment consisting in causing the field to be displaced in such a manner as to cause it to surround more or less of the armature, thereby modifying its action.

Extension of the 40,000-Volt Lines of the Telluride Power Transmission Company in Utah.

By J. R. Cravath.

To the Telluride Power Transmission Company the engineering world owes a debt of gratitude. The management of this company was the pioneer in commercial transmission at high voltages in the mountain districts of the United States, going ahead where others feared to tread, and demonstrating facts which were of the greatest value. Then followed the famous Scott experiments, which were made on this company's property at Telluride, Colo., and where line voltages reached 135,000. This company has for three years been operating a line at 40,000 volts, transmitting from the Provo Cañon, north of Provo, Utah, to Mercur, Utah, a distance of 35 miles. This was principally for supplying power to mines, and is the highest voltage line in regular commercial use at present writing. In addition to this, 70 miles more of high-tension line have been completed, so that the transmission line now completely encircles Utah Lake, supplying power and light to various points on the circuit as desired, and returning to the Provo Cañon plant from whence it starts. In ordinary operation this practically gives two circuits to any point on the circuit, and is much better than duplicate lines on the same pole line, because some kinds of interruptions would affect both circuits equally if on the same pole line. The circuit is sectioned up so that in case of a breakdown on one section that section can be cut out and the service supplied by the lines on both sides of the interruption. Repairs are regularly carried on in this way without interruption of service. No repairs are made on the live line, as it is impossible. The transformers are operated with Y-connection, and the neutral point is grounded for the protection of the transformers against lightning. In the three years since the plant started the only 40,000-volt transformer lost was one which accidentally got wet. The first transformers for the 40,000-volt line were built under the supervision of this company's men at the Wagner factory in St. Louis. They are oil insulated. The line insulators are triple petticoat glass, made by the Hemingway Glass Company, Muncie, Ind., and designated as Provo No. 1. There is no trouble from puncturing these insulators from the voltage alone, but they are shot at and broken occasionally. The Telluride Company uses glass for insulators on all its work, and believes it to be superior to porcelain. The glass insulators are not put to any electrical test before being put up, because defects are apparent to the eye with glass, as they would not be with porcelain. These insulators are about 7 in. in diameter. They are not center-bearing, but the wires are tied into a groove on the side.

It is of value to note that this line has not been subject to interruption by the throwing of wires, sticks and weeds across the lines, as have some of the other lines in the State. This is mainly because of the great distance apart of the line wires. They are placed to form the corners of an equilateral triangle, and are 64 in. apart. The top wire is on a pin on top of the pole, and the other two are on a cross arm 7 ft. long. This creates conditions so that it takes a great deal more skill and strength than the meddlers seem to care to exert to throw over the lines anything long enough to make a short circuit. It has been found not only impossible to use the telephone over circuits run on this same pole line, but the presence of the telephone circuits proved a source of danger to the poles. The telephone wires were run on short cross-arms, and discharges across from the pole to the telephone wire frequently burned holes in the pole. Running with a grounded neutral doubtless has much to do with these effects. The locust pins on the transmission line were all boiled in paraffin, and the cross-arms were treated by being kiln-dried and then dipped in a bituminous compound at 100 degs. F. The bitumen penetrates ⅜ in. into the wood. It is found that metal bolts and nails are good things to avoid in poles, because if there is any leakage down the pole it is concentrated by the metal so as to char the wood around the bolts. This company's new work will have no bolts, but will have holes cut through the pole tops to fit the cross-arms, and the cross-arms will be driven through and held in place by locust pins. On level ground 40-ft. poles are used, and in mountainous country 35 ft. Lines for the telephone service, which is necessary in operating a system of this kind, are leased from the Rocky Mountain Bell Telephone Company.

The high-tension line from the Provo Cañon power house to Mercur, which was the one first built, has 44 poles to the mile, and consists of three No. 5 copper wires. From Mercur to Eureka the line is of aluminum stranded cable, equivalent to No. 5 copper, and made up of seven strands .088 in. diameter. From Eureka to Provo the line is stranded aluminum cable, seven strands of .090 in. diameter. Poles on the aluminum line are set only from 26 to 33 to the mile on account of the lightness of the aluminum. This, of course, makes quite a difference in the cost of the line as compared with copper in addition to the saving in the cost of the wire. Solid aluminum wires were first put up, but had to be replaced with stranded cable, because of breakage.

At most of the sub-stations, the reduction is from 40,000 to 5000 volts, for local distribution. The greater part of the company's load is in the shape of induction motors. There are a few towns lighted but that load is small compared to the total. All charges are by flat rates.

The capacity of the 105 miles of line is very great. With no load on but the transformers, the apparent kilowatts at the power house are 750, and the actual watts nearly nothing. As the load comes on, the wattmeter rises and the ammeter falls until at about two-thirds of the station's full load, the power factor is 95 per cent. No need for synchronous motors to improve the power factor on that line! It is, however, a novel sensation to the majority of engineers to see the ammeter fall as the load rises. The 5000-volt distribution in the town of Provo is over No. 8 B. W. G. iron wires. The pole lines are run down the center of the wide streets, and transformers and incandescent street lights are hung directly from the cross-arms. The primary wires have a cross-arm on top of the pole, while below it are the secondary mains. The Eastern reader may smile at this arrangement, but it is not exaggerating to say that the pole lines are neater in appearance and safer in fact than in nine out of ten Eastern towns of the same size. The East has much to learn from the West in the matter of neat pole-line construction.

Although the Telluride Power Transmission Company's Utah system is already extensive, important permanent additions are to be made to it. In place of the present plant in Provo Cañon, a more permanent one will be built at the mouth of the cañon to develop 8000 hp at 380-ft. head. There is now going in at Logan, Utah, a 3000-hp plant, which will connect in parallel with the present 105-mile circle by a 90-mile 40,000-volt aluminum line running down past Ogden and Salt Lake City, at which latter place it is not unlikely that some power will be delivered. A. S. Woodhouse is superintendent of the Utah department, with headquarters at Provo. The main office of the company is at Telluride, Colo. A 15,000-hp water-power is also being developed 70 miles from Butte, Mont., by parties interested in the Telluride Power Transmission Company.

Telephone Meeting of the New York Electrical Society.

The 212th meeting of the New York Electrical Society was held on Feb. 14. Mr. Kempster B. Miller, chief engineer of the Kellogg Switchboard & Supply Company, of Chicago, lectured on "Modern Telephone Engineering." Mr. Miller discussed very fully the equipment of the telephone exchange, its functions, and many important engineering problems connected with it. Mr. Miller also exhibited a number of curves and views, etc., which were of the greatest interest, and in many ways threw important light on improved telephone practice, about which there has been a lack of information in recent years. The lecture was greatly enjoyed by a full audience.

The president announced the election of Mr. C. E. Knox as vice-president, to take the place of Mr. W. C. Burton, who has resigned in consequence of his continued stay in England.

The following members were elected: A. L. Orton, New York Telephone Company, 32 Gold Street, city; Munson D. Atwater 22 Thames Street, city; Walter L. Thompson, 115 West Forty-ninth Street, city; Frank B. Rae, 45 Broadway, city; William Kent, *Engineering News*, 220 Broadway, city; A. B. Eads, Western Electric Company, Bethune Street, city; James R. Strong, 35 South William Street, city; E. B. Lever, 174 Washington Avenue, Newark, N. J.; William B. Osgood Field, president Holophane Company, 15 East Thirty-second Street, city; E. L. Elliott, 15 East Thirty-second Street, city; J. M. Wakeman, Electrical World and Engineer, 120 Liberty Street, city; David Killock, 214 West 105th Street, city.

The lecture, like that of Mr. Steinmetz on alternating-current work, is to be put into shape for publication by the Society, and can therefore be referred to but briefly here. Mr. Miller said he believed it to be a well-established fact that the best telephone service can be given where all the lines of the subscribers in a city run to a single exchange, and are there handled by a single multiple switchboard. By this means all calls for connections by any subscriber may be handled by a single operator. Where the number of subscribers, however, is too great to be connected to a single switchboard, or where the distribution is such as to naturally group them about well-defined and remote centers, a greater number than one exchange must be installed and lines provided between them for connecting the subscribers in the different exchanges. Such lines are called trunking lines in distinction to subscribers' lines which connect the subscribers with the central office. In most cases where trunking is necessary, most calls have to be trunked. He said the percentage of trunked calls to total calls for Greater New York is in the neighborhood of 80. A connection made over a trunk line necessarily occupies more time and thereby renders the service a little slower; in fact, the aggregate time required for connection over a trunk line is practically twice as great as where accomplished by a single operator in a multiple board. The fact that two operators necessarily handle a trunk connection necessarily increases the liability to error in making the connection and therefore produces less satisfactory service. The trunking apparatus and circuits in order not only to transmit speech but to convey the requisite signals between the operators are necessarily more complex than subscribers' line circuits, and thereby a greater liability to trouble exists than where no trunks are required.

Mr. Miller then went on to consider the question from the standpoint of operating expenses, and came again to the conclusion that it was altogether best to have one big exchange, even of 100,000 subscribers. As to length of subscribers' line with one central, he said that Mr. F. J. Dommerque had shown that in Chicago it would be 20,000 ft. He noted the fact that hitherto the Bell systems had been limited to exchanges of a switchboard capacity not to exceed 6000 lines. But there was a tendency to larger exchanges among both the Bell companies and the independents. The Cuyahoga Telephone Company, of Cleveland, is now equipped with a multiple Kellogg board having a capacity of 9600 lines installed, and with an ultimate capacity of about 20,000. The board at Paris, France, equipped by the Western Electric Company, has a present capacity of something like 9300 lines, and the Kinloch Telephone Company, of St. Louis, Mo., has a present equipment of 8800 lines. Mr. Miller understood that a number of exchanges to be operated by the Bell Company are now being planned or built, having a capacity of 9000 lines and upwards.

In this connection the lecturer discussed the practical limitations in building boards, and mentioned that in the Paris Western Electric board the jacks were inserted on three-eighths of an inch centers, both horizontally and vertically. His own company had recently worked out a system in which the jacks could be built on quarter-inch centers, giving one operator control of at least 25,000 lines. Another way out was the "divided" multiple board as seen in the Kellogg exchange at St. Louis. With an exchange in four divisions, and jacks on quarter-inch centers, over 90,000 lines could be brought together without giving the operators as great a reach as they have at present on some multiple boards; while there would be no trunking.

Mr. Miller stated that with prompt service, connections could be made in about six seconds. The average time of a conversation was less than two minutes. He showed by elaborate diagrams how the connections were made, employing Bell circuits for this purpose. He also showed by curves how the load of an exchange ran through the day. It was curiously brought out that with the cheaper "independent" service shown, business began earlier, less time was consumed for lunch, and the load continued later into the afternoon. After showing views of large Bell and Kellogg exchanges, Mr. Miller illustrated most interestingly the details of modern telephone apparatus, including plugs, jacks, relays, lamps, cords, cables, etc. He closed by saying that in the future of telephony the large cities would be the main offices, the smaller towns and villages the branch exchanges, and the long-distance lines the trunks of the systems.

Automobile Legislation.

A bill was prepared by the Automobile Club of America and offered in the United States Senate by Senator Platt, of New York, and it has already undergone several stages of advancement. So far there has been no opposition to the measure.

The Dynamo in Recent Telephone Practice.

By D. M. Bliss.

An inspection of a modern telephone exchange reveals many interesting departures from the standard practice of a few years ago. This is especially true of the latest development in the telephone field, the central energy or common battery system. In this method of operating an exchange the subscribers' local battery and calling generator are dispensed with and the energy necessary for the signaling and talking currents are supplied by a suitable plant at the central office and distributed throughout the system. In an exchange, therefore, of any reasonable size the amount of power to be continuously taken is much greater than is usually supposed to be necessary in telephone work; hence it is a matter of considerable importance when remodeling or equipping new systems to give the most careful consideration to the generating devices and to arrange it in accordance with modern engineering practice.

Most of the generating apparatus required for modern telephone work is distinctly special in character, and cannot be purchased in the open market. A description, therefore, of apparatus which may now be considered standard for supplying exchange systems, its location and the most desirable arrangement of circuits will, no doubt, prove of interest to those engaged in the telephone field.

Considering, first, the source of direct current for transmitter service, the storage battery has been and is still very largely employed. Its low internal resistance, high e. m. f., compactness and great current capacity render it particularly well adapted for common battery service.

Fig. 2 shows a good arrangement of circuits using storage battery in duplicate, with means for charging furnished by a dynamo of the ordinary description. It will be noticed that one set of batteries is continuously on the system while the other set is being charged; all necessary connections between the lines, batteries and the charging mains being effected by means of double throw, double-pole switches so arranged that there is no danger of interrupting the service.

It is of vital importance that storage batteries of whatever make or description have systematic and intelligent care. If properly installed and attended to they give excellent service at a moderate expense, but if from any cause deterioration of cells once sets in effective service will be impossible, and the life of the batteries will be greatly shortened, to the discredit of the storage battery rather than the management, which in nine cases out of ten is responsible for such a result.

The proper care of storage cells, the location and cure of their troubles can only be learned by practical experience and only men who have had this training should be put in charge of this important part of a modern exchange equipment.

The charging machine is usually of the shunt-wound type, wound for a maximum pressure of about 35 volts. If for any reason a compound-wound machine is used, means should be provided for shunting the series winding while the cells are being charged, the charging pressure being regulated in the usual manner by a shunt field rheostat as shown.

Both gas and gasoline engines have been used with success for operating charging dynamos where the local conditions allow of their use. But as exchanges are often built in residential districts, it may be found necessary in some cases to drive by electric motor and thus avoid a frequent source of complaint where gas engines are used.

When only one set of storage batteries is used or where it is intended to operate a system directly from the dynamo the selection of a suitable generator for this service is a matter of great importance and telephone engineers should not be misled by the idea that the ordinary bi-polar and multi-polar design, however successful it may be for lighting and power purposes, will be suitable for telephone work. While the current they generate is direct, it is not of a sufficiently steady character for transmitter service.

Modern dynamos are built with slotted core armatures and a high-field density. This, with the high self-induction and comparatively few number of coils in the armature, combine to produce a current which is so noisy in the telephone circuit as to make intelligible conversation impossible; no better proof of this can be furnished than listening on a telephone circuit subject to leakage and excessive induction frequently found on telephone systems. In these cases the disagreeable hum and buzzing of railway and lighting circuits is a serious hindrance to conversation, and if this is the case with the comparatively feeble currents induced in such a circuit it can be readily seen that a machine of this type feeding a telephone system directly is out of the question, and no arrangement of choke coils and condensers will remedy or remove this defect.

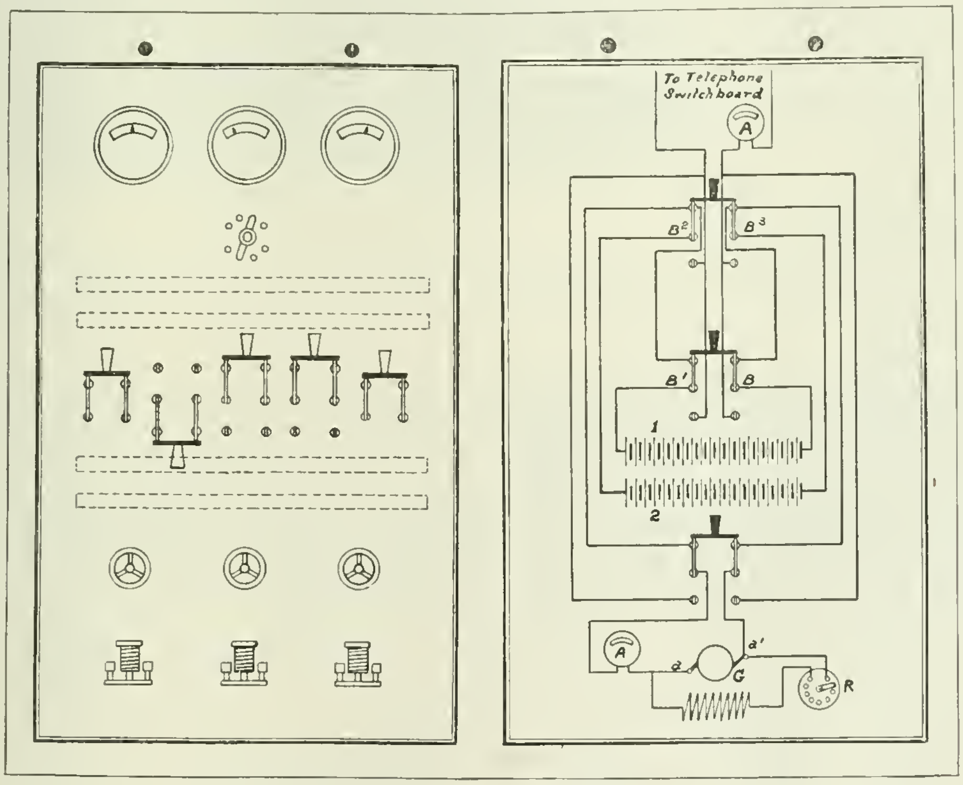
A dynamo for direct service or for use in multiple with storage batteries must deliver a current perfectly free from pulsation, and the commutator and collecting device must be of such a character as to eliminate any possibility of imperfect contact at this part of the machine. These desirable results can only be reached by having a machine designed especially for telephone service. Such a machine is shown in Fig. 3, coupled to a driving motor, both mounted on an iron sub-base.

It is of the multipolar type, the armature is smooth or surface wound with a great number of coils of only one turn each, and connected to a commutator having an equally large number of segments. The induction in the field is comparatively low, and the pole shoes are so shaped that any given coil enters the field in a very gradual manner regardless of the speed at which the armature is running. The brushes are of finely woven copper wire so that perfect contact is obtained at all times with the commutator, and the very slight pulsations in the current are so rapid in character as to be inaudible.

With this machine a very slight whistling is noticed at times, which is due to the action of the brushes on the commutator, and which is entirely corrected by impedance or choke coils.

This dynamo has become practically a standard with several leading telephone companies and solves quite a serious problem in the power equipment of most common battery systems. The largest size known to the writer is of 10-kw capacity of the above design, which is in use in several of the exchanges of one of the leading subcompanies. A smaller size very much in demand is rated at ¾ kw, delivering a current of 20 amperes at 30 to 35 volts.

In some cases, when used in connection with storage batteries, these machines are compounded, provision being made for short-circuiting the series coil when batteries are being charged; at other times the dynamo feeds the circuits directly. A machine of this sort renders unnecessary the use of a spare or duplicate set of storage cells, or where power can be obtained at all times the cells may be dispensed with entirely.



FIGS. 1 AND 2.—DIAGRAMS OF SWITCHBOARD AND CIRCUITS.

Referring again to Fig. 2, the storage batteries in two equal groups, Nos. 1 and 2, are connected to independent double-throw switches. The generator, G, is a plain, shunt-wound machine, with a field regulating rheostat, R; the latter should have a large number of contacts so as to give the closest regulation and should have sufficient resistance to give a suitable variation of pressure at the dynamo terminals.

The dynamo leads are connected to a main double-throw switch, as shown. This switch in one position will connect the dynamo to the battery charging mains, and when thrown to the lower position will be connected directly to the main telephone bus-bars so that if the machine is of the noiseless type it may be used in case of accident to the battery system to support the telephone circuits directly. As arranged in this diagram the battery switches when thrown to their upper contacts will connect the battery to the charging dynamo, and when thrown down will be connected to the telephone mains.

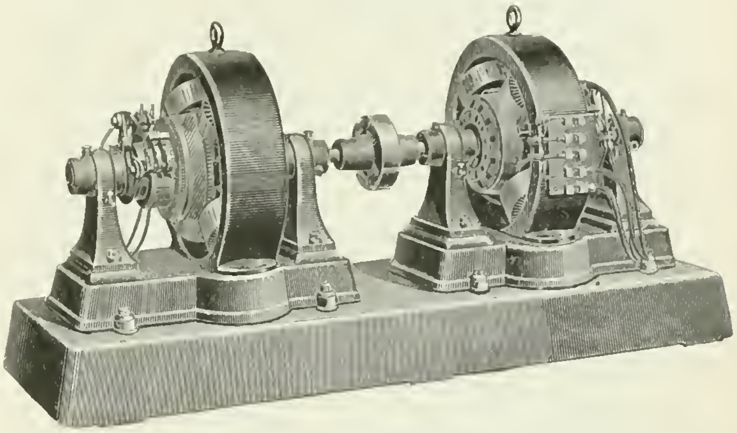


FIG. 3.—MOTOR DYNAMO.

An ammeter should invariably be used on the dynamo circuit, and in the telephone mains. It is also convenient, but not absolutely necessary, to have one in each of the battery circuits.

A voltmeter with a suitable switch should be arranged so that the pressure can be taken from A, A^1, B, B^1, B^2, B^3. It is essential for good service that the ammeters and voltmeters should be standard and of first-class construction. A low-priced instrument usually proves a very costly investment in the long run, as the readings, not any too accurate at first, soon show such a large error that they are practically worthless and liable to lead to serious results, especially when used with storage cells.

Referring to Fig. 1, in which the details of the switchboard are shown, this arrangement has proved very satisfactory in practice, and as here illustrated, corresponds to the system shown in Fig. 2; the voltmeter switch being placed in the center with the dynamo and main circuit ammeters on each side. The double-throw dynamo switch is in the center with the double-throw battery switches on either side.

One of the two smaller switches shown at the outside of the board is used for the motor switch when the generator is motor-driven. The other switch at the opposite side of the board is for connecting in the ringing or pulsating current generator.

Immediately below the main dynamo switch at the center of the board is the field regulating rheostat for the charging dynamo; while the small rheostats at either side control the motor and ringing generator, respectively.

Circuit breakers at the lower part of the board are shown, and it will be found in practice that automatic circuit breakers of standard make are much to be preferred to the uncertain and unsightly fuse.

The switchboard should be made of the best quality of slate, free from veins, if possible, and filled by driving paraffine into the pores of the stone by means of a gas torch and blow-pipe. This precaution is quite necessary where good insulation is required, as in a switchboard of this character 500 volts is quite frequently used to operate the motors and motor generators.

A very frequent error in erecting a switchboard is placing the board too close to the wall or partition. It should stand out as far as possible with plenty of room and light for making connections, inspecting and cleaning the back of the board. The connections to the bus-bars, switches, etc., should be most thoroughly soldered or connected by heavy well-fitting bolts.

Considerable energy is frequently lost in imperfect contacts, and it should not be forgotten that the small area of contact or conductor necessary to carry the currents formerly used for telephone work are totally inadequate for the proper handling of the large currents used in the common battery systems.

It is to be regretted that the manufacturers of storage batteries are so interested at the present time with light and power equipments that very little information regarding the storage battery as applied to telephone service is available for the telephone engineer. Descriptive bulletins without number of central station and isolated lighting plants may be had for the asking, but, so far as the writer knows, nothing relating to telephone service has been published.

It is possible, however, that the fault is not altogether with storage battery manufacturers, but partly due to the reluctance of telephone companies to publish their plans of installation. This antiquated policy on matters of general interest to the profession is to be deplored. It has been abandoned to a great extent in the other branches of engineering, and there is no good reason for its continuance in telephone practice.

When noiseless dynamos of proper construction are used one of the batteries may be dispensed with to advantage, and the dynamo and central battery run in multiple, provided proper arrangements are made to take care of the increased pressure required during the period of charging.

The day of cheap and flimsy construction in telephone plants has gone by, and it should be unnecessary to state that all the generating apparatus of an exchange system should be of the best quality and located where there is plenty of light and space; and it should be borne in mind that such arrangements of circuits and insulation which might prove satisfactory where the entire generating plant is composed of a few cells of battery, is not at all adapted to present conditions in which the current is generated by dynamos or storage batteries of large capacity and considerable pressure. There are many other featurs in connection with the installation and operation of a plant of this character which can only be appreciated by those who have had experience in this branch of engineering. Ordinary business policy will therefore demand that the work be under the supervision of an engineer who has made this class of work a specialty.

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Ganz Three-Phase Traveling Crane.

THE accompanying engravings illustrate a 20-ton traveling crane made for the Hungarian State Railway by Ganz & Co. of Budapest, and operated by three-phase induction motors.

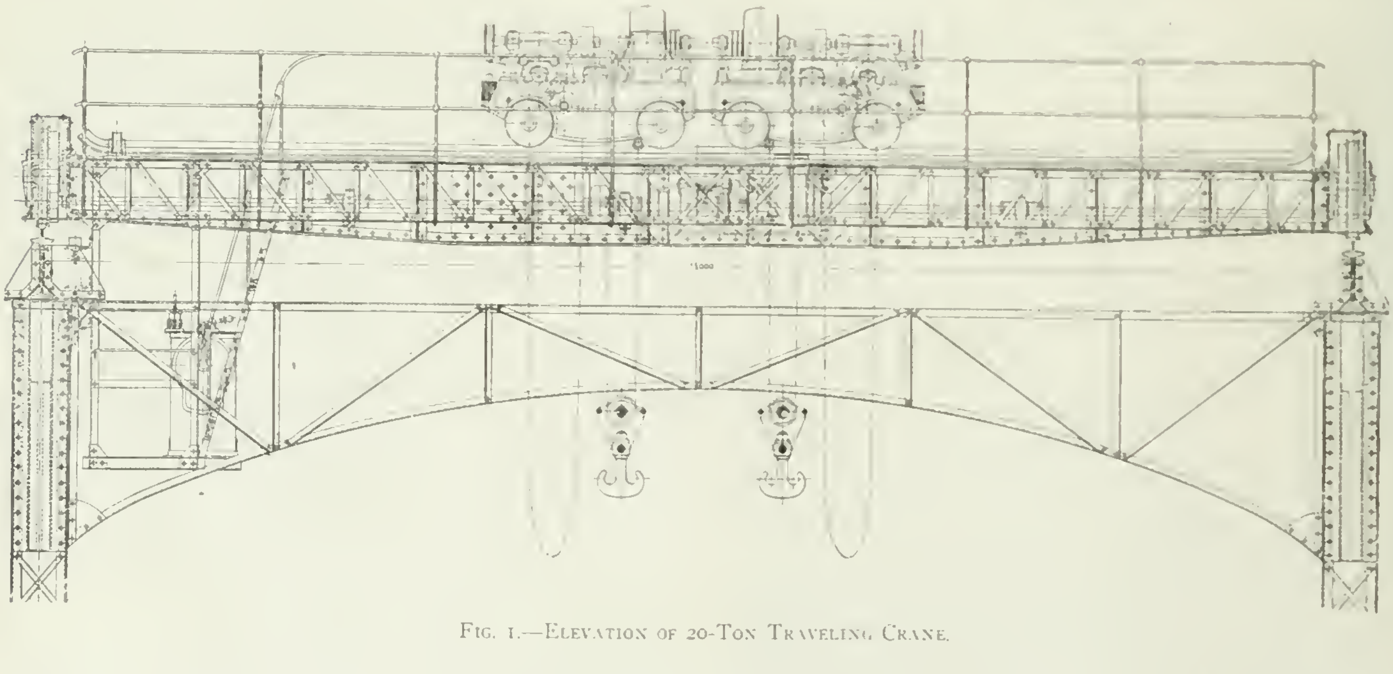


FIG. 1.—ELEVATION OF 20-TON TRAVELING CRANE.

The crane is provided with two 10-ton hoists, each of which has two motors, one of 12 hp for lifting the load and one of 3 hp for traversing. There is also an 8-hp motor for moving the crane itself. All of these motors are wound for 220 volts and a frequency of 42. The work of the hoisting motors is transmitted by means of a worm and wormwheel, and that of the traversing motor by a pinion and wheel gearing.

Each of the hoists is provided with a three-phase solenoid brake for holding the weight. If the current should be interrupted, the solenoid releases a weight on the lever of a band brake, which latter then grips and holds the load. The moment, therefore, the hoisting motor is placed out of action the load is held by the action of the brake.

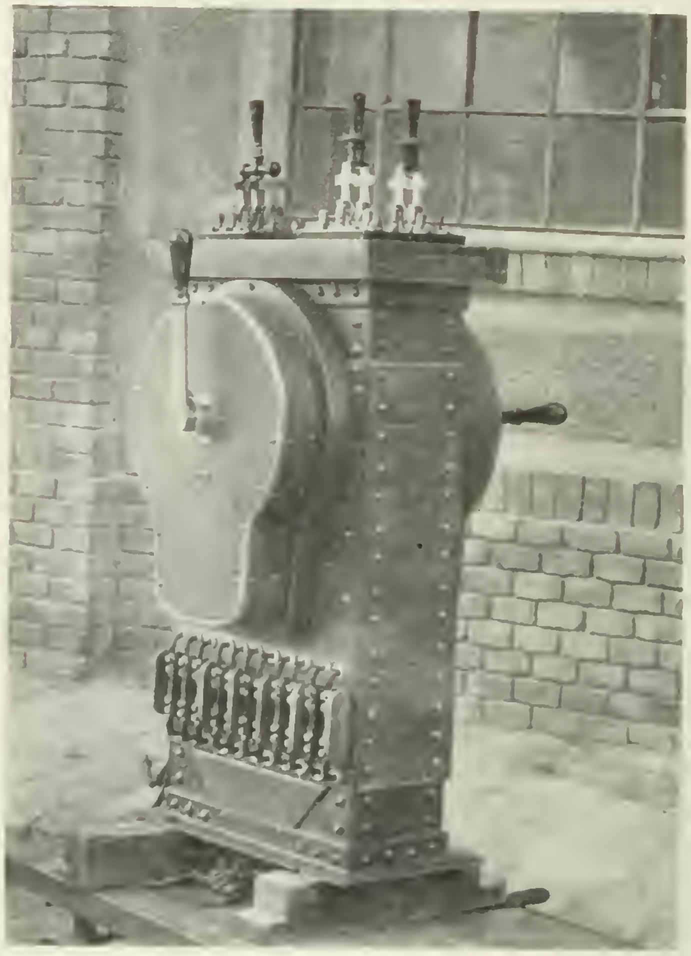


FIG. 2.—CRANE CONTROLLER.

The load is lifted at a speed of 12½ ft. per minute. The traversing speed of the hoists is at the rate of 60 ft. per minute, and the speed of the crane 130 ft. per minute.

The body of the crane is constructed of two double T-shaped riveted iron plate girders, secured to two box-shaped front girders; and two smaller girders, secured partly to the main girder and partly to the front girders.

The 8-hp motor for moving of the crane is placed in the middle of the crane body, below the walking-plank on a foundation resting on "U"-shaped irons. Its power is transmitted by means of a worm and worm-wheel in connection with symmetrically placed pinion-wheels transmitting to the crane wheels. The body of the hoists is of cast-iron

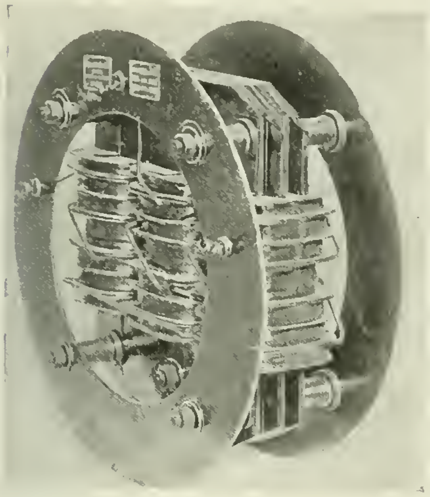


FIG. 3.—30-KW THREE-PHASE TRANSFORMER.

The current is conducted to this crane through three bare wires suspended along the line of the crane, the current being taken off by contact-rollers on which the conductors bear by their own weight, thus securing an efficient contact. From the rollers the current is conducted to the to the controllers, which are mounted in the operator's platform at one end of the crane under the horizontal beams. Thence the current is conducted by 16 bare hard-drawn copper wires suspended along the line of the crane.

The hoisting motors are provided with rings by means of which current is conducted to the primary part of the motor, which is the rotating part, the stationary or secondary part being connected to the controlling rheostat. All other motors are provided with short-circuited rotating parts, the current being conducted to the stationary primary part. There are for each hoist nine contacts, but as two of the six conductors can be united—since in the reversing of a three-phase motor it is only necessary to change the conductors—8 contacts are sufficient for each hoist, or 16 for the pair.

The motors for moving the crane are provided with current by means of insulated wires, which are mounted on the body of the crane. On the operator's platform are situated all switches as well as two controllers, all movements being regulated from this point. Fig. 3 shows the type of three-phase transformer used, which transforms the voltage from 2200 to 200 volts.

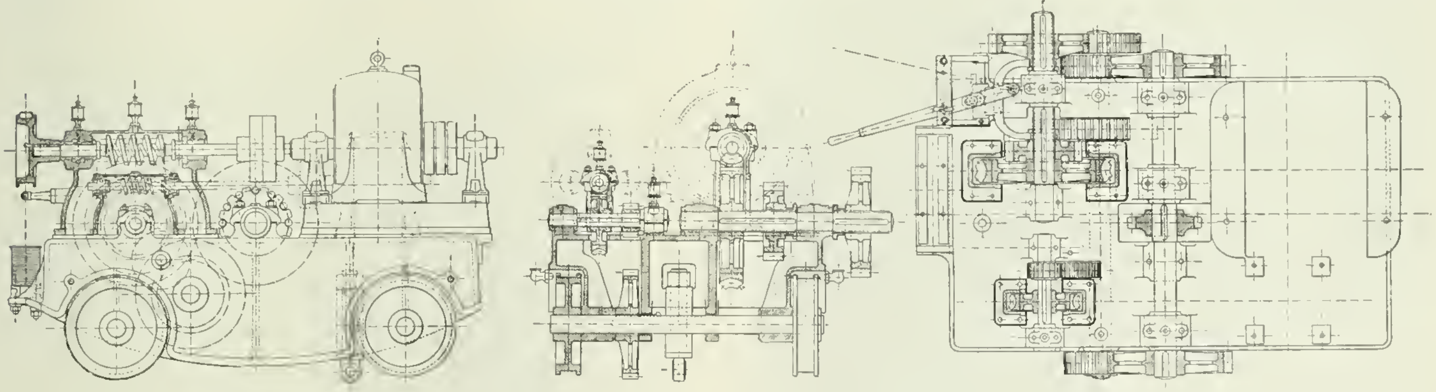


Fig. 4.—Elevations and Plan of Crane Mechanism.

Dr. Pupin's Telephone Patents.

The Pupin patents on the art of reducing attenuation of electrical waves, Nos. 652,230 and 652,231, of June 19, 1900, have been reprinted by the Patent Office and copies can now be obtained once more. The recent acquisition of these patents by the American Bell Telephone Company has created a general interest in them, and led to a demand for them. They are an interesting contribution to telephone literature, and are referred to elsewhere in this issue.

Transformer Incidents.

By Thomas W. Varley.

A TRANSFORMER is an electromagnet with a perfectly closed all-iron magnetic circuit. If now this circuit is strongly magnetized and the current which magnetized it removed, the iron will preserve its magnetic strength for a long time. It is in consequence of this effect that some peculiar results are obtained, which may seem puzzling and startling to the ordinary user of a transformer.

Suppose we take a transformer, on, say, a 25-cycle alternating circuit, and suddenly open the circuit while, say, the positive wave of current is at its maximum. This would leave the iron highly magnetized in a certain direction. Now, if the circuit is closed while the current wave is in a negative direction, this current has to demagnetize the iron and magnetize it in the opposite sense, and where this takes place in the 50th part of a second, the rate of change of the magnetic field is so great that but a small current will flow on account of the counter e. m. f. This current is known as the magnetizing current.

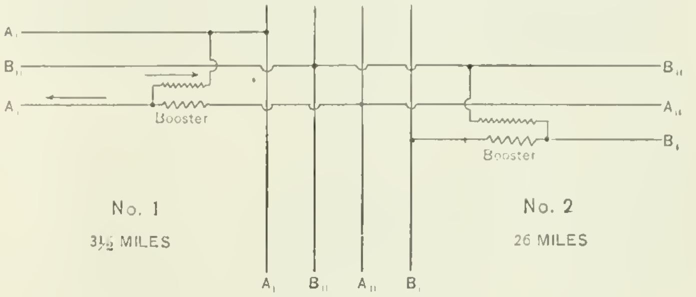


FIG. 1.—DIAGRAM OF CIRCUITS.

Suppose now that instead of closing the circuit while the current would be negative, we closed it in such a way that the current wave would be positive or in the same direction as it was when the circuit was first opened. This positive wave could not magnetize the iron more strongly, at least not much more, and the rate of change of the magnetic field would be very slight; in fact, so slight that an enormous rush of current would take place while this positive wave lasted.

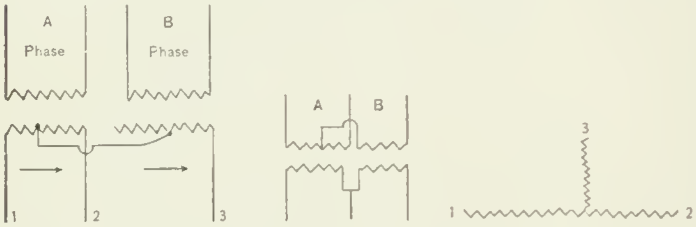
This effect has actually taken place, to my certain knowledge, in the case of a large transformer on 25 cycles where the normal current with secondary open is 30 amperes. The circuit can be opened and closed again, and in about once out of four times the rush of current was great enough to throw an 800-ampere circuit-breaker. It was such a serious matter that a water rheostat was introduced to allow the current to come up slowly to its normal value.

Another matter of some interest happened where there were two long underground circuits, one of 26 miles and one of 3½ miles, feeding from the same set of bus-bars, both using Stillwell boosters, as shown in Fig. 1. The two circuits were regular three-wire, two-phase. No. 1 circuit was boosting up as shown, while No. 2 could be boosted either up or down. Just so sure as a variable ground showed up on No. 2 circuit on the *A″* leg and discharged this *A″* leg disruptively, the booster in No. 1 circuit, which was on the same leg, would be exploded so violently that even the iron casing would be blown off, while the coils would be bent far away from each other. And this on a 30-kw transformer.

When this effect had taken place four times in succession the booster of No. 1 circuit was changed from the *A″* to the *A′* leg. Since then no trouble has developed. This may be explained as follows: Suppose the voltage of *A″*, with respect to earth were, say, a positive maximum. This condition would give the greatest current to earth through the ground. If now the circuit were carrying its full load the current curve in the booster or transformer would be very nearly in step with the e. m. f. curve. As this discharge takes place very rapidly and would amount to a large current, it would remagnetize the core in the opposite sense to what it was, leaving it in such a condition that the next e. m. f. wave of a negative direction would have no iron to magnetize. In consequence its c. e. m. f. would be next to nothing and its rush of current great enough to do the damage shown.

Another case of interest is in a plant where two-phase currents are generated, then stepped up and changed to three-phase currents by means of a Scott connection, as shown in Fig. 2.

On open circuit the voltage between 1 and 2, 2 and3 and 1 and 3 is similar, but when loaded up so that each leg of the three-phase carries the same current the voltage of 1 and 2 and 2 and 3 is similar, while that between 1 and 3 may be 15 per cent less. This same effect takes place where the two-phase three-wire service is used with the connections like in Fig. 3. Also in the monocyclic system where a winding is brought out midway between the main windings like in Fig. 4, and connected to the center of the main winding the same trouble will be found in keeping the phases balanced for the balancing will be different for all loads.



FIGS. 2, 3 AND 4.—DIAGRAMS OF TRANSFORMER CONNECTIONS.

In changing from two-phase to three-phase with the Scott connection, if a number of taps were brought out to one side of the center so as to be able to vary the connection with the load, this unbalanced effect would be entirely overcome.

This might be explained as follows: The transformer on the *A* phase has a wave of current from 1 to 2 in the direction of the arrow, which, as it dies out, leaves the core magnetized in a fixed direction. As it dies out a wave of current starts through the transformer on phase *B*, as shown by the arrow, whose return path is from the center of the transformer on phase *A*. If its path through *A*, by way of leg No. 1, is in the same direction as the previous current from 1 to 2, it will be a much better circuit than that by way of leg No. 2, which would have to oppose the previous state of affairs.

These are but a few of the many incidents that take place in the operation of transformers, and though simple enough if explained, which I hope is done correctly, may and do cause a good deal of hard thinking and ingenuity to overcome.

American Municipal Debts.

New York City's debt was $489,905,900 on Jan. 1, 1901, an increase in one year of $31,000,000. Three years ago the net public debt of Chicago was $17,013,000. It is now $26,332,000. Th debt of Baltimore, which was $15,000,000 three years ago, is now $31,000,000, and the debt of Boston, which was $49,000,000, is now $56,000,000. Within three years the debt of Philadelphia has increased from $34,000,000 to $43,000,000. The debt of Rochester has increased from $8,400,000 to $10,002,000, and of Buffalo from $13,200,000 to $14,100,000. Three years ago the debt of Cleveland, Ohio, was $6,200,000; it is now $9,200,000. In the same period the debt of Columbus increased from $3,500,000 to $6,000,000; of Detroit from $3,500,000 to $4,600,000; of Indianapolis from $2,000.000 to $3,000,000, and of Kansas City from $3,700,000 to $4,600,000. The rapid increase of such indebtedness is becoming a cause of serious alarm, which may presently check the growth of municipal enterprises, and leave more to private initiative.

The Forerunner of the Telephone.

By Edward A. Calahan.

THAT the conservative management of a bank inspires more confidence in the depositors than the amount of the bank's capital, surplus or the great names among its board of directors, is too well known to dispute. The introduction of a stock ticker into a bank in the year 1869 was, or would have been, equivalent to placing a keg of gunpowder underneath the vault, or establishing a Monte Carlo outfit in a side room. The bank loaned its thousands daily on stock collateral with its fluctuating value. It had no means of knowing the condition of the market except by such methods as were in use before the advent of the stock ticker.

No one realized this disadvantage more than the late William A. Camp, who was then and for many years afterward the manager of the New York Clearing House. He early became an enthusiastic stock holder in the Gold & Stock Telegraph Company. Through his energy and perseverance he secured for that company about 48 of the 60 banks which at that time were members of the Clearing House Association as subscribers to a system of telegraphy by which each bank could be placed in communication with the Clearing House, especially in order to procure as early in the morning as possible its daily balance. Also, to be enabled to communicate with any other bank in the system, and on Saturdays to receive the bank statement (which was compiled at the Clearing House) before it became known on Wall Street. All these things and more were provided by our company.

The instrument adopted for this purpose was one invented by myself, and will be remembered as the "Bank Printer" (Figs 1 and 2). It was particularly desired that there should be no figures or fractions on the typewheel, and that it should in no way resemble or be mistaken for a stock ticker It was of necessity a single-wire printer. Each and every bank had its own wire to the Clearing House, and being insulated the cost of construction was far greater than the cost of the apparatus, the reverse of the conditions of the stock ticker system Each bank was provided with a transmitter and a receiver.

The Transmitter was practically the same as that shown in the article entitled "Evolution of the Stock Ticker," published in the Electrical World and Engineer, Feb. 9, in which two are shown, one for each wire. In this case only one was used, and contained but 15 contact points instead of 30, the make and break being equally effective. The pointer was turned with moderate speed and uniformity, stopping suddenly opposite the letter desired when the impression would be taken on the receiving instruments at both ends of the line. This transmitter is better explained in the diagram of the switch, Fig 3.

The Receiver.—The motive power was a weight and clockwork, a ratchet or escapement wheel, and the well-known form of pallets. This receiver could be worked up to the fullest capacity of the operator, who was limited through the inefficiency of the transmitter. The more rapid the revolutions were the more perfect was the work. A small independent or secondary piece of clockwork was kept in motion, while the typewheel was revolving. A sudden pause on the part of the typewheel would cause this piece of mechanism to close two contact points, which brought the press magnet into circuit and broke this circuit an instant later, leaving the typewheel free to move. This device was readily adjustable, in order to conform to the speed of the different operators.

The Switchboard.—To bring all these requirements into practical use a switchboard was necessary. There was nothing suitable on the market, and therefore one had to be made for this purpose. Fig. 3 is a slightly modernized or condensed copy of the original working drawing made by me in the year 1869. For convenience in describing this switch, six banks only are shown connected with the Clearing House, or what would now be called "Central." Each line was connected with its own spring jack, *S. J.* When simultaneous transmission was required, as in the case of the "Bank Statement," or other important news which would be interesting to all banks, a movable bar or multiple switch, pivoted at both ends, would be brought down to the spring jacks. Six wedges, which were electrically connected together and permanently attached to this bar, were inserted between the spring jacks. Each of the six banks were thus brought into connection with the contact points of a relay, main battery, sounder and to earth. The relay magnet was in a local circuit with a transmitter and local battery. The wedges, as shown, were made of an insulating material on one side.

This multiple switch was continued along the board so that any operator could transmit simultaneously to any group of six banks, which groups were selected as to distance from the Clearing House, and resistance of the circuits without interfering with other operators performing the same service. The bar being removed, the spring jacks were pressed together and the normal condition of the system restored.

The circuit can now be traced from the bank which is, of course, at earth to *S. J.*, its sounder, main battery and earth.

In this condition a bank would call *C. H.* by simply turning the transmitter one revolution. This was received on a sounder connected with and numbered to correspond with the number of that bank. *C. H.* would insert wedges P^1 into the spring jack of that number, and so substituting the printing apparatus for the sounder, when local communication would take place. The daily balance and the prices of stocks were usually all that would be required.

Intercommunication between banks was much more frequent. The sounder of No. 10, for instance, would buzz. *C. H.* would answer as above. No. 10 would simply say 56. The two wedges, *P. P.*, would be inserted in jacks 10 and 56, thus connecting the two banks, through a special battery and sounder at *C. H.* The sounder was used to notify the *C. H.* operator that the two banks had "finished"; or if either of them was wanted by another bank while they were communicating the third bank would be informed that the bank wanted was "busy."

There was quite a demand for "private" lines in consequence of the successful working of the bank system; but the subscribers were not connected with any bank nor with the Clearing House, which was a "close community." The Gold & Stock Telegraph Company found it necessary to establish a separate department for the development of this industry, which was known as the "Private Line Department." It will be plainly seen that everything in switching, such as is used to-day, was done at the Clearing House seven years before the invention or discovery of the telephone. The words and phrases, such as "hold the wire," "finished," "busy," etc., were in use then as they are now. When we wanted to say, "Hello!" which was very seldom, we would spell it, as we also did when we wished to express laughter by spelling "Ha! ha!"

It never at that time occurred to me that there was any particular novelty in such a switch as described. It was common practice in a telegraph office to switch a wire on or off of different sets of instruments. I believe there was no system known at the time where all wires led to a central office, and were worked to it, from it, and through it simply or in multiple.

A Mr. Coy, of New Haven, who was evidently not aware of the details or even the existence of the "Bank System," applied for and obtained a patent for substantially the same switch after the telephone had become a substantial fact, and brought suit against the Bell Company for infringement of his patent. The Bell Company learned of my prior invention and use of the switch, and instead of meeting the question in court they discovered through the records of the Patent Office that Mr. Coy had transferred to a certain party in New Haven one-twelfth of the patent in consideration of money advanced for the cost of obtaining it, and quietly purchased his interest, which gave it the right to use it, as it would have given any one else owning a small fraction of it; but as there was no other telephone at that time there could be no possible use for the other eleven-twelfths remaining, and Mr. Coy was simply frozen out.

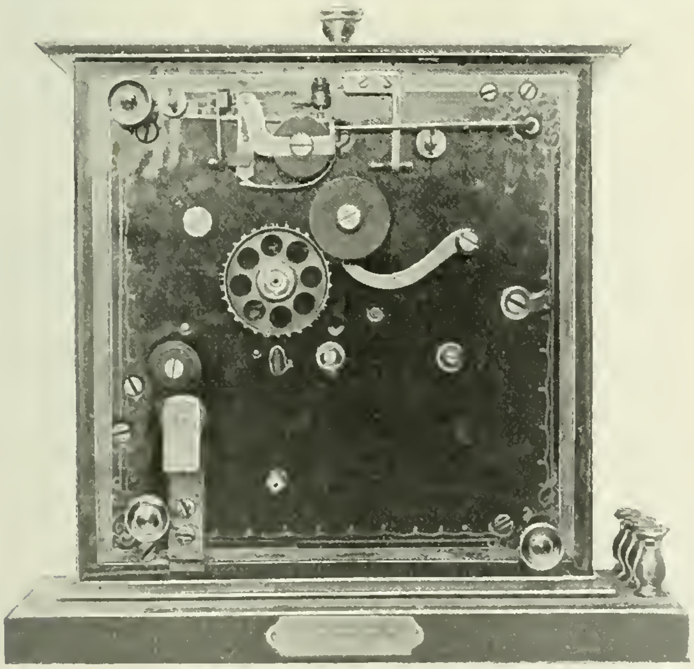


FIG. 1.—THE BANK PRINTER, FRONT VIEW.

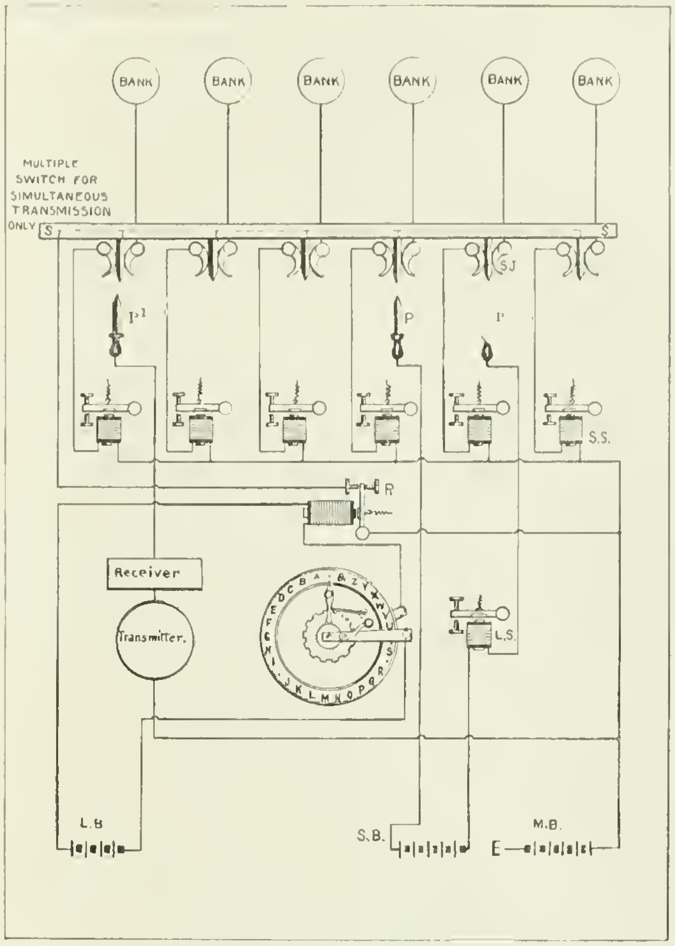


FIG. 3.—SWITCH FOR BANK PRINTER.

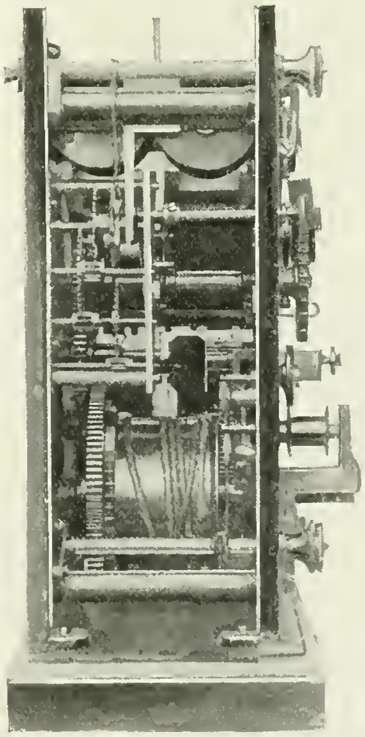


FIG. 2.—THE BANK PRINTER, SIDE VIEW.

It might be interesting to the many friends of Mr. George L. Wiley to note the fact that it was in this "Central" that he took his first lessons in telegraphy, and being an exceedingly apt scholar he prepared himself to introduce telephony into Mexico.

The great whaling industry of New Bedford was practically destroyed within a week after the discovery and introduction of "coal oil," as it was then known. This bank and private line system was literally wiped out in about the same length of time by the telephone. Thus changes come, but in the long run they are for the general good of the public.

Tesla and Wireless Telegraphy.

THROUGH the New York *Sun*, Tesla announced last week that he is about to begin the construction of a plant for telegraphing without wires across the Atlantic Ocean, and that he estimated the work of preparation will consume eight months, adding, however, "but I am prepared to encounter some delays and drawbacks which always turn up somehow." From a statement in the same journal, it appears that the system to be employed was the subject of a patent issued to Tesla in May of last year. In looking over our files we find that two patents on "apparatus for transmission of energy" were issued to Tesla last spring, one dated March 20, and the other May 15; the latter is the one referred to by the *Sun*. We reproduce the following analyses of the patents from our issues of March 31 and May 26, 1900, respectively:

The patent dated March 20 (application filed Sept. 2, 1897), relates to the production at one point of an electrical pressure of such character and magnitude as to cause thereby a current to traverse elevated strata of the air between the point of generation and a distant point at which the energy is to be received and utilized. As illustrated, the apparatus consists of a generator supplying current to the primary of a transformer; the secondary consists of a coil of many turns and is connected at one side to the earth and at the other side to a terminal of large surface, maintained at a high elevation by such means as a balloon. The receiver duplicates this apparatus, except that instead of a generator being in one circuit of the transformer, receiving devices such as lamps and motors take its place.

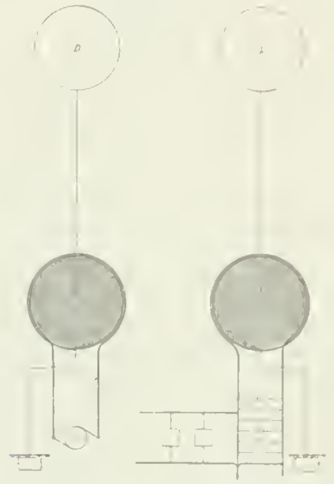


DIAGRAM OF TESLA APPARATUS.

The transformer consists of a coil of very large diameter wound in spiral form, either with or without a magnetic core. The inventor claims that this furnishes a practical method or system of transmission of energy through natural media without the use of wires.

The patent of May 15 (application filed Feb. 19, 1900), is on "apparatus for transmission of electrical energy." Referring to the accompanying illustration, which is a duplicate of that appearing in the patent of March 20, *DD'* are terminals of large surface maintained by such means as a balloon at a high elevation, the elevation depending upon the amount and quality of the work to be performed, the condition of the atmosphere, and also by the character of the surrounding country. The aerial conductors to these terminals are connected to the secondary of a spiral coil, the other end of the coil being connected to earth.

It is stated that the length of the thin wire in each of these coils should be approximately one-quarter of the wave length of the electric disturbance in the circuit, this estimate being based on the velocity of the propagation of the disturbance through the coil itself and the circuit with which it is to be used. For example, if the rate at which the current traverses the circuit including the coil be 185,000 miles per second, then the frequency of 925 miles per second would maintain 925 "stationary moves" in a circuit of 185 miles long, and each wave would be 200 miles in length. For such a low frequency, a secondary 50 miles in length would be used.

As will be noted from the illustration, the primary of the transmitting coil is supplied with a current by a dynamo, and the large coil of the receiver is connected with a circuit including lamps and motors. It is stated that the phenomenon involved in the apparatus is one of true conduction, and not to be confounded with the phenomena of electrical radiation which have heretofore been observed, and which from the very nature and mode of propagation will render practically impossible the transmission of any appreciable amount of energy to such distances as are of practical importance. The specification states that if the potential is sufficiently high and the terminals of the coil be maintained at the proper elevation where the atmosphere is rarefied, the stratum of air will serve as a conducting medium for the current produced, and the latter will be transmitted through the air "with, it may be, even less resistance than through an ordinary conductor."

Independent Telephony in Cleveland.

The annual meetings of the Cuyahoga Telephone Company and the United States Telephone Company, of Cleveland, were held in that City Feb. 4. Directors were elected as follows: H. A. Everett, E. W. Moore, John Sherwin, H. Clark Ford, J. B. Hanna, F. M. Stearns, C. W. Wason, R. A. Harman, Barney Mahler, T. F. Pomeroy and Mark Davis. The officers of both companies are H. A. Everett, president; E. W. Moore, vice-president; James B. Hoge, secretary; John Sherwin, treasurer. Mark Davis is general manager of the Cuyahoga Company.

In his report, President Everett said that after six months operation the Cuyahoga Company has more telephones than the Bell Company had when the Cuyahoga Company started construction in July 1899. The present number of direct lines connected up is 5735. 2110 contracts now on the waiting list are being rapidly supplied. Party lines have been carefully avoided, as they are unsatisfactory. New contracts are coming in at the rate of 100 to 150 per week. The strongest points in the independent telephone movement, he said, have been (1) reduction of rates to a fair basis, (2) superior service and (3) local influence of its stockholders.

"In addition to the local business," Mr. Everett continued, "we are pleased to say that the long distance connections are rapidly assuming a very comprehensive aspect, and at the present time we can reach over 30 per cent more telephones in the State of Ohio than can the Bell Telephone Company. The independents have 332 exchanges in Ohio and the Bell 129; 1300 toll stations to the Bell's 504, and 69,000 subscribers against the Bell company's 47,000. Within a very short time we shall be able to talk to Pittsburg, which has a fine new exchange, and will connect with the Western Pennsylvania system; also with Indiana, West Virginia and Kentucky.

"The Cuyahoga Company was organized Sept. 13, 1898, with a capital stock of $3,000,000, and with bonds outstanding to the amount of $2,000,000. We are pleased to state that at the present time the company is earning more than 5 per cent on its entire cost, and as soon as contracts that are now waiting are connected, we will be able to earn a moderate surplus on the capital stock.

"In the early days we made the usual mistake of thinking that facilities as great as those of the Bell Company would be sufficient, but our original contract for 20 per cent more telephones than the Bell Company had in use has been exceeded, and has caused us not a little worry and annoyance in not being able to supply promptly in all districts the unexpected demands of our subscribers.

"We are pleased to say that, on the whole, the business has been far in excess of our expectations, and that there is large enough field for the independent companies to make a handsome profit when operating in straight competition with the Bell Company."

The Wisconsin Independent Telephone Association.

The State Independent Telephone Association held a meeting in Madison, Wis., on Feb. 13 and 14. The following officers were elected: President, A. L. Hutchinson, of Weyauwega; vice-president, C. P. Schweiser, of La Crosse; secretary and treasurer, H. C. Winter, of Madison. Executive Committee: Richard Valentine, of Janesville; F. H. Sweet, of Fond du Lac; J. C. Harper, of Madison; J. A. Gaynor, of Grand Rapids; W. F. Gunaer, of Appleton. It was decided to hold an adjourned meeting at La Crosse in June and the next annual meeting in Milwaukee in February. A visit was made to the University of Wisconsin, where the members attended a lecture by Prof. Trowbridge on "Wireless Telegraphy." Resolutions were adopted against the passage of the Rossman bill regulating telephone rates, and in favor of requiring telephone companies to connect their lines and exchange messages. Thirty-six companies were represented and fifty delegates were present. Twelve new companies were admitted to the association.

The Origins of the Telephone and Phonograph.

Prof. T. C. Mendenhall contributes to the admirable series of articles in the New York *Sun* reviewing the last century, one on physics. It runs a length of seven columns, of which two are devoted to electricity and magnetism. After discussing the scientific principles and discoveries relative to telegraphy, Prof. Mendenhall says: "Faraday's discovery of induction furnished the basis of that marvelous improvement upon the telegraph by which actual speech is transmitted over hundreds and even thousands of miles. In connection with the invention of the telephone the names of Philip Reis, Graham Bell, Elisha Gray and Dolbear will always be mentioned, each of whom, doubtless independently, hit upon a way of accomplishing the result with more or less success. To Bell, however, belongs the honor of having first practically solved the problem and of devising a system which, with numerous modifications and improvements, has come into extensive use in all parts of the world. No other application of electricity has come into such universal use and none has contributed more to the comfort of life.

"While it is doubtless true that since Faraday's time no discovery comparable with his in real importance has been made, the past 25 years have not lacked in results of scientific research, some of which may, in the not distant future, eclipse even that in the value of their practical applications. Among these must be ranked Clerk Maxwell's theory of electric waves and its beautiful verification in 1888 by the young German physicist, Hertz. This brilliant student of electricity succeeded in actually producing, detecting and controlling these waves, and out of this discovery has come the "wireless telegraphy" which has been so rapidly developed within the last few years. Many other discoveries in electricity of great scientific interest and practical promise have been recorded in the closing years of the century, but the necessary limits of this article forbid their consideration.

"No account of the progress of physical science during the nineteenth century would be even approximately complete without mention of other investigations of profound significance. For instance, the study of the phenomena of sound has yielded results of great scientific and some practical value. The application of the theory of interference by Thomas Young; the publication of Helmholtz's great work, the *Tonempfindungen*, in which his theory of harmony was first fully presented; the publication of Lord Rayleigh's treatise; the invention and construction by König of acoustic apparatus, the best example yet furnished of scientific handicraft; all of these mark important advances, not only in acoustics but in general physics as well. The phonautograph of Scott and König, by which a graphic record of the vibrations of the vocal cords was made possible, was ingeniously converted by Edison into a speech recording and reproducing machine, the phonograph, by which the most marvelous results are accomplished in the simplest possible manner."

Bell Telephone Expansion.

Some figures compiled recently in Boston give an excellent idea of the rapid growth of investment now going on in the Bell telephone industry. To this list subjoined might be added other items, however, such as the money put lately into the Erie properties, while it may be stated that on the New York and New Jersey systems large sums are being spent. In Chicago also the Bell Telephone Company estimates its expenditures on new work in 1901 at $2,000,000, and will probably issue the new stock, pro rata, in April and October.

The Rocky Mountain Bell Telephone Company, operating 32 exchanges in Utah and Montana, has increased its capital stock from $842,000 to $2,500,000 for improvements. The new stock will be issued as funds are required. The Central District & Printing Telegraph Company, of Pittsburg, has voted to increase its capital stock from $4,000,000 to $7,500,000 for further development of the territory. The Hudson River Telephone Company, operating in Albany, Poughkeepsie, Saratoga and other points in northern and eastern New York, will increase its capital stock from $3,000,000 to $4,000,000 for construction purposes. The capital stock was increased $1,000,000 last March. The Chesapeake & Potomac Telephone Company operating in Washington, D. C., and the State of Maryland, has made an additional issue of $750,000, 5 per cent bonds, making total issue to date of $1,250,000. The total authorized issue is $1,500,000.

At the time of the consolidation of the several subsidiary telephone organizations making up the New England Telephone Company in 1883, $4,058,400 stock was issued to the American Bell Telephone Company for franchises, etc., and $5,842,800 to other stockholders, making a total capital of $9,901,200. Up to March 31, 1900, the capital has been increased for extensions and development to $13,759,100 and bonds and debts created amounting to $4,387,866. Add the probable cost of new extensions in 1900, estimated at $2,000,000, and the total amount of capital employed to-day will be $20,146,966.

Mr. J. P. Morgan in British Traction.

A special cable dispatch from London, of Feb. 16 says: "J. Pierpont Morgan has entered the English electric railway field. The prospectus of the British Electric Traction Company with a capital of £2,000,000, was issued a few days ago, with the notice that J. P. Morgan & Co. guarantee the underwriting of £350,000 preference shares, which were offered to the public at a premium. Morgan gets an option of taking £800,000 of the company's capital, which will not be offered for allotment just at present. The company is to combine numerous newly started and proposed electric railways in 40 English provincial towns and also in some suburbs. A London member of the Morgan banking house said he believed England's congested districts, with their great populations, and the numerous closely lying cities afforded a fine field for the development of electric traction."

The British Traction Company is a concern well known in American electrical circles. The business of the company consists of the financial promotion of all kinds of electric railway undertakings including the acquisition of Parliamentary charters for new lines, the extension of existing properties and the conversion of horse-power roads into modern electric systems. The company, it was said, since its organization in 1896, has built upward of 50 roads in the United Kingdom. It is reported that among Mr. Morgan's associates in the transaction are Sir Charles Rivers Wilson, president of the Grand Trunk Railway; Sir Charles Fremantle, the British director of the Suez Canal, and Lord Rathmore, a privy councillor.

An Institute Conversazione.

Encouraged by what has been accomplished by other technical societies, and what they have recently seen abroad, the Council and Committee on Meetings of the American Institute of Electrical Engineers have arranged for a conversazione to be given by that body some time in April. Through the courtesy of Columbia University, the conversazione will be held in the electrical engineering department, with the co-operation of Prof. Crocker, Dr. Pupin, Mr. G. F. Sever and others of the staff there, and so much interest has already been shown in the matter that a brilliant success is forecast. While the conversazione will be largely social in character, a special feature will be the exhibition of latest electrical apparatus, inventions, etc., in working condition. Mr. T. A. Edison, Prof. Elihu Thomson, Dr. Pupin and others have promised personal assistance in this respect, and as Mr. W. J. Hammer has that part of the programme in hand, and is working hard, it is believed that the demonstration will be one of the best of this kind ever seen in this city, especially as the electrical resources of the University will also be available. Secretary Pope and Mr. W. S. Barstow, chairman of the Papers and Meetings Committee, extend through the press an invitation to all members to contribute features of scientific interest and to give an early notification of what they will do in this respect.

New Headquarters for the Automobile Club of America.

In a quiet and dignified fashion the new clubrooms of the Automobile Club of America, at Fifty-eighth Street and Fifth Avenue, were thrown open to the members on the afternoon of Feb. 16, and an informal reception was held at night. The location, looking out upon the Plaza and the Park, is admirably situated for the owners of automobiles, and all club runs will start from the Plaza hereafter. The new quarters are immediately over the Plaza Bank, and occupy the entire second floor of the building. The furnishings are handsome and particularly appropriate. The main room, which overlooks the Plaza, is handsomely fitted up, the prevailing color being automobile red. It is well suited for lecture purposes. Just off it is a pretty library, with writing facilities, and committee room.

The Dutch, or grill, room is in the rear, where the members sit, chat and eat at their leisure. There is no bar attached to the club, and members desiring liquid refreshments are provided with lockers, which they can supply as their fancy dictates. No storage has been provided for automobiles, and none will be, at least for the present. There are several automobile storage places in the immediate neighborhood.

At the evening reception there was an excellent attendance of members. President Shattuck delivered a brief address of welcome, and stated that the club had moved, fitted up its new quarters and had a balance on hand, after all expenses were paid, of $4,000. He gave some details of the recent work of a public character in which the club had taken a leading part. His remarks were followed by a collation prepared under the supervision of the acting chairman of the House Committee, Mr. J. M. Hill, who, with the other officers, is greatly to be congratulated on the success of the evening, and of the club opening in general. Among the electrical people present were R. McA. Lloyd, J. M. Hill, C. E. Corrigan, H. Ward Leonard, C. J. Field, E. T. Birdsall, T. C. Martin, A. H. Whiting and F. Hird and R. Dumas, of London, England. Arrangements have been made by President Shattuck for some early lectures.

Russian Duties on Electrical Apparatus.

Owing to the belief or claim that Russia pays a sugar bounty, the duties on Russian sugar imported into this country have been increased. This has immediately been followed by an ordinance from the Russian Finance Minister, M. de Witte, increasing duties on American importations of machinery into Russia, 30 per cent. It is believed that a grave crisis has been reached in the trade relations between the United States and Russia. The immediate effect of the Russian decree, when it becomes operative on March 1, will be to increase by 50 per cent the duties on American machinery, steel and iron goods. These goods already enjoy two separate reductions, 30 per cent being taken off from the general and 20 per cent from the conventional duties. The articles referred to in the Russian decree are machinery and tools, and manufactures and products of cast iron and steel. Roughly stated, the United States is said to have exported goods of this description to Russia last year to the amount of about $30,000,000. The addition of 50 per cent to the duty will, it is thought, prove practically prohibitory.

The text of the Russian order is as follows: "An order of the Russian Minister of Finance directs additional tariff of 30 per cent net imposed upon articles included in Paragraphs 150, 151, 152, 153, 161, and Section 2, discriminating tariff, upon American hardware, iron, steel, boilers, pipes, forgings, castings. tools, gas and water meters, dynamos and sewing machines, (Paragraph 167) of the Russian tariff laws when such articles are of American manufacture. This includes motors and machinery of all kinds.

State Control of Lighting Companies in New York State.

A bill has been introduced by Assemblyman Bedell placing all the gas, electric light, heating and power companies of New York State under the control of the State Railroad Commission. It will indirectly make the board the arbiter of the price of gas and electric light in the various cities of the State. It will practically compel new electric light, heat and power companies to obtain the consent of the commission before they can commence business. It will prevent the same class of companies discontinuing a part of their service, if they deem it no longer profitable, should the commission decide that such service must continue. The bill amends the State railroad law by adding to the powers of the State Railroad Commissioners a general supervision of "corporations formed for supplying gas, or for electric lighting, heating or power purposes." Such companies are to be treated the same as the present law directs the commission to treat railroads—that is, the commission "shall examine the same and keep informed as to their condition and the manner in which they are operated for the security and accommodation of the public and their compliance with the provisions of their charter and of law. The commissioners or either of them may enter and remain during business hours in the offices and plants of all corporations, subject to its jurisdiction, and examine books and affairs of any such corporation and compel the production of books and papers."

The greatest increase of power to the commission by the bill is the inclusion in the present railroad law of the illuminating companies, with reference to the board's recommendations concerning the latter. Section 161, which is amended to so include illuminating companies, says:

"If, in the judgment of the board, after a careful personal examination of the same, it shall appear that any corporation formed for supplying gas or electric lighting, heating or power should furnish additional facilities for the convenience or accommodation of its patrons, or should reduce its charges for gas or for electric light, heat or power, or should otherwise modify the methods of conducting its business, the board shall give notice and information to the corporation of the improvements and changes which they deem to be proper."

Under the proposed law the commission can grant hearings upon application for the reduction of the price of gas and electric light. Legislative lawyers also construe the powers of the commissioners under the Bedell bill to include the power to deny the right of a new corporation to lay mains of wire conduits that may parallel any other company. Should this construction be sound, the State Railroad Board will have the right to say whether or not at any point in the State new gas pipes or electric light poles or conduits shall be established.

CURRENT NEWS AND NOTES.

ELECTRICAL EXECUTIONS IN INDIANA.—A correspondent in Indiana informs us that the Indiana Senate has voted to adopt electrical means for inflicting capital punishment in that State.

IMPROVING THE PRESS.—The Correspondents Club of New York, having invited opinions as to increasing the good influence of the press, got the following among others: Thomas A. Edison—"By publishing a fact now and then." Nikola Tesla—"The influence of the press might be greatly increased by adopting a better system of informing the world of technical and scientific advances"

TROLLEY FUNERALS.—The St Louis Liverymen and Undertakers' Association are discussing a complaint of its president, Louis Spellbrink, against the Transit Company, which has been operating a funeral car. On this account the liverymen felt that their business was being invaded. President Spellbrink says that his association has adopted a rule that any of its members who act in conjunction with non-members shall be expelled. As the funeral car cannot run into the cemeteries provision must be made for the conveyance of the corpse and mourners after they have arrived at the borders of the cemetery. Mr. Spellbrink says that there are 103 members of his association, none of whom will do this work. The immediate cause of the liverymen's action was the recent funeral of a nephew of George W. Baumhoff, manager of the Transit Company. Mr. Spellbrink says that this was conducted by an undertaking company, one of whose members is a relative of Mr. Baumhoff, after another firm refused to take charge because of the intended use of the funeral car.

TRADE WITH CHINA.—A special cable dispatch to the New York *Sun* of Feb. 8, says: "Exceptional importance is attached here to the 41st annual congress of the British and Irish Chambers of Commerce, which is to be held in London in the middle of March. The Chinese question will hold a very prominent place in the deliberations of this body, which is truly representative of the commercial community. As practical men a majority of the delegates strongly object to the manner in which England has been acting in the Far East. They believe that instead of pressing fantastic schemes of vengeance and exorbitant indemnity demands upon the wretched Chinese Government, advantage should be taken of the evident willingness of that Government to give increased trading facilities in the vast, unknown regions of the Empire, and the congress will be asked to appoint a deputation to wait upon the Marquis of Lansdowne, Minister of Foreign Affairs, to urge these views. It is believed that the congress will also call upon the British Government to buy out the Eastern Cable Company and allied subsidiary concerns in order that the entire cable system of the mother country with the colonies and dependencies shall be in the hands of the Imperial administration. This scheme is very big, but business men consider practical this project which would yield a comfortable profit to the State, irrespective of the undeniable political advantages.

STREET RAILWAY FRANCHISES.—A controversy over the extension of a franchise in Columbus, Ohio, has been settled by a compromise. The ordinance provides for straight cash fares at 5 cents, seven tickets for 25 cents, with transfers, until the gross receipts of the company reach $1,750,000, and after that eight tickets for 25 cents, with transfers. All-night cars are to be operated on four of the principal lines, under a schedule of 10-cent fares, with transfers, for the first five years, and under a 5-cent schedule with transfers for the remaining years of the life of the franchise.

LONDON'S UPTORN STREETS.—A special dispatch from London, of Feb. 16, says: "A week ago the indignation of Londoners over the inconvenience and loss caused by the long barricading of the streets in the business part of the city while a new telephone system and electric lighting apparatus were being installed found voice in a protest in a committee which was elected by the omnibus railway companies and trades people. As a result the City of London Corporation ordered the street operations continued night and day. This order has now been modified so as to apply to the main streets only. As every thoroughfare in London must be taken up the condition of things is serious, and all business seems destined to suffer from an indefinite prolongation of the trouble. Strenuous efforts are being made to secure the intervention of Parliament.

SHAWINIGAN FALLS POWER.—The first power at Shawinigan Falls, Quebec, was turned on Thursday, Feb. 7, and the town, which two years ago did not exist, but now has a population of over 3000 persons, was lighted by electricity. The generator first supplies a comparatively small amount of power, but it constitutes the initial step in a development of electric energy which promises to be the greatest in the world. The initial use of electricity at Shawinigan is notable in that the development of power from water there, with the exception of Niagara Falls, offers more scope than any other point in the world. The company has completed the hydraulic development of 75,000 hp, which is about 25,000 more than has as yet been developed at Niagara. An electrical installation for 10,000 hp is being put in place, from which the company proposes to take its supply for the city of Montreal.

TRANSFER APPARATUS FOR STORAGE BATTERIES.—Two patents were granted Feb. 12 to C. O. Mailloux on apparatus for the transfer of storage batteries to and from street cars and automobiles, and for the handling of the batteries in a charging station. Among the principal features are the application of power-driven mechanism to the insertion or withdrawal of the battery or trays from the vehicle; an adjustable drawbridge for supporting the batteries in transit to and from vehicles; a transfer carrier and transfer table with tracks from the latter to a series of charging racks, etc. All operations requiring power are performed by means of electric motors. The specifications describe the numerous details with references to 51 illustrations on 20 sheets of drawings. The two patents contain 49 claims, those of one relating to the mode of transfer between the vehicle and carrier, and of the other between the latter and the charging racks.

A TWISTED TELEGRAPH LINE.—A strange condition of affairs has developed, it is said, in connection with the construction of the Yukon telegraph line from Quesnell, B. C., to Telegraph Creek and Atlin. Construction was completed between Quesnell and Hazleton, and then a party was sent out from Hazleton to continue construction north while simultaneously another party was started out from Telegraph Creek to work south, and make connection with the Hazleton party about half way between those two points. In their work one party struck along a certain valley, and the other party along an entirely different valley. The result is that the actual work of construction has overlapped, but instead of the wires being connected, the ends are 70 miles apart, with two gigantic ranges of mountains intervening. The result must be the destruction or abandonment of a large portion of the line already built and the building of a new line.

CANADIAN TELEGRAPHS.—The Dominion Government has, it is stated, taken steps to purchase the telegraph systems of Canada, extend them enormously and operate them in connection with the Post Office Department. It is also seriously proposed to follow a similar course with the telephone, but in the case of the latter municipalities will be licensed, as in Britain, to operate the system within their own areas. The question of the absolute control of the Canadian telegraphic service has long been discussed, but not until the present Liberal Government came into office has it been possible to talk of purchase. With a surplus running from $6,000,000 to $7,000,000 for 1900-1901 and a prospect of an equally large surplus for 1901-1902, the plan seems feasible. A submarine cable scheme is included in the general plan. The Canadian Pacific telegraphs are said to be worth $7,000,000, the Great Northwestern about as much, and the Bell telephone system at least $5,000,000.

BUCKET-SHOP TAXATION.—It is said that the action of the Senate Committee on Finance in proposing a tax on bucket-shops has called attention to the extent of the business of irregular stock speculation. It is said that a tax of $400 a year upon these establishments would yield $10,000,000 in revenue. Considerable opposition to the bucket-shop tax has been aroused among the brokers and Board of Trade men generally. They say that the effect of the tax would be to add respectability to the bucket-shop business, and that Congress might with the same propriety legitimatize faro, keno, or any other well-known form of gambling. To this the Senate Committee's practical reply is that this tax ought to be levied as a police regulation, if for no other reason. The Finance Committee in making its report favoring the bucket-shop tax had directly in mind the supervision of that business by the officers of the Internal Revenue Department. It is better, the Committee thinks, to regulate the business as proposed, with a prospect that the regulation will remove many of its objectionable features, than to permit it to run as heretofore, subject to no regulation except that provided in the Penal Code.

AN ELECTRIC BRIDGE.—A special dispatch from Duluth, Minn., says: "Bids have been advertised for and the contract will probably be let in two or three weeks for a bridge to cross the ship canal at the entrance of Duluth harbor. The conditions are peculiar. About 100 large ships pass through the canal daily, besides innumerable tugs, etc. A swing-bridge would not be permitted by the Government, and the Lake Carriers' Association would bring pressure to bear against any kind that would hinder navigation. So the bridge is to be aerial, but is to carry a traveling car that will cross the 300-ft. canal at street level every few minutes. This car will be swung from a truss 150 ft. high, far enough up to clear the masts of the tallest ships. On the truss will be a carriage running on a track, and suspended from this carriage by wire ropes will be the bridge at the level of the adjoining streets. The carriage will be operated by electricity, and will cross very quickly. The car will be covered and comfortable. The design is the invention of a French engineer, and a bridge similar in general plan is in use in Rouen. It will cost about $100,000, and while it will be erected and owned by private capital, the city is to reserve the right to buy, and will, from the first, operate it as a part of the municipal street system.

SPLIT-PHASE MOTOR PATENTS.—In addition to the decision noted in these columns last week enjoining a fan motor company from infringing a claim of Tesla patent No. 401,520, the same court has rendered a decision against the same company enjoining it from infringing claims in two other Tesla patents. These latter patents were both issued Dec. 26, 1893, on applications filed Dec. 8, 1888, and both relate to the split-phase method of starting single-phase motors. One of the patents, No. 511,550, is on the method of operating motors having independent field circuits which consists in sending an alternating current from a single source through both circuits and varying or modifying the relative resistance or self-induction of the circuits, thereby producing a difference of phase. The claims of the second patent relate to means for carrying out the above method patent. One of the contentions of the defense was that the inventions of the patents in suit are covered by a prior patent issued to the same inventor, namely, patent No. 416,193, issued Dec. 3, 1889, on an application filed May 20, of the same year. The claims of this patent, the court decides, are only on a specific form of construction and not on the method or process by which all the motors of its class are operated. Moreover, the applications for the three patents were pending at the same time, and under these circumstances priority of date can have no prejudicial significance among the three patents, and the defense of double patenting, therefore, cannot stand.

STANDARDIZATION BILL.—The bill before Congress to establish a National Standardization Bureau has been made a special order in the House, but has not yet been reported from the Senate Committee on Commerce, owing to the Subsidy Bill having seriously interfered with its work. We learn that an endeavor will be made to pass the measure as an amendment to the Sundry Civil Bill.

AMERICAN ELECTRIC AUTOMOBILES.—Mr. J. S. Critchley, manager of the automobile department of the British Electric Traction Company, Limited, of London, has been in this country for the last three weeks, investigating various things connected with the development of self-propelled vehicles. "Except for your electric vehicles," he said before leaving for England last week, "New York seems to me to be about two years behind London in the use of automobiles. Your roads and streets are not so well adapted to their use as ours, of course, but besides that, you have not yet achieved the same excellence in model or construction. Your smaller electric vehicles are in advance of anything I have seen elsewhere, and I think some of your developments along that line will soon be imported by us."

TO PREVENT DAMAGE BY ELECTROLYSIS.—A bill has been introduced in the Indiana Legislature to prevent injury to water and gas pipes by electrolysis. The measure is prolific in drastic provisions, and is aimed principally at the Indianapolis Street Railway Company, although its general application includes all electric companies. The bill provides that all electric street railway companies operating in a city shall use the "double trolley system," or "some other equally good insulated metallic-circuit system." It also provides that after six months from the time the bill becomes a law all companies furnishing electric current, heat, light or power for any purpose shall comply with the provisions of the act and submit to the Board of Public Works a copy of the changes to be made. All ground circuits are to be unlawful, unless thorough insulation is observed. A penalty of $25 a day for non-compliance with the provisions of the law, and the company's charter and rights and privileges in the city are to be forfeited if the company offending does not carry out the provisions of the law. The measure has aroused the representatives of electric companies of all kinds.

TELEPHONE INVENTION CONTROVERSY.—In noting the letter to this journal, written just before his death by Dr. Elisha Gray, claiming again priority of invention as to the telephone and asserting that he was cheated out of his rights by the rascality of Wilbur, Mr. George C. Maynard, who is the Washington correspondent of the *Electrical Review*, and whose statements were attacked by Dr. Gray, quotes the well-known earlier letters of 1877, in which Gray addressed Prof. Bell in terms that fully conceded the latter's priority. Mr. Maynard also cites Wilbur's notoriously bad character and vicious habits, as fatally affecting the value of any kind of statement he might make. In addition to this, when the Gray letter was shown him, "Prof. Bell simply said that the records show plainly that the statement is not true; that his invention and application were completed long before the papers were filed in the Patent Office, and that he received no information or suggestions of value from Gray." We do not see how Prof. Bell could be expected to say anything else. The record is there. The point of interest was the revelation that Dr. Gray died apparently more convinced than ever that he was a deeply wronged man in regard to one of the greatest inventions of this or any age.

MAGNETIC SEPARATOR.—A Canadian correspondent writes that the Wetherill magnetic separator is attracting a good deal of attention in mining circles. The feature of this machine is the great power of its magnets, and the concentration of the magnetic field. One of the best machines of this type in existence forms part of the equipment of the mining department of McGill University, Montreal. In this machine, the two magnets have 40,000 ampere turns, and by the peculiar shape of the pole-pieces all the magnetic field is concentrated into a space less than the area of a leadpencil. The powdered ore is carried on a belt under the poles of these fields. Just over the belt and under the magnet pole is a second belt, running crosswise. When the ore passes under the magnet the magnetic particles rise and are held by the magnetism to the under side of the upper belt. This belt carries them out of the field of the magnet, and they then drop into an appropriate receptacle. Meanwhile, the residual ore again goes through the same treatment to insure a thorough separation, and is dumped into another receiver.

LETTER TO THE EDITORS.

Pupin's Long Distance Telephony System.

To the Editors of Electrical World and Engineer:

Sirs:—I have looked in vain through recent issues of your journal for information concerning the ocean telephone of Prof. Pupin, which, according to newspaper accounts, renders ocean telephony possible. Have you printed anything on this subject?

Pittsburg, Pa. C. N. Manning.

[We are not aware that Dr. Pupin has invented an "ocean telephone." As we have received several similar requests for information, we reprint below an editorial from our issue of May 26, 1900, commenting on Dr. Pupin's paper on "Telephony Over Cable and Long-Distance Air Lines," read before the Philadelphia meeting of the American Institute of Electrical Engineers; and an analysis from our issue of June 30, 1900, of the two patents issued June 19, 1900, to Dr. Pupin on his system. These two articles summarize quite fully the principal features of Dr. Pupin's work.—Eds.]

The most important, and from several points of view, the most interesting paper presented at the Philadelphia meeting of the American Institute of Electrical Engineers, was that of Prof Pupin on "Telephony Over Cable and Long-Distance Air Lines." The plan of the paper is most admirable, and may well be taken as a model for future papers dealing with complicated subjects. In the development of the subject, the physical conceptions are first given and illustrated by mechanical analogies. The deductions from the theoretical portion of the paper—which is wisely made to form a separate section—are then introduced and explained with reference to the phenomena involved. Next, the results of complete experimental tests of the principles established are given. These latter are so conclusive that the final or mathematical portion of the paper might have been omitted, though as a beautiful specimen of analysis its presence will be pardoned even by those who look askance at higher mathematics The practical value of Dr. Pupin's paper lies in its theoretical and experimental demonstration that at little expense and with simple means a practical equivalent of Heaviside's distortionless conductor is possible That is, by a proper disposition of inductance along a line, the attenuation and distortion of telephonic currents may be reduced to a minimum. It has, of course, been long known that the distortional effect of a telephone line could be controlled by maintaining certain relations between the capacity, inductance and resistance of the line. These relations, however, have been stated in terms of distributed inductance; or, at least, it has not been shown that a distortionless or uniform conductor could be approximated to within a definite limit by an equally definite distribution of inductance coils along a line It is true that experiments have been made to test the efficacy of the introduction of such coils in a line, but lacking a theoretical guide, failure has been the result. Prof. Pupin points out very clearly the reason for such failure, for if the inductance introduced has not its proper value and is not distributed in a perfectly definite relation, the phenomenon of reflection occurs. That is to say, the inductance itself becomes a source of secondary waves which react on the line, thus increasing rather than decreasing its effectiveness. Dr Pupin, basing his mathematical analysis upon the theory of wave propagation, establishes a simple law which determines the degree of equivalence between a non-uniform conductor—or a line in which inductances are inserted at intervals—and a uniform conductor; and by means of the formulas deduced, the value and distribution of the inductances along a line for an allowable attenuation that may be exactly calculated. The interest of the paper would have been much enhanced had the commercial bearing of the law deduced been set forth by definite statements as to the effect of its application on the design of long-distance telephone lines—that is, the probability of substituting ordinary telegraph wire for the present expensive copper conductors of large sectional area. This probability would appear to be a deduction from the principles established, for the attenuation factor shows that an increase of inductance will compensate for an increase of resistance; and the law indicates how the increased inductance may be inserted into the line in a manner not to introduce ill effects of itself.

Two patents were issued to Prof. M. I. Pupin, June 19, relating to the method of improvement of telephonic transmission which formed the subject of a recent paper read before the American Institute of Electrical Engineers.

In one patent the claims are on a method of diminishing the attenuation constant of a uniform wave conductor, which consists in sufficiently increasing the inductance of the conductor by distributing along it inductances at periodically recurring points; the distance between consecutive points being such as to preserve approximately the character of the line as a uniform conductor with respect to the waves to be transmitted. As will be seen, the above is a method patent, and the second patent relates to details for putting it into effect. One claim specifies that the distance between the interposed coils shall be adjusted in such a way as to equal a fractional part of one-half of the shortest wave length which is to be transmitted; another claim specifies that the distance between the interposed coils shall be adjusted in such a way as to be equal to the fractional part of one-half of the wave length corresponding to the highest frequency essential to the transmission of speech. Two other claims specify that the distance between consecutive inductance coils shall be equal to or less than one-sixteenth of the smallest wave length which is to be transmitted, or to one-sixteenth of the electrical wave length corresponding to any frequency which is essential to the transmission of speech.

The method is illustrated with reference to two particular cases. One of these is for a telephone line 3000 miles long, consisting of a copper wire of 4 ohms per mile resistance (No. 9 B. & S.); the capacity per mile of such wire hung as are the long distance air lines of the American Bell is .01 microfarad. To secure a sufficiently high degree of approximation to a uniform telephone line, one coil per mile is required, the inductance of which should be .2 henry and the resistance .6 ohm. Such a coil, using no iron, would take about 1000 ft. of wire, of 2 ohms per mile (No. 6 B. & S.), wound into a coil of 5 inches internal diameter and 12 inches in length. This line would be of comparatively high inductance, and transmitter coils of a larger transformation ratio than those employed at present will be found more suitable for working over such a line.

The other case is that of a submarine cable 2000 miles long. According to present cable construction, the capacity per mile would be .3 microfarad, and it would be necessary to introduce 8 coils per mile, having an aggregate inductance of .3 henry, and a resistance of 1 ohm per mile, thus increasing the cable resistance to 6 ohms per mile. Employing cores of iron or steel, it is stated that coils of this inductance can be readily made which will be small enough to go within the sheathing of a submarine cable, as these are constructed to-day, and at the same time show negligibly small Foucault-current and hysteresis losses. The construction of a coil is described in detail, it having a diameter when finished less than 2.5 inches and a length of 4.25 inches. It is added that unless induction coils with iron cores are constructed in such a way as to keep down the magnetization, hysteresis, Foucault losses and distortion of the current by the varying value of the magnetic permeability of each cycle of magnetization, they will work disastrously.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Direct-Current Dynamo Curves and Parallel Operation.—Adams.—An article pointing out the relation between the external characteristics of dynamos and the facility with which they may be operated in parallel.—*Am. Elec.*, Feb.

A Sparking Dynamo for Gas-Engine Service.—A complete description, with working drawings, of a small bipolar dynamo of the Manchester type for gas engine ignition. Two windings are given, one for 14 volts and 3 amperes, and the other for 32 volts and 1¼ amperes.—*Am. Elec.*, Feb.

Fan Motors.—Henshaw.—A very long illustrated article on the history and development of the electric fan motor. Also an article by Riggs on electric fans in the export trade.—*Elec. Rev.*, Feb. 9

POWER

Electric Power in Iron and Steel Works.—Walker.—A long illustrated article in which the different electric and magnetic methods used in iron and steel works are discussed. He deals with magnetic separations and the use of electric motors for cranes and other power purposes. He thinks that electric motors should be employed with success in the rail and plate mills; but motors of sufficient size should be chosen and actual tests upon existing plants should be made. He also deals briefly with the electromagnetic brake, the electric furnace, the lighting of the plant and the wiring. He recommends using cables covered with a thick coating of vulcanized rubber, overlaid with some substance, such as yarn, that will protect it from the action of moisture and the friction of the metallic masses that it is practically impossible to keep it free from; but the wrapping should also be of considerable thickness, and the cables should be overhauled periodically, and any damaged places repaired. The article concludes with some favorable remarks on the polyphase system, as compared with the direct-current system, especially on account of the advantages of the induction motor.—*Eng. Mag.*, Feb.

Gas Power for Central Stations.—An editorial referring to a recent paper of Humphrey, in which he said the limitation of gas-driven electric power stations in stations of small size has arisen from two causes—the non-esistence of a gas generator capable of producing power gas on a large scale at a cheap rate, and the low power of the largest available gas engine units. These obstacles he considers to have been removed respectively by the Mond gas producer, and by the practicability of building gas engines of several hundred, or even 1000 to 1500-hp rating, which will work as economically and satisfactorily as the best of the smaller sizes. The prospects of the gas engine are said to be very bright, and the days of the steam engine are claimed to be over.—Lond. *Elec.*, Feb. 1.

REFERENCES.

Electric Driving of Looms.—An illustrated description of the gearing used with an induction motor. In order to change the speed to suit the work in hand, the motor pulley is altered when driving by belt, while if toothed gearing is used the pinion is changed, the distance between centers being suitably adjusted by a simple eccentric device.—*Genie Civil*, Sept. 29; abstracted in *Science Abstracts*, Jan.

Induction Motors in a Tobacco Factory.—Bausch.—An illustrated description of a three-phase power plant in the Wetmore Tobacco Factory at St. Louis, Mo. The plant is of a conventional character, the motors being in some cases belted to single machines, and in others belted to line shafts driving a group of machines.—*Am. Elec.*, Feb.

Water-Power Plant.—Fitch.—A well illustrated description of the water-power plant for transmitting electric power from the Apple River to St. Paul, Minn. There are four 800-volt, 60-cycle, 750-kw three-phase alternators, running at a speed of 300 r. p. m. For transmission the voltage is raised to 25,000. The length of the line is 27 miles, the voltage drop 7.7 per cent.—*Cassier's Mag.*, Feb.

TRACTION.

Electric Locomotives and Multiple Driving.—Tyler.—A paper in which he compares the use of electric locomotives and of multiple driving for electric traction on main lines. He points out that the feature of railways, as distinct from tramways, is that each company is merged in one vast network of lines over which neighboring companies run their rolling stock, without regard to the limits of their own systems. It follows that, pending the universal adoption of electric traction, the service will be a mixed one, and it will be necessary to handle the ordinary rolling stock of any company possessing running powers. The only means of applying electric traction to this influx of through trains is by electric locomotives. The conclusions of the paper are as follows: "Where the total effort required is not more than can be exerted by a 50-ton locomotive, equipped to haul up to its full limit of adhesion, and where the question of control from either end without shunting is not an essential, the separately driven axle system does not offer any advantages commensurable with its greatly increased complication. Where the power required is in excess of the above, the alternative lies between multiple-driven axles and coupled locomotives. The general question of convenience would even here seem to pronounce in favor of the coupled locomotive. There is an undoubted advantage in having the equipments separate from the coaches, so that a defective locomotive may be replaced without breaking up a train. If, however, the trains must be controllable from either end, then some kind of multiple-driven axle arrangement is necessary, although if the traffic is frequent enough to make shunting impossible, it should be worth while to end the line in a loop connecting the up and down rails."—Lond. *Eng'ing;* abstracted in *Eng. Mag.*, Feb.

Polyphase Traction.—An illustrated article on the Secco-Colico-Sondrio-Chiavenna railway in Italy, which has a length of 106 kilometers and will start running in the course of the coming spring. As already noticed in the Digest, a voltage of 20,000 is used for transmission and reduced to 3000, at which pressure it is conducted directly to the induction motors on the vehicles by means of the working conductors. In order to test the new system, Ganz & Co. built a trial line in 1899 near Buda Pest, where they have running a motor car provided with two motors, each of 150 hp, which are directly fed with current at 3000 volts. This trial line has worked to great satisfaction. Several illustrations show the truck of the motor cars to be used on the Italian railway, and also the trial line. —*Lightning,* Jan. 31.

Storage Battery Cars.—A description of the Bologna & San Felice Railway, which is 42 miles long, and serves a purely agricultural district, so that the traffic is anything but heavy. The cars are equipped with two motors and batteries of Pescetto cells. Charging is done at Bologna by conversion of the three-phase current from a power distribution company there, and for this purpose synchronous motor-generators are used. The working pressure is 500 volts, and the battery capacity is 300 ampere-hours. On this basis, trains are run at three-hour intervals. The comment is that the introduction of lighter types of battery like the Pescetto and others seem to have altered the conditions which formerly made accumulator traction impracticable.—*L'Elettricita;* abstracted in *Lightning* Jan. 31. Another description of these cars in *St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Acceleration of Electric Cars.—Morse.—A paper illustrated by diagrams. The first refers to the accepted theory that in train operation acceleration should be rapid and constant in such cases where the maximum speed is to be reached soon after the staritng in order to secure the best economy. He then proceeds to lay out acceleration curves for different conditions. The acceleration curves employed in best practice coincide very closely with a parabola. He shows a number of parabolas so drawn, which can be closely duplicated from actual curves. For very rapid rates of acceleration an ideal curve would consist of a straight line, the upper third of the curve being a parabola. He then assumes a train of 132 tons, starting against a grade ½ of 1 per cent. and designed to reach a maximum speed of 24 miles an hour in 30 seconds. The first thing is to draw a curve, which is made up of three curves, one being the force to overcome inertia, the other due to train resistance and the third due to grade. It is then possible to find the mile pounds per hour required to drive every ton weight of the train. This quantity expressed in watts and determined for each thirty-second is given in a curve. He gives curves from which the power required and the efficiency of the motors under different conditions of starting can be determined—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

How to Make Non-Paying Roads Pay.—Cooper.—The third article of his series. He discusses the question of fares, and divides the passengers into five classes. Great conservatism and caution should be exercised in reducing fares, as a slight reduction often means all the profit, and it is very difficult to restore the old fares after a reduction. Partial reductions can be made by selling a number of tickets for less than the regular fare. The following concessions can often be made to advantage: To a particular class of persons or travel; to certain fixed hours or days; between certain fixed points; a combination of any or all of the above. The chief rule to observe is, do not issue more concessions than are absolutely necessary, and reserve some concessions for future use.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Current Supply to Long Railways.—Sieber.—A communication in which he makes some critical remarks on the paper of Rasch (Digest, Jan. 26). The three-wire system in the form suggested by Henry (Digest, Sept. 15), is recommended. He claims that the numerical values upon which Rasch bases his calculations, differ greatly from those in actual practice, so that his conclusions also cannot be regarded as strictly correct.—*Elek. Zeit.*, Jan. 17.

Telpherage.—An illustrated description of the automatic aerial electric car, of the Consolidated Telpherage Company's system in daily use at the works of the Crocker-Wheeler Company for carrying castings from the brass foundry to the machine shop. Two grooved wheels resting upon the carrying cable are directly connected each to two small electric motors. A trolley carried upon a short pole upon the upper side of the carriage takes current from the trolley wire suspended about 15 in. above the carrying cable, which forms the return.—*Eng. News*, Feb. 7.

Street Railway Association Meeting.—An account of the proceedings at the recent annual meeting of the Ass. of St. R'y Managers of the Rhine region and Westphalia. Director Geyl, of Frankfurt, referred to the advantages of uniformity of equipment, in which he was a thorough believer. The next subject discussed was that of electric heating. Lange thought electric heating very expensive, but recommended the use of the motor rheostats as heaters. Hippe quoted the somewhat peculiar fact that the cars equipped with motor-driven air brakes took less current than those equipped with hand brakes. This is due to the fact that the motorman having greater confidence in the certainty of the airbrake operation, applies the brakes less frequently than he would a hand brake. He also quoted figures as to power consumption in different cities. Another question discussed was the greatest permissible grade for electric motor cars using trailers. One road is mentioned with a grade of 1 in 14, where a trailer is used between two motor cars. On other roads, where the grades are 1 in 15, trailers without brakes are used. "At Lausanne, Switzerland, there is a road with several 12 per cent grades, 100 m. in length, on which a special safety brake is employed, which acts upon a wooden block buried in the pavement next to the rail."—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Foreign Tramway Situation.—An interview with W. J. Clark, general manager of the Foreign Department of the General Electric Company, with headquarters in London. There are no important interurban lines existing to-day in Great Britain, although there are some on the Continent. One proposed in South Lancashire, England, however, when completed will be very important. The great difficulty in Great Britain has been that, as the interurban lines are necessarily under private control, and as most of the city lines are owned by the municipalities, the former have difficulty in making arrangements to secure terminal routes. Sentiment in England is now favorable toward electric railway construction. The practice in Great Britain of using small generating units is also disappearing. He then criticizes the use of alternating-current motors for traction work, and says that American manufacturers have had far more experience with alternating-current work than Continental manufacturers, but decline to recommend them. His own company has had a car at its works operating with alternating-current motors for seven years. Germany has so far been the leader in Europe in electric traction, but the entire investment in all the tramways and light railways of Europe is only about one-third that in the electric railroads of the United States.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Denver Tramway.—A long, well illustrated description. The company operates about 430 cars. The method of dispatching cars by telephone is first described. There is a main dispatcher at the downtown office, to whom all the conductors report as soon as they reach the end of each trip. In case of delay the dispatcher knows exactly where every car is, and can alter the runs if he desires. The construction of the rails and the cars is described and illustrated. The cost of power generation was 1.1 cents per kilowatt-hour during October, 1900. A description is then given of the company's repair shop. Compressed air is used largely for blowing out copper dust from the motor cases. The motors are removed from the cars regularly every one or three months, and all parts are carefully gone over. A part which is found to wear considerably is the armature shaft. As the armature bearings have to fit the armature shaft, the company keeps four sets of bearings on hand, each 1-32 in. smaller than the one next larger. When a shaft is worn so that it is too small for the larger bearing, it is turned down so as to fit the next sized bearing. When it is too small for this bearing it is reduced to the next smaller, and so on. In this way a close enough fit for practical purposes is obtained, while the bearings are made in quantities and kept in stock instead of being made separately for each motor, as required.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Ohio River Electric Railway & Power Company.—This new road has recently been opened and connects several adjoining towns on the Ohio River. Its length is about 12 miles. Overhead trolley construction is used, and the road is constructed under steam railway specifications. It is expected that many freight cars will be hauled, an electric locomotive being provided and the tracks of the electric road connecting with the terminal of the steam road. The power is obtained from a steam plant near the center of the road. The rolling stock consists at present, beside the locomotive, of six 10-bench open cars, two standard closed cars and two combination cars.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

New Cars for Fairhaven & Westville Railroad Company.—These cars are intended for running at a very high speed, and their details have been carefully worked out. The vestibules are completely enclosed. The trolley board extends the entire length of the car, and is supported on rubber washers to prevent the transmission of vibration. Two trolley poles are provided, and links near the base hold down the pole not in use.—*St. R'y Jour.*, Jan. 19, and Int. Ed., Feb.

Control of Car Heaters at St. Joseph, Mo.—The conductors are not allowed to regulate the electric heaters on the cars. All cars are run by the company's office, and during cold weather a sign is posted in the office, indicating the position at which conductors must keep their heater switches. In case of a shortage of power, the company thus has control over the use of the current in the heaters.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Pekin-Machiapu Electric Railway.—The steam railroad between Tientsin and Pekin is obliged to terminate at a distance of about two miles from Pekin, on account of the prejudice of the natives. This distance is now covered by an overhead trolley line. The power station, which contains the waiting room for the road, is situated a short distance from the railroad station, and contains two 45-kw dynamos run by 75-hp engines.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

REFERENCES.

Control of Tramway Motors.—Sieber.—An article illustrated with many diagrams. He classifies the different types of motors and their control into several classes. He calls attention to a disadvantage which is common to shunt motors, motors excited by means of current from an independent source, as a battery, motors with the Sprague system in double-motor cars, and motors with compensating conductors between armature and exciting coils in cars with 10 or more motors. The common disadvantage is that, if in a car equipped with two motors, the speed or the field of one motor varies only a very little relative to the second motor, a considerable variation of the load of the motor at once occurs. The control of the different systems is shown in diagram. The article is concluded by a detailed enumeration of the different advantages and disadvantages of each system.—*Elek. Zeit.*, Jan. 10; translated in Lond. *Elec. Eng.*, Jan. 25.

Sleet Cutters.—Weeks.—A description of a sleet cutter used by the author, which is said to give superior results to the ordinary sleet-cutting wheel. The form advocated is a scraper with bifurcated wings, which straddle the trolley wire.—*Am. Elec.*, Feb.

Electric Traction in Great Britain.—A map, accompanied by an editorial note, showing the distribution of electric tramways and railways in the United Kingdom. The trolley system is prevalent, but the third-rail systems are also growing in number—23 lines are municipal, the remaining 40 are owned and worked by companies.—Lond. *Elec.*, Feb. 1.

Spokane.—An illustrated description of the street railway of this city which has about 40,000 population. The company operates 25 cars in winter and 40 in summer.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

New Power Houses in St. Louis.—The principal street railways in St. Louis have recently been consolidated, and the consolidated companies will install two new power stations, from one of which current will be distributed at 6000 volts. There will be two 1200-kw, three-phase generators. The other station will contain four 2250-kw, three 1500-kw and three 600-kw direct-current generators.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

School for Motormen.—A long article on the school for motormen, conducted by the Metropolitan St. R'y Company, of New York.—*St. R'y Jour.*, Feb. 2, and Int. Ed., Feb.

Installations, Systems and Appliances.

Northwich.—An illustrated description of the electric plants of Northwich. It was first intended to utilize water-power, but it was found that if Mond gas was used, obtained from neighboring chemical works, both the capital outlay and the running expenses would be lower. A gas holder is used of 2000 cubic ft. capacity; it is intended, not for storage, but to minimize the effect of the intermittent demands of the engines upon the regular flow of gas in the mains. There are three 60-kw current generators, giving 125 amperes at 480 volts; there are also two 7-kw boosters, giving 100 amperes at 70 volts. A battery of 256 chloride cells, with a capacity of 200 ampere-hours, takes the whole of the night-load after 12 p. m., and most of the forenoon. The battery is generally connected with the outers of the three wire systems, and a balance is provided to equalize the loads. At Northwich there are 9000 lamps of 8 cp, and a number of motors for hoists, and for turning the swing bridges across the Weaver River. The latter installation is described in detail, and is said to be highly successful.—Lond. *Elec. Rev.*, Feb. 1.

Wigan.—A very long and well illustrated description of this British lighting plant. There are four steam-driven dynamos, two larger ones, giving 420 amperes at 400 to 500 volts on lighting load and 300 amperes at 500 to 550 volts on traction load. The two smaller ones give 300 amperes at 460 to 500 volts on lighting load and 215 amperes at 500 to 550 volts on traction load. There is also a battery of 280 cells, giving 75 amperes for 10 hours or 300 amperes for one hour. The charging is done as follows: The battery is put across the bus-bars, and the number of cells reduced until charging takes place. The cells so cut out of circuit are charged independently by a small motor-driven dynamo.—Lond. *Elec. Eng.*, Feb. 1.

Electric Installation in a Store.—An illustrated description of the electric installation in a new store in Chicago, owned by a large firm doing mail-order business. The three-wire direct-current system is used. There are four 115-volt, 100-kw generators. There are 5000 incandescent lamps of 16 cp and 40 enclosed arc lamps of 110 volts. Considerable power is also used, the total amounting to 170 hp, nearly all the motors being connected to the 220-volt circuits.—*West. Elec.*, Feb. 9.

REFERENCES.

Heating of Resistances in Discontinuous Service.—Bethke.—A communication referring to the paper of Oelschlaeger, abstracted in the Digest, Feb. 16. He first considers the case in which the heating of the resistance is entirely due to the Joulean effect. With given dimensions of the coils, formulas for the heating of the coils can be easily deduced by considering the current density. His deductions are too mathematical to be abstracted. The formulas, however, seem to be practical. He also gives analogous formulas, if the heat produced in the iron in the neighborhood by hysteresis and eddy currents, is also to be considered. He has used such formulas for calculating the heating of railway motors which are also in discontinuous service.—*Elek. Zeit.*, Jan. 17.

Immersed Rheostats vs. Water Rheostats.—Rucker.—An article describing two forms of immersed rheostat used by the author for testing purposes, and pointing out the disadvantages of the ordinary water rheostat and the superiority of the immersed type. A table is given showing safe capacities for iron wire in the ordinary exposed type and the immersed type of rheostat.—*Am. Elec.*, Feb.

Three-Phase System.—Fynn.—An article on "The development of three-phase working in the twentieth century." It gives a general review of the applications and advantages of the system, but does not seem to contain anything new.—Lond. *Elec. Rev.*, Feb. 1

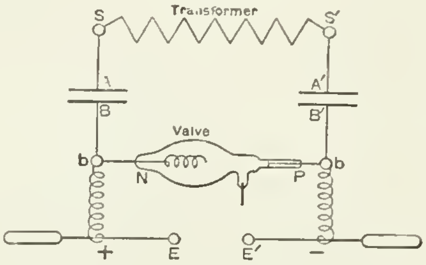
Wires, Wiring and Conduits.

REFERENCE.

Transmission Lines.—Edmands.—An illustrated article on "Some power transmission difficulties on high-tension electric circuits." He briefly discusses the difficulties experienced with circuit breakers, lightning arresters and porcelain insulators in overhead lines, and refers briefly to trouble experienced in underground transmission lines.—*Cassier's Mag.*, Feb.

Electro-Physics and Magnetism.

Transformer with Cathode Rectifier.—Villard.—An illustrated description of a new high-voltage transformer, in which one of the alternations is suppressed by means of a cathode-rays valve, which possesses at a certain exhaustion a resistance capable of opposing 60,000 volts in one direction, when the wire coil is the anode, and a very feeble resistance to a current in the opposite direction. As shown in the adjoining diagram, the circuit is interrupted by condensers at A B A^1 B^1, as in Tesla's arrangement, and the valve is inserted between b and b^1. It contains a small rod of platinum in a side tube, which is heated to liberate the necessary amount of hydrogen. The same transformer may be made to feed two exciters.—*Jour. de Phys.*, Jan.; abstracted in Lond. *Elec.*, Feb. 1.



TRANSFORMER WITH CATHODE RECTIFIER.

Luminosity of Gases.—Stark.—Luminosity is due to the impact of ions upon each other and upon central molecules, the luminosity being greater in the former than in the latter case. The greatest amount of luminous energy is evolved where the greatest number of encounters between positive and negative ions takes place, i. e., at the points of maximum ionization. The gas itself sends out the luminous rays, and the process is intimately connected with the diffused reflection of cathode rays by solid bodies. It is in the luminous portions of the discharge that the kinetic energy of ions produced at the cathode is absorbed. Luminosity is produced not only by the primary cathode rays, but also by the secondary ones, and indeed at a greater number of points by the latter, since, owing to their smaller velocity, they are diverted and dispersed to a greater extent by the positive ions.—*Phys. Zeit.*, Jan. 19; abstracted in Lond. *Elec.*, Feb. 1.

Lifting Electromagnets.—Clark.—A description of some practical forms of magnets used by the Illinois Steel Company for handling sheet iron. Mr. Clark's experience indicates that the round form of iron-clad magnet, which has been so popular on paper, is not as good for lifting purposes as a multipolar magnet whose outline is substantially rectangular. A table is included in the article in which are given complete data for the designs of the magnets which are illustrated. The round magnet referred to lifted 19.4 lbs. per lb. of magnet structure, while a smaller bipolar magnet with slab-shaped cores lifted 26.7 lbs. per lb. of magnet.—*Am. Elec.*, Feb.

REFERENCES.

Alternating-Current Diagrams.—An explanation of the use of vectors to represent phase relations in alternating-current working.—*Am. Elec.*, Feb.

Induction Coil and Roentgen Ray Tube.—Walter.—A paper on "The scientific use of the induction coil with the X-ray tube." He discusses the best design of an induction coil, especially if it is to be used with a Wehnelt interrupter. He recommends primary coils with variable self-induction.—*Fortschritte auf. d. Gebriet el Roentgenstrahlen*, v. 4, p. 1; translated in abstract in Lond. *Elec. Rev.*, Jan. 25.

Constancy of Permanent Magnets.—Klemencic.—An account of observations extending over a year, regarding the constancy of permanent magnets of different makers.—*Akad. Wiss. Wien. Sitz. Ber.*, April 1900; abstracted in *Science Abstracts*, Jan.

Electro-Chemistry and Batteries.

Lead-Zinc Battery.—A description of the Lecoll storage battery, which is a lead-zinc battery made in England. There are vertical lead tubes, each in the center of a strong cylindrical porous pot which is packed around the tube with lead peroxide. The other electrodes consist of sheets of fine gauze, of an alloy of copper, on which is deposited a coating of metallic zinc and cadmium. The sheet is passed around one of the outside cups and is then stitched together from top to bottom. The free ends are then passed around each half of the next cup, stitched again, and so on, so that each cup is wholly surrounded by gauze. The solution is said to be composed of metallic sulphates, those of zinc and cadmium predominating. The working voltage of this battery is between 2.5 and 1.8 volts, about 80 per cent of the normal discharge being above 2 volts. The ampere-hour efficiency is from 70 per cent, if discharged 20 hours after charging to 100 per cent if discharged at once. "Under the latter condition, indeed, the ampere-hour efficiency may rise to 120 per cent" (which throws a doubt on the other data). The watt-hour efficiency is, however, claimed to be only 95 per cent. The average output of these cells is about 10 watt-hours per pound of battery, equivalent to 3 hp for 4½ hours from 1000 lbs. of cells.—*Automotor Jour.; The Automobile*, Feb.

Formation of Storage Battery Plates.—Carro Cao.—An account of experiments made to determine the variation of capacity and resistance of pasted plates during the period of their formation. The lead plates were immersed in dilute nitric acid, then washed, and made up in their cells with 10 per cent acid. After undergoing several charges and discharges they were pasted, and 46 charges an' discharges made, the discharge being carried on until the e. m. f. had diminished to per cent below its initial discharge value. Both the capacity and resistance were found to increase regularly during the formation of the plates, but became constant after the fortieth charge and discharge.—*Elettricita*, Nov. 10; abstracted in *Science Abstracts*, Jan.

Electrolytic Bleaching.—An article on electrolytic bleaching with the "S-electrolyzer" of Schoop, for which high economy of working is claimed. The electrolyzer is said to be based upon three new principles. The solution of salt is electrolyzed in the form of thin columns of liquid; the surface of those platinum parts where chlorine is formed, is about 10 times greater than the surface of those platinum parts, where hydrogen is formed: the products formed at both electrodes are at once mixed by automatic circulation in the liquid.—*Schweiz. Blaetter. fuer Elek.*, Jan. 8.

Electromotive Activity of the Elementary Gases.—Bose.—A study of gas batteries with special consideration of Grove's. His conclusions are as follows: The electromotive activity of the elementary gases is conditioned by their solubility in the metals forming the electrodes. The gases dissolved in the metal are to be considered as dissociated either wholly or partially into single atoms by reason of the high dissociating power of metals. The ions of an electromotively active substance are to be looked upon as formed in the electrode The electrolytic solution pressure is measured by the product of the osmotic pressure of these previously formed ions by a factor, constant for each solvent, which may most simply be termed the electrolytic co-efficient of distribution. The general theory of gas batteries in which formation of the solvent occurs, may be developed on this basis. The saturation of the electrodes with the gases is a process of diffusion in the metal of the electrodes which proceeds with extraordinary slowness. The Grove gas battery works reversibly, "but its e. m. f. with the gases under atmospheric pressure is in any case higher than the received value." The acid and alkaline aqueous batteries differ in the place of formation of water, this being at the oxygen electrode in the acid element and at the hydrogen electrode in the alkaline. The second decomposition point corresponds to an irreversible process.—*Zeit. f. Phys. Chemie*, Sept. 18, abstracted in *Science Abstracts*, Jan.

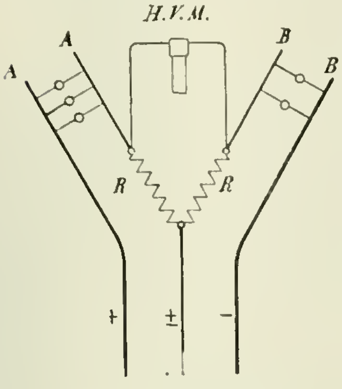
REFERENCE.

Zinc Processes.—Belloc.—A description of three patents of Canova and Bertani, and one of Casaretti and Bertani, the first for the production of zinc white, and the three others for the production of metallic zinc in the electric furnace. The last process is worked by an electrometallurgical company. To produce 1 kgr. of zinc, 2 hp-hours are required, and the consumption of coal in the furnace is 15 kg. per 100 kg. of ore.—*Elettricita*, Sept. 22; abstracted in *Science Abstracts*, Jan.

Units, Measurements and Instruments.

Units.—An abstract of a report of Guillaume to the recent Int. Congress of Physics in Paris. After some notes on the definition of the kilogram, the following unit of pressure is suggested: "The pressure of 75 c. m. of mercury, which, under normal conditions, is one of a megadyne to the square cm. is proposed for a practical unit of pressure, and the name barye is proposed for it." Reference is made to a resolution of the French Phys. Soc'y, to use "the term specific mass for the ratio of the mass of a body to its volume, and the word density for the ratio of the mass of a body to that of an equal volume of some other body taken as a type." It is thought that this resolution will not be agreeable to English physicists.—Lond. *Elec. Rev.*, Feb. 1.

Maximum Demand Indicator.—Hohmann.—A long and detailed article on the principles of the Wright maximum demand system of charging; also a description of the maximum demand indicator. For use on three-wire circuits Dick has devised the arrangement shown in the adjoining diagram. In the neutral conductor two equal resistances, *R* and *R* are inserted, made of platinoid or a similar material with a small temperature co-efficient. The ordinary demand indicator, *H. V. M.*, is connected across the ends of these resistances. The indications are then proportional to the sum of the currents consumed in the systems, *A* and *B*. The indications are correct also when the loads in both systems are not balanced.—



MAXIMUM DEMAND INDICATOR

REFERENCES.

Phase-Turning Apparatus.—Campbell.—A reply to Duddell's criticism (Digest, Feb. 9). He explains the cause of the limitations of his apparatus and shows the apparatus can be safely used, not only to measure small voltages and "power lags," but also to indicate the occurrence of differences of wave form. Also a brief criticism by Marchant of Campbell's device.—Lond. *Elec.*, Jan. 25.

Galvanometer.—An illustrated article, in which the construction of a simple galvanometer is described.—*Tel. Mag.*, Feb.

Power Measurement in Alternating-Current Circuits.—Campbell.—His illustrated Phys. Soc'y paper in full, an abstract of which was given in the Digest, Dec. 15.—Lond. *Elec.*, Jan. 25.

Telegraphy, Telephony and Signals.

Insulated Telephone Wires.—West.—A communication on the use of insulated telephone wires, as suggested by Hackethal (Digest, Nov. 24). He agrees that these wires can be used to advantage for telephone wires, which are placed on the same poles with light and power circuits. Such telephone lines would be generally of shorter length. He believes, however, that the Hackethal system cannot be used in cities, nor in long-distance lines.—*Elek. Zeit.*, Jan. 3.

Method of Measuring the Vibration of a Transmitter Diaphragm.—Merrill.—A short description of a method of computing the excursion of a diaphragm, which consists of mounting a small mirror parallel with the diaphragm, connecting the two by a light needle so that the mirror oscillates with the vibrations of the diaphragm, and reflecting a beam of light on a screen from the mirror. The travel of the beam of light bears a fixed relation to the excursion of the diaphragm.—*Am. Elec.*, Feb.

Wireless Telegraphy.—Guarini.—A communication, in which he refers to some recent experiments made by him. The most interesting observation is said to be "that the transmitter and receiving coherer, about which there was nothing particular, were not connected with the earth nor with a capacity. One of the balls of the oscillator on the one hand, and one of the electrodes of the coherer on the other hand, were connected to the air wires, while the other ball of the oscillator and the other electrode of the coherer were completely free. This proves that electric waves are not propagated by the earth, but by the air, and that they do not follow the curvature of the earth."—Lond. *Elec.*, Feb. 1.

REFERENCES.

Hughes Telegraph.—Garland.—A brief illustrated note on a modification of the Hughes telegraph, consisting in a re-arrangement of the keyboard.—Lond. *Elec. Rev.*, Feb. 1.

Telephonograph.—Rellstab.—An illustrated article on the design and theory of Poulsen's instrument.—*Elek. Zeit.*, Jan. 17.

Small Telephone Switchboard Systems.—Henry.—An explanation of two of the simpler forms of small telephone switchboards, with diagrams.—*Am. Elec.*, Feb.

Telephone Auto-Commutator.—An illustrated description of an "Auto-commutator," i. e., an apparatus for automatically making connections with a party wanted. The apparatus is being tried by the French Post Office, which is in charge of the telephone system of France.—*Sc. Amer.*, Feb. 9.

Miscellaneous.

Electrical Fatalities.—Kennedy.—A brief article calling attention to the fact that it is not the pressure upon which fatality depends, but the current, and that does not depend upon the pressure alone. "What is the amount in amperes of the fatal dose is not at present known, but it is probably much under one ampere." "It would be safer to affirm that all pressures over 200 volts can be dangerous to life, all over 500 volts certainly dangerous."—Lond. *Elec. Rev.*, Feb. 1.

REFERENCES.

Elihu Thomson.—A biographical sketch of Elihu Thomson, with a good portrait.—*Cassier's Mag.*, Feg.

Paris Exposition.—The fifteenth part of the illustrated serial, dealing with the crane of Flohr, a Gramme electrically-driven slotting machine and forge, and arc lighting machines of the Gramme Company and the Western Electric Company.—Lond. *Elec.*, Feb. 1.

Korda.—An illustrated description of several three-phase alternators of French manufacture.—*Elek. Zeit.*, Jan. 10.

New Books.

Rapports Presentés au Congrès International de Physique. Rassemblés et publiés par Ch. Ed. Guillaume et L. Poincaré, Secrétaires Généraux du Congrès. Trois tomes. Paris: Gauthier-Villars, 25 Quai des Grands Augustins. Tome I., 696 pages; tome II., 570 pages; tome III., 619 pages. Price, each volume, 18 francs, or for the three volumes, 50 francs.

These three portly volumes contain the papers presented at the Paris International Physical Congress of 1900, and form undoubtedly the most important single contribution made in many years to the literature of the physical sciences. The list of authors contains 81 names, and is almost totally inclusive of the leaders in the theoretical departments of practically the whole range of physical science. The plan of the papers consists, in general, in giving the present status of the department of science treated, preceded by a rapid résumé of the various steps to date, and followed by a discussion as to future development. The work as published thus consists of a well-ordered résumé of the state of physical science at the beginning of a new century, and as such will long form an authoritative record to which advances may be referred, and with which to start the study of a given branch.

Tome I. contains the papers on general questions on metrology, mechanical physics and molecular physics. The first paper is a remarkable one by H. Poincaré, entitled "Relations Between Experimental and Mathematical Physics," but which is really a discussion of the methods of scientific thought and investigation of an order that places it in the same category with Descarte's Discours, Locke's Essay and Bacon's Novum Organum. Among the authors represented in this volume are Poincaré, Guillaume, Barus, Ames, Violle, Bjerknes, Voigt, Van't Hoff and Lippman. A section of papers in this volume of particular interest deals with the determination of the speed of sound, the mechanical equivalent of heat, the measurement of high temperatures, precision of measurements, etc.

The second volume is devoted to optics, electricity and magnetism, and contains 27 papers, among the authors being Kelvin, Lummer, Cornu, Poynting, Righi, Branly, Arrhenius, Blondlot, Warburg, Bouty and Nagaoko. The paper by Kelvin is on the hypothetical ether. Among the papers of a more general interest are those by Righi on hertzian waves; Branly on coherers, Arrhenius on electrolytic dissociation of solutions, L. Poincaré on the theory of the voltaic cell, Gouy on standards of e. m. f., Leduc on the electro-chemical equivalent of silver, Warburg on hysteresis, and Van't Hoff on some magnetic properties of cast and laminated iron. A paper by Poynting is on the mode of propagation of energy and electrical stress in the electromagnetic field.

Tome III. in the title page specifies as the subjects covered Electro-optics, ionization, applications of physics, cosmic and biologic physics, the third head covering several of the more practical papers read before the Congress. A paper by Lorentz treats of recent advances in electro-optics, and is followed by seven papers dealing with the new departments of physical science, opened up by the discovery of Röntgen, and the researches of J. J. Thomson and others in electrical discharges in gases—the authors being Drude, Becquerel, Curie, Villard, J. J. Thomson, Villari and Bichat. These papers are almost indispensable to those who would inform themselves on the interesting and highly promising subjects of which they treat. Other papers are on the counter e. m. f. of the arc, by Lang; polyphase currents, by Potier; the direct inscription of variable currents, by Blondel; recent researches on atmospheric electricity, by Exner; the aurora borealis, by Paulsen; molecular phenomena produced by electricity on inorganic and living matter, by Bose; progress of heat engines, by Witz.

The Cost-Keeper. Some Original Systems of Shop Cost-Keeping or Factory Accounting. By Horace Lucien Arnold. New York: The Engineering Magazine Press. 408 pages, illustrated.

The subject which this book covers is a rather difficult one to handle and make the contents applicable to the majority of cases, but the compilation of H. L. Arnold makes a start in the right direction, and its reading will convince the layman and shop keeper of the necessity of an up-to-date accounting of the details of his business. It is impossible to give, within the confines of some 400 odd pages, examples of each and every industry. The compiler has, however, chosen types from shops employing 50 men to those employing 300 and more, which are sufficient to answer general purposes.

The preface strikes the keynote—"Am I obtaining my true costs? Am I obtaining my costs in the best form? Am I exactly informed as to all separate expense items? Do I pay too much for cost-keeping, or shall I pay more and obtain my costs more in detail? Are there known cost-keeping systems so much better than mine that I should change my present methods?" We are led in turn to ask ourselves the questions—"Are our business affairs in tangible shape? Can we lay hold of any information in our possession without loss of time? Do we have to wait until an inventory to ascertain our gain or losses? Is our business being conducted on guess work or up-to-date principles?"

The first shop mentioned is that of a drop-forging plant employing about 100 men; the second, a roller bearing company employing about 50 men; the third, a cream separating establishment with 150 men; another, a general iron works, manufacturers of engines, boilers, tanks, pipes, etc.; and, lastly, a switch and signal manufactory In each of the cases mentioned the card system is used; in some extensively; in others, enough to show the advantage of a still further increase.

The general tendency is to divide the departments into, for example, the office, factory, rough store, general stores, pattern and drafting and officers, as follows: General manager, having charge of the general business affairs and disposal of production, and responsible only to the directors of the company. The next in authority is the general factory manager, who bears the entire responsibility of production and is subordinate to the president only. His staff consists of a cost clerk and paymaster, a purchasing agent and a production order clerk, who originates production orders on the factory under requisition from the superintendent. The superintendent is in charge of the foremen. The drawing room is under control of the consulting engineer, who is under immediate direction of the superintendent. Then in turn follow the foremen, shipping clerk, general stores clerk and tool clerk.

Various types of card systems are illustrated, showing the use of cards, not only for production orders, shipments and general data, but also for book-keeping and a complete inventory of all stock, including memoranda of all the general details of business. The reports of the systems employed in the various industries mentioned are quite complete, having in most cases been exhaustively treated by the managing head of the individual establishments.

Factory organization and accounting is well taken care of by James Newton Gunn in a 50-page section under that heading. An article on the "Card System of Accounting," by R. A. Simonson, follows, and is a comprehensive general consideration of the economies and advantages arising from the use of cards instead of books. Among these advantages may be mentioned unlimited expansion, unity of item entry, collective value, collation of typical costs, cross reference, current summaries, perpetual inventory, department analysis, individual reference, self-indexing, transposition, saving of "overtime" money, no duplicate labor, numeric system, classification, mechanical features.

A short article entitled "The Expense Account" is an analysis of shop expense production, particularly with reference to the proper position under expense of duplicate or special machinery or apparatus, and the position in inventory of such items as patterns, etc. The final article is illustrative of the various aids to factory accounting, such as the time clock recorder, computing machines, such as slide rules for all problems in proportion, multiplying and dividing, and the various forms of comptometers for addition and subtraction, watchmen's clocks, book typewriters', etc.

BOOKS RECEIVED.

The Inspector and Trouble Man. By A. E. Dobbs. Reprinted from *The Telephone Magazine.* Chicago: Electrical Engineering Publishing Company. 106 pages, 67 illustrations. Price, $1.00.

Mesures Electriques. Lecons Professées a L'Institut Electrotechnique Montefiore. By Eric Gerard. Second edition. Paris: Gauthier-Villars. 532 pages, 217 illustrations. Price, 12 francs

Les Phenomenes Electriques et Leurs Applications. Etude Historique, Technique et Economique des Transformations de l'Energie Electrique. Par Henry Vivarez. Paris: Georges Carre et C. Naud. Octavo, 376 pages, 225 illustrations. Price, 15 francs.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 17-20, 1901.

Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

Canadian Electrical Association. Next meeting, Ottawa, Ont., 1901.

30-Drop Desk Switchboard.

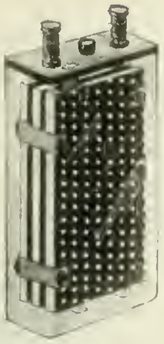
The desk switchboard illustrated herewith, placed on the market by the Haines & Noyes Company, Chicago, Ill., is of the automatic self-restoring express type. The company recently acquired the patent rights on it, and it has been improved by their engineers. Its principal features, making it extremely simple and rapid may be enumerated as follows: It has a reliable night alarm; the drops are of the tubular type; all parts are readily removable for repairs; the drops are cut out of the talking circuit; the drops and jacks are mounted independently, and can be taken out by simply removing the two thumbscrews at the back; the shutter is automatically restored from the front of the jack, and not from the rear, the restoration being done by the side pressure of the plug on the drop as it slips into place, thus doing away with complicated self-restoring mechanism; the clearing out drops are of the tubular type, bridged across the cord circuit, and the springs are of German silver, with scraping contacts.

DESK SWITCHBOARD.

The operator's equipment is for long-distance use. The switchboard cabinet work is of quartered oak, and the mechanical and electrical work throughout is said to be of the best quality.

The company manufactures a cheaper board than its "Express." It is similar to the latter, but the drops are not self-restoring.

Reuterdahl Accumulators.



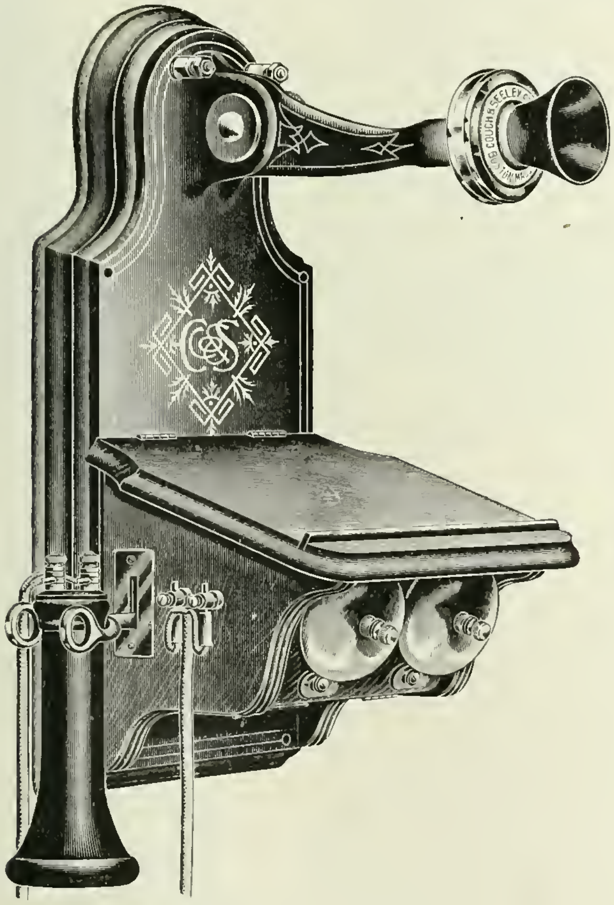
ACCUMULATOR.

Announcements are now being made in regard to light, small and compact batteries, which the Reuterdahl Electric Company, of Providence, R. I., is putting on the market. The jars are sealed and being made of pressed glass, and are very neat in appearance. This company has made a departure from conventional types, and has dispensed with grids, depending upon a case of acid-proof material to retain the active material. This construction permits a large saving in weight and an increase of about 100 per cent, it is asserted, in capacity, size for size, or weight for weight. The cells are constructed durably, and the low prices, neatness and large capacity are expected to make large sales.

A New Common Battery Telephone.

There is being placed on the marked by the Couch & Seeley Company, of Boston, a telephone for common battery exchanges, which is claimed to embody some especially desirable features.

The back of the telephone is a hollow casting highly finished in black, handsomely striped, this being mounted on a half-inch oak backboard, as shown. The space between the backboard and the front plate of the casting is sufficient for mounting a condenser, which the company also manufactures. The ringer is attached as shown, and when the shelf is raised the ringer tips forward on hinges so that it is accessible for any adjustment or other attention which may be necessary. This also opens up the entire box in such a manner as to make it easy to reach the hook contacts, induction coil and all parts. This telephone is equipped with the company's regular long-distance coal grain microphone and bipolar receiver.



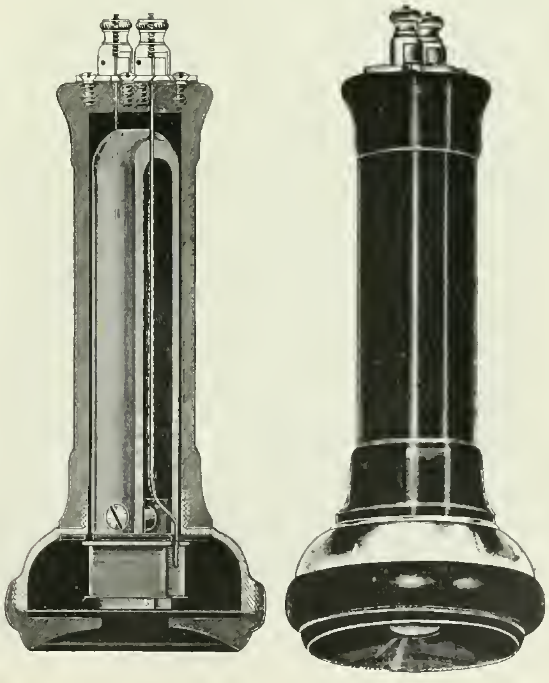
COMMON BATTERY TELEPHONE.

The company has been furnishing this common battery telephone to a limited number of exchanges for some time, but has not placed it on the open market heretofore, because it wished the instrument to be given a thoroughly practical test from every standpoint. It is now placing this instrument on the market as its standard type. Its various forms of desk sets are also made for common battery purposes, and for use on any of the various common battery systems employed.

A New Double-Pole Receiver.

The accompanying illustrations show the internal construction of a new double-pole receiver, and the instrument in perspective, manufactured by the Lambert Schmidt Telephone Manufacturing Company, of New York. The magnet is of special Wolfram steel, highly saturated and horseshoe shaped, with broad bobbins at the terminals. These bobbins have soft iron cores and are wound with silk insulated copper wire. At the intersection of the bobbins with the magnet is set a disk of brass for use in fastening the magnet to the outside shell. The receiver case consists of a heavy brass cup at the head, the handle being one piece of hard rubber covering the body of the magnet and threaded on the inner surface at the open end. This handle is screwed to the metal cup on a similar thread. The magnet itself is screwed into the brass cup by two machine screws extending through the brass disk before mentioned, these screws projecting into the rubber shell to prevent this shell from twisting. By this design, the metal cup and the magnet becomes one solid piece and the contraction, expansion or breakage of the rubber shell does not change the relative position of the magnet poles to the diaphragm.

The diaphragm is tin plated soft iron lying evenly on the metal cup. The receiver cap is hard rubber, shaped to clamp the diaphragm at exactly the same point with the edge of the metal case. The binding posts are peculiarly constructed. The body is an arch with a partially flat top. Inside this arch is a square block not filling the entire space, and with a long threaded pin extending through a hole at the top of the arch, but not screwed to it; on the contrary, this hole allows easy play. A finger nut is screwed to this pin and is in position directly over the arch. On the opposite sides of the arch are two small holes. There is also a similar hole through the metal block. The block is brought into position so that these three holes are in alignment and the cord tip is then pushed through. The finger nut is turned, thus drawing up the block and clamping the cord tip on each side of the arch so that it cannot possibly work loose. The binding posts have screw plates to prevent twisting. The finger nut cannot work off the threaded pin. Fixture wire is used from the binding posts to the bobbins. This receiver, it is claimed, requires no adjustment whatever, and for that reason never gets out of adjustment.



DOUBLE-POLE TELEPHONE RECEIVER.

Telephone Ringing Generators.

The two styles of generators shown in the accompanying cuts are among the latest productions of the Connecticut Telephone Company, Meriden, Conn. They are similar in general construction, the principal difference being in their size. They are substantially constructed, and are intended for use where a powerful and lasting machine is desired. The magnets are made of the best grade of magnet steel, and are bent and tempered in such a manner as to spring onto the pole pieces with a tight grip. In addition to this they are held rigidly in place by means of screws, and are so fitted between ridges on the pole pieces that they wil not shift by rough handling. The armature is laminated, the best of insulation being used in its assemblage. The company states that it gives a large output for its size. The bearings are extra long and closely fitted. The gears, which are heavy and made of a special grade of cast brass, are turned and cut on the shaft so as to make them run true, at the same time being adjustable.

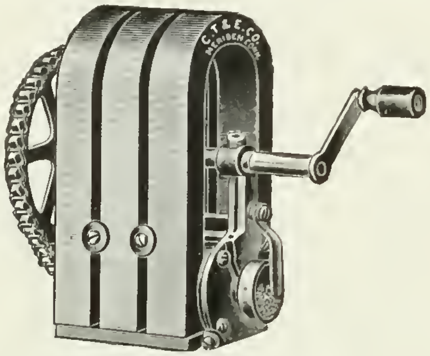

C.T.&E.CO.
MERIDEN, CONN.

FIG. 1.—TYPE U GENERATOR.

The pole pieces are made of soft iron carefully bored out so that the armature will fit very close, thus reducing the air-gap to a minimum. These generators are designed for all the different styles of telephone apparatus, and are either mounted on blocks or in cases with the ringers and switchhooks.

The company is also furnishing an efficient power generator for short lines, and a double 8-magnet machine where an extra large output is desired. These generators are provided with either series automatic shunt or multiple automatic cut-in. The latter device, the company states, is a new departure. It is mounted directly on the end of the armature shaft, as shown in one of the illustrations. The company states that in some cases 35 to 40 of the 4-magnet type machines are in use on a single circuit, and are giving the best of satisfaction.

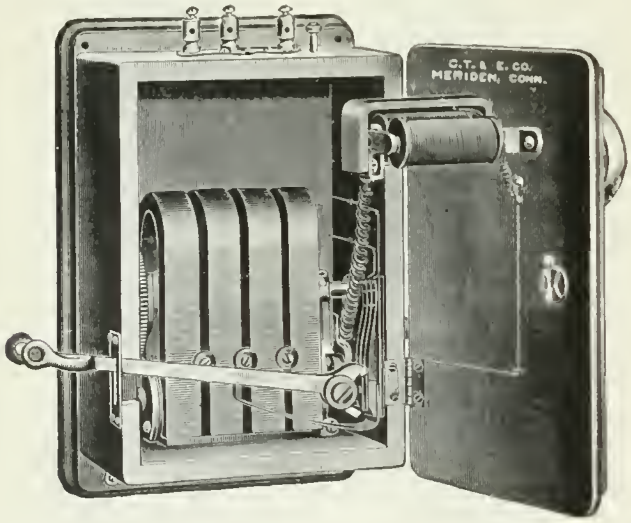

C.T.& E.CO.
MERIDEN, CONN.

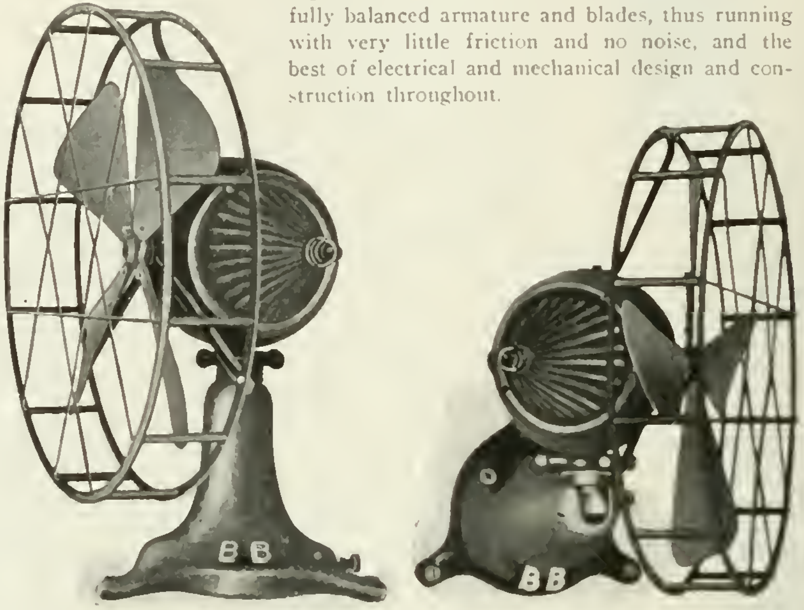
FIG. 2.—MULTIPLE MAGNETO.

B. B. Fan Motors.

The accompanying illustrations show the B. B. combination bracket and desk fan, which is manufactured by the B. B. Electric Company, 216 Greenwich Street, New York.

This motor is made with a ball joint, so that the fan and its mechanism can be set in a standard, for the desk, or in a bracket, and the joint is claimed by the manufacturer to be the only one with which the fan can be adjusted with one operation so as to throw air in any direction. All parts are made in jigs, and are therefore interchangeable, thus making it possible to order by mail any required part. Three speeds are obtainable by means of resistance, and a regulating switch in the base of the machine.

The features of this fan may be thus enumerated: Self-oiling bearings, which require very little attention; carefully balanced armature and blades, thus running with very little friction and no noise, and the best of electrical and mechanical design and construction throughout.



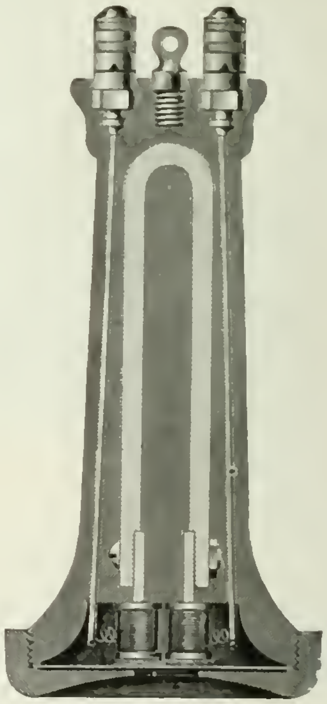
FIGS. 1 AND 2.—FAN MOTORS.

The standard fan is finished in black enamel, with solid brass guard and blades, but any other style of finish may be had on order Each motor is thoroughly tested before leaving the maker's hands

A "Solid" Telephone Receiver.

A new departure in telephone receivers is just being introduced by William J. Murdock & Co., of Chelsea, Mass., under the name "The Solid." The distinctive feature of this receiver lies in the fact that the magnet, the pole pieces, the binding posts, the wires connecting with the binding posts and extending through the case, and the supporting rings, are covered with the insulating material which forms the case and are solidly moulded therein, making the case and all these parts practically one piece. This gives the magnet a permanent position, and leaves the pole pieces always in the same relative position with respect to the diaphragm seat. The binding posts are made hexagonal in shape and grooved, this shape preventing all possibility of turning, and the grooves insuring them against pulling out when moulded into the case.

The claims of the manufacturers are that the adjustment of their receivers being exact on the outset, this construction makes it permanently perfect, and gives a strength to the whole instrument that renders it capable of withstanding all sorts of hard knocks without injury; while the first cost is not in excess of that of familiar types of receivers, the cost of its maintenance is reduced to the minimum. The cut herewith shows a cross section of "The Solid," standard shaped receiver. Watch-case receivers are also made on this principle.



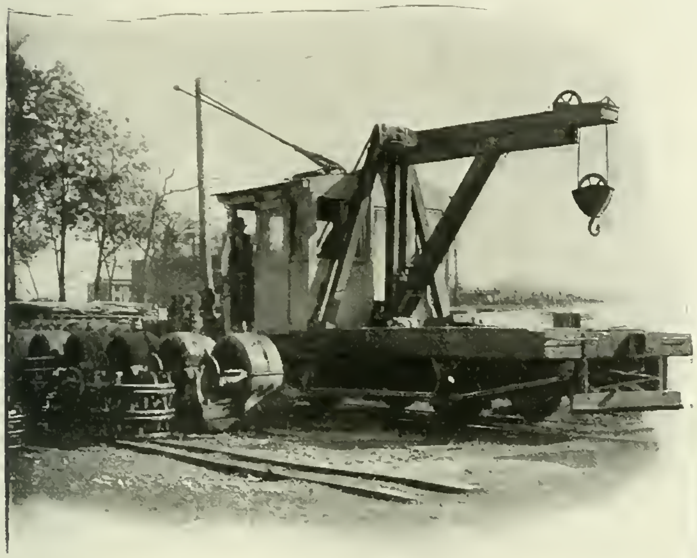
TELEPHONE RECEIVER.

Electric Locomotive and Car Crane.

The electric locomotive illustrated herewith embodies the features of a flat car and crane car, and was designed by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, to meet the convenience of manufacturers in handling their products in and about their works.

The side trusses of the car are made of cast iron of especial heavy construction to provide weight for tractive effect and as a counter balance for the crane. The center of gravity of the car is therefore low down and well distributed. The car body is 22 ft in length over all, and 9 ft. 6 in. wide, and the height from top of rail to top of crane is 13 ft. 6 in. The cab contains the controller from which the propelling motors are operated, a brake, a main switch from trolleys, and main line fuse block. Also controllers for the hoisting and swinging motors for the operation of the crane.

As a locomotive it is capable of handling eight loaded cars on a level track or two fully loaded cars on a 2 per cent grade. Power for it can be supplied from any direct-current circuit. The car is propelled by two motors, one upon each axle, and they may be wound for either 110, 250 or 500 volts. Double trolley wires are used to avoid the necessity of grounding one side of the line. The locomotive is provided with a jib crane having an extensible arm, so that the radius of operation may be varied. With a 10-ft. radius the crane will handle 10,000 lbs. The jib can be used at either side of the car, and the movement of the arm is controlled by the operator within the cab.



ELECTRIC LOCOMOTIVE AND CRANE CAR.

Cars set upon a track parallel to the one upon which the crane car stands may be loaded and unloaded. The capacity of the crane either in lifting power or radius of work within certain limits may be made to suit the requirements of manufacturers.

As a flat car there is available a space 14 ft. by 9 ft. 6 in. upon which may be loaded material for transfer from one part of the works to another. This feature of the car renders it a great convenience, and the entire load can be handled by the crane, the work of loading and unloading being quickly accomplished. The capacity of the car is 40,000 lbs.

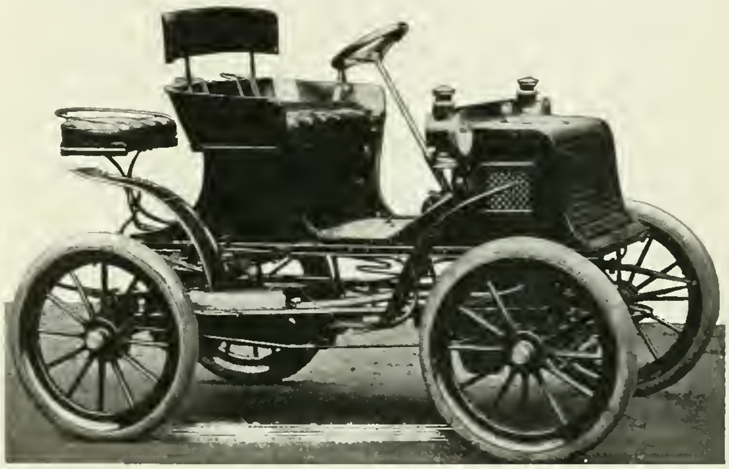
A New Type of Gasolene Runabout.

It is a rather curious fact that one of the most improved forms of gasolene automobiles to be put on the market is due to the efforts of the Electric Vehicle Company, of Hartford, Conn. Mr. Hiram P. Maxim and other engineers of the company appear to have produced a machine of high excellence for work in the hydrocarbon branch of the art, and note of its remarkable "long distance" performance was made recently in these columns.

The automobile used in that 500-mile continuous test was a Columbia gasolene runabout, known as Mark VIII., having a total weight ready for duty of 1640 lbs. In this weight is included 11 gallons of gasolene, 1 gallon of lubricating oil, a fully-equipped toolbox with tools and spare parts, a complete equipment of headlights, a cyclometer, rear groom's seat and boot. The engine is a single-cylinder Otto cycle. The cylinder dimensions are 4.6 diameter by 6.8 stroke. The complete engine with 19-in. flywheel weighs 240 lbs. This weight includes governor, carburetter with piping, water cooling pump and necessary piping therefor. The power of the engine is 5-brake hp actual at 750 r. p. m. The engine is located in the front of the vehicle. Being of single cylinder and of low speed, the latter insuring long life and low repair expense, it is mounted upon a separate spring-supported frame of its own.

Power is transmitted from the engine flywheel through a friction clutch operated by a pedal in the floor. From the friction clutch a shaft runs longitudinally and carries four gears, three of them being for different gear reductions ahead and one for reverse. The countershaft to which they gear continues to the rear axle, which is "live," and which it drives through the medium of very large and generously proportioned bevel driving gears. The entire gearing is encased in one cast steel box, which includes the rear axle and which positively insures the alignment of everything. That this construction is carefully worked out may be judged by the fact that at 4-hp input at the friction clutch, the losses in transmission to the rear axle are only 6 per cent.

The gear reductions are, respectively, 15.2 to 1, 7.8 to 1 and 4 to 1, with 13.9 to 1 for reverse. These gears are thrown in by positive clutches, which are operated in a very simple manner by one lever projecting up at the side of the seat. While the principle of control is identical with that used on the best European vehicles, it is much simplified in this American arrangement. In the latest vehicles brought out by prominent European builders, it is to be noted that this getting of all the change gear functions into one lever is being done. In order to insure positively against attempting to throw in changes of gear without disconnecting the engine or source of power, a very simple and ingenious interlock is provided, which makes it impossible to change the gear without first pressing forward the clutch pedal which disengages the friction clutch on the engine flywheel.



GASOLENE RUNABOUT.

The friction clutch is a plain windup brake faced with leather so that all degrees of slipping can take place without danger of cutting or running dry, ensuring wearing nothing more than a leather band. This, of course, is of ample proportions so as to prolong the life before the new leather has to be put in. The speed of the engine is controlled by a governor. This governor operates a valve in the suction pipe. In the suction pipe beyond the governor throttle is the aspirating carburetter, so arranged that when the governor throttle opens and permits a vigorous suction a larger amount of gasolene aspirates, or when the governor throttle by partially closing the suction pipe reduces the vigor of the engine suction, less gasolene is aspirated. This insures a uniform quantity of gas mixture at all engine speeds.

The engine is speeded beyond its normal by means of foot pedal control. The ignition is automatically advanced or retarded by the engine, according to its speed, so that the maximum effect is always produced from whatever charge the governor permits the engine to get. The ignition is by secondary current.

In the recent 500-mile run, when the climatic and road conditions were as severe as they are ever likely to be in this latitude, it was found that 14.4 miles were obtained per gallon of gasolene, the load being 2040 lbs., including the weight of two passengers, heavy wraps and baggage. The best average speed on this trip was 23 miles per hour, made on the west side of the Connecticut River, between Hartford, Conn., and Springfield, Mass., over roads that were a succession of grades.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In the money market there was general quiet. The quotation for 30 to 90 day money is held at 3½ per cent, and 3½@4 per cent is the quotation for longer arrangements. Commercial paper was quoted at 3½@4 per cent for prime double names. Call money is quoted at 1¾@2½ per cent, the prevailing rate being 2 per cent. In the stock market conflicting influences were apparent. The railroad share list was quieter. Less attention was given to stories of further deals and combinations, but confidence was shown in the continued ability of railroads to pay their dividends, and the investment buying of securities was notably large. At the end of the week the activity relaxed somewhat. Expectations of a favorable outcome in the negotiations for a combination of the principal steel companies caused the stocks of those concerns to show decided firmness and a readiness to advance. Uncertainty as to the terms of the deal, however, checked the development of speculation in them. The sensational feature of the electric list was the sharp advance in General Electric common. On Thursday this stock registered a net gain for the day of 12½ points on transactions of between 5000 and 6000 shares. There is little floating stock on the market, which accounts for the advance in the face of such comparatively small transactions. The advance was the result of a report that the company had agreed to reinstate the stock in its old position, relative to the reduction in capital. There were also rumors about a stock dividend. The active interest in the stock was maintained and at the close the quotation was 211, representing a net gain over the close of the previous week of 14 points. The total sales were 14,499 shares; the range of prices was 197-217½. Western Union also revived from its long period of lethargy and the dealings were particularly active early in the week. The sales amounted to 112,340 shares, the highest price reached being 91, the closing quotation being 89, which is a net gain of 2 points. In the traction list there was little activity. Transactions in both Metropolitan and Brooklyn Rapid Transit were much smaller than those of the previous week. Metropolitan closed with a net gain of ⅞ of a point, at 163⅜, and Brooklyn Rapid Transit at a net loss of 1¼ points, the closing quotation being 77⅛. American District Telegraph made a net gain of 1 point on total sales of 200 shares, and American Telegraph & Cable made a like gain. The market for outside securities was devoid of any particular features, prices holding about steady. American Bridge was strong, as was Sheet Steel, the bullish sentiments on both stocks being predicated on the part the respective companies are supposed to play in the new steel combine. There was trading in 2000 shares of Bridge common between 45½ and 46½, while 200 shares of the preferred were dealt in at 94. American Sheet Steel sold to the extent of at least 1200 shares at 78½ and 78¾. Following are the closing prices at the four centres named:

NEW YORK.

	Feb. 9.	Feb. 16.		Feb. 9.	Feb. 16.
Gen. Electric	197	211	Elec. Veh.	16	15
Bklyn Rap. Tran.	78⅜	77⅛	Elec. Veh., pfd.	30	30
Met. St. Ry.	162½	163⅜	Gen. Car	2⅜	2¼
Am. Tel. & C.	96	97	Ill. Elec. Veh. Tran.	¾	¾
West. Un. Tel.	86½	89	Hud. Riv. Tel.	117	120
Am. Dist. Tel.	35	36	N. E. Elec. Veh. Tran.	3	3
Com. Cable	—	160	N. Y. Elec. Veh. Tran.	4¼	4½
Elec. Boat	27	27	Tel. & Tel. Co. of Am.	4	4
Elec. Boat, pfd.	51	52	N. Y. & N. J. Tel.	174	174

BOSTON.

	Feb. 9.	Feb. 16.		Feb. 9.	Feb. 16.
New Eng. Tel.	—	—	Erie Tel.	63	*62
Mex. Tel.	2¼	2½	Gen. Elec., pfd.	—	160
Westing. Elec.	—	60	Am. Tel. & Tel.	163	162
Westing. Elec., pfd.	—	—	Boston Elec. Light	210	210

PHILADELPHIA.

	Feb. 9.	Feb. 16.		Feb. 9.	Feb. 16.
Elec. Stor. Bat.	75	70	Phil. Elec.	7⅝	7⅜
Elec. Stor. Bat., pfd.	75	75	Pa. Elec. Veh.	—	2
Elec. Co. of Am.	8⅛	8⅞	Pa. Elec. Veh., pfd.	—	1
Gen. Elec. Auto	—	—	Am. Rys.	33	35½

CHICAGO.

	Feb. 9.	Feb. 16.		Feb. 9.	Feb. 16.
Chicago Edison	150	150	Chicago Telep. Co.	260	260
Chic. City Ry.	255	256	Union Traction	12	13¾
Nat'l Carbon	16	18	Union Traction, pfd.	53½	55
Nat'l Carbon, pfd.	83	83	Northwest. Elev. Com.	34	33

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* Asked.

LOCKPORT POWER SCHEMES.—A special dispatch from Lockport, N. Y., of Feb. 7 says: The Whitney-Elkins syndicate has a big scheme on in this part of the State, which will involve millions. Those who are informed say that the same men who recently purchased the Buffalo & Depew trolley line are behind the Buffalo, Rochester & Niagara Falls Electric Railway Company's ridge road project, the water company which desires to furnish Lockport with water, and the Niagara, Lockport & Ontario Power Company, which has offered to construct a power canal from Niagara River to this city. S. Q. Mingle and the Depew Investment Company are known to be associated with the Philadelphia and New York men who have purchased the Buffalo & Depew line, and Mr. Mingle and the American Pipe Company of Philadelphia are backing the water and power companies referred to. The Ridge Road Trolley Company has said that it will take its supply of power from the Lockport power canal, if the canal is built, and there is evidence that it is interested in the construction of this canal. Two capitalists have gone over the route of the proposed Buffalo, Rochester & Niagara Falls trolley line, and it is said on pretty good authority that the interests of all the companies named will be consolidated and that the capitalists interested will build the trolley line, construct the power canal and provide Lockport with water.

ALASKAN LIGHTING DEAL.—A special dispatch from Seattle, Wash., of Feb. 2 says: "C. R Collins, formerly manager of the Seattle Gas & Electric Company, has purchased a controlling interest in the Alaska Light & Power Company, operating an electric light plant at Skagway. The Skagway *News* of recent date speaks of the purchase as likely to lead to substantial improvements in the plant. It is stated that new boilers and modern dynamos are to be immediately installed. It appears that Mr. Collins sent an expert in electric light plant construction to examine the property, and on his favorable report made the investment Charles B. Hurley of Tacoma, who is president of the company, still retains an interest in the concern, it is said.

BALTIMORE TROLLEYS.—Hambleton & Company report the earnings of the United Railways & Electric Company of Baltimore for the year ended Dec. 31 as follows:

	1900	1899.	Changes.
Gross	$4,431,742	$4,274,304	Inc. $157,438
Expenses	2,059,559	1,948,363	Inc. 111,195
Net	$2,372,183	$2,325,941	Inc. $46,242
Fixed charges and taxes	2,327,980	2,198,339	Inc. 129,640
Net revenue	$44,203	$127,602	Dec. $72,398

TELEPHONE, TELEGRAPH & CABLE COMPANY OF AMERICA.—The Telephone, Telegraph & Cable Company of America stockholders have elected the following directors: Joseph McCall, F. M. Jenks, C. W. Morse, H. Gawtry, G Crocker, O Ames, F. Tilford, Daniel O'Day, G F. Hawkins, H R Wilson, W J. Latta, F. M. Riter, R. Morgan, J. L. Welsh, J D Crimmins, E R. Chapman, Samuel Thomas, J. C. Bullitt, J. J. Sullivan, M. W. Ayers and G W. Elkins. The first eleven are members of the old board In some quarters the opinion prevails that the management is not as yet quite positive that all the new directors will qualify.

ERIE TELEPHONE.—Although the subsidiary companies of the Erie Telephone system have not made up their figures for 1900, it is understood that the estimates show gross earnings of $4,050,000, or an increase over the previous year of $1,273,000. The net earnings are estimated at $1,760,000, an increase over 1899 of $487,000. The total number of telephone subscribers to this system was, on Dec. 31, 1900, 141,599. The net gain in subscribers, as compared with the previous year, was 35,041. It is estimated that the gross income for 1901 should be $6,500,000. If there were no gain in subscribers during the year, gross business would be not far from $6,000,000.

DETROIT UNITED RAILWAY.—At a meeting of the directors of the Detroit United Railway Company the following officers were elected: President, Henry A. Everett of Cleveland; vice-president and treasurer, Jere C. Hutchines of Detroit; secretary, A. E. Peters of Detroit. Three of the directors—R. T. Wilson, M. Orme Wilson and James M. Edwards of New York—retired from the board, and their places were taken by E. W Moore of Cleveland, Arthur Pack of Pontiac, Mich., and H. B. Vancourtlandt of New York.

BOSTON EDISON.—The Edison Electric Illuminating Company of Boston will petition the Gas & Electric Light Commissioners for authority to issue between 6000 and 7000 shares of new stock. Edison stock is now selling for about $250 per share and if the gas commissioners approve the issue of new stock they will undoubtedly place a value on the new stock in excess of $200 per share, which will give the Edison Company at least $1,400,000 of new capital.

DIVIDEND.—The American Railways Company directors have declared a dividend of 1 per cent (50 cents a share) payable March 15. Books close March 1 to March 15, inclusive

BOSTON LIGHTING CONSOLIDATION.—The directors of the Edison Electric Illuminating Company and of the Boston Electric Light Company are reported to be again holding conferences with a view to consolidation. The proposed basis of consolidation is said to be somewhat similar to the original "Morgan" plan as to interest return of 11½ per cent and 10 per cent, respectively, to Edison and Boston Company stockholders, but the proposed amalgamation will be in the nature of a consolidation rather than a lease by a third company.

PHILADELPHIA & WESTCHESTER.—The gross receipts of the Philadelphia & Westchester Traction Company for the fiscal year ending Dec. 1, 1900, were $93,515, an increase of $7,532. The stockholders, at their annual meeting, authorized the allotment of $100,000 of the treasury stock to the present stockholders at par ($50 per share, payment for the same to be made in cash), each present stockholder having the right to subscribe to one share of new stock for each five shares of the old stock held by him, the privilege to be exercised by Feb. 1.

WESTERN UNION STRENGTH last week was largely due to reports of some arrangements to be made between Western Union and the Postal Telegraph Company. One of the reports in circulation is that the Postal Company is willing to give a collateral trust 5 per cent bond for each 10 shares of Western Union stock, with a view of controlling the Western Union Company. Another report was exactly the reverse of the above. A third report dealt with Western Union control of a Pacific cable.

CHICAGO TRACTIONS.—Mr. Charles Yerkes denies that he has sold his traction stock which is necessary for the reported change in control. There is little doubt of a change in the ownership of Union Traction sooner or later. It is authoritatively stated in Chicago that Thomas F. Ryan has purchased control of Union Elevated, Lake Street Elevated, Northwestern Elevated and Chicago Union Traction. Mr. Ryan was seen and refused to discuss the subject.

LONG ISLAND GAS.—Wilson & Stephens have purchased the Long Island Gas, Electric & Water Company, the Long Island Illuminating Company and the Suburban Electric Light Company, all operating in and around Jamaica and Hempstead. It is supposed that these properties will be merged or consolidated with the New York & Queens Electric Light & Power Company.

MEXICAN TELEPHONE shows, net, for 10 months, a gain of 385 subscribers, to 3385, and a gain in net earnings of $16,027, up to $69,233.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received by the commercial agencies as to the trade conditions indicate a very satisfactory state of affairs at all centres, and general confidence as to the outlook for the year is manifest. All things considered, prices are strong, and the Western and Southwestern trade continues to be of large volume. In the iron trades, the strength of prices increased as a result of the reports of pending consolidations, although the volume of business was restricted from the same cause. Structural material is active, and the largest consumption since 1895 is looked for. The gross earnings of 108 roads for the calendar month, according to *Bradstreet's*, aggregate $58,366,708, a gain of 8.1 per cent over January a year ago, which showed an increase of 16 per cent over 1899 and following progressive gains in January, ranging from 8 to 15 per cent, for a period of years past. This compares with a gain of 8.8 per cent in December and of 2 per cent in November. The Southwestern roads showed the heaviest gains, 25 per cent, and the grangers the smallest, 3.6 per cent. Mexican road earnings fell off 2.5 per cent from last year. The number of business failures during the week, as reported by *Bradstreet's*, was 226, as against 250 the week previous, and 199 during the corresponding week last year. In the metal market, copper continues very firm, and the prominent producers are large sellers at full prices, 17c. for Lake and 16⅝c. for electrolytic. Buyers are purchasing freely for home consumption. The production of January, according to John Stanton's estimates, was as follows: Mines reporting, 19,279 tons; outside sources, 3400 tons; total, 22,679 tons, as compared with 21,013 tons during January, 1900.

THE C & C ELECTRIC COMPANY, of New York City, has secured a contract for the supply of a large lighting and haulage plant, including two 25-kw generators, switchboard and all supplies for the Montezuma Copper Company, Mexico. Other recent foreign orders comprise four 25-hp and the same number of 6-hp slow-speed motors for shipment to South America; two 40-kw vertical generators to be utilized for driving Wheeler condenser fans in the main generating plant of the Lisbon Tramways Company, Portugal, and five 4-kw generator sets for marine work at Manila. The same New York concern's recent domestic orders include one 175-kw belted generator for the Chicago Shipbuilding Company, one 25-kw and one 50-kw generator and engines, also switchboard, for the Hotel Albert, New York City; three 60-kw generators for the Weed Apartment House, Central Park West, New York City; two 25-kw engine type generators for another large New York apartment house; two 80-kw generator engines and switchboards for the plant of the Defender Manufacturing Company of New York City; one 75-hp variable speed motor for the Nairn Linoleum Company of Kearny, N. J., while a 50-hp series-parallel printing press equipment is about to be shipped to one of the leading newspaper plants in Portland, Ore.

CUBAN LIGHTING CONTRACTS.—A cable dispatch from Santiago de Cuba of Feb. 17 says: The municipal authorities of Santiago express surprise and displeasure at the postponement until March 1 of the opening of tenders for the new electric lighting plant. The advertisements which appeared some months ago announced Tuesday, Feb. 19, as the date. All the official requirements had been complied with, and representatives of New York and Pittsburg syndicates came here some time ago to make arrangements to bid and to deposit the necessary bonds. A local syndicate also qualified. At the last moment Señor Selis, of Havana, who is a partner of a brother of Señor Tamayo, Secretary of State and Government, secured a postponement. American and local capitalists charge him with an improper use of political influence, and some of them announce that they will retire from competition for the contract. The city is poorly lighted and the public generally condemns Havana authorities for hindering important local improvements here in this respect.

THE PHILIPPINES.—A correspondent in Manila writes us: "This is a fine city and since McKinley's election things are going forward with a boom. It is one of the busiest places I have ever seen and the harbor almost reminds one of New York. There are great chances here for almost any kind of work, particularly in the electrical and engineering side. We need American trolley lines badly, American machine shops and an American bank, which would prove a gold mine here in the city of Manila. The Civil Commission has just appropriated $1,000,000 in gold to improve the harbor. It is a compact legislative body and is dispatching business in an efficient manner. Manila is destined to be one of the greatest commercial and shipping centres of the far East."

CENTRAL STATION AUTOMOBILES.—The Electric Vehicle Company has sold two of its Mark XII runabouts to the Hartford (Conn.) Electric Light Company. One is to be used by the superintendent for inspection purposes and the other by the head repair man for hurry calls. It is said that the lighting people gave the subject of electric automobiles considerable study before buying, and the selection of these vehicles carries with it, therefore, no small significance. The only wonder is that central stations, with the possible sale of so much current at stake, have not been more enterprising in this direction, setting a shrewd example in each community.

THE INTERNATIONAL BRASS & ELECTRIC COMPANY, Incorporated, has been formed, virtually a successor to the International Electric Company. Edwin Huerstel is president, Robert A. Scott vice-president and Gustave Huerstel secretary and treasurer. Headquarters are at 76 Beekman Street, New York City, where it will continue with enlarged facilities the production of Ruhmkorff coils, general electrical devices and small machinery.

ELECTRIC LIGHT CABLE FOR NEW SOUTH WALES.—The New South Wales Government Railways is advertising for the supply, delivery and laying of about 29 miles of 6600-volt, three-core lead-sheath cables, and about 2 miles of other cables, together with the necessary materials and labor for laying. The contract closes March 4. The office of the electrical engineer is at 51 Philip Street, Sydney.

THE EASTERN ELECTRIC COMPANY has removed its incandescent lamp manufactory from Middleton, Mass., to Lynn, Mass., where it occupies a larger and more convenient factory at 217 Market Street. Here it is able to turn out its well-known product, "Eastern" lamps, in largely increased quantities. Its main office is, as heretofore, in Boston.

STATION EQUIPMENT FOR SALE.—The Allegheny County Light Company, of Pittsburg, Pa., is about to abandon the Broad Street power house in the East End, and the company is now advertising in various papers the sale of all the old apparatus in that station, amounting to a capacity of about 15,000 incandescent and several hundred arc lights. The entire outfit is to be sold together.

THE AMERICAN BRIDGE COMPANY is to furnish Cooper & Wigand with about 2800 tons of structural steel for the Kingsbridge Road power house of the Third Avenue Railroad, New York City. Its Gillette-Herzog branch will furnish the steel work for the large steel building which is to be shipped to the Montezuma Copper Company at Nacozani, Mexico.

BATTERIES WANTED.—The Springfield, Mo., Plumbing Company, E. L. Hoke manager, is desirous of receiving quotations on carbon open-cell batteries, with catalogues, etc.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Feb. 6: Antwerp—16 cases electrical machinery, $2,782; 20 packages electrical material, $733. Amsterdam—1 box electrical material, $15. Argentine Republic—18 packages auto vehicle parts, $1,800; 18 packages electrical material, $350. Brussels—1 package electrical material, $49. Bremen—5 cases electrical material, $840. Brazil—3 packages electric railway material, $595; 60 packages electrical material, $5,359. British West Indies—18 cases electrical material, $227; 1 motor vehicle, $900. British East Indies—8 cases electrical material, $442. Central America—136 packages electrical material, $2,379. Chili—39 packages electrical material, $1,758. Cuba—211 cases electrical material, $5,048. Dutch West Indies—2 packages electrical material, $25. Dutch Guiana—2 cases electrical material, $25. Dutch East Indies—19 cases electrical material, $279. Ecuador—1 case electrical material, $23. Glasgow—81 packages electrical material, $34,177; 18 packages electrical machinery, $175. Genoa—101 packages electrical material, $12,430. Hull—34 cases electrical material, $5,828. Hayti—4 packages electrical material, $158. Havre—10 packages electrical material, $985. Halifax—1 case electrical material, $18. Hamburg—76 packages electrical material, $2661; 1 package electrical machinery, $100. London—4 packages electrical machinery, $1,015; 114 packages electrical material, $12,870; 1 case motor vehicles, $880. Liverpool—434 cases electrical machinery, $19,940; 149 packages electrical material, $28,969. Mexico—1147 cases electrical material, $15,547; 35 packages electrical machinery, $14,950; 3 packages auto vehicles, $2,000. Manchester—66 packages motor trucks, $3,200. Milan—1 case electrical material, $28. Newfoundland—1 package electrical material, $66. Newcastle—105 cases electrical machinery, $4,871. Nova Scotia—18 packages electrical material, $586. Peru—45 packages electrical material, $658. Palermo—1 case electrical material, $7. Rotterdam—6 cases electrical material, $60. Riga—2 cases electrical material, $306. Ramsgate—26 packages electrical machinery, $4,000. Southampton—4 packages electrical material, $213. United States of Colombia—16 cases electrical material, $289. Venezuela—55 packages electrical material, $818.

A. L. BAGNALL, of the American electrical engineering and contracting firm of Bagnall & Hilles, of Singapore, Manila and Yokohama, left New York last Saturday en route for San Francisco, from which place he intends to sail for Japan about March 1. The numerous contracts placed by Mr. Bagnall during his three months' sojourn here—which, it will be recalled, were duly noted in these columns—will very likely be considerably augmented before he leaves the United States, as he proposes to stay over a week or ten days in Chicago and other Western cities for the purpose of closing some important deals. Such transactions will be made necessary in view of his having received notification from Japan on the eve of his departure from New York that his firm has secured the contract for the conversion of a steam road in Tokio into electrical power. All the orders for equipment, however, may not be determined upon until he personally goes into details in Tokio. He anticipates expending fully $250,000. It may be well to state that the above-mentioned road has no connection with the new Tokio Electric Railway Company, contracts for which amounting to $300,000 have already been placed. Mr. Bagnall while in Chicago will make his headquarters at the local offices of the New York Insulated Wire Company, at 320 Dearborn Street.

THE AUTOMOBILE & CYCLE PARTS COMPANY, of Cleveland, Ohio, is now being incorporated, with $5,000,000 capital stock, to manufacture and sell automobile and bicycle parts, carriage fittings and hardware specialties of all kinds. The company has recently taken over all the parts and fittings plants until recently controlled by the American Bicycle Company, and the storage battery business formerly owned by the Cleveland Machine Screw Company; also the sheet steel plant at Chicago owned by Hart & Cooley. The board of directors of the new company will include A. L. Garford formerly treasurer of the American Bicycle Company; Windsor T. White, general manager of the White Sewing Machine Company, Cleveland; J. D. Climo, formerly secretary of the Cleveland Machine Screw Company, Cleveland; E. H. Hill and E. H. Bourne, Cleveland bankers, and M. B. Johnson, a prominent attorney. The company also has options on several other plants of a nature similar to those above mentioned. The general offices of the company will be in the American Trust Building, Cleveland.

THE NEW YORK GLUCOSE COMPANY, which is equipping a huge plant at Shadyside, N. J., has just decided as to the placing of some of its important machinery contracts. The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, through its New York manager, Mr. George W. Neff, has been awarded the contract for the furnishing of oil mill, pumping and filtering machinery, having a capacity for extracting the oil from the germ yield of 20,000 bushels of corn every 24 hours. This machinery will be electrically driven. The electrical portion of the contracts will be closed during the latter part of this week. Thos. Gaunt, the chief engineer of the Glucose Company, states that it is now prospecting for a water supply in Hackensack Valley for the purpose of supplying their plant, which will use 4,000,000 gallons per 24 hours.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has secured a contract for the shipment of a complete electric lighting plant, which is intended for utilization in the machine shops of the Guayaquil & Quito Railroad, Ecuador. Henry Potter, of the Westinghouse Company, has just returned from a six months' tour in South America. Mr. Potter's mission was principally made with a view to look up the various Westinghouse agencies in that part of the world. He reports that the outlook for increased sales in electrical machinery is very promising, particularly in the Argentine Republic, Chili and Peru.

THE HAVANA ELECTRIC RAILWAY COMPANY continues to make heavy purchases here. McAvoy & Co., of Philadelphia has been awarded the contract for the furnishing of 4,000,000 paving bricks. The contract, which was placed through the Morris Electric Company, of New York City, is said to be worth nearly $90,000. The Morris Company has recently secured miscellaneous orders for engine supplies, tools and such like for shipment to both the Lisbon and Mexico City Tramways. These orders are stated to have aggregated close on $18,000.

ORDERS FOR WATERTOWN ENGINES received recently are two 100-hp engines direct connected to Bullock generators for the Jacob Ruppert Brewing Company; two 125-hp engines direct connected to Westinghouse generators for the St. Bartholomew Mission House, Forty-second Street and Third Avenue; two 150-hp engines direct connected to Sprague generators for the Manhattan State Hospital at Central Islip; two 350-hp belted engines for the Oxford Paper Company at Rumford Falls, and four 80-hp direct connected engines for apartment houses in New York City.

BLAKESLEE & COMPANY, of New Haven, Conn., are at present distributing a number of contracts for equipment, etc., required by the Wabash & Peoria road. The American Car Company, of St. Louis, has obtained an order for 12 car bodies, the trucks for which are being built by the McGuire Manufacturing Company, of Chicago. Ten thousand rail bonds have been ordered of the Morris Electric Company.

THE ANNESS-FREEMAN COMPANY, recently incorporated at Springfield, Ohio, to manufacture motors, generators and other electrical appliances, has organized with the following officers: W. P. Freeman, president; George Duerch, vice-president; W. A. Utz second vice-president; Louis Utz, secretary; W. H. Anness, treasurer. The company will secure a site at once and erect a plant as soon as possible.

THE YOUNGSTOWN CONSOLIDATED GAS & ELECTRIC COMPANY, Youngstown, Ohio, has filed a mortgage deed for $500,000 in favor of the New York Security & Trust Company. The bonds are payable Jan. 1, 1931, and bear 5 per cent interest, payable semi-annually. A number of improvements will be made to the local lighting plant.

THE COMPANHIA MINEIRA DE ELECTRICIDADE, Juiz de Foia, Minas, Brazil, is extending its plant and is at present making some fair-sized purchases of machinery in this market. Both the Westinghouse Electric & Manufacturing Company and the Stilwell-Bierce & Smith-Vaile Company have secured orders for electrical machinery and water wheels, respectively.

THE AMERICAN ELECTRICAL HEATER COMPANY, of Detroit, Mich., has received a very large order for its telephone soldering irons from one of the largest electrical manufacturing concerns in France. This order was given after thoroughly testing these irons at telephone work.

THE RUSSIAN GOVERNMENT is about to place contracts for the furnishing of 6000 water meters required by the municipal water works of St. Petersburg. The National Meter Company, of New York City, is figuring on the contract, which, it is estimated, will be worth in the neighborhood of $400,000.

CORNER BROS & COMPANY, of New York City, which concern acts as financial agent for a London company operating various South African breweries, is inquiring for electrical machinery to be utilized in said plants.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY of Cincinnati, Ohio, has been awarded a contract for the supply of a 400-hp direct connected motor, which is to be installed in the plant of the Montreal (Can.) Water & Power Company.

THE PELTON WATER WHEEL COMPANY, of New York City, is about to export 500 tons of piping for a power plant in South Africa.

THE J. G. BRILL COMPANY, of Philadelphia, has obtained an order calling for the shipment of several snow plows for the Genoa Tramways, Northern Italy.

MUNICIPAL PLANT.—The city civil engineer of Mansfield, Ohio, has been instructed to secure estimates and prepare plans for a water works pumping station and a municipal lighting plant.

Telephone News and Notes.

RIPLEY, OHIO.—The Ripley Telephone Company, a newly organized independent company, has been granted a franchise.

VAN BUREN, IND.—The Van Buren Telephone Exchange operates a 100-drop board and has 65 subscribers. An increase is expected.

ADA, OHIO.—The Ada Telephone Exchange Company has increased its capital stock from $10,000 to $30,000. Improvements will be made.

PORT CLINTON, OHIO.—The Central Union Telephone Company will soon open an exchange in this place. About 130 subscribers have been secured.

MARION, OHIO.—The Marion County Telephone Company, a recently organized independent company, has applied for a franchise for a city exchange.

SYRACUSE, IND.—The Syracuse Telephone Company is doing an excellent and steadily progressing business. It has a 100-drop board and 110 subscribers.

LEAVENSWORTH, IND.—The Crawford County Telephone Company operates a 100-drop board and has 60 subscribers. Considerable increase is projected.

MILWAUKEE, WIS.—The Wisconsin Telephone Company reports a net gain of 206 subscribers in January, making a total number of 20,749 subscribers on Jan. 31.

INDIANAPOLIS, IND.—The New Telephone Company has paid the city its semi-annual installment of $3,000, compensation to the city for the use of the streets.

WHITEHALL, WIS.—The Arcadia Telephone Company has American Electric apparatus, a 50-drop board and 40 subscribers, with more than that number in prospect.

HOYES, MD.—The Garrett County Telephone Company has 75 subscribers and American Electric apparatus. A number of improvements are projected and prospects are good.

LAKE CREEK, TEX.—The Southern Telephone Company, which has Western Electric apparatus, operates a 50-drop board and has 40 subscribers. Its outlook could not be better.

INDIANAPOLIS, IND.—A bill has been introduced in the Legislature requiring telephone, telegraph and electric light wires to be at least 25 ft. above the ground at all railway crossings.

NEW FLORENCE, MO.—The People's Telephone Company has been incorporated with a capital stock of $3,100. The incorporators are Howard Ellis, T. M. Marlow, W. C. Crone and others.

SALEM, OHIO.—The Columbiana County Telephone Company installed 110 new telephones in Columbiana County during January. The local exchange is now in direct connection with Pittsburg.

HILLSBORO, IND.—The manager of the Hillsboro Telephone Company, Mr. Wright, informs us that the prospects are excellent. With a 300-drop board, it has 275 subscribers, with a steadily increasing list.

SABETHA, KAN.—The Sabetha Telephone Company uses American Electric and Stromberg-Carlson apparatus. It operates a 200-drop board and has about 135 subscribers. The future looks very promising.

WABASH, IND.—The United Telephone Company, which owns a system of telephone toll lines in Northern Indiana, has purchased the line built along the Cudahy oil pipe line from Beufflon to Kankakee, Ill.

LA RUE, OHIO.—The La Rue Telephone Company, recently organized, is preparing to install its exchange. Over 200 subscribers have been secured. It is expected that the exchange will open with about 300.

PLYMOUTH, WIS.—The Plymouth Telephone Company at a recent meeting elected officers as follows: President, C. Pfister; vice-president, B. W. Rowe; secretary, C. D. Eastman; treasurer, H. W. Hostman.

RIO, WIS.—The People's Telephone Company has been incorporated with Y. L. Farrington as president. The company will take possession of all the lines formerly operated by the Farrington Telephone Company.

APPLETON, WIS.—The toll line of the Fox River Valley Telephone Company, between this city and Kaukauna is now in operation. The company will place its wires underground through the main part of this city.

WORTHINGTON, OHIO.—The Citizens' Telephone Company of Columbus has secured a franchise for a local exchange with direct connection with Columbus. The Central Union Telephone Company was refused a franchise.

CAPE GIRARDEAU, MO.—The Cape Girardeau Telephone Company has apparatus of the American Electric Telephone Company, 700-drop board capacity and 625 subscribers, with 100 miles of toll line and a large expected increase.

ASHLAND, VA.—The General Assembly of Virginia has granted a charter to the Henrico Telephone & Telegraph Company, capital, maximum, $5,000; minimum, $1,000. W. C. Saunders and others are directors. The home office is at Ashland.

SOUTH MILWAUKEE, WIS.—The Southern Telephone Company, incorported by G. Long and F. Koch, of South Milwaukee, and W. J. Sutton, of Milwaukee, has applied to the Common Council of South Milwaukee for a 25-year grant for a telephone system.

CHARLOTTE, N. C.—A special from Barnwell, S. C., says that the exchanges and toll lines of the Southern Telephone & Telegraph Company have been sold to the South Carolina Long Distance Telephone Company. S. H. Brown is president of the former company.

SHEBOYGAN, WIS.—The Northwestern Telephone Company will soon begin stringing wires from this city to Plymouth, thence south of Fredonia in Ozaukee County. At Plymouth connection will be made with the Little Wolf Company, which has a line in operation to Fond du Lac.

KNOXVILLE, TENN.—Frederick E. Judson, of Nashville, Tenn., has been appointed as manager of the Knoxville (Tenn.) exchange of the Cumberland Telephone Company. Mr. Judson has served the company in Nashville, Jackson, Tenn., Louisville, Evansville and other points.

ST. LOUIS, MO.—At the February meeting of the St. Louis Railway Club, held a few days ago, a paper was read by President Miller of the American Telegraph & Telephone Exchange, submitting a plan for a railroad telegraph and telephone exchange for St. Louis and East St. Louis.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has just completed an additional loop from San Francisco to Los Angeles. The new construction extends from San Pablo, 12 miles from Oakland, via Bakersfield, and the line is of 7-strand aluminum.

TRENTON, N. J.—The Keystone State Telephone & Telegraph Company, with $2,000,000, has been incorporated. The incorporators are Norman Grey, Edward H. Chew and Wilfred B. Wolcott, all of Camden. It is believed that large moneyed interests in Philadelphia are back of the company.

ALTON, ILL.—The fight between the Kinloch Telephone Company and the Central Union Telephone Company of Alton has been ended by the granting to the Kinloch Company of a franchise. The Central Union Company is expected to cut its rates when the Kinloch telephones are in opeartion.

GUTHRIE, OKLA.—The Osage Telephone Company, which was recently chartered, expects to build toll lines from Elgin, Kan., to Cleveland, Okla., and from Bartlesville, I. T., to Ponca City, Okla. It will also establish an exchange at Pawhuska. The total length of the lines will be 142 miles.

DAWSON, KLONDIKE.—The Yukon Telephone Syndicate operates an extensive system in this region. It has 143 telephones in Dawson, 21 in Grand Forks, 14 in Bonanza Creek, 6 in Eldorado Creek, 3 in Gold Run, 2 in Dominion and one each at Sulphur Creek and the Dome Road House—a total of 191.

CENTRAL LEBANON, OHIO.—The Valley Telephone Company has a 200-drop board at Lebanon, 100 at Mason and 200 at Waynesville. There are 400 subscribers, 100 within a month, and it contemplates two more exchanges. We are indebted to Mr. Roll, manager, for this information, who says that prospects are very good.

MONROE, N. C.—The Carolina & Virginia Telephone Company has drop board capacity at Rock Mount of 250, Greenville 130, Chase City, Va., 50, and Clarksville 75. Henderson apparatus is used. There are about 500 subscribers. The company is now building three exchanges and 100 miles of toll line in Virginia. Its prospects are very good.

SEATTLE, WASH.—The Independent Telephone Company, operating in Seattle, Wash., under the franchise recently granted to J. S. McGroarty and others, has elected the following board of trustees: E. W. Andrews, J. W. Clise, E. E. Burwell, Sherwood Gillespy, W. H. White and J. S. McGroaty of Seattle, and Charles Kurtz of Columbus, Ohio.

INDIANAPOLIS, IND.—W. L. Hill, manager of the Central Union Telephone Company, has announced that on April 1 the company will offer on independent lines a residence service at $24 and $36 a year. The $24 service is with a Blake transmitter; the other has a solid back, long-distance transmitter. The party line rates will remain as heretofore, six on a line at $18 a year.

NEW LONDON, WIS.—The Wolf River Telephone Company has secured connections with 100 stations in Appleton and Kaukauna through the Fox River Valley Telephone Company, with Plainfield and Hancock through the Almond Telephone Company, with Grand Rapids through the Union Telephone Company and with Marshfield through the Wood County Telephone Company.

DAYTON, OHIO.—The Dayton Home Telephone Company, which, two years ago, was refused a local franchise, has applied to the Probate Court for a grant. Under a new ruling of the Supreme Court, the Probate Court has the right to grant a franchise where the city and company cannot agree. The company offers residence telephones at $28 per year and office lines for $40 per year, with a discount of $1 per quarter for cash payment of bills.

LOGANSPORT, IND.—The City Council on Feb. 8 passed the telephone ordinance submitted by citizens, which opens the field to all competition, under the restricted rates of $12 and $18 per year. If the Bell Company declines to accept the terms of the ordinance, a citizens' company will occupy the field. The Council also authorized the bringing of a suit to revoke the Mutual Company's franchise, which is alleged to be the property of the Bell Company.

WAUSAU, WIS.—The report of the directors of the Wausau Telephone Company shows that the value of the plant is $19,500. The total amount of stock sold is $7,800, leaving $11,700 that has been paid out of the earnings of the company. During the year 18 per cent, or $1,130, was paid to stockholders for dividends, making the cash dividends in five years 68 per cent. These earnings were exclusive of the large sum used in extending and improving the plant. The company is in a very flourishing condition and now has 454 telephones in use.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company, which has recently secured a franchise from the Probate Court, has consolidated with the Zanesville Citizens' Telephone Company, continuing the name of the former. The capital stock has been increased from $100,000 to $200,000, and officers have been elected as follows: Sherman M. Granger, president; W. D. Schultz, vice-president; H. A. Sharpe, secretary and treasurer; J. B. Rhodes, general manager, and Maxine Reber, Cleveland, consulting engineer. The company is backed by the United States Telephone Company of Cleveland, and J. B. Hoge and Harry Critchfield are among the directors. The present system will be rebuilt and a new exchange building erected.

TELEPHONE NEWS.—(Continued.)

HOOP POLE, ILL.– Mr. A. Mathis informs us that a large board is to be put in here to connect with other lines.

MEMPHIS, TENN. The Citizens' Telephone Company of this city has applied for permission to begin construction work at once.

NATCHITOCHES, LA.—The Natchitoches Telephone & Electric Light Company uses American Electric apparatus, has a 100-drop board and 98 subscribers.

GRANT CITY, MO.—The Grant City Telephone Company has American Electric apparatus, a 100-drop board and 98 subscribers. An increase is projected.

DIVIDE, ILL.—The Farmers' Telephone Company has D. A. Kusel apparatus, toll line board for five toll lines and 24 subscribers. This is a local toll line company.

REYNOLDS, ILL.—The Reynolds Telephone Company has 175 subscribers and a 60-drop board. The increase has been good and prospects are better. Mr. M. Schoonmaker is president.

MENTOR, OHIO.—The Mentor Telephone Company operates a 100-drop board and has 60 subscribers. Apparatus of the North Electric Company is used. Its prospects are very good.

WAVELAND, IA.—The Waveland Telephone Company operates a 120-drop board and has 180 subscribers. It intends rebuilding several of its lines. It uses Sterling Electric apparatus.

ABBEVILLE, GA.—We are indebted to Mr. S. L. Hoton for the following: His apparatus is of Phœnix make and he operates a 100-drop board with 76 subscribers. He looks for many more.

LAKEVIEW, MICH.—The manager of the Union Telephone Company, Mr. J. W. Kirtland, informs us that the company operates a 100-drop board, has 43 subscribers and excellent prospects.

SALEM, S. D.—The Salem Telephone Company uses Western Telephone apparatus, has a 100-drop board and 81 subscribers. It is not yet a year old, but is flourishing and paying good dividends.

BRECKINRIDGE, MO.—The Breckinridge Telephone Company has a 100-drop board and 93 subscribers, using American Electric Telephone apparatus. The prospects are good for more subscribers.

VINTON, IA.—The Vinton Telephone Company operates a 300-drop board and has 252 subscribers. It has put in 20 new telephones this year and expects a large increase. Mr. Lichty is the manager.

NEVADA, MO.—The Nevada Telephone Company has Sterling, Ericsson and Swedish-American apparatus, a 435-drop board and 347 subscribers. The addition of a large number of subscribers is looked for.

FREMONT, IA. The Farmers' & Traders' Telephone Company has Stromberg-Carlson apparatus, a 50-drop board and 22 subscribers. Business is steadily increasing. This year will be favorable for extensions.

HALEY'S MILL, KY. The Haley's Mill Telephone Company uses Stromberg-Carlson apparatus, has a 30-drop board and 20 subscribers. A 30-mile line has recently been built and another is projected. Prospects are good.

FLEMINGSBURG, KY.—Mr. B. B. Stone, electrician of the Flemingsburg Telephone Company, informs us that prospects are very good. The company operates a 100-drop board, has 82 subscribers and improvements are contemplated.

HENRIETTA, MICH.—The Henrietta Telephone Company informs us, through Mr. J. M. Fuller, manager, that it has apparatus of the North Electric Company, 16 farmers' lines and about 175 subscribers. Its outlook is very favorable.

EDGAR, NEB.—The Edgar Telephone Company uses apparatus of the Central Telephone & Electric Company of St. Louis and has a 100 drop board and 100 subscribers. It has just started and expects to double the number of subscribers soon.

MORGANSFIELD, KY.—The Morgansfield Telephone & Telegraph Company has in its Morgansfield exchange a capacity of 300 lines, and at Sturgiss 150, the apparatus being mostly of the Stromberg-Carlson Company. It has a total of 450 subscribers.

MAGNOKETA, IA. The Magnoketa Telephone Company has Eureka apparatus and a 200-drop board, all full metallic. Another 200-drop board is projected. It has 225 subscribers and will add another hundred as fast as the work can be done.

ROCKPORT, ILL.—Mr. W. H. Gay, secretary of the Rockport & El Dara Telephone Company, informs us that its apparatus is of Stromberg-Carlson make. This is a party line plant, using not more than 8 instruments per line. The service is efficient and economical.

MORNING SUN, IA.– The Morning Sun Telephone Exchange has just started business with 56 subscribers. It has a 70-drop switchboard of the Western Electric Company's make. Some large extensions are projected. Mr. B. T. De Long is manager of the company.

BLAND, N. M.—Mr. Graves, of the Albemarle-Bland Telephone Company, informs us that it operates a 25-drop board with 24 subscribers. A new 60-drop board is to be put in this spring and the outlook is fine. It uses Standard Telephone & Electric Company apparatus.

CREIGHTON, NEB.—The Theisen & Diehl Camp Dewey Telephone Company and the Diehl & Thiesen Creighton Telephone Exchange Company, operate a 100-drop board and have 130 subscribers. Two more exchanges are to be built, and future prospects are very good.

LA GRANGE, IND.—The Northern Indiana & Southern Michigan Telephone, Telegraph & Cable Company operates a 700-drop board with Stromberg-Carlson and American Electric apparatus. There are 900 subscribers and many more are expected. The prospects are for great success.

ANTELOPE, ORE.—We are informed by Mr. F. N. Wallace, of the Wasco Southern Telephone Company, that it operates a 10-drop board and has 25 subscribers. It has recently built a 32-mile line and projects two others to Ashwood and Mitchell, 25 and 50 miles, respectively.

TROY, KAN.—The Troy Telephone Exchange is using American Electric telephone apparatus, the board having 100 drops. It has 90 subscribers, 16 of whom are of recent acquisition. The company will build party lines and toll lines. Mr. S. P. Zimmerman is owner and manager.

GARNER, IA.—Mr. E. C. Abbey, of the Garner Electric Light, Power & Telephone Company, informs us that the company has a 100-drop board and has 80 subscribers and the number is constantly increasing. Its apparatus is from the Stromberg-Carlson Manufacturing Company. Its prospects are good.

MOUNT VERNON, IND.—We are indebted to the president of the Posey County Telephone Company, Mr. McGregor, for the following: The company uses Phœnix Electric apparatus, has a 100-drop board and 66 subscribers, with 4 farmers' lines. An exchange here is projected. The outlook is favorable.

WORTHINGTON, IND.—Mr. J. D. Myers, superintendent of the Worthington Telephone Company, informs us that prospects for rapid growth are excellent. Two toll lines are in course of construction and several farm lines are contemplated. It has Eureka Electric apparatus, a 200-drop board and 71 subscribers.

HIGH POINT, N. C.—The High Point Telephone Exchange informs us, through Mr. Hayden, its manager, that its subscription list has been doubled in little more than a year. It has Sumter Telephone Manufacturing Company apparatus, a 130-drop board and 118 subscribers. Full metallic lines are projected.

BOISE CITY, IDAHO.—The Idaho Independent Telephone Company, although only six months old, has made rapid strides. It has Stromberg-Carlson apparatus, a drop board of 1500 capacity, of which 500 are installed, and 380 subscribers. It is gaining about 50 per month and prospects are good for an increase. Mr. Clement is the secretary.

DANA, IND.—The Indiana Electric Company has lately been bought by Mr. E. Van Sickle. The two exchanges at Dana and Newport are furnished with Eureka Electric apparatus. Dana operates a 200-drop board, Newport 100. There are 225 subscribers and a large increase is looked for The prospects are good for all the work that can be undertaken.

HUNTINGTON, IA.—The United Telephone Company has drop boards of 400 at Huntington, 300 at Bluffton and 300 at Portland, and 400, 300 and 230 subscribers. Larger boards at the first named places are projected and many farmers' lines are to be built. American Electric apparatus is used. Toll business is increasing and will necessitate doubling the capacity

LEXINGTON, NEB.—The Lexington and Crozad telephone exchanges are owned and managed by Mrs. Eva Zimmerer, to whom we are indebted for the following items: The apparatus used is of Stromberg-Carlson make and the two places are connected by a toll line. The Lexington operates a 200-drop board and the Crozad exchange has 100 capacity and 50 drops. They have 175 and 45 subscribers, respectively, with excellent prospects of increase.

CHARLESTON, S. C.—The Bell Telephone Company has agreed to operate all the city telephones at the rate of $8 a year for three years. The contract calls for about 20 instruments. Bids were asked from the Bell Company and the Gordon Company, which is an independent concern, and cutting of prices was the result. The Bell Company claims that it will lose money by the deal, but prefers to lose rather than have the official business go to its rival.

PONTOTOC, MISS.—We are indebted to Mr. C. W. Bollon, manager of the Alabama, Mississippi & Tennessee Telephone Company for details of the very progressive corporation with which he is connected. It uses a Utica board with 100 drops and has 52 subscribers. The exchange is only one year old, but has a very encouraging future. It has about 100 miles of toll line branching out in various directions and extending to several towns. These lines are to be carried further and are all of first-class build.

LITTLETON, W. VA.—The Exchange Telephone Company is operating an exchange with 100-drop capacity, the switchboard being of the Keystone make and Standard telephones being used. The company has 250 subscribers and has trunk lines to Moundsville, New Martinsville, and 20 local lines to different points in Wetzel County. Mr. B. J. Ferral is secretary of the company and states that he expects to have 500 more instruments in use by next fall, and to get connected with Wheeling some time during the summer

LAWRENCEBURG, MO. The Lawrenceburg Telephone Company has about 100 miles of toll line running to Ash Grove, Mount Vernon, Miller and Everton, interchanging business with the lines of the other companies and connecting with about 75 or 100 different places in Lawrence, Green, Dade, Christon and Stone counties. It uses the apparatus of the Central Electric & Telephone Company of St. Louis, Mo. It has a switchboard with a capacity of 50 lines. The company has 15 subscribers at the present time and the outlook for more business is excellent.

PITTSBURG, PA.—A bill has been introduced in the State Legislature providing that no corporation, association, partnership or individual owning, operating or controlling any telephone line, shall acquire, either by purchase or otherwise, any competing telephone line, or the controlling interest in the stock or bonds of any competing line, or in any wise control, operate or own any competing line or the controlling interest in the stock or bonds thereof. The purpose of the bill is to prevent the consolidation of competing lines. If it becomes a law the bill will prevent any possibility of the purchase of the Pittsburg & Allegheny Telephone Company of this city by the Bell interests.

FRANKFORT, IND. The Central Energy Telephone Company, one of the most prominent in the State, was incorporated in November, 1900, and began business last January with 300 subscribers, which number has been increased to 615 in little more than a month. The company is operating a board of 1200 drops and conducts a large long-distance toll service. It uses the Stromberg-Carlson central energy sytem. The company owns the building in which the exchange is located. Its toll service is conducted over copper metallic circuits in connection with the new long-distance company of Indianapolis. In addition to this it has several toll lines running to different points in the county. The plant was conceived and installed by Mr. John H. Murphy, a well-known telephone engineer of Indianapolis, assisted by Mr. Wm. Pogue as superintendent, who still retains this position. The most prominent men of Frankfort are members of the board of directors. The company enjoys an excellent business.

TELEPHONE NEWS.—(Continued.)

PULTENEY, N. Y.—The New York & Pennsylvania Telephone & Telegraph Company has 31 subscribers here.

ST. JOHN, KAN.—The St. John Telephone Company has a 100-drop board and 77 subscribers. It uses National Automatic apparatus.

GALVA, IA.—The Galva Telephone Exchange Company operates a 50-drop board with 53 subscribers. A 10-mile party line for farmers is contemplated.

OSKALOOSA, KAN.—The Oskaloosa Telephone Company reports business and prospects very promising. It has a 200-drop board and 150 subscribers.

ONLEY, VT.—The Onancock Telephone Company uses Keystone apparatus, has a 50-drop board and 42 subscribers. Prospects for the future are very good.

LAFAYETTE, IND.—The Shawnee Mound Telephone Company has Sterling apparatus and operates a 200-drop board. It has 195 subscribers and good prospects.

MISSOURI VALLEY, IA.—The Missouri Valley Telephone Company has a 200-drop board and 176 subscribers, 65 of whom were added last year. Mr. Kellogg is manager.

VERONA, OHIO.—The Eureka Telephone Company operates American Electric Telephone Company apparatus, has a 50-drop board and 15 subscribers and good prospects.

GLASGOW, KY.—The Glasgow Telephone Exchange Company, which operates American Electric apparatus, has a 200-drop board and 126 subscribers. Its outlook is very bright.

SHURMAN, IA.—The Shurman Telephone Company has 45 subscribers and a 100-drop board. The town is not large enough for much growth, but toll line business is increasing.

CHILLICOTHE, MO.—Messrs. Leach & McArthur operate a switchboard of 500-drop capacity and have 398 telephones. Increase of the last six months has been rapid and prospects are fair.

EVART, MICH.—The Citizens' Telephone Company has eight stations and 45 miles of copper toll line from Marion to Farwell, via Evart. Mr. C. E. Bell, the secretary, favors us with the above information.

CARROLLTON, ILL.—Mr. Halleday, manager of the Illinois Telephone Company, informs us that it operates a 100-drop board and has 76 subscribers. Country lines are projected and the outlook is very bright.

DODGE CITY, KAN.—The Dodge City Telephone Exchange operates National Automatic apparatus, has switchboard capacity of 100 drops and 75 subscribers. An increase of 20 telephones is projected.

FALLS CHURCH, VA.—The Falls Church Telegraph & Telephone Company operates a 100-drop board, with 50 subscribers, and has Southern Bell apparatus. A large increase of subscribers is expected in the near future.

PHILANTHROPY, OHIO.—The Butler County Western Telephone Company has only recently commenced operations, but will extend its service over a great part of Butler County. It has a 25-drop board and 50 subscribers.

CYNTHIANA, KY.—The Cynthiana Telephone Company, which has American Electric apparatus, operates a 300-drop board and has 231 subscribers. Toll lines over every road in the county are projected, and the outlook is good.

ALLIANCE, OHIO.—The Central Union Telephone Company (Bell) employs Western Electric apparatus and has a 350-drop board with 445 subscribers. It had a gain of 200 in the last seven months and expects to do better this year.

OSWEGO, KAN.—Mr. E. B. Morgan, manager of the Oswego Telephone Company, informs us that the company has a switchboard capacity of 100 drops and 93 subscribers. The American Electric Telephone Company's apparatus is used.

PATTONSBURY, MO.—Mr. J. S. Adams advises us that the maker of his apparatus is the American Electric Company, that he operates a 75-drop board and has 63 subscribers. He has also 45 miles of toll line and expects to build farmers' lines.

ALEDO, ILL.—The Aledo Telephone Exchange Company has a 400-drop board, with 320 instruments installed. Western Telephone Construction apparatus is used. The company has over 300 subscribers. Some cable work is projected.

OAKVILLE, IA.—The Oakville Telephone Company has a Eureka board of 100 drops and is using Swedish-American bridging apparatus. It has 150 subscribers and expects to double that number within the next 12 months. Mr. F. C. Edwards is secretary.

EDINBURG, IND.—The Citizens' Telephone Company informs us, through its manager, Mr. A. W. Winterberg, that it operates two switchboards of 100 drops each, and has 185 subscribers, with a large expected increase. The outlook could not be better.

MULDROW, I. T.—The J. W. Bindlove Long Distance Telephone Company uses apparatus of the Bell Telephone Company and a 25-drop board. Last year 45 miles of wire were put up and this year more will probably be built. The service is in fine condition.

TIFFIN, OHIO.—The Home Telephone Company, using American Electric Telephone Company apparatus, has a 780-drop board and 815 subscribers, of whom 143 were added last year. Mr. Briggs informs us that it expects to put in many additional farmers' lines.

DENNISON, OHIO.—The Uhrichsville & Dennison Home Telephone Company, which began business in September, 1900, has two boards of 300 drops each and has 425 subscribers. A very large increase is expected. The apparatus used is of American Electric Company make.

FRANKLINVILLE, N. Y.—We are informed by Mr. Y. W. Ferris, of the Franklinville Telephone Company, that consolidation with some six or eight nearby towns, with $50,000 capital, is projected. The company uses Eureka apparatus, has a 19-drop board and 165 subscribers.

MOUNT HOLLY, N. J.—The Burlington County Telephone Company operates a 400-drop board and has 300 subscribers and the number is steadily increasing. It is putting in new telephones all the time and has a busy season in view. It uses American Electric and Western apparatus.

SHEFFIELD, ALA.—The Southern Bell Telephone Company projects a new exchange building here. It has a 100-drop board and 118 subscribers. The service has been much improved between Sheffield, Tuscumbia and Florence.

GREENWICH, MICH.—We are indebted for the following items to the manager of the Greenwich Telephone Company, Mr. W. B. Serviss: Eureka Electric apparatus is used, a 300-drop board with 255 subscribers. Increase was rapid last year and prospects are good for the same this year.

RAVENNA, OHIO.—Eureka Electric apparatus is used by the Ravenna Home Telephone Company, which operates a 300-drop board and has 325 subscribers. A 500-drop board is projected to meet growing demands. Business is fine, dividends of 6 per cent being paid, and the outlook could not be better.

CHARLESTON, ILL.—The Charleston Telephone Company informs us, through the proprietors, Messrs. Brooks & Cadle, that its apparatus is of Western Telephone Construction Company and Sterling make; it operates a 325-drop board and has 300 subscribers. Additions are projected and prospects are very bright.

FLEMINGTON, N. J.—We are indebted to Mr. A. B. Reading, owner of the local telephone exchange, for the information given herewith. He operates a 50-drop metallic board and 50 party lines. A new line to Cherryville has been built and others, to several small towns, are projected. Phœnix Electric apparatus is used.

VANDALIA, MO.—The Vandalia & Hutchison Telephone Company has a switchboard capacity of 100 drops and operates apparatus of the Mexico Telephone Company, of Mexico, Mo. It has 60 subscribers and several waiting for telephones. Some party lines are projected and the outlook for country lines is favorable.

BELL PLAIN, N. J.—The Enterprise Telegraph & Telephone Company operates a 200-drop board at Millville, 100 at Ocean City, 50 at Egg Harbor and at other places. It has 500 subscribers and has recently built toll lines to Egg Harbor and elsewhere. Novelty Company apparatus is used. Many extensions are contemplated.

GRAND RAPIDS, MICH.—Mr. J. Brown, secretary of the Citizens' Telephone Company, furnishes us with a few items of interest. The company uses American Electric Telephone Manufacturing Company apparatus and has 3485 telephones. There was a large increase last year and a large one is looked for during the present one.

NORSELAND, MINN.—The Nicollet County Telephone & Telegraph Company is operating a double metallic toll line with nine stations, a total length of 36 miles. Each of the toll stations will eventually be made a central station, and a telephone will be placed in every farm house along the line. Mr. H. A. Burke is secretary of the company.

NORRIDGEWOCK, MAINE.—Mr. O. F. Hall, of the New Sharon & Norridgewock Telephone Company, informs us that its apparatus is of the make of the Couch & Seeley, Connecticut Telephone Company and Viaduct Manufacturing Company. It operates a 12-drop board and has 35 subscribers. More line and instruments will be put in to meet a growing demand.

CANYON CITY, ORE.—The Pacific States Telephone & Telegraph Company has an exchange here with a capacity of 40 lines, using Western Electric Company apparatus. It has 24 subscribers and 19 additional ones already contracted for. The business outlook for the company is good, especially for the toll line service. The exchange was established in July of last year.

ST. JOHNSBURY, VT.—We are indebted to Mr. G. W. Buzzell, president of the Citizens' Telephone & Telegraph Exchange, for a very interesting account of his successful undertaking. Commencing in a very small way in 1900, he has now a fine central office with Couch & Seeley Company apparatus, a 450-drop board and 400 subscribers. The outlook is very bright, indeed.

NEW HAVEN, IND.—Mr. D. H. F. Berherich, an officer of the New Haven Home Telephone Company, furnishes us with the following: Its apparatus is of American Electric Telephone Co. make, and it operates a 100-drop board, with 35 subscribers. Several miles of toll line have been recently put up and more are projected, with an increase of telephones. The prospects are excellent.

VALLEY FALLS, KANS.—Mr. J. A. Zimmerman, owner of the Valley Falls and Baldwin telephone companies, informs us that he uses apparatus of the American Electric and Western Electric Supply Company makes. His switchboards are of 100-drop capacity each and he has 100 subscribers at Valley Falls and 90 at Baldwin. Toll lines to various places are contemplated, and the outlook is good.

MALONE, N. Y.—The Racket River Telephone Company, of Potsdam, and the Franklin County Telephone Company, of Malone, are owned by Messrs. Ferensen and Crawford, of Hamden, N. Y. The former uses American Electric apparatus, the latter Stromberg-Carlson. Both are in good shape and report bright outlooks. While both have 200-drop board capacity, the Racket River has 200 subscribers, the Franklin 180.

MANHATTAN, KAN.—The Wareham & Wood Telephone Company of this city and the Wareham-Dewey Telephone Company of Junction City and Fort Riley, Kan., are jointly operating a system including 300 subscribers at Junction City and Fort Riley, and 350 in Manhattan. The Junction City system is a new plant, recently installed, and is rapidly growing. It is expected that 500 subscribers will be obtained there. Sterling apparatus is used in both towns. Mr. H. P. Wareham is manager.

ELMORE, OHIO.—Through the courtesy of Mr. J. G. Steinkamp, of the Elmore Home Telephone Company, we are in possession of the following: This is part of the system of the Ottawa County Telephone Company, with an exchange at Oak Harbor and nearly 100 subscribers. It also owns a system of toll lines connecting 12 towns and is building an exchange at Woodville with over 70 subscribers, and projects more toll lines. It uses North telephones. There is a 100-drop board here and 73 subscribers. This plant is newly opened. It has Kellogg apparatus.

TELEPHONE NEWS.—(Continued.)

PEKIN, ILL.—The Pekin Telephone Company has built 90 miles of toll line.

KINEO, MAINE.—The Kineo & Northeast Carry Telephone & Telegraph Company has 10 offices from Kineo to Chesuncook.

FLORA, ILL.—Mr. S. J. Friend kindly informs us that he operates a 200-drop board and has 165 subscribers. The outlook is good.

WABASHA, MINN.—The Wabasha Telephone Company has a 100-drop board and 100 subscribers. The prospects for business are good.

MONTICELLO, N. Y.—The Monticello Telephone Company has a 100-drop board and 20 subscribers. It is just commencing business.

SMITHLAND, IND.—The Smithland Telephone Company informs us that prospects are good. With a 65-drop board it has 55 subscribers.

WEATHERBY, MO.—The Weatherby Telephone Company has a 30-drop board and 40 subscribers. A line to Cameron is projected and the outlook is very good.

OTISCO, N. Y.—The Otisco & Cedarville Telephone Company sends a report of excellent business and prospects. The toll line has only been in operation a few weeks.

MORENCI, MICH.—The Morenci Telephone Company is in excellent condition, has a 130-drop board and 141 subscribers. A large increase is expected in the near future.

NORTH CONWAY, N. H.—The North Conway Telephone Company has a 25-drop board and 27 subscribers. A large increase of business is expected during the summer.

SOUTH WHITLEY, IND.—The South Whitley Telephone Company has a 100-drop board and 82 telephones. It is about building a 22-mile line and its prospects are good.

UNION CITY, IND.—The Union City Telephone Company operates a 300-drop board and has gained 210 subscribers in one year. Business is good and steadily increasing.

THOMASTON, GA.—The proprietor of the Thomaston Telephone Company informs us that he has 100-drop board capacity and 110 subscribers. The outlook is most encouraging.

TIPTON, IA.—The Tipton Telephone Company, which commenced business last October, has 150 subscribers and a quick and steady increase. Its switchboard capacity is 200 drops.

PALMYRA, ILL.—The Palmyra Telephone Company intends putting in several farmers' lines. It operates a 110-drop board and has 90 subscribers, with very good prospects for more.

MICHIGAN CITY, IND.—The Merchants' Mutual Telephone Company reports steady increase of business. It uses a 600-drop board and has 560 subscribers. Its prospects are excellent.

NORTHWOOD, IA.—Mr. F. C. Hall, of the Northwood Telephone Company, informs us that its prospects are good for a steady increase. It operates a 100-drop board and has 92 subscribers.

CHAMPAIGN AND URBANA, ILL.—The Home Telephone Company has a drop board capacity of 700 and 640 subscribers, many being of recent addition. It is now getting in 40 and 50 per month.

MOORESVILLE, IND.—The Mooresville Telephone Company, established but a few months ago, has made good progress. It has 95 subscribers and a 100-drop board. Continued increase is expected.

WARSAW, IND.—The Commercial Telephone Company is in fine shape. We learn from Mr. Baker, the secretary, that it operates a 200-drop board and has 165 subscribers, with a steadily increasing list.

RIDGEVILLE IND.—The Ridgeville Telephone Company operates a 100-drop board and has 6 subscribers, it having but recently commenced business. Toll lines are to be built to some six or eight places.

BROCTON, ILL.—The Hume Telephone Company has a 120-drop board at Hume and a 100 at Brocton. Hume has 100 subscribers, Brocton 43. The prospects are good and they expect to fill both boards this year.

PLATTE CITY, MO.—Messrs. Wall & McBeath, who have just taken possession of the telephone exchange, report very favorably on the outlook. They have an American Express board of 100 drops and 74 subscribers.

CHERUBUSCO, IND.—The Cherubusco Telephone Company has only been in operation six months, but finds prospects good and expects to build several toll lines. A 100-drop board is used, and there are 92 subscribers.

MARLBORO, N. Y.—The Marlboro & Milton Telephone Company informs us, through Mr. H. C. Cooley, that it has just been organized and is merely a local line. It uses two centrals, 10 drops each, and has 13 subscribers.

KINGMAN, IND.—The Millcreek Telephone Company has two boards, one each at Kingman and Yeddo. A new board is to be put in at the former place, and quite a large increase is projected. There are 60 subscribers.

ALBANY, OHIO.—The Albany & Vales Mill & Athens County Telephone Company operates a 300-drop board and has 280 subscribers, many being recent additions. A large increase is expected and prospects are very good.

FORT WAYNE, IND.—The Home Telephone & Telegraph Company has made great improvements in its equipment and expects to double its business in the near future. It operates a 2500-drop board and has 2100 subscribers.

AUBURN, ILL.—Mr. H. R. Ramsey, proprietor of the Auburn Telephone Exchange, informs us that an increase in local and toll lines is projected. Growth has been very rapid. It operates a 200-drop board and has 115 subscribers.

NAPPANEE, IND.—We are informed by Mr. Stoops, of the Nappanee Telephone Company, that the outlook is excellent. Its switchboard capacity is 200 drops and it has 108 subscribers. Country lines are to be built in the spring.

SEYMOUR, IA.—The Seymour Telephone Company operates a 150-drop board with 212 subscribers. Last year 95 telephones were added and as many more are expected this year. The farmers use party lines of from 1 to 20 on a line.

CHADWICK, ILL.—The Carroll County Telephone Company informs us, through Mr. Frank Zinnel, the proprietor, that the outlook is very bright. It uses a 500-drop board and has 500 subscribers. The number is daily increasing.

LOCKPORT, ILL.—We are indebted to the president of the People's Telephone Company for the following information: It operates a 200-drop board and has 150 subscribers. A large increase is projected and the outlook is very bright.

HUNTINGDON, TENN.—The Carroll County Telephone Company has a 200-drop board here and 100 at McKenzie. Mr. Wright, the secretary, informs us that there is a great demand for country lines. The company has 300 subscribers.

WINDSOR, MO.—The Union Telephone Company operates a 100-drop board at Windsor, one of 400 at Clinton and one of 50 at Calhoun. Altogether it has 650 subscribers and 80 miles of metallic toll line and intends building 60 miles more.

STANFORD, ILL.—Through the courtesy of Mr. W. Patch we obtain the following concerning the Patch Telephone Company: With a 100-drop board it has 106 subscribers. An exchange is to be put in at Danvers, Ill., with prospects of 300 subscribers.

PITTSTON, PA.—The People's Telephone Company, using Sterling Company apparatus, has a 300-drop board and 300 subscribers, an increase of 200 in 12 months. We are informed by Mr. Smith, the manager, that a like increase is expected this year.

ROSSVILLE, ILL.—The Rossville Telephone Company is growing steadily. It operates drop boards at all its stations and has 300 subscribers. It intends to develop territory and build a short line. We are indebted for the above to Mr. P. M. Warner, the secretary.

REED CITY, MICH.—The Reed City Telephone Exchange has a 200-drop board and 85 subscribers, with a large expected increase. We are informed by the manager, Mr. Marshall, that the maker of its apparatus is the American Electric Telephone Company.

RICHMOND, IND.—The Richmond Home Telephone Company has a 1200-drop board and 1300 subscribers. It records a growth of 270 in 12 months. Two new sections are to be added to the board. The outlook is favorable, with an increasing demand for country lines.

GLOUSTER, OHIO.—The Union Telephone Company, recently in active operation, informs us, through its secretary, Mr. Edwards, that business is good and the outlook could not be better. It has 143 subscribers and is now building to Nelsonville and intermediate points.

JOHNSTOWN, PA.—The Johnstown Telephone Company has a switchboard capacity of 1000 drops and 1200 subscribers. It is now constructing a complete underground, full metallic, central energy multiple system and erecting a fine fire-proof exchange and office building.

EVART, MICH.—Mr. C. E. Bell, proprietor of the Evart Telephone Exchange, favors us with the following interesting items: The exchange has a drop-board capacity of 100 and 60 subscribers. An increase is projected, and extensive farmers' lines will be installed soon.

CHATSWORTH, ILL.—The Peoria & Eastern Telephone Company is doing good business, having added 200 to its subscribers' list last year. These now number 520. It operates a 700-drop board, Western Electric apparatus being used. Lines for rural subscribers are projected.

NEVADA, IA.—We learn from Mr. Boardman, manager of the Nevsda Mutual Telephone Company, that its switchboard capacity is 300, with 220 subscribers. Seventy miles of toll line have been recently built and two exchanges are projected. Improvements are now being carried on.

PENDLETON, IND.—We are indebted to Mr. E. D. Allen, of the Pendleton Telephone Company, for the following: Its apparatus is of the Eureka Electric Company; it has a drop board of 100 capacity and 150 subscribers, with a large expected increase. The prospect is very encouraging.

OLATHE, KAN.—The Olathe Citizens' Telephone Company, which uses Stromberg-Carlson apparatus, has a 200-drop board and 175 subscribers and a large expected increase. It has a 50-mile toll line. It recently replaced its primary cells with storage battery, and the iron wire with copper.

HANCOCK, WIS.—The Union Telephone Company, with exchanges at Hancock and Plainfield, has 200 subscribers and 8 or 10 farmers' lines, which it proposes extending considerably. The Plainfield board has 100 drops. We are indebted to the president, Mr. D. B. Borden, for this information.

LIMA, OHIO.—The manager of the Lima Telephone Company, Mr. G. H Metheany, favors us with the following: Its switchboard capacity is 700 and the number of subscribers 690. It is now installing a 2000-line multiple switchboard and underground system, covering the business district of the city.

COLUMBUS, OHIO.—We have received the following information from Mr A. W. Hoge, superintendent of the Columbus Citizens' Telephone Company. Its switchboard capacity is 6000 drops and it has 4600 subscribers, the number increasing at the rate of 200 per month. It has very bright prospects.

COLUMBUS, IND.—The Citizens' Telephone Company of Columbus, and the Rural Telephone Company of Clifford have been sold by Mr. Butler and are now in the hands of Mr. S. P. Sherin. They operate, respectively, 400 and 25 drop boards, and have 400 and 10 subscribers. A large increase is projected.

KEOKUK, IA.—The Mississippi Valley Telephone Company of Iowa has exchanges in Keokuk, Fort Madison, Burlington, Wapello, Columbus Junction and Muscatine, and operates boards of 2000 drops in the six places. It has 1500 subscribers and 300 are to be added. More toll lines and two exchanges are to be added to the system. Its prospects are excellent.

BOONVILLE, MO.—We are indebted to Mr. E. P. Erwin, superintendent of the Boonville Telephone Company, for the following interesting items: It uses American switchboard and telephones and Sterling heat coil and pole top terminals. Its switchboard capacity is 300 and it has 300 subscribers. A one-section 100-drop board is to be installed. The company contemplates building long-distance lines in all directions and expects a large increase in the number of subscribers.

TELEPHONE NEWS.—(Continued.)

HOWARDSTOWN, KY.—Howard Bros. operate a 15-drop board and have 15 subscribers.

GRANVILLE, ILL.—The Granville Telephone Company has about 40 subscribers and a 25-drop board.

ELMWOOD, NEB.—The Elmwood Telephone Company operates a 100-drop board and has 37 subscribers. Prospects are very good.

MURPHYSBORO, ILL.—Logan & Minton operate a 300-drop board with 250 subscribers and an increasing business. The outlook is good.

NORTON, KAN.—The Norton Telephone Company has a switchboard capacity of 100 drops and 100 subscribers. The outlook is very good.

LISBON, IA.—The Lisbon Telephone Company has a 100-drop board and 120 subscribers. Country lines are projected and prospects are good.

SAUGATUCK, MICH.—The Saugatuck & Ganges Telephone Company uses Harrison apparatus and has a 250-drop board with 147 subscribers.

COLDWATER, OHIO.—The Co-Operative Telephone Company has a 100-drop board and 38 subscribers. Extensions are projected in the near future.

WILSON, KAN.—Messrs. W. F. Zeigler & Company operate a 100-drop switchboard and have 60 subscribers. They project a line to Russel, 25 miles distant.

PONCA, NEB.—The Ponca Telephone Company is of recent formation, but Mr. E. W. Gray informs us that a boom is expected and business promises well.

DE WITT, NEB.—The De Witt Telephone Company uses party lines and has 37 instruments, which were all installed in 1900. This number will be doubled soon.

GREAT BEND, KAN.—The Grimes Bros. Electric Light & Telephone Company operates on the automatic system. It has 80 subscribers and an increase is projected.

MUNISING, MICH.—The Munising Telephone & Electric Company operates a 150-drop board and has 65 subscribers, with an expected increase. Prospects are bright.

HOPKINS, MO.—The Hopkins Telephone Company reports bright prospects. It has a drop board capacity of 100; subscribers, 94. A new switchboard is to be added soon.

NORTH SALEM, IND.—The North Salem Telephone Company has 100-drop board capacity and 100 subscribers. Recent growth has been good and prospects are favorable.

MOODY, TEX.—The Moody Telephone Company, Mr. O. R. Porterfield, manager, has a 100-drop board and 80 subscribers. The company is of recent formation and has a very economical plan for country lines, giving speical attention to farmers.

STURGION, MO.—The New Century Telephone Company operates a 100-drop board and has 227 subscribers, with a large expected increase. The prospects are exceedingly bright.

RIPLEY, N. Y.—The Ripley Telephone Company reports a good demand in the rural districts. Its apparatus is Standard make and it operates a 100-drop board with 105 subscribers.

LOCKPORT, N. Y.—The Crosby Telephone line informs us, through Mr. E. B. Crosby, that prospects are very bright. It operates a toll line and projects an extension of 10 miles.

FORNICA, ILL.—The Fornica Switchboard Company has a 100-drop cabinet, operates 50 with 70 subscribers. Steadily increasing growth will probably necessitate a larger switchboard.

NORTH CAPE, WIS.—Mr. G. Spillum, of the North Cape & Union Grove Telephone Company, informs us that it operates farm lines which have been extended considerably of late.

WATERVILLE, MINN.—The Cannon Valley Telephone Company contemplates another local exchange and has now a 250-drop board with 188 subscribers. The outlook is very promising.

SPRINGFIELD, KY.—The Washington County Telephone Company has increased its business steadily. With a 100-drop board it has 100 subscribers, and improvements are in contemplation.

EUREKA, ILL.—The Eureka Telephone Exchange Company operates apparatus of the National Automatic Telephone Company. Its switchboard capacity is 100 drops and it has 75 subscribers.

RISING SUN, IND.—Green Bros. operate exchanges at Rising Sun and Vevay. Each exchange has a 100-drop board. There are 191 subscribers, and it has 200 miles of toll and country lines, principally metallic.

GIRARD, ILL.—The Girard Telephone Company expects to build toll lines and has bright prospects. It operates Eureka Electric apparatus, has a 200-drop board and 130 subscribers, of whom 40 have recently joined.

GAULLERSBURY, IND.—The Montgomery County Telephone Company has apparatus of the Viaduct Manufacturing Company. It has a 20-drop board with 80 subscribers and good prospects of an increase in the number.

GREENVILLE, OHIO.—The Greenville Home Telephone Company sends a report of good business and a bright outlook. With a 600-drop board it has 350 subscribers and expects a rapid increase during the present year.

NASHVILLE, ARK.—The president of the Nashville Telephone Company reports business looking bright and prospects good. The company operates a 100-drop board with full number of subscribers. New lines are projected.

CHARLESTON, MO.—The Charleston & Southeast Telephone Company's system is quite extensive. Charleston has 175-drop board capacity, Bloomfield 100 and Dexter 75, and about 250 subscribers. Its prospects are very good.

LA CROSSE, WIS.—The La Crosse Telephone Company projects an increase of capacity for 2000 subscribers. It operates at present a 900-drop board and has 810 subscribers. Mr. Lohmiller reports prospects very encouraging.

GALLIPOLIS, OHIO.—We are indebted to Mr. Forrest, manager of the Gallipolis Telephone Company, for the following information: It operates a 400-drop board and has 350 subscribers. Extensions are projected in the near future.

MUNCIE, IND.—The Townhill Telephone Company is devoted exclusively to rural lines and commenced business last year. It has 61 subscribers and will build other lines in the spring. We are indebted to Mr. G. A. Ribble for the above.

NEW AUGUSTA, IND.—The New Augusta Independent Telephone Company uses apparatus of the Eureka Electric Company. It has been lately organized, has a 50-drop board and 20 subscribers. Mr. Nagle, the secretary, reports a good outlook.

ALBION, NEB.—The Albion Telephone Company, T. F. Martin, manager, has been in operation one year. It has a 200-drop board and 176 subscribers; has built a toll line to Cedar Rapids, where it has installed an exchange with 48 subscribers.

WICKLIFFE, KY.—The manager of the Wickliffe Telephone Company has kindly furnished us with the following: It uses American Electric Telephone Company apparatus, a 100-drop board and has 81 subscribers. The outlook is very good.

JEFFERSON CITY, MO.—The superintendent of the Capital Telephone Company informs us that business could not be better, as it can scarcely put in equipment fast enough. Its switchboard capacity is 400; toll board, 10. There are 400 subscribers.

BETHANY, ILL.—We are indebted to Mr. W. S. Herman for the following information regarding his telephone lines: He operates a 100-drop board with 61 subscribers and intends running country lines, the outlook for farmers' telephones being very good.

FARMLAND, IND.—The Farmland Telephone Company has a 100-drop board besides party lines, and 65 subscribers. More party lines, with from 35 to 50 subscribers, are projected. Mr. Wright, the superintendent, informs us that the outlook is excellent.

BUSHNELL, ILL.—The Bushnell Telephone Company, owned by Mr. J. Lightner, operates a 200-drop board. It has 160 subscribers in the city exchange and 150 farmers' single-ground toll lines. Recent growth has been good, and extensions are projected.

HAGERSTOWN, IND.—The Hagerstown Telephone Company operates a 100-drop board. Commencing in September, 1900, with 55 telephones, it now has 112 subscribers and contemplates building several toll and party lines. The outlook could not be better.

NEW RICHLAND, MINN.—We are indebted to Mr. H. Jarhning, proprietor of the New Richland Telephone Exchange Company, for the information given below: Prospects for the future are good. A 50-drop board is in operation and there are 56 subscribers.

ALBION, IND.—The Noble County Telephone Company is of recent formation, and extremely enterprising. With a 200-drop board it has 150 subscribers and is building several country lines. Mr. M. C. Meyer, the secretary, informs us that the outlook is very encouraging.

JACKSONVILLE, FLA.—We are indebted to Mr. W. N. Shine, president of the Jacksonville Telephone Company, for the following: His company operates a 1000-drop board and has 864 subscribers. An increase is projected, including a 1200 multiple board and underground work.

FOREST CITY, IA.—Mr. J. A. Peters, of the Winnebago Telephone Company, informs us that his system will probably be changed and improved. His switchboard capacity is 300, of which 150 drops are installed. It has 135 subscribers and the number is increasing steadily.

BERLIN, MD.—The Synepuxent Telephone Company was started in July, 1900, as a small line from Berlin to Snow Hill, but has increased rapidly and now has 50 miles of toll line. It operates a 50-drop board and has 60 subscribers. New lines to Ocean City and Liberty are projected.

TISKILUA, DEL.—The Tiskilua Telephone Exchange has been in operation little over a year but is prospering and has a fine outlook. Mr. May, the manager, has kindly furnished us with details. It has a 100-drop board and 44 subscribers, which number it expects to double this year.

RURAL RETREAT, VA.—We are indebted to Mr. J. W. Eiffert, of the Rural Retreat Telephone Company, for the following items: The company operates a 100-drop board and has 105 subscribers, with a very bright outlook. Its apparatus comes from the Telephone Manufacturing Company of Sumter, S. C.

DANVILLE, IND.—The Vermilion County Telephone Company operates at Ridgefarm, Georgetown, Catlin and Indianola, besides Danville. With 1400 capacity drop board, it has 1100 subscribers and a large expected increase. Prospects never were better, says Mr. Baum, to whom we are indebted for the above information.

PONTIAC, MICH.—The Oakland County Telephone Company has a switchboard of 300 drops and 375 subscribers. Business was started in October, 1900, and has progressed rapidly. It has toll lines to all points in the county and to Detroit and several other cities. We are indebted to Mr. C. S. Bartlett for this information.

COLUMBUS CITY, IND.—We are indebted to the president of the Home Telephone Company for information concerning its business. It operates a 200-drop board and has 189 subscribers. An additional board of 100 capacity is projected and more toll lines. At present it has about 260 miles, reaching all parts of the county.

NEWTON, KAN.—Mr. A. R. Champlin, proprietor of the Newton Telephone Company, kindly sends us the following: Its apparatus is from the American Electric Telephone Company and it operates a 400-drop board with 330 subscribers. It has recently installed 30 miles of toll line and contemplates 30 miles more, into Wichita, Kan.

BATAVIA, OHIO.—The Batavia Telephone Company uses Swedish-American apparatus and has a 100-drop board with 50 subscribers. It commenced operations with the new century and has very good prospects. An exchange at Milford is ready to open with 50 subscribers, and it will build to Loveland, Amelia, New Richmond, Moscow and several other places. We are indebted to Mr. W. H. Baum for the above.

TELEPHONE NEWS.—(Concluded.)

LAVARAT, MO.—The Lavarat Telephone Company has switchboard capacity of 550, and 600 subscribers. Prospects are very good.

GIRARD, GA.—The Girard Telephone Company has 20 subscribers and a switchboard capacity of 25 drops. Mr. W. R. Buxton is secretary and treasurer of the company.

DEER CREEK, ILL.—Messrs. Davis & Son are operating an exchange in this place with a capacity of 100 drops, having 90 subscribers. They expect to double the number during the year. Mr. D. I. Davis is secretary of the company.

PRESCOTT, ARK.—The Southwest Arkansas Telephone Company has 82 subscribers and a switchboard capacity of 100. Eighteen of its subscribers are of recent addition, and it is expected that the limit of the board will soon be reached.

CHELSEA, MICH.—The Chelsea Telephone Company is contemplating the building of a number of farmers' lines. At present it has a switchboard capacity of 100 drops and 84 subscribers. It uses the apparatus of the Victor Telephone Company. L. L. Gordon is president.

MAYFIELD, KY.—The West Kentucky Telephone Company is operating exchanges at Mayfield and Fulton, with switchboard capacity at each place of 200 drops. There are 200 subscribers in each town and 100 more are expected to be added during the next year. Mr. J. E. Wright is manager. He reports a good outlook for business.

BEMIDJI, MINN.—The Bemidji Telephone Exchange Company has a switchboard capacity of 150 drops, the apparatus being of the Minnesota Electric Company's make. The company has 102 subscribers and began business on Sept. 20, 1900. Mr. J. H. Haner, president of the company, states that business is flourishing, the outlook excellent and that an increase of 30 per cent is projected.

FREEPORT, L. I.—The South Shore Telephone Company has 400 subscribers and is using Phœnix Electric and Sterling apparatus. The lines were recently extended to Sea Cliff and Roslyn, and the extensions will be carried westward toward Jamaica; also eastward. In spite of the strong Bell opposition the company is reported to be a great success and paying 6 per cent dividends.

WINCHESTER, ILL.—Mr. Geo. E. Woodhead is operating an exchange in this place with a switchboard capacity of 135 drops. Toll and country lines are on jacks through the exchange. He has 151 subscribers and uses the apparatus of the Monarch Telephone Company, Palmyra, Ill. Mr. Woodhead started business in 1898 with 73 subscribers and the growth has been steady ever since. He expects to add 12 more town subscribers to his list and will extend his lines to reach 50 new subscribers in the suburbs and on toll lines. The extensions will be about 40 miles in length. Mr. Woodhead reports a very encouraging outlook. He is charging $1 for residence instruments and $1.50 for business.

JEFFERSON, IA.—The Jefferson Telephone Company is operating two exchanges, one at Jefferson with a 200-drop board, and one at Grand Junction, Ia., with 100 drops, using the apparatus of the American Electric Telephone Company. The total number of subscribers is 300. The Grand Junction exchange was recently burned to the ground, the fire also destroying the terminal poles, etc. If nothing prevents, the company expects to get it in operation again by March 1 next. The outlook for business is very bright. Mr. Chas. G. Cockerill, president of the company, states that the farmer lines are going to be an important part of the business, which is growing very fast, and the company is compelled to take care of it.

WATERLOO, MICH.—The Rural Telephone Company has 160 subscribers and uses the Williams-Abbot Electric Company apparatus. This number of subscribers is divided among 20 lines. The company has 200 miles of lines and it reaches 21 towns and villages in this section. The subscribers have free service with one another and with the Chelsea Telephone Company and the Mason Telephone Company. Mr. Lyman L. Gordon is secretary of the company. Its lines also connect with other farmers' lines, thus giving connection with 300 other subscribers on payment of a toll of 10 cents per message. The company will, in the spring, complete lines to Howell, Williamstown and Jackson. Besides operating country lines the Rural Company has exchanges at Stockbridge and Gregory, besides Waterloo.

General News.

ELECTRIC LIGHT AND POWER.

ARCHBOLD, OHIO.—The village authorities are investigating the cost of a municipal lighting plant.

WHITEHALL, WIS.—The electric lighting plant is shut down on account of the washing out of the dam.

RIPON, WIS.—Bids are asked until March 5 for a franchise for an electric plant for the city for from 5 to 15 years. F. W. Allen is the City Clerk.

VINCENNES, IND.—E. J. Julian, manager of the Vincennes Electric Light Company, has been appointed receiver thereof by the Circuit Court.

HAMILTON, OHIO.—The Hamilton Corliss Engine Works have purchased two 40-hp motors, direct connected to Fort Wayne 40-light arc machines.

CLEVELAND, OHIO.—School Director Bell has announced that electric lights will be installed in all public school buildings. Gas is now used in the majority of the buildings.

INDEPENDENCE, MO.—It is reported that the gas and electric lighting interests of this place are to be consolidated. Mr. C. H. Hammett, of Kansas City, is promoting the consolidation.

CAMBRIDGE, OHIO.—The Cambridge Electric Energy Company, reorganized as the Cambridge Ice & Electric Company, has added a 150-kw low frequency alternator, sold by the Fort Wayne Electric Works.

BUCYRUS, OHIO.—Peter Young, of Mt. Vernon, Ohio, and Isaac Baxter, of Detroit, Mich., have bought out the plants of the Bucyrus Electric Light Company and the Bucyrus Gas Company. The companies are capitalized at $70,000.

RICHMOND, IND.—The citizens have brought further injunction proceedings and amended complaint against the city to prevent the erecting of a municipal electric light plant. They allege that the indebtednes will exceed the constitutional limit.

JERSEY CITY, N. J.—The Sussex Light & Power Company has been incorported with a capital stock of $500,000. Incorporators: Franklin J. Myers, R. H. Batchelor, Alex. T. Rice, Wm. Duncan and Wm. J. Schneider. The principal office of the company is in this city.

COLUMBUS, OHIO.—A resolution has been introduced in the City Council directing the committee on gas and electricity and the director of public improvements to prepare and report a plan and detailed estimate of the cost of an electric light plant, complete, for city use.

GRAND RAPIDS, WIS.—At a meeting of the stockholders of the Twin City Electric Company it was decided to change the name to "The Electric & Water Company" and double the capital stock, making it $40,000; also not to declare a dividend of more than 12 per cent in the future.

JEFFERSONVILLE, IND.—The engineer and employees of the electric light works of this city banked the fires, shut down the machinery and locked up the place, stopping the entire service and throwing the city into darkness with the view of enforcing the payment of their wages, which were back for seven weeks.

ALLIANCE, OHIO.—A Council committee, appointed to investigate the probable cost of operating a municipal lighting plant, has returned a report that a suitable plant would cost $35,000. It recommended that it would be more economical to renew the contract with the Alliance Gas & Electric Company, which will probably be done.

CHARLOTTE, N. C.—It is announced that the Cape Fear Power Company, which proposed to develop the falls of the Buckhorn on Cape Fear River, near Fayetteville, N. C., has succeeded in placing itself on a sound financial basis and will be able in the near future to furnish electric power to Fayetteville, N. C. W. M. Morgan is one of the chief promoters.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company has about completed one pole line from the power house on the Yuba River to Vallejo, Calif. The line now extends to tidewater near Suisun. Electric power, to fill contracts in Vallejo, may be supplied during the present month. Work is in progress on the two spans of 4700 ft. each at a height of 400 ft. over Carquinez Straits.

MENASHA, WIS.—This city is much agitated over the prospects of possible municipal ownership in a water works and electric light station. A franchise for a water works and electric light station has been granted to Y. P. Miller & Company, of Chicago. The plan is for the company to erect a $60,000 plant, to be paid for by the city on the installment plan. Thirty-seven arc lamps are called for in the contract.

DENVER, COLO.—The Denver Gas & Electric Company has offered to supply to the city for a period of 1, 3, 5 or 10 years, 1000 2000-cp arc lights for all night and every night service at $60 per year per lamp. It also offers, if the proposition to the city is accepted, to charge private consumers on the average less than 10 cents per kilowatt-hour for incandescent lighting and less than 4 cents per kilowatt-hour for current for power purposes.

CALIFORNIA POWER.—A dispatch from San Francisco of Feb. 15 says: "The electric transmission line from the immense plant in the mountains of Calaveras County was completed to San Jose to-day, and preparations are complete to furnish light and power to the surrounding country. The value of manufacturing interests will be greatly enhanced by this power installation. New factories are contemplated, and the street railways of San Jose will use the current."

SAN FRANCISCO, CALIF.—The San Francisco Gas & Electric Company, under an order from the Board of Supervisors, recently filed a statement showing the cost of producing gas and electricity during the past year. The receipts from the sale of gas and its by-products were $1,335,069.73; cost of production, $913,151.25. Receipts from sale of electricity, approximately, $781,205.57; cost of generating the same, $575,006.51. Net profits, $628,717.54; dividends paid, $516,717.96; bond interest, $37,380; surplus, $74,019.58.

OTTAWA, ONT.—The annual meeting of the Cataract Power Company, of Hamilton, Ont., was held on Feb. 11. The gross receipts of the company, including the Electric Street Railway, the Hamilton & Dundas Railway and the Radial Railway, were $421,311. After payment of operating expenses, interest on bonds, franchises, taxes, etc., as well as two dividends on the preferential cumulative stock, a balance of $29,689 remained at the credit of profit and loss. Hon. J. M. Gibson is president, John Moodie treasurer and John Patterson secretary.

SAN FRANCISCO, CALIF.—The new Cedar River water system is now ready to supply Seattle, Wash., with water. Several pumping stations and reservoirs of the old system will be abandoned. The Lake Washington station, however, may be used as a municipal lighting station, in case such a plant is decided upon. The plan, which is now under consideration, is to install a number of water wheels and generators at the Lake Washington station and operate them by surplus water from the Cedar River system. There would be quite a high working head at the level of Lake Washington.

VICKSBURG, MISS.—The Board of Aldermen on May 15, 1899, contracted with the Vicksburg Railroad & Power Company to furnish 125 street lights for 10 years at $100 a year each on a moonlight schedule, which contract was contested by two large tax payers and the lighting company enjoined. The case was tried and a verdict was rendered in favor of the company. An appeal was taken to the Supreme Court and the verdict sustained. On Jan. 28 four members of the board, a majority of those present, voted to annul the contract. Feb. 1 the Chancellor issued an injunction restraining the city from further action. Another long legal battle will now be fought.

THE ELECTRIC RAILWAY.

MATTOON, ILL.—Edgar County capitalists will construct an electric railway from Paris, Ill., to Clinton, Ind.

ELYRIA, OHIO.—George Chamberlain is securing right of way for an electric railway from Elyria to Grafton.

SANDUSKY, OHIO.—A new line to extend from Clyde to Sandusky by the way of Castalia is being promoted here.

SCHENECTADY, N. Y.—The capital stock of the Schenectady Railway Company will be increased from $300,000 to $1,000,000.

INDIANAPOLIS, IND.—A bill has been introduced in the Indiana Legislature to make it unlawful for any street car to have running boards.

SANDUSKY, OHIO.—The Lake County Commissioners have granted a 25-year franchise to the Cleveland, Elyria & Western Electric Railway.

OTTAWA, OHIO.—Local citizens are trying to interest capital in an electric railway to connect Ottawa with Delphos, Defiance, Findlay and Lima.

AKRON, OHIO.—The Northern Ohio Traction Company is making surveys to extend its new Barberton line to Turkeyfoot Lake, a summer resort.

OTTAWA, ONT.—The Niagara Falls, Wesley Park & Clifton Tramway Company has appointed a committee to arrange for the construction of the road.

TROY, OHIO.—Work of erecting the power house and car barns of the Dayton, Tippecanoe & Troy Electric Railway has been started at Tippecanoe City.

NEW HAVEN, CONN.—It is announced that the Pittsfield (Mass.) Street Railway Company will extend its line southward to Lenox and thence to Lee.

SOUTH BEND, IND.—The Indiana Street Railroad Company has decided to make some extensive improvements and extensions, on which work will begin at once.

CLEVELAND, OHIO.—The Northern Ohio Traction Company is looking over the field with a view to securing a private right of way into the centre of this city.

YOUNGSTOWN, OHIO.—The officials of the Mahoning Valley Railway Company are considering the advisability of extending their line from Warren to Ravenna.

DILLSBORO, IND.—It is reported that the Big Four Railroad is trying to buy the Aurora Pike with a view of building an electric road from Aurora to North Vernon.

ELIZABETH, N. J.—The Elizabeth, Plainfield & Central Jersey Traction Company will extend its system from Plainfield to Watchung and through the Passaic Valley to Stirling.

JERSEY CITY, N. J.—The Union Traction Company has been incorporated; capital, $500,000. Incorporators: Moses M. Broadwell, Frank E. Baker, H. C. Balcom, Leonard J. Burtis.

UPPER SANDUSKY, OHIO.—Dr. G. W. Kemp has secured right of way for a road from Kenton to Upper Sandusky and is negotiating with Eastern capitalists to build the road.

HUNTINGTON, IND.—Chief Engineer Moran, of the Fort Wayne & Southwestern Traction Company, is now engaged in locating the company's power plant, barns and shops in this city.

PAINESVILLE, OHIO.—The Lake County Commissioners have granted a franchise to the Cleveland, Painesville & Eastern Electric Railway to build a branch line to Fairport on the lake shore.

TOLEDO, OHIO.—The County Commissioners have granted a 25-year franchise to John Kumler, promoter of the Toledo, Napoleon & Defiance Electric Railway, which was recently incorporated.

ALBANY, N. Y.—A bill has been introduced in the Senate providing that street surface railway companies whose lines extend a mile beyond the limits of cities and villages shall have vestibuled cars.

CHICAGO, ILL.—The Chicago Heights Street Railway Company has been organized with a capital stock of $100,000. The incorporators are Major McGregor, F. E. Von Ammon and A. H. Pugh.

DANVILLE, IND.—The Commissioners of this county have reported favorably on the petition of Fairbanks and others for a franchise through this county for an electric railway from Indianapolis to North Salem.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company has elected these officers: President, John A. Rigg, of Reading; vice-president, Henry C. Moore, Trenton; secretary and treasurer, M. C. Aulenbach, Reading.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company will, it is stated, expend about $500,000 in extending and improving its system. The line now operated by steam will be operated by electric power. The entire system will be rebuilt.

GREENWOOD, IND.—At a recent meeting of the directors of the Indianapolis, Greenwood & Franklin Electric Railway Company the following officers were elected: President, W. G. Irwin; vice-president, C. F. Coffin; H. T. Miller, secretary and treasurer.

KANSAS, CITY, MO.—The cable power house of the Metropolitan Street Railway Company, at Ninth and Washington Streets, in this city, was destroyed by fire recently. The loss is placed at $75,000. Sixty cars and 1200 gallons of kerosene were destroyed.

BOSTON, MASS.—The Selectmen of Southborough have voted to extend the time of completion of the Southborough link of the Boston & Worcester Street Railway to Jan. 1, 1902. This line will form one more link in the system of through electric service between Boston & Worcester.

TOLEDO, OHIO.—J. L. Stratton of Toledo is securing right of way for a road to extend from Swanton, Wauseon and Archibold to Toledo. It will be called the Toledo, Swanton & Wauseon Electric Railway, and it will be incorporated within the near future with $600,000 capital stock.

OTTAWA, ONT.—Application will be made to the Ontario Legislature by the Ontario Colonization Railway Company for a charter to construct and operate a railway through the Parry Sound and Nipissing districts from Georgian Bay, with the privilege as to choice of motive power, either steam or electricity.

PITTSBURG, PA.—The Tarentum Traction Company has let the contract for the erection of a new car barn and several other improvements of the road. The project is also under advisement of connecting the line with one of the Pittsburg traction lines. The distance from Tarentum to Pittsburg is 28 miles.

COLUMBUS, OHIO.—The State Canal Commission has decided to refuse to make leases of canal banks for electric railway use until the State Legislature has made the law on the subject more definite and certain. This will not affect the experiments being made by T. N. Fordyce on the electric propulsion of canal-boats.

CINCINNATI, OHIO.—It is stated that the Ohio Southern Traction Company has purchased the right of way of the Cincinnati & Northwestern Railroad, an abandoned steam road, which will enable it to operate its cars almost to the centre of Cincinnati. It is said that the price paid for the property was $100,000.

NORRISTOWN, PA.—The Lansdale & Norristown Electric Railway Company has been organized with a capital stock of $60,000. The stockholders are George H. Young, Bethlehem; George Hallman, Lower Nazareth; A. T. Groman, Easton; S. S. Emery and E. A. Bilheimer, of Butztown. Mr. Emery is president.

WHITE PLAINS, N. Y.—A company is being organized here to build a trolley line from here to Kensico Station on the New York & Harlem Railroad, about three miles above this village. The projectors also intend purchasing a tract of land between Washington's Headquarters and Kensico, upon which to establish a summer resort park.

KANSAS CITY, MO.—The Kansas City & St. Joseph Electric Railroad Company, whose organization was recently noted in these columns, has so far progressed with its plans that it is now ready to receive bids on the work of constructing its line. About 45 miles of track will be laid. Seventy-pound T-rails will be used in the work.

CLEVELAND, OHIO.—Henry A. Everett is authority for the prediction that in the near future the Lorain & Cleveland Electric Railway and the Sandusky & Interurban Electric Railway will be consolidated under one management and through cars operated from Cleveland to Sandusky. The two systems are practically owned by the same people.

HAMILTON, ONT.—At the annual meetings of the three electric railway lines, controlled by the Cataract Power Company of Hamilton, Ont., good showings were made in connection with each company. The reports of each of the lines disclosed a substantial surplus over the operating expenses, fixed charges, and the 5 per cent dividend that was declared.

BOSTON, MASS.—It was reported recently that the N. Y., N. H. & H. R. R. Company had practically decided to install the third-rail system on the Boston and suburban lines. President Hall and First Vice-President Merrill, however, deny that any immediate plans of the character are contemplated, and that the entire matter stands exactly where it was six months ago.

CHICAGO, ILL.—An ordinance has been introduced in the Council to amend the franchise of the Northwestern Elevated Railway Company so that instead of building an elevated structure to the city limits, as required by the present statute, it may construct an incline at Wilson Avenue and thence run surface cars by the trolley system north or norwesterly to the city limits.

WORCESTER, MASS.—A plan is being considered for the liquidation of the Worcester Traction Company of New Jersey, which owns the Worcester Consolidated Street Railway Company of Massachusetts. Owing to the difficulties of managing the property through a foreign corporation, it is proposed to revert to the older and local charter, doing away entirely with the New Jersey corporation.

YOUNGSTOWN, OHIO.—The stockholders of the Youngstown Park & Falls Street Railway Company have elected the following officers: President, Samuel C. Greir; vice-president, Joseph Hastings; secretary and treasurer, Charles W. Dahlinger. Directors, the above, with W. H. Park, H. G. Hamilton, Robert McAfee and John R. Murphy. A resolution to double track the Market Street line was voted down.

WATERVILLE, OHIO.—The Council recently called for bids to settle a fight for a franchise made by rival lines. The Toledo, Waterville & Western offered to give six tickets for 25 cents for adults and six tickets for 15 cents for children under 10 years of age; rate to Toledo, 30 cents, and round trip 50 cents. The Toledo, Napoleon & Defiance Railway Company offered to carry passengers free of charge within the city limits. Both companies gave bond of $2,500.

CLEVELAND, OHIO.—The Cleveland City Railway Employees' Association has agreed to support the Farley franchise extension ordinance providing the company will agree to pay its motormen and conductors 22 cents an hour instead of 20 cents, and to shorten the hours of labor for the motormen. The association, which numbers 600 men, is against low fares, as the members claim they would tend to decrease the wages of employees. The company thinks favorably of the proposition.

BOSTON, MASS.—It is understood here that by a new arrangement all the street railways south of Boston owned by the Massachusetts electric companies are to come under one management and be known under the title of the Old Colony Street Railway. Robert S. Goff of Fall River will be the general superintendent. Ex-President John Graham of the Quincy & Boston Street Railway has been elected vice-president. The consolidation of the system is in the line of better service and reduced fares.

TOLEDO, OHIO.—At the meeting of the stockholders of the Toledo & Western Electric Railway Company, held a few days ago, the following officers were elected: Luther Allen, president; J. R. Seagrave, vice-president; F. E. Seagrave, secretary-treasurer. The above, with Judge J. M. Stone, F. C. McMillen and C. E. French of Cleveland and L. H. Clendenin of Metamora, constitute the board of directors. The roadbed work has been completed and track laying will be commenced in a few days. Machinery is being placed in the power house at Sylvania.

SPRINGFIELD, OHIO.—The Springfield Street Railway Company has decided on a number of improvements.

WATERVILLE, OHIO.—The Toledo, Napoleon & Defiance Railway Company has secured a franchise through Waterville.

DELAWARE, OHIO.—The Delaware County Commissioners have granted a 25-year franchise to the Union Railway Company.

CLEVELAND, OHIO.—The owners of the Chagrin Falls & Eastern Railway Company are securing right of way for an extension.

CHARLOTTE, N. C.—The electric line of the Spartanburg (S. C.) Electric Railway, Gas & Power Company will be extended to Converse, S. C.

CRESTLINE, OHIO.—L. M. Coe and F. D. Carpenter, of Cleveland, are securing right of way for a road to extend from Mansfield to Crestline and Galion.

COLUMBUS, OHIO.—The Worthington, Clintonville & Columbus Street Railway Company has decided to extend its road north to Delaware and Marion with branch lines.

COLUMBUS, OHIO.—The long controversy over the street railway franchises was settled on Feb. 5 by the Council granting a 25-year blanket franchise to the Columbus Railway Company.

RAVENNA, OHIO.—The Northern Ohio Traction Company, which is securing right of way to extend its road from Kent to Ravenna, is also figuring on a line from Ravenna to Alliance.

EAST LIVERPOOL, OHIO.—The Columbiana County Commissioners have granted a franchise to Hait & Smith of Cleveland, promoters of the Salem, Lisbon & East Liverpool Electric Railway.

TIFFIN, OHIO.—The owners of the Tiffin Electric Railway & Power Company, backed by Chicago capitalists, are planning to build a road from Tiffin to Fremont, Port Clinton, Lakeside and Catawba Island.

DAYTON, OHIO.—The stokholders of the Dayton & Northern Traction Company will meet on Feb. 23 to decide on a proposition to float bonds to the amount of $450,000 to enable it to complete the construction and equipment of the road.

NORWALK, OHIO.—The Toledo, Fremont & Norwalk Electric Railway Company has perfected traffic arrangements with the Sandusky, Norwalk & Southern Railway Company so that its cars may be operated into Norwalk over the latter's tracks.

AKRON, OHIO.—The deal whereby the lines of the Akron & Cuyahoga Falls Rapid Transit Company became the property of the Northern Ohio Traction Company was closed on Feb. 1 and the property was turned over on the following day. The price paid for the lines is said to have been $480,000.

NORWALK, OHIO.—The Sandusky, Norwalk & Southern Railway Company has asked the County Commissioners for a franchise over a new route near Norwalk which will enable it to shorten its line and avoid a long grade. The road is to be rebuilt with heavy rails, and several large cars are to be ordered.

TOLEDO, OHIO.—Mr. Thomas H. McLean, vice-president and general manager of the Toledo Traction Company, on his return to his office, after his recent trip, was presented with a magnificent office chair of antique oak and Russia leather, by the conductors and motormen employed by the Toledo Traction Company.

SPRINGFIELD, OHIO.—The Springfield & Western Railroad Company, of Springfield, has been incorporated with $100,000 capital stock by Jonathan S. Harshman, James F. Mahoney, Frederick J. Green, Charles A. Ackerman and John G. Webb. It proposes to build an electric road from Springfield to New Carlisle.

CLEVELAND, OHIO.—The formal organization of the Cleveland & Southern Electric Railway Company has been effected, with W. H. Lamprecht president, A. H. Pomeroy vice-president and F. T. Pomeroy secretary and treasurer. The directors include the above, with A. E. Aikins, L. J. Wolf, F. T. Fuller, U. G. Walker and F. H. Ginn.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Southwestern Railway Company, of Springfield, has been incorporated with $250,000 capital stock by Jonathan S. Harshman, James F. Mahoney, Frederick R. Green, Charles A. Ackerman and John G. Webb. It proposes to build an electric road from Springfield to Yellow Springs, Cedarville, Xenia, Jamestown and Clifton.

BUCYRUS, OHIO.—The stockholders of the Buckeye Traction Company, recently incorporated, have elected the following officers: R. V. Sears, president; C. Feiring, vice-president; W. A. Blicke, secretary-treasurer. The above, with S. J. Kibler, A. J. Scott and H. V. Flickinger, constitute the board of directors. Right of way is being secured between Bucyrus, Sulphur Springs, New Washington, Shelby and Norwalk.

LEGAL.

SPRAGUE CONTROLLERS IN BOSTON.—In the United States Circuit Court last week Judge Colt heard a motion in the case of the Thomson-Houston Company against the Boston Elevated Railway Company. The plaintiff had filed a motion seeking an injunction to restrain the defendant from using a controller alleged to be protected by patents held by it. The railway company asked the court to dismiss the motion of the plaintiff on the ground that it did not contemplate using a controller protected by the plaintiff's patents, and should not be put to the expense and trouble of making a defense with regard to the use of any other or different system of equipment than which it proposed installing. It produced an affidavit from G. H. Hill, electrical engineer of the Sprague Electric Company, which has the contract for the equipment of the Boston Elevated road, explaining the Sprague multiple unit system, which is to be used by the road. Mr. Hill said the system would contain no such controller as that on the Brooklyn Heights Railroad, which has been enjoined by Judge Lacombe of New York, nor any controller wherein a motor connecting switch and rheostat switch are mechanically connected, but, on the other hand, it would contain one in the form adopted in accordance with the terms of the contract with the elevated road. Judge Colt allowed the motion of the defendant. F. H. Betts, of New York, appeared for the plaintiff, and C. A. Mitchell, of New York, for the defendant.

OBITUARY.

MR. W. R. LEHMICKE, secretary and treasurer of the Hot Springs, Ark., Electric Light, Water & Gas Company, died on Jan. 31.

MR. F. H. TWITCHELL.—We regret to note the death, on Feb. 5, of the Hon. Fritz H. Twitchell, well known in Bath, Maine, as a former mayor, etc., and one of the large holders of stock in the Bath Gas & Electric Company.

PERSONAL.

MR. E. P. BURCH, consulting engineer, gave a lecture on "Electric Railways" to the class in that subject at the University of Minnesota on Feb. 14.

PROF. GEO. D. SHEPARDSON, of the University of Minnesota, will read a paper on "Electric Lighting of Trains" before the St. Louis Railway Club March 8 next.

PROF. ELIHU THOMSON has favored the Lowell Institute, Boston, with two lectures on electric undulations, accompanied by experimental demonstrations, etc.

DR. M. I. PUPIN is to lecture before the Franklin Institute on Feb. 20 on the subject of "Electrical Wave Propagation," which he has made peculiarly his own for some time past.

MR. ROBERT HUTCHIN JEFFREY, of Columbus, Ohio, general manager of the Jeffrey Manufacturing Company, was married on Feb. 6 to Miss Alice Kilbourne, of Columbus.

PROF. F. B. CROCKER lectured on Feb. 15 before the Department of Electricity of the Brooklyn Institute on "The Meaning of the Most Important Electrical Terms." The lecture was illustrated by experimental demonstrations.

MR. S. G. McMEEN, chief engineer of the Central Union Telephone Company, Chicago, Ill., will lecture before the engineering students of Purdue University, Lafayette, Ind., on Feb. 27, his subject being "Modern Developments in Telephony."

MR. F. HIRD, B. A., and Mr. R. Dumas, A. M. I. M. E., of the English house of Siemens Bros. & Company, Ltd., have arrived from London and are making a month's tour around the country in order to acquire some idea of America's methods at first hand. They are greatly pleased with what they have seen already and hope to make as thorough an inspection as their short stay will allow.

PROF. ALEXANDER GRAHAM BELL has been serving as a special agent of the Census Bureau in charge of the enumeration of the deaf, dumb and blind population of the country, and is now preparing his report. Mr. Bell is very wealthy, but is entitled to $6 a day from the Government while he is employed in this work. A large part of his life has been spent in the investigation of means for promoting the education of deaf-mutes and sightless people.

MR. JAMES MITCHELL, of Rio Janeiro, and one of the leading dealers in electrical machinery in South America, is now in New York for the purpose of placing several contracts relating to electrical equipment and appliances required for various plants in Brazil. Mr. Mitchell, who expects to be in the United States for about 10 days, is making his local headquarters at the offices of the Flint-Eddy & American Trading Company in the Johnson Building, Broad Street.

LIEUT. J. WILSON.—"Jack" Wilson, a veteran of the Klondike, who has been made a lieutenant of Gen. Kitchener's Body Guard, has had a remarkable career. He is only 33 years old, began life as a telegraph messenger in London, became an operator, studied law, and was made a solicitor. During the gold boom in Australia he was Mayor of Kalgoorlie. He afterward went to the Klondike. On the outbreak of the war he joined the Light Horse as a trooper and was twice invalided. He is now commissioned as a lieutenant.

PROF. D'ARSONVAL, in lecturing in Paris on liquid air last week said: "I know that apparatus has been constructed in America and I have models of it at home, but I continue to assert that liquid air cannot be utilized in running motors because they produce only 5 per cent of the force spent in producing liquid aid. Such motors can only be used in laboratories or in floating companies to drain the money of silly people or for submarine boats, where expense is of no consequence. Regarding the utility of liquid air, the German savant Linde shares my views." He spoke very favorably of submarine boats.

MR. T. G. SEIXAS, vice-president and superintendent of the Germantown Electric Light Company, Philadelphia, Pa., was very quietly married on Thursday, Feb. 14, to Miss Amelie L. Bunont. The wedding took place at the home of the bride's mother, 6 West Thirteenth Street, New York City. Mr. Seixas was for years associated with Mr. Thos. A. Edison at that gentleman's laboratories and mines, but for the past four or five years has been connected with the Philadelphia Electric Company as vice-president and superintendent of the Germantown Electric Light Company. Mr. Seixas' many friends unite in wishing the young couple a happy and prosperous future. Mr. and Mrs. Seixas, upon returning from their wedding trip through the South, will reside in Germantown, Philadelphia.

MR. GARDINER C. SIMS, who has of late been engaged on important work for the United States Navy, including lately the supervision of steam equipments on the new transports, has decided to return to the commercial field, in which his name was made and where his reputation stands high as that of one of the foremost American exponents of modern steam engineering. He has become a stockholder in, and superintending engineer of, the William A. Harris Steam Engine Company, of Providence, R. I., builders of the Harris Corliss engine, who will now also, under his direction, build the improved version of the famous Armington & Sims engine with which incandescent lighting began its successful career in America. Mr. Sims has been residing in New York to discharge his official duties, but will be found this summer at his charming country home on Narragansett Bay. Mr. W. F. Haring will represent the new interests, as formerly the old ones, in New York City, where Mr. Sims will fortunately be a frequent visitor. We know of hardly any event in the steam field which could give as much pleasure to the electrical community as this return of Mr. Sims to his former engineering work.

Trade Notes.

THE MILWAUKEE ELECTRIC COMPANY, Milwaukee, Wis., has been authorized to increase its capital stock to $150,000.

OIL FILTERS IN FINLAND.—The Burt Manufacturing Company, Akron, Ohio, has just shipped six Cross oil filters to Finland.

CHANGE OF NAME.—The title of the Wolfe-Lovett Construction Company, Omaha, Neb., will be changed to Wolfe-Lovett Electrical Company.

THE WESTERN ELECTRIC COMPANY, Chicago, is carrying a large line of construction material of use to central station and street railways. Bulletins of this material are being sent out.

CHAS. WESLOW, Warren Street, Harrison, N. J., conducts a business of buying broken and defective incandescent lamps and selling renewed lamps. His business is neatly illustrated in a little calendar just issued.

THE AMERICAN ELECTRIC FUSE COMPANY, New York and Chicago, has issued a neat little calendar containing a colored picture of two hungry pigs. The legend underneath tells what they are after, and what the company is after.

THE HIRSCH-VOTH MANUFACTURING COMPANY, Milwaukee, Wis., is manufacturing small power motors and dynamos. The company's specialty is a small dynamo for gas engine ignition for automobiles, and several good orders have been received.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out literature describing Adams-Bagnall arc lamps. These lamps are made in seven different styles and for alternating, direct current, constant potential and direct constant current series and street railway work.

ASBESTOS PRODUCTS.—Asbestos papers, packings, mill-boards, etc., constitute the subject of a little pamphlet issued by the H. W. Johns Manufacturing Company, New York. Those concerned in these lines of goods will find much of interest in this pamphlet, copies of which may be had on application to the company's office.

BARGAINS IN AUTOMOBILES.—The St. Louis Automobile & Supply Company, Twenty-third and St. Charles Streets, St. Louis, Mo., is sending out a lot of literature pertaining to second-hand automobiles and automobiles complete and parts of the same. Every one interested in this class of vehicles might find it to his interest to communicate with the company.

LAUFKETTER & BENDIT, of St. Louis, long favorably known as a mechanical supply house, have added an electrical department to their business, with Mr. Louis E. Fischer in charge. Prominent among the manufacturers they will represent in that section are the Onondaga Dynamo Company and the Syracuse Electric Instrument Company, both of Syracuse, N. Y.

THE SUBMERGED ELECTRIC MOTOR COMPANY.—In our issue of Feb. 2 appeared an item about this company being ready to proceed with the manufacture of its apparatus, after preliminary experimental work. It was there stated that the company's headquarters were at Menomonee, Mich. This location, we are informed, is an error; its headquarters are at Menomonie, Wis.

FIRE.—On the evening of Feb. 9 fire visited the factory of W. R. Ostrander & Company, in Brooklyn, N. Y., and did some damage, although it was not as great as was reported in the daily papers. The firm expects to have everything running again in a very short time, and as it had a large stock of goods on hand in its New York store rooms, it is in position to fill all usual orders without delay.

BUSINESS CHANGE.—Messrs. Percival & Jones, mechanical and electrical engineers, 211 North Seventh Street, St. Louis, Mo., notify us that they have purchased the entire stock and instruments of the late Geo. J. Percival and will continue business at the old headquarters. The business of this firm is that of writing specifications, drawing up contracts, superintending work in the course of construction, etc. The members of the firm are Isaac W. Percival and Houston Jones.

GRAPHITE AS A LUBRICANT.—In a 44-page booklet of the Joseph Dixon Crucible Company, Jersey City, N. J., is given much information on the use of graphite as a lubricant. The subject is scientifically and practically considered, and its manifold uses as an accessory for engineers and mechanics are pointed out. This is the seventh edition of this work and is revised to date. The company will be glad to send a copy of the pamphlet to any one interested in better lubrication.

RAILWAY MOTORS.—The Westinghouse Electric & Manufacturing Company has issued two circulars, Nos. 1038 and 1039. The former describes and illustrates the Westinghouse No. 49 railway motor and the latter the Westinghouse No. 38B railway motor. The No. 49 motor is one of the company's standard motors for medium speed, city and suburban work, and the 38B motor is suitable to the conditions ordinarily met with in commercial service where a high power motor is required.

MEDBERY INSULATION.—H. M. Shaw & Company, 115 Broadway, New York, manufacturers of Shaw's non-arcing lightning arresters, have secured the exclusive management and control of the Medbury insulation, well and favorably known to the street railway trade. The firm will have the exclusive right to manufacture this insulation. It is now in a position to supply promptly all the designs of the Medbery overhead material, which is in use on many of the large street railways in the United States and abroad.

MR. WILLIAM B. LYNCH, 101 Beekman Street, New York, has been engaged in pattern and model making for the past 15 years. For a year and a half of that time he was engaged entirely in electrical work and has therefore wide and thorough familiarity with the parts that go to make up electrical machinery and supplies. He has just opened an office at the foregoing address, where he is prepared to undertake pattern and model work, paying a great deal of attention to—in fact, making a specialty of—electrical work.

TELEPHONE CATALOGUE.—The Bruckner Electric Company, 141 East Twenty-fifth Street, New York, is manufacturing a full line of telephones and telephone equipments. In a 24-page pamphlet just issued the company describes and illustrates its desk instruments, intercommunicating system, switchboard system, automatic release intercommunicating telephone system, its new adjustable telephone arm without connection cord, and its transmitter. At the back is given a long list of individuals and concerns using the Bruckner apparatus.

RHEOSTATS AND CIRCUIT BREAKERS.—Messrs. Geipel & Lange, Parliament Mansions, Westminster, London, Eng., are sole agents for Great Britain and France for Ward Leonard rheostats and circuit breakers. We have received from this firm a copy of its 64-page catalogue devoted exclusively to the subject of these devices. The list includes over 700 different articles, each one being specially designed and constructed for the duty mentioned. Messrs. Geipel & Lange keep in stock a large number of these devices in most common use for early delivery.

THE GARTON-DANIELS COMPANY, of Keokuk, Ia., so well known in connection with the Garton lightning arresters, is now making a name for itself among the telephone people as manufacturer of extension circuit devices, the merits of which seem to have attracted the attention of many of the most prominent telephone companies in this country. As a result it is getting inquiries and orders for them that are very encouraging. It publishes a little eight-page pamplet on the subject of extension circuit devices which is well worth perusing by every telephone man and which may be had for the asking.

GUY ANCHORS.—In a booklet issued by W. N. Matthews & Bro., St. Louis, Mo., the Stombaugh guy anchors are illustrated and described. These anchors are used for anchoring telephone poles, telegraph poles, street railway poles, electric light poles, fences, smoke stacks, etc. This anchor resembles a large auger and is screwed into the ground, being left there. It saves much time and labor and avoids digging, filling, tamping, etc. It is made in six sizes; the smaller sizes are put into the ground with a hollow wrench keyed to fit them, and the larger sizes are put in by using their own shank as a wrench.

THE COLONIAL ELECTRIC COMPANY, of Ravenna, Ohio, is reported to be enjoying the largest business in its history. The number of lamps shipped the first month of this year exceeded that of any previous month by about 15,000. The average monthly shipment is about 75,000. There is considerable rivalry between the vacuum pumping departments of the Ravenna and the Warren plants. Until recently an employee of the Warren plant held a record of 1265 lamps in one day. A few days ago Miss Orpha Thomas, of the Ravenna plant, pumped 1400 lamps in 10 hours, which is considered a remarkable day's work.

PAN-AMERICAN EXPRESS.—A folder containing maps, and profusely illustrated—the latest of the "Four-Track Series"—has just been issued by the New York Central & Hudson River Railroad Company. A large amount of its space is devoted to the Pan-American Exposition. It contains interesting facts about Buffalo and the Exposition. An interesting and astonishing fact is pointed out on a map. It is shown that a circle with Buffalo as its centre, and with a radius of 500 miles, has within its limits more than one-half of the entire population of the United States, and more than three-fourths of the entire population of Canada.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that its factory is fully engaged in the manufacture of Emerson desk and ceiling fans for the season of 1901 and that the demand for Emerson apparatus has necessitated a considerable increase in factory facilities and additional machinery. In order to make the desk fans with the special hardened steel shaft that has been used by the Emerson Company for some years past, very accurate, expensive machinery is necessary, and the company has recently received from the Brown & Sharpe Manufacturing Company, of Providence, R. I., a grinding machine which was made specially by it as a part of its exhibit at the Pan-American Exposition.

RECORDING GAUGES.—Messrs. Schaeffer & Budenberg, Brooklyn Borough, New York, call attention in a leaflet to their Columbia and Metropolitan recording gauges. The Columbia gauge is adapted for recording pressures of steam, water, gas, air, also vacuum, and may be placed near the boiler or at any distance therefrom. The Metropolitan gauge is adapted for both indicating and recording pressures of steam, water, gas or ammonia and hydraulic; also vacuum. Besides the apparatus mentioned, the firm manufactures tachometers, indicators, planimeters, reductors, calorimeters, steam whistles, etc. The exhibit of this firm at the Paris Exposition of last year was awarded three gold medals and one silver medal.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, has been enlarging its business and branching out very extensively, until at present it is carrying constantly the largest stock of any electrical supply house in the country, with the exception of one or two. It is exclusive representative in its territory for the Adams-Bagnall Electric Company, Emerson Electric Manufacturing Company, Hart Manufacturing Company, H. W. Johns Manufacturing Company, Phillips Insulated Wire Company and Sprague Electric Company, besides carrying the lines of a number of other electrical manufacturers. It has just issued a catalogue for 1900, consisting of 240 pages, profusely illustrated, showing the lines which it carries, with prices and all other necessary particulars. This catalogue shows its line to be full and complete. It is bound in heavy cloth boards and is a handy reference for the desk of any one who purchases electrical supplies frequently.

MR. I. P. FRINK, of 551 Pearl Street, New York, has just completed the installation of lighting fixtures for the Second Church of Christ, Sixty-eighth Street and Central Park West, this city. This church is almost entirely lighted by concealed lamps backed by powerful reflectors that throw all the light upon the large domed ceiling, which again reflects and diffuses the light all over the church. The Frink name has been identified for nearly half a century with successful church lighting by reflecting chandeliers and prismatic sun-lights, but this method as applied to churches is comparatively new, though it has been most successfully used in fine ball rooms, concert halls, banquetting rooms, etc., where a soft and perfectly diffused, but at the same time strong light is required by the scheme of decorations. Mr. Geo. Frink Spencer, manager of the Frink business, who has made a specialty of this method of lighting, has been frequently consulted by leading architects and electrical engineers, and has been commissioned to devise and execute the fixtures for some of the finest interiors in New York.

REMOVAL.—The San Francisco Electrical Works, H. P. Thayer, manager, recently removed to 523 Mission Street.

THE COLONIAL ELECTRIC COMPANY, Ravenna, Ohio, manufacturer of the Orient and Colonial incandescent lamps, is sending out a calendar for the new year. The card contains an interesting picture.

MILLING MACHINES.—The Becker-Brainard Milling Machine Company, Hyde Park, Mass., gives a description and illustrations of its No. 5B plain horizontal milling machine, in a pamphlet just issued. The dimensions of the machine are given in a table.

PUSH-BUTTON SWITCH.—The General Incandescent Arc Light Company, New York, has issued a bulletin on its new push-button switch. This device is illustrated. The bulletin also describes and illustrates an attaching plug and flush receptacle with outlet box for wall, floor or surbase; also the new G. I. 100-ampere triple-pole automatic switch.

THE MILWAUKEE ELECTRIC COMPANY, Milwaukee, Wis., has moved into new office quarters in order to furnish much-needed room in the factory. The company reports business as very flourishing and has closed a contract with the Locomobile Company of America, Hartford, Conn., for a 225-kw generator and several motors for the complete installation equipment.

THREE CARS OF MOTORS.—One of the largest shipments of electric motors ever received on the Pacific Coast recently arrived in San Francisco. The motors were manufactured by the C & C Electric Company of New York for the Mutual Label & Lithograph Company and are now being installed in the immense press rooms of the company's new building. The shipment filled three cars.

CENTRIFUGAL PUMPS.—A very complete line of centrifugal pumps is shown in a 52-page catalogue of the Lawrence Machine Company, Lawrence, Mass. These pumps are designed for water supply, irrigating and draining land, pumping out coffer-dams and excavations, dry docks, and for use in all places where a large body of water has to be elevated to a moderate height, quickly, cheaply and efficiently. Each illustration is accompanied by a table of dimensions of the various sizes of the class thus represented. Several electrically driven pumps are also illustrated.

TELEPHONE OF NEW DESIGN.—The Central Telephone & Electric Company, St. Louis, Mo., is putting on the market a telephone of new design. The feature of the instrument is that it presents a handsomer appearance than the ordinary telephone and is easier to operate. The generator, being placed in a box just below the desk, is on a level with the arm. Ordinarily these relative positions are reversed. The company believes that the new design will meet with considerable demand. The working parts of the instruments are of the best throughout.

THE NORTHWEST FIXTURE COMPANY, Seattle, Wash., has made an arrangement whereby, on Jan. 1 last, it became selling agent for Partrick, Carter & Wilkins, of Philadelphia. The arrangement is such that the Fixture Company's plant practically becomes a part of the factory of the Philadelphia firm. It will carry in Seattle a large stock of Partrick, Carter & Wilkins goods. The company has greatly increased its stock of electrical supplies, covering everything from an engine to a push button. It has a purchasing department and a warehouse in New York, at 26 Cortlandt Street. The Western house of the Northwest Fixture Company is drawing on its warehouse stock of electrical supplies to the extent of about one car load a week.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 12, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

667,666. CALENDERING MACHINE; D. Beswick, New York, N. Y. App. filed Feb. 21, 1900. An electrical heater is arranged inside of a calendering cylinder in such a way as to uniformly heat the surface thereof.

667,727. AUTOMATIC ALARM SYSTEM; F. McGloin, New York, N. Y. App. filed May 21, 1900. A phonograph is connected with a telephone circuit so as to send in a fire or other alarm by automatically sending an articulate message over the line.

667,728. TALKING MACHINE; F. McGloin, New York, N. Y. App. filed June 6, 1900. Relates to the preceding, the phonograph being adapted to repeat the message a number of times.

667,729. ELECTRIC BRAKE MECHANISM; Frank C. Newell, Chicago, Ill. App. filed Aug. 26, 1899. When the track brake operates, the wheel shoes are thereby also set. The magnet is magnetically insulated from the wheel shoes.

667,730. ELECTRIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed May 2, 1900. The operation of the rail shoe also sets the wheel shoes. Mechanism in compact form for application to a multiple truck.

667,764. ELECTRIC SWITCH; D. R. Bruce, London, Eng. App. filed July 28, 1900. Details of a quick-acting switch.

667,805. SIGNALING APPARATUS; W. A. Swaren, Chicago, Ill. App. filed Jan. 2, 1900. A plurality of contacts corresponding respectively to railway switches or other devices to be controlled, are so arranged that an alarm or signal cannot be sounded until all of said contacts are moved to their proper position.

667,859. SHIP'S TELEGRAPH; F. W. Wood, Newport News, Va. App. filed July 11, 1900. The reversing shaft of the ship's engine is arranged to automatically repeat the signal sent to the engine room from the bridge.

667,882. FEEDER WIRE INSULATOR; C. K. King, Mansfield, Ohio. App. filed Dec. 10, 1900. Details.

667,889. ELECTRIC SPARK COIL; S. B. Morss, Rahway, N. J. App. filed March 21, 1900. The coil is hollow and carries a battery inside thereof.

667,903. TROLLEY SWITCH; C. P. Cornell, Baldwinsville, N. Y. App. filed June 29, 1900. Details of an overhead switch.

667,904. CLOSED CONDUIT ELECTRIC RAILWAY; L. Dion, Boston, Mass. App. filed Aug. 6, 1900. The flexible conductor deposited in the roadbed lies a considerable distance below the surface, but has upwardly extending loops reaching into boxes which come within the influence of the magnet carried by the car, to be lifted to make the necessary contact.

667,958. ALARM APPARATUS; R. Segerdahl, Chicago, Ill. App. filed Sept. 2, 1899. This is a bell in which the mechanism is attached to what is usually the cover, the back plate being omitted.

667,966. ELEVATED ELECTRIC RAILWAY; L. A. Brown, St. Louis, Mo. App. filed Oct. 22, 1900. Details of construction of a single rail overhead system, in which the motors are disposed below the platform and on each side of the single rail.

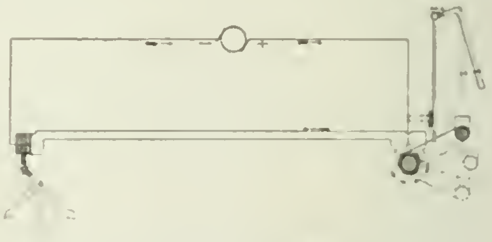
667,980. TERMINAL SOCKET; E. W. G. C. Hoffman, Charlottenburg, Germany. App. filed Oct. 11, 1899. The socket is divided longitudinally so that the contact parts can be readily inserted, after which the parts are clamped together by means of screws.

667,996. TRANSFORMER; F. Schwedtmann and W. A. Layman, St. Louis, Mo. App. filed June 1, 1900. The insulation which separates the coils from each other is provided with conduits for the circulation of air, oil or other insulating or cooling fluid.

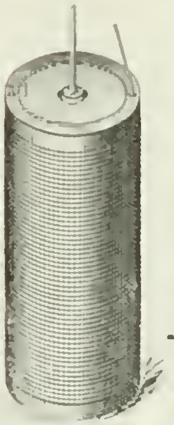
668,022. SIGNAL CONTROLLING RELAY; H. E. Shreeve, Dedham, Mass. App. filed Oct. 1, 1900. A special form and winding of two-coil relay for telephone systems.

668,030. MEANS FOR STOPPING ELECTROMOTORS; J. J. Wood, Fort Wayne, Ind. App. filed Oct. 15, 1900. A magnet for a motor controller adapted to remain inactive during the normal range of current vibrations, and to respond to either a minimum or maximum current, having a double winding comprising a series coil and a shunt coil wound to receive currents in like direction so as to co-operate in the magnetization of said magnet, whereby the magnet will act as an underload magnet so long as a magnetizing current continues in either of said coils.

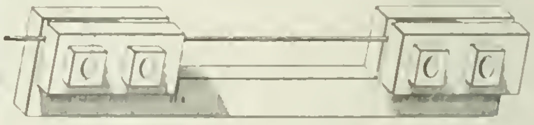
668,044. TELEPHONE SWITCHBOARD AND CIRCUIT; F. L. Gilman, New Bedford, and C. H. Herzig, Boston, Mass. App. filed Nov. 6, 1900. Small sub-stations having a number of lines running to central, have one of these lines connected to a socket in the usual space on the switchboard, in front of the operator, while the other lines run to sockets in a special space on the switchboard. The first socket carries a distinguishing sign, adjacent to it, which indicates that there are other sockets connected with the same sub-station in the special space. When a call for the sub-station comes in, the operator tests the regular socket first; if that is busy, she then tests in succession the other sockets in the special space, until one not busy is found. This avoids the usual wide distribution of the sub-station sockets throughout a multiple board.



667,859.—Ship's Telegraph.



667,889.—Electric Spark Coil.



668,142.—Wire Splicer.

668,108. TRANSFER APPARATUS FOR ELECTRIC BATTERIES; C. O. Mailloux, New York, N. Y. App. filed Dec. 29, 1899. (See Current News and Notes.)

668,109. STORAGE AND TRANSFER SYSTEM FOR ELECTRIC BATTERIES; C. O. Mailloux, New York, N. Y. App. filed April 24, 1900. (See Current News and notes.)

668,140. RHEOSTAT AND CIRCUIT BREAKER; H. B. Cutter, Philadelphia, Pa. App. filed Feb. 24, 1899. A spring actuated resistance controlling switch, electromagnetic means for normally restraining the same, and an automatic magnetic circuit breaker, the coil and switch of which carry the motor actuating current.

668,142. WIRE SPLICER; E. Figueredo, New York, N. Y. App. filed July 20, 1900. A wire splicer, consisting of a pair of wire-grasping jaws, and an intermediate connecting bar arranged below the same, and combining therewith to form a recess open at both sides, whereby unobstructed access may be had thereto.

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SOMETHING TO SELL.

That the United States has something to sell abroad is made manifest by the rapid growth of its export trade in all branches of mechanical production. These exports, coming to the support of those in agricultural and mining products, have placed this country at the beginning of the century first on the list of exporting nations. The figures for 1900, in millions of dollars, are: United Kingdom, 1418; Germany, 1050; United States, 1453. The recent gain, moreover, has been quite striking. That for the United Kingdom in the last four years was 20 per cent; for Germany, 23 per cent, and for the United States, 45 per cent. The export trade of France has, unfortunately, been stationary.

There seems little reason to fear that foreign appreciation of our goods will diminish. It might do so if subject to "retaliatory" measures such as have been encountered recently in connection with the import tax on Russian sugar; but there is a marked tendency toward the cultivation of trade on a basis of reciprocity. Beyond such reciprocal trade, capable of pushing the figures far above anything now known, there is, of course, the trade of new regions. The protectorates that the United States and the Powers of Europe are now establishing in one form or another over all other parts of the world has but one meaning in these modern days—more trade, from which all benefit.

METHOD PATENT CLAIMS

An important decision appears in the current *Official Gazette* of the United States Patent Office relating to method claims. The question of method or process claims has been in a very unsatisfactory state, inventors putting such claims in their applications being almost invariably met with the stereotyped objection, "The claims are merely on a function of the machine and are, therefore, not proper methods." The decision in question was on an appeal from a decision of the Commissioner of Patents relating to certain details of an electrical measuring instrument. Two of the claims are on mechanical operations consisting in drawing a section of a metal over a mandrel and subjecting it to pressure until a desired configuration is acquired, and then turning down the lateral edges. The court decided that this is a simple and well-known operation which contained no element of patentable novelty.

The other two claims at issue were paraphrased by the court as follows: "The appellant has discovered that by taking a spool of sheet metal with a coil properly wound around it, and adjusting it in a certain manner on pivot pins and adjusting the needle in a certain manner through the instrumentality of the pivot which supports it, he can accomplish a desired purpose." The Court held that "this process or method, while it may require the use of delicate mechanism for its actual development and manifestation and to effect the desired adjustment, seems to be a mental operation entirely independnt of such mechanism; that the process is first in the logical order of things and the mechanism only a sequence."

In discussing the principles at issue the court stated that a certain decision of the Supreme Court seems to have been understood by some courts, and to some extent by the Patent Office, as restricting the patentability of processes to those which involve chemical or other elemental action. This the Court held to be an erroneous impression, and it added the following from authorities bearing on the point:

"First, that processes involving a chemical or other elemental action, if new and useful, are patentable; second, that a process which amounts to no more than mere invention of the machine is not patentable; third, that a process or method of mechanical nature not absolutely dependent on a machine, although perhaps best illustrated by the mechanism, may, if new and useful, be the subject of a patent, even though it involve no chemical or other elemental action." In the latter case the criterion of the patentability would seem to be, not that the process or method in question is independent of the special mechanism by which it is given practical effect, but that it is clearly conceivable as a mental operation independent of any such mechanism. The view taken by the Court in this case appears to be an eminently sensible one, and the precedent set by the decision is of the highest value to inventors.

HOMES AND AUTOMOBILES.

One of the noteworthy feature of recent development in New York City has been the erection of homes and fine buildings where stables once stood. The change, for example, in such a street as West Forty-fourth, now full of beautiful clubs and hotels, is in reality extraordinary, but it is being duplicated elsewhere. The work which the trolley began in redeeming large areas of the city from horse occupation and rendering them available for human beings is now being carried forward and finished by the automobile. The new electric automobile stables in West Forty-ninth Street, occupying a whole block, have relieved the region of the horse taint and odor and dust, and have made it possible to put up handsome buildings on ground that once was hardly deemed fit for negroes. The same change can be seen working all over the same district, and as soon as the automobile has been brought up to the level of the trolley car in economy and efficiency, that portion of New York will not be recognizable. Further down town, where trucks and wagons are stored, the old insanitary conditions will prevail much longer, it is to be feared. Malodorous horse stables can still be found shoulder to shoulder with artisan homes, breeding and fostering disease in a manner that needs legislation, just as the cow and pig did in old New York.

OHM'S LAW.

There is scarcely any proposition so generally recognized among electricians, and so generally ascribed to one and the same individual, as that law of electric-current strength in continuous-current circuits dependent upon their electromotive force and resistance which bears the name of "Ohm's law." It may surprise electricians, therefore, to learn that in the field of acoustics there is another and totally different Ohm's law; namely, that a complex harmonic musical tone is only recognized by the ear by first analyzing it into its harmonic constituents, and that the sensation is the sum of the sensations of the individual simple component tones. To an acoustician, therefore, who had no knowledge whatever of electrical matters, Ohm's law would stand for an entirely different conception to that recognized in the electrical world. It is a curious fact that in the electric transmission of waves, either in wireless telegraphy through the ether, or in the transmission of electric energy to long distances over wires the attempt is made to restrict the electric pulses to simple harmonic tones. In music, however, simple tones are comparatively uninteresting, and complex harmonic tones are greatly preferred for their richness. But in electric telephony in order to transmit the vocal tones with any approach to faithfulness, the transmitted waves have to be of many different frequencies, and harmonics have to be cultivated and fostered.

TRANSFORMER INCIDENTS.

An article by Mr. T. W. Varley in last week's issue called attention to some of the more unusual and puzzling phenomena occasionally presented by alternating-current transformers. Particular attention was called to the rush of current which will sometimes enter a transformer primary on closing the primary circuit, even when the secondary circuit is broken. As explained in the article, this is due to the interruption of the primary circuit at an instant when the current wave was close to the peak when the current was last shut off. This is a phenomenon that has excited considerable attention in England, and where a paper was read upon inductive current rushes before the British Institution of Electrical Engineers.

On a reduced scale the effect may be noticed in any transformer, even to the smallest size. On suddenly making or breaking the primary current a number of times in succession, there are always some breaks occurring at the top of a current wave and some near the zero. When a make happens to succeed a break at full wave in the same direction, the entering current strength will be greatest. The current rush in such cases is usually insignificant in transformers operated on circuits employing a relatively high frequency, but may be much more marked on circuits of relatively low frequency. This is for the reason that with high frequencies, transformers are not pressed in magnetization, because the hysteresis loss with so many cycles would amount to a considerable waste of energy. The maximum cyclic magnetic intensity is, therefore, kept comparatively low, and, if necessary, the magnetic intensity might be nearly trebled in value for a special effort, without requiring any violent magnetizing current. On low-frequency circuits, however, the magnetic intensity is economically increased, and then the magnetization reserve up to the maximum that the iron will carry may not be sufficient to carry the transformer over the first wave of e. m. f. without an enormous wave of magnetizing current If the same reserve of magnetic intensity range were kept in low frequency, as in high-frequency transformers, the former would be heavier than they actually are, and additionally expensive.

If it were not for the extra loss in iron by hysteresis and eddy currents, it would be manifestly advantageous to increase the frequency for the supply of transformers, and, even allowing for these losses, if the question of frequency depended merely upon the transformers, it would still be more economical to adopt a reasonably high frequency. The opposite proposition is obviously true, that where a very low frequency is used, the iron cores must be greatly increased in area, for the same number of turns, in order to carry the necessary magnetic flux. As a broad proposition, high-speed motors and high-frequency transformers must be lighter than low-speed motors and low-frequency transformers of the same power; but, in practice, low-speed motors are often greatly to be preferred to high-speed motors, even at extra cost, and low frequencies are rendered imperative for commercial service notwithstanding the requirements of transformers.

THE TRANSFORMER'S POSITION IN A POWER TRANSMISSION SYSTEM.

In all long-distance transmission systems we have one generator plant, one motor set, and one transmission line, in the broadest sense of those terms. But we have two transformer sets, one stepping up and the other stepping down. Electrically speaking, and ignoring for the moment the change of pressure effected by the transformers, the latter machines are simply equivalent to the insertion in the main circuit of a definite amount of resistance accompanied by a definite amount of reactance. In other words, although there is in long-distance transmission a marked advantage by the use of transformers in the reduction of the amount of aluminum used in the line, yet the advantage has to be paid for at the expense of some extra resistance, and several times more reactance virtually inserted into the main circuit.

In the case of overloads, generators always possess some reserve and often a considerable reserve of capacity for temporary extra service. Most generators will stand 25 per cent overload for an hour or two, and some are guaranteed to stand 50 per cent overload for a shorter interval. The motors also will usually stand overload to a similar extent. In both cases the limiting load is practically imposed by the temperature elevation of the machine, and the normal temperature elevation of 40 degs. C. is not so serious but that it may be temporarily exceeded without danger, especially in cold climates. But in the case of the transformer, the margin of overloads is usually much more restricted, since they are compact machines, without internal moving parts to fan them and change their surrounding air. They have to depend in large sizes upon external cooling for the best performances of their work, as otherwise they have to be made of unduly large size. And even when cooled by external means, their normal range of overload without considerable heating is more sharply defined than in the generator or motor. It is for this reason, as well as for improved regulation, that in well designed transmission plants it is usual to employ ample transformer capacity, or an excess above the normal full-load requirement, whenever temporary overloads are likely to occur. It is, therefore, a great blessing when the pressure at which the generator and motor can be constructed is sufficiently high to call for only a moderate amount of conductor to connect them over the intervening distance. Pressures of from 6 to 10 kilovolts are now capable of being safely employed in the generator, and step-up transformers are only absolutely needed when the line pressure has to exceed this.

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THE ELECTROLYTIC VARIETY OF BLACKMAIL.

It unfortunately often happens that scientific facts are turned to queer purposes. Garbled quotations from reputable medical papers are made the working capital of quacks or the favorite weapons of wild-eyed fanatics. A post-prandial *jeu d'esprit* on the part of a reputable investigator may appear next morning with "scare" headlines to help along the thievery of a stock-jobbing swindler, or an innocent research may be used to further the exploitation of an alleged invention. The fakir is splendidly resourceful in little matters like these, and often uses data of this kind with consummate skill. A quarter of a century ago, before the electrical renaissance was fairly under way, the lightning rod agent gained full sway over rural communities. He was often heralded by an advance agent with a peculiarly weird and horrible collection of tales of fatalities from the "deadly fluid," which he judiciously planted among the local newspapers. Presently along came the glib tongued agent with science fairly oozing from his finger tips, and a full collection of wonderfully gilded rods of strange cross-sections which he dispensed at a dollar per foot, more or less.

The lightning-rod fraud has now for the most part gone out of business, but his art has not been forgotten, and his methods still flourish. We are moved to recall him to memory by such bills as that introduced into the Indiana Legislature recently for the abolition of the single-trolley system on account of the destructive effects of electrolysis. Now we have no grudge against the double trolley, we do not wish to decry the storage battery, and we greet with earnest approbation any and every improvement of the track circuit; but we fancy the legislative hearings will be of a character to provoke smiles. It is well known that legislatures have been used to club electric railways in various ways and from a variety of mixed motives, but there are few more flagrant instances than this. When a few years since attention was called to the effect of grounded circuits in producing electrolytic effects in underground pipes, the subject was taken up as a practical scientific problem, and all the parties concerned co-operated in a friendly spirit. There was no denying the fact and little hesitation in applying vigorous remedies. But no sooner were the facts fairly established than they became the subject of malevolent and disingenuous misinterpretation. Logic was thrown to the winds, and the simple and truthful statement that currents in the earth can and sometimes do attack pipes, was expanded into loud asseverations that every single trolley road was responsible for an untold amount of destruction, and that the gas and water systems of every city were at the mercy of the evil-minded interloper. Every gas company that owned a set of rusted-out and worthless mains, never sound and yearly growing more useless, girded itself for the fray and laid it all to the electric railway. In this noble cause they were joined by disinterested water commissioners who in consideration of the customary rake-off had accepted mains that could not have been sold for old iron elsewhere. Again science was involved, for it was soon made evident that electrolytic corrosion as such could not always be told from every-day rust, and the railway had to take the blame.

Now, there is no doubt that electrolysis may be a serious matter, and in some instances has done a deal of mischief. On the other hand, it is incontestably true that in a very large number of places there is practically no damage from electrolysis, and in still other cases that the damage is trivial and local. The facts can easily be made evident by a careful and thorough investigation of the conditions by some competent engineer. And when the damage, if any, is located and its extent is determined, proper steps can be taken to remedy it and to prevent its recurrence. Such matters had better be settled out of court, and if both parties are acting in good faith this can generally be accomplished. But such drastic measures as that to which we have referred are obviously not in good faith, nor are they impelled by disinterested motives. In fact, they are open to the implication of being next of kin to blackmail. We never hear of such an attack without instinctively casting about for the nigger in the woodpile, and with a very good prospect of locating him.

This raiding of quasi-public corporations is a growing evil. Electric railways, electric light companies and telephone companies are favorite victims, so that the practice presses the electrical arts very closely. In times past and present legislative bodies have not been always pure, nor lobbies philanthropic. But to tell the truth the companies themselves have sometimes developed cannibalistic tendencies that have not exactly tended to public sanctification. When two such fall out they are not always scrupulous to set a good example as to ways and means. The bitter and prolonged fight against the introduction of high-tension alternating currents waged by the advocates of low tension did more to guide the guileless legislator and the high-minded alderman into the devious ways that lead unto corruption than can be undone by a quarter century of upright living. There have been other struggles little less disastrous as campaigns of education. With the present tendencies of the times such internecine strife can be productive only of evil results. The public that is the final court of appeal in such cases is, mayhap, fickle and short of sight, but it can tell its friends from its enemies, and in the long run will see fair play. The enterprise that deals always squarely with its public will find that public standing with it in time of adversity, and will settle upon a firm foundation when fake enterprises and stock-watering combinations are tumbling like card houses. But it behooves the electrical industries to oppose a united front to such attacks as that to which we have referred, and never by internal dissensions or hope of temporary gain to give the common enemy a chance to break their square.

Bell Telephone Growth in New York.

It is understood that in order to cope with the growth of the business, the New York Telephone Company has begun to install a 9400-subscriber central energy lamp signal switchboard at its Cortlandt Street exchange. The board may be ready about July. It will be one of the largest in the world, and marks the new departure in Bell telephone practice, a board of 6000 subscribers having been the general limit hitherto in America, as pointed out by Mr. Kempster B. Miller in his telephone lecture recently before the New York Electrical Society.

In regard to this rapid growth of the telephone in the Boroughs of Manhattan and the Bronx, one of the executive staff of the company makes the assertion that within five years and probably within three years the total number of telephones in the old City of New York will aggregate 100,000. "In the last year of the old century," he said, "14,210 new stations were established in the district of Manhattan and the Bronx, which is practically the old City of New York. The first exchange was established in 1879, and two years later there was a system of about 2000 stations. We had rising 10,000 stations on Jan. 1, 1895, making a gain of about 7400 stations, or an average increase of 530 stations a year. Up to this time there had been a flat charge for the use of the telephone. Then came the change to the rate system, and with it the steady increase that has surprised even those most familiar with the use and workings of the exchange. From that time, Jan. 1, 1895, to the end of the last century there was an increase in the number of stations of 41,175, an average yearly increase of 6862 stations. That increase was at a rapidly accelerating rate, however, for in 1899 the growth was 10,500, and for 1900 14 200, the latter a growth of more than 35 per cent as between the two years. The exchange system has been in general use for 20 years, say, and yet there are scarcely a dozen cities in the whole world that have as many stations in their entire system as there was increase in one year in the single exchange in this city. Of course, it is impossible to tell what the percentage of increase of stations will be in the future, but the telephone has become so indispensable that I feel safe in saying that three will be fully 100,000 stations here in five years, probably in less. If the average of increase from the beginning to 1895 had only been maintained there would to-day be but 13,000 stations in New York, less than the actual gain of last year. At that old rate of increase it would have taken until 1975 to have reached the total number of stations now actually in existence. It would also have taken 170 years to reach a total of 100,000 stations, which we now look upon as a certainty by the middle of the year 1904, and possibly before that time. The telephone comes now about as near to being a universal necessity in the life of the city as gas or water."

Trade with Russia.

Advices from Washington state that exports of manufactures from the United States to Russia do not amount to $30,000,000 per year, as has been asserted, nor have they ever reached one-fourth that sum. This assertion is sustained by the official figures of both the United States and Russia. According to the figures of the United States Bureau of Statistics, exports of manufactures to Russia range from three to four million dollars per annum, and according to the Russian official statistics, they have averaged a little over $4,000,000 a year since 1895, the earliest date at which the detailed figures of Russian imports are obtainable.

The Russian statement of total imports of goods of all classes originating in the United States have never, save in two exceptional years, shown as much as $30,000,000, and have averaged since 1895 less than $25,000,000 per annum, and of this sum more than three-quarters represents raw cotton, which is not affected by the recent order of the Russian Government. Much of the American cotton imported into Russia is bought in the markets of Europe and thus, while represented in the Russian importations as of American origin, does not show in the export statements from the United States, because it is sent from this country direct to the great cotton markets of Europe, Liverpool and Bremen, and thence is distributed to Russia and other interior States of Europe.

The reports of the United States Government only show total exports to Russia of about $10,000,000 per annum, while those of the Russian Government show imports of American products averaging about $25,000,000 per annum; but an analysis of the two statements shows that the discrepancy is chiefly in cotton, which discrepancy is accounted for as above indicated.

International Conference on Patents and Trade Marks.

Secretary Hay has asked for an appropriation of $10,000 for an international conference to be held in Washington this year for the protection of patents, trade-marks, etc., under the terms of the international convention concluded in Paris in 1883, to which the United States is a party. This provides that the convention shall be submitted to periodical revisions for the purpose of introducing improvements, and that conferences shall take place successively in one of the contracting States. A conference was held at Brussels, Belgium, in December last, which adjourned to meet at Washington on a date to be arranged by the Government of the United States. The work includes the gathering and distribution of the propositions for amendment, all of which must be completed at least six months before the meeting. In view of the fact that the members of the Union are widely separated, it requires considerable time to make the necessary arrangements. Secretary Hay says that in order that the duty of the United States may be fulfilled in a timely and suitable manner, it is necessary that early provision should be made by Congress for vesting in the Secretary of State the appointment of persons as delegates to the conference, and for an appropriation.

International Increases in Export Trade.

The United States now stands at the head of the world's exporting nations. The complete figures for the calendar year 1900, when compared with those of other nations, show that our exports of domestic products are greater than those of any other country. The total exports of domestic merchandise from the United States in the calendar year 1900 were $1,453,013,659, those from the United Kingdom, which has heretofore led in the race for this distinction, were $1,418,348,000, and those from Germany $1,050,611,000. Additional interest is given to the rank which the United States now holds as an exporting nation by the fact that a quarter of a century ago she stood fourth. In 1875 the domestic exports of the United States were $407,263,737, those of Germany $607,006,000, those of France $747,480,000, and those of the United Kingdom $1,087,497,000. To-day the United States stands at the head of the list, the United Kingdom second, Germany third and France fourth, with the figures as follows: United States, $1,453 013,650; United Kingdom, $1,418,348,000; Germany, $1,050,611,000; France, $787,060,000. All of these figures, it should be remembered, relate to the exports of domestic products. Thus in the quarter century the United States has increased her exports from $407,263,737 to $1,453,013,650, or 192 per cent; Germany from $607,006,000 to $1,050,611,000, or 73 per cent; the United Kingdom from $1,087,497,000 to $1,418,348,000, or 34 per cent, and France from $747,480,000 to $787,060,000, or 5 per cent.

Hardware Dealers and Electrical Goods.

At the recent meeting of the retail hardware dealers of Iowa, one of the papers read contained the following remarks: In some parts of the State rural telephones are quite the fashion, and soon most farmers will have telephones and free delivery mail boxes. The hardware dealer should post up on these subjects and not only be able to furnish all the supplies in the way of wire, batteries, telephones, insulators, brackets, etc., but he should interest his farmer customers and promote new lines. The profits are small, but it requires no extra capital, as the sales are for cash, and it brings people into the store.

Electrical door bells and batteries are staple goods and are regularly called for, but there is a long list of other electrical appliances that might be profitably handled, such as burglar alarms, automatic fire alarms, annunciators, motors, fans, house and factory telephones, call bells, electric light wiring, etc. It is an interesting subject, and the ingenious dealer who fits up an attractive sample board, connected with a battery, will find profitable returns from this side line.

The much-abused lightning rod should not be overlooked by the dealer who is ambitious to handle goods that will afford him more profit than the sale of saws at about cost. Most people believe that a well-made lightning rod, properly put up, will afford some protection to the building thus equipped. The sale of lightning rods will depend entirely on the ability of the salesman to work up sales. Few, if any, will come into a store and call for them, even though they have always considered them a good thing. It requires less ability to put up lightning rods than to put up eave trough and conductor. Fifty dollars will supply sufficient stock for a start in this line.

Electrical Transmission from Coal Mines.

By Fred Wilson Hart.

About three years ago the Cochiti Gold Mining Company erected a large cyanide mill at its Albemarle mine near Bland, New Mexico. A large Corliss engine was installed for driving the crushers, rolls, screens, etc., cord wood being used for fuel. Owing to the phenomenal development of the mine it was deemed advisable about two years ago to increase the capacity of the mill. The question of fuel was one of the points to be considered, as wood cost from four to five dollars per cord, and owing to the extremely rough character of the country surrounding the mine there was a limit to the amount to be had at this price, a large percentage having to be packed in on the backs of burros. It was impracticable to use coal, as it would have to be hauled by wagon from the nearest railroad station, over a rough, mountainous country, a distance of 25 miles.

A careful examination was made of the streams within a radius of 40 or 50 miles and it was found that there was no available water power that could be economically applied, the minimum flow being so small as to necessitate the construction of large reservoirs. An examination was therefore made of the large coal deposits belonging to the Santa Fe Railroad at Madrid, New Mexico, and as bituminous coal of an excellent quality and almost unlimited quantity could be had at a nominal price, it was decided to install a modern steam plant at Madrid and transmit power electrically to the Cochiti Company's property, a distance of 32 miles. The idea of installing a plant at Madrid was decided upon definitely by the Cochiti directors in June, 1899, but owing to the crowded conditions of all factories manufacturing apparatus required for this work, active construction was not commenced until October of the same year, and current was turned on the line on April 13, 1900.

While the transmission of power over long distances is now nothing unusual where the source from which the power is derived is water, very few attempts have been made to transmit electric power from plants located at coal mines, and it may therefore be of interest to note the following comparisons:

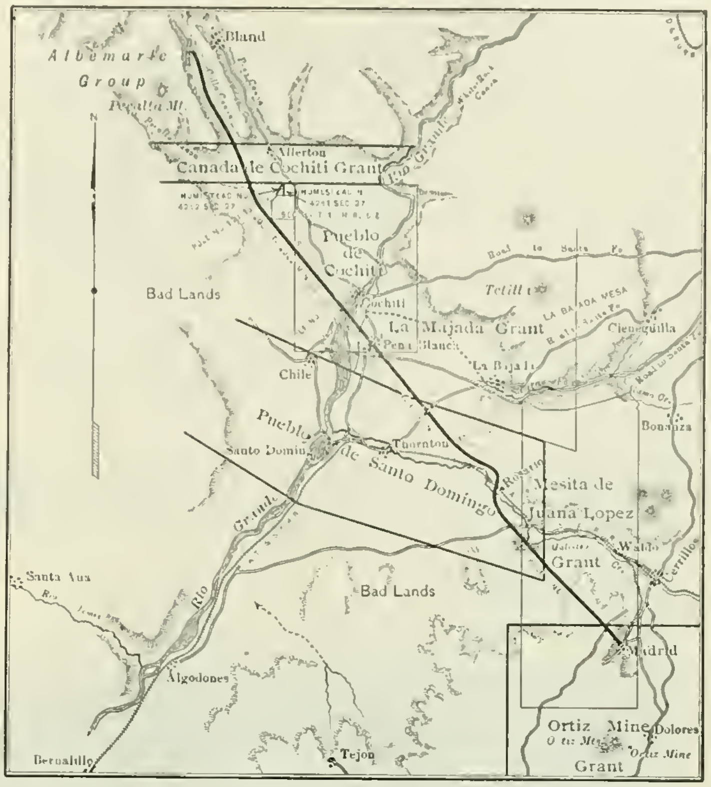


FIG. 2.—MAP OF TRANSMISSION LINE.

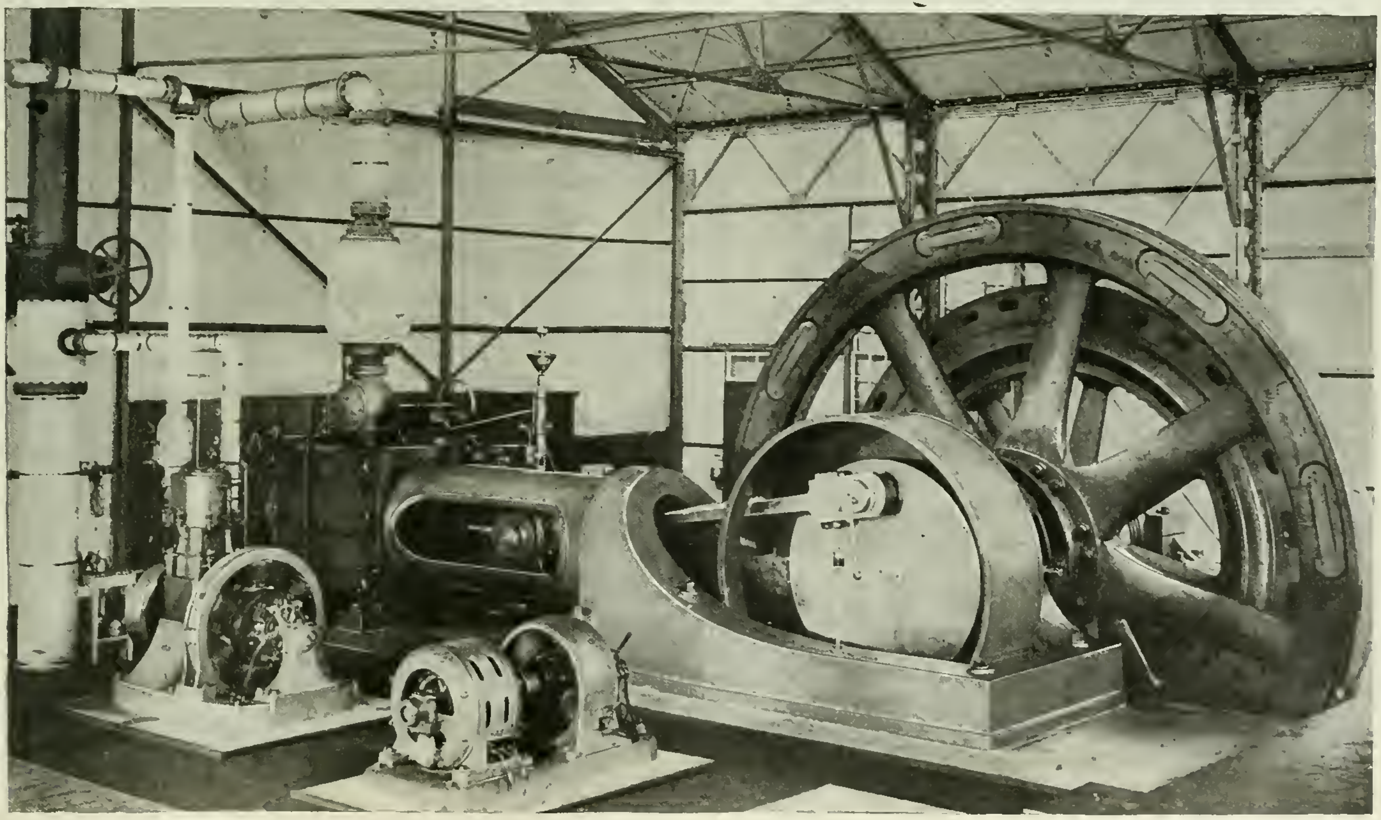


FIG. 1.—ENGINE ROOM.

The total cost of supplying power with the old steam plant, using cord wood as fuel, hoisting and milling 200 tons per 24 hours, was $218 per day. The cost of doing the work with electric power generated at Madrid and transmitted 32 miles is $52.75 per day for hoisting and treating 300 tons, which is a half more ore than handled by the old steam plant. (These figures do not include interest and depreciation on either equipment.) As the load was of an intermittent character, consisting of an air compressor, hoist, pumps, etc., which were not fitted for attaching indicators, no reliable data regarding the amount of power used by the old steam equipment could be had, therefore a comparative cost per horse-power cannot be given. There are probably few localities presenting conditions so advantageous for utilizing power generated at coal mines as those under which the Cochiti plant is operated. The saving made demonstrates that under favorable conditions power generated at coal mines can be transmitted long distances and compete with steam power.

While the conditions concerning the comparative cost of fuel were favorable for the Cochiti plant, its isolated location, the rough, mountainous country across which the pole line had to be constructed, the lack of feed water of any kind at the coal mines, made the cost of construction much greater than would be required for the average plant. The feed water supply was the one point on which the success of a plant installed at Madrid seemed to depend. The coal company operating the mines was obliged at times to ship water in tank cars a distance of 40 miles. This, of course, was not practicable for a power plant, and it was necessary to procure a supply within pumping distance or haul coal to where water could be had. Owing to the excessive freight demanded by the railroad company, the former plan was adopted and a 4-in. pipe line was built from the power house to the Galisteo River, a distance of 14,000 ft.

The Galisteo is a typical Mexican arroya in which, for 11 months of the year, there is no sign of water on the surface, but which has a heavy underflow at a depth of 3 or 4 ft. A crib was built under the quicksand in which the water was collected, and on a test lasting 48 hours demonstrated that a supply of 250,000 gallons per day could be depended upon. As the water was known to be of a very bad quality, an artesian well was drilled at the same time the crib was being built, with a view of getting water of a better quality. It was not deemed advisable to locate this well at the power house owing to geological conditions, and it was therefore placed at the point where the crib was located on the Galisteo River.

One pump house contains an artesian well pump and two motor-driven Gould triplex force pumps. The force pumps can be connected either to the artesian well supply or to that of the crib. Fortunately, the artesian well has been able to supply all demands up to the present time. A motor-driven deep well pump with the pump barrel 200 ft. below the surface delivers water to a small receiving tank from which the force pumps deliver it through the 4-in. pipe line to two steel storage tanks having a capacity of 100,000 gallons. The elevation of these tanks is 410 ft. above the Galisteo River, and high enough above the power house to allow the water to flow by gravity into the exhaust feed water heater, a butterfly valve automatically regulating the supply to this heater. The water is pumped from the heater into a live steam purifier which is under boiler pressure. The purifier is located above the boilers and water is fed to them by gravity. The heater and purifier are of the type manufactured by the Hoppes Manufacturing Company, the steam coming in direct contact with the water, which is held in a series of pans.

The analysis of the artesian water gives an idea of the conditions under which boilers in the Southwest are working, and it may be of interest to note that this is considered good water in that locality.

Analysis of water from Cochiti artesian well.

	Grs. in U. S. Gals.
Organic	5.715
Sulphate of lime	27.502
Carbonate of lime	2.378
Carbonate of magnesium	8.204
Chloride of sodium	7.382
Sulphate of sodium	45.737
	96.018
Incrustating solids	38.084

No trouble has been experienced with the boilers, which are carefully cleaned and inspected every eight days.

The power house equipment, when complete, will consist of two General Electric three phase, revolving field type, 605-volt, 60-cycle generators, direct-connected to 32 by 48 ft. Allis-Corliss engines, running at 60 r. p. m., having flywheels 20 ft. in diameter and weighing 70,000 lbs. Only one of these units is installed at present. The commercial efficiencies of the generators, not including friction losses, are 93 per cent at full load, non-inductive; 92 per cent at three-quarters load, non-inductive, and 89 per cent at half load, non-inductive.

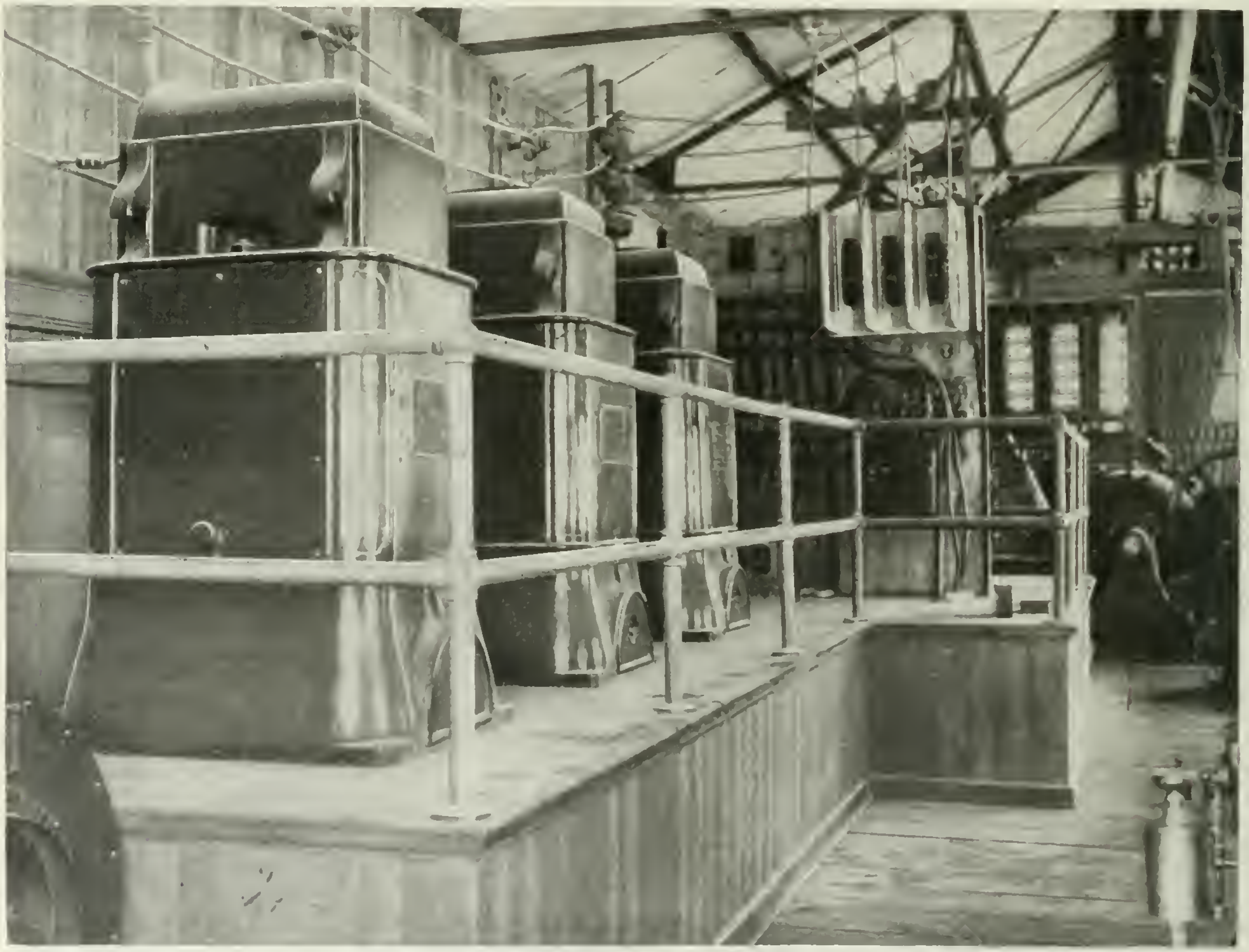


Fig. 3.—Interior of Receiving Station.

There are two 125-volt exciters, one being direct connected to a

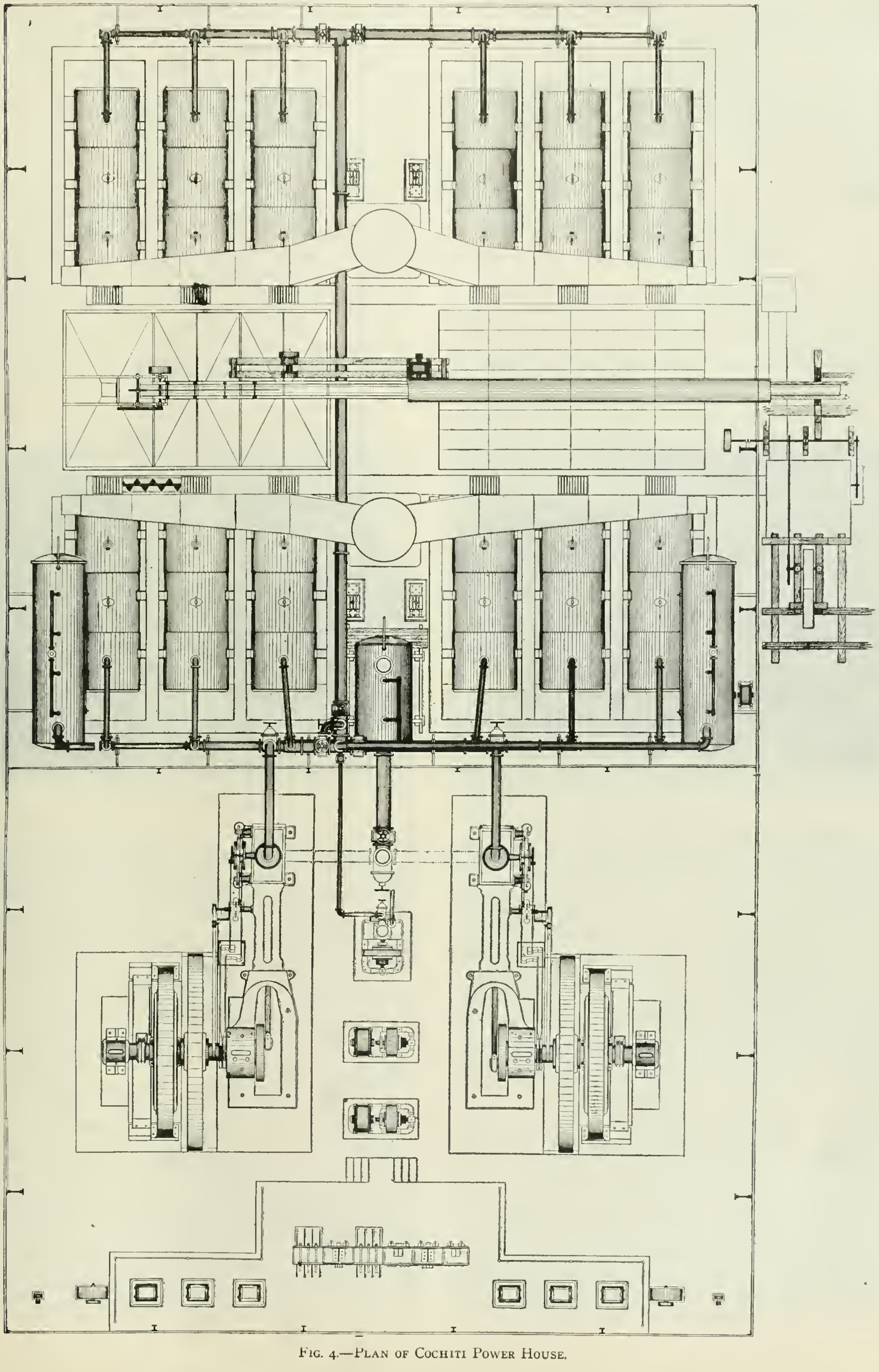


FIG. 4.—PLAN OF COCHITI POWER HOUSE.

vertical marine-type engine; the other is a motor-generator set. Both exciters are compound wound. An additional motor-generator will be installed with the new generator.

There are three step-up transformers of 200-kw each, of the vertical air-blast type, wound to transform a voltage of 605 to 20,000, and having a full-load efficiency of 97 per cent. The transformers are placed over a brick conduit 6 ft. wide and 10 ft. deep, both primary and secondary connections being made through this. The connections from the generator to the switchboard are made through vitrified conduits.

The switchboard of blue Vermont marble is of the latest type. It is supplied with two sets of bus-bars, double-throw oil switches, expulsion fuse blocks, etc. The switchboard is placed over the conduit in such a manner as to facilitate connecting to transformers and generators. The 20,000-volt switches are of the knife-blade type, and they, as well as the expulsion fuse blocks, are provided with large marble barrier plates.

The boiler equipment consists of two batteries, each consisting of three 175-hp return tubular boilers, built to stand a working pressure of 125 lbs. This type of boiler was used on account of the very poor quality of feed water. The boilers were supplied by the Denver Engineering Works.

Coal from the coal company's tipple is fed from a weighing hopper direct into a Jeffrey conveyor, which delivers it into steel coal bins above the boilers, the bins having a capacity of 100 tons. From the bins the coal is drawn through spouts at convenient points in front of each boiler. A coal crusher is provided so that, in case the supply of slack is not sufficient for the demands of the plant, mine run can be handled. An ash conveyor delivers the ashes into a storage hopper from which they are drawn into a steel ash car, a switch being provided so that this car can be run over the coal mine track to the waste dump. With this coal and ash arrangement one man per shift easily does the firing. The coal crusher, ash and coal conveyor are each driven by a 10-hp induction motor.

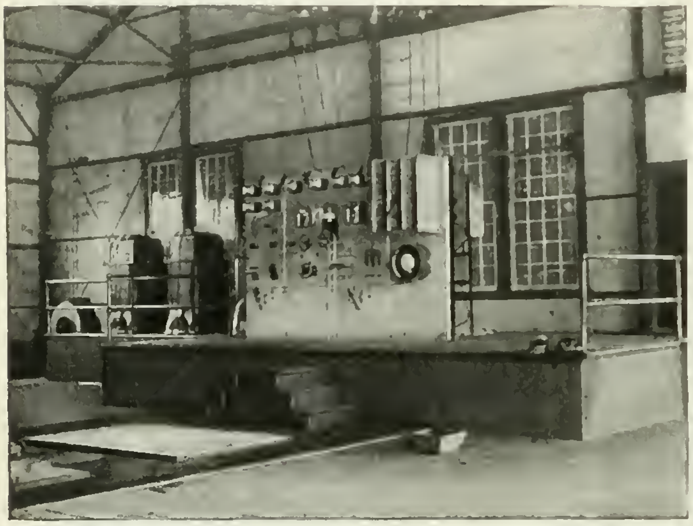


FIG. 5.—INTERIOR OF GENERATING STATION.

Until within the last two or three years there was no market for the slack coal made at the mine, and hundreds of tons of it were dumped at a point near the power house. This furnishes an ample reserve supply in case the mine is shut down, and was used for about two months last summer during a strike. While the slack has been exposed to the weather for 5 or 6 years no trouble is experienced in using it beyond the trouble of loading it into wagons.

The smoke stack is of steel, 72 inches in diameter and 150 ft. high. It is placed in the center of the building between the two batteries of boilers. The Gillette-Herzog Manufacturing Company supplied the stack, storage bins, water tanks and building. The latter consists of a steel frame covered with wire netting, asbestos paper and corrugated iron.

The pole line is designed to eventually carry two circuits of No. 4 wire, the three wires of each circuit being placed at the points of an equilateral triangle, the distance between wires being 24 inches. A telephone circuit of No. 12 hard-drawn copper is placed 5 ft. below the power circuits. The power circuits are transposed every half mile, the telephone every five poles. No difficulty is experienced from inductance on the telephone circuit. The poles on the line are spaced 100 ft. apart. Owing to the fact that the line crosses several arroyas at right angles and for several miles is constructed through a narrow, rocky cañon, poles varying in length from 20 to 40 ft. were used to reduce the strain due to vertical angles. The poles used under normal conditions were 28 ft. long. The butts of the poles for 2 ft. above and below the ground were treated with "carbolineum." The line crosses the Galisteo and Rio Grande Rivers, and as both these streams are subject to heavy floods annually it was necessary to support the line on towers located on the banks as far as practicable above the water level; hard-drawn copper wire is used for these spans, which are about 400 ft. long.

It was with great difficulty that a survey of the line could be made through the cañon because of its rough and precipitous sides, and the construction of the line presented several obstacles such as blasting holes in rock ledges where there was hardly room enough for a man to stand; hauling poles with tackle several hundred ft. up the sides of the cañon; material having to be carried on men's backs for long distances over sections where it was impossible to get pack mules. On one section the heavy pine timber made it necessary to clear a right of way for several miles, some 6000 trees being cut out. There are now no trees on the line that in falling could strike the wires. The timber thus cut was purchased from the owners of the grant and used at the Albemarle mine for stulls, lagging and cord wood.

An idea may be had of the character of the country from the fact that there is but one point on the line where water can be obtained, and but one where there is a house within many miles of it. Poles for the entire line were hauled on wagons from a point near the Albemarle mill. A saddle trail was constructed along the line and telephone stations are located every four miles; a supply box is placed at each station, and in it are kept all materials required for repairing that section of the line. Extra poles are also placed along the line at intervals. Glass insulators of the Provo type, manufactured by the Hemingray Company, were used, mounted on special locust pins, which were boiled in paraffine. The cross-arms are of selected Oregon fir and angle iron cross-arm braces were used. Great care was exercised in the erection of the line, and up to the present time there has been no interruption of the service due to line trouble. The energy loss in the line when delivering 600-kw to the mine is 8.5 per cent.

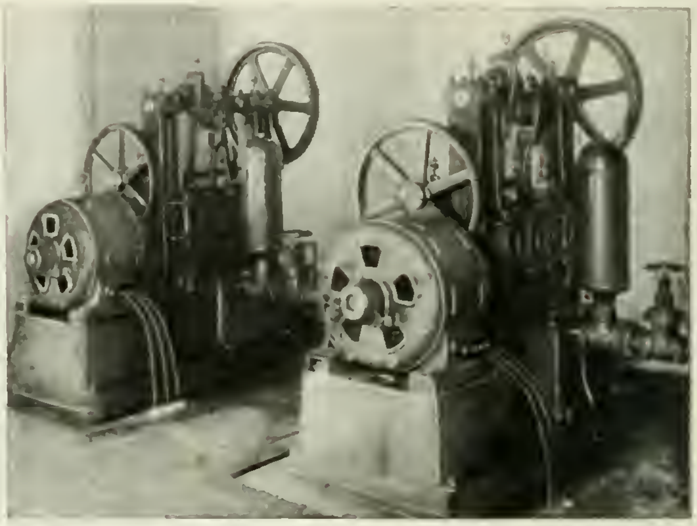


FIG. 6.—INTERIOR OF PUMPING STATION.

The equipment at the receiving end of the line consists of three 180-kw transformers, reducing the potential from 18,500 volts to 605. The transformers are of the vertical air-blast type. A distributing board of blue Vermont marble is equipped with primary and secondary switches for each motor circuit, and the necessary instruments. This apparatus is placed in a fireproof building with the electric hoist and a motor-driven air compressor. The air compressor is a Sargent-Ingersoll $22\frac{1}{2} \times 14\frac{1}{2} \times 18$ in., fitted with an air regulator, and operated by a 150-hp induction motor. The receiver pressure is 90 lbs.

The electric hoist was manufactured by the Lidgerwood Manufacturing Company. It is a double drum, and is arranged so that cages can be run balanced or independent, as desired. The drums each carry 1000 ft. of 1-inch rope, and the rope speed is 840 ft. per minute. The shaft has a slight incline. The weight of the cage is 1762 lbs., and the weight of the loaded car 1825 lbs. A 100-hp induction motor is geared to the hoist by means of a rawhide pinion and operated at 450 r. p. m. The motor is of the variable speed type, with controller and resistance. By means of the controller the resistance in the secondaries can be varied and the direction of rotation reversed, and no sudden jerk is experienced in starting the cage. Three hundred and fifty tons of ore per day of 20 hours can be readily handled with this hoist from a 500-ft. level. The gearing was originally so proportioned as to give a rope speed of 1000 ft., but owing to the short lift it was found that very little more ore could be hoisted than at a speed of 840, and as the current required to accelerate was excessive, the gearing was changed.

The crushing mill is in two sections, each section forming a complete mill for crushing, rolling, drying and screening ore to 40 mesh. Both sections were, however, dependent on one line shaft to which they were belted, this shaft being driven by a Corliss engine. In designing the motor equipment this shaft was divided in the center and a 150-hp motor belted to each section, thus making two complete mills with independent motive power. The mill when treating 350 tons of ore per day requires a maximum of 230 hp, this amount varying slightly with the character of the ore.

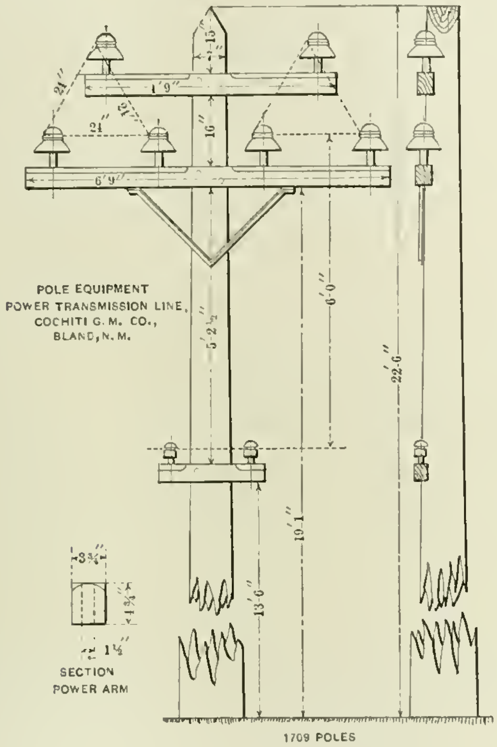


Fig. 7.—Pole and Cross-Arm.

The motors at the receiving end of the line are:

1—150 hp for compressor,
1—100 " for hoist,
2—150 " for mill,
1— 20 " for saw mill,
2— 20 " for Peletin tanks,
1— 10 " for solution pumps,
1— 10 " for machine shop,
1— 1 " for transformer blower,
10 " for lights.

Making a total of 621 hp.

At the generating end the motors are:

1— 20 hp for motor-generator set,
1— 10 " for coal conveyor,
1— 10 " for ash conveyor,
1— 10 " for coal crusher,
1— 1 " for transformer blower.

At the pump house, 14,000 ft. from the power house, there are two 10-hp, 450 r. p. m. motors geared to triplex feed pumps for forcing water up to power house, and one 10-hp motor belted to an artesian deep well pump. This makes a total of 702 hp in induction motors. They are all supplied with oil switches and expulsion fuse blocks. The 150-hp motors are mounted on sub-bases and have outboard bearings.

The demand on the power plant is for continuous service. It is the intention to shut down for an hour on Sunday mornings in order to take up wear and make any necessary adjustments. At times, however, the engine has run 21 days without interruption. When the additional engine is in place one unit can be cut out for repairs during periods of light load, which occur when the miners are out between four and seven in the morning. The old steam equipment at the Albemarle mine and mill was left intact, and the changes required for motor driving so arranged as to permit of either being used on short notice, thus avoiding the necessity of installing a duplicate unit at Madrid. The new Navajo mill will, in connection with the compressor plant, haulage system, lights, etc., require about 500 hp.

The plant was designed and constructed by the writer. The General Electric Company furnished the electrical equipment.

Cost of Current in Massachusetts.

The gas and electric light commissioners of Massachusetts have submitted to the House a communication in response to the order which was pased by that body recently. The order asked the commissioners to state the cost of manufacturing and distributing electric light, and what, in their opinion, is a fair and reasonable price for consumers to pay for the same. In answering they say the order as passed presents peculiar difficulties in the way of a clear and specific reply. "As we understand it, it is general in character and does not apply to any particular company or locality, and requires a statement of the cost per kilowatt-hour, the unit in common use. There is necessarily a considerable variation in the different companies under different conditions, in the class of both manufacture and distribution, and there is no standard of cost in either of these departments which is applicable to companies generally.

"The cost of generating varies materially according to whether water power or steam power is used. If the latter, the pipe or steam plant in use, the cost of fuel and ample water supply, the relation of the ordinary to the maximum demand and the conservative steadiness of the daily station road, are important factors affecting the generating cost. Using the term distribution in its strictest sense, the variable factor of most importance affecting the cost is probably the relation of the volume of business to the area in which the electricity is supplied. If the term distribution be used in the wider sense to include all the cost outside of the station, such as management and taxes, the volume of business and the value of the plant and the relation of these two to each other are important in determining the cost per unit. When the fair and reasonable price to the consumer is to be determined, not only these variables to the cost of production and distribution are to be considered, but the necessary charges for such depreciation as may not be provided otherwise together with interest or dividends upon the investment.

"The last named is frequently of more importance than any of the others and may vary more than the others according to the relation of the volume of business to the investment. From data in the annual returns it appears that the cost at the station or cost of manufacturing varied during the year, ended June 30, 1900, in different companies from less than 2 to more than 7 cents per kilowatt-hour; the cost of distribution, including management, from 1 to nearly 6 cents, while the dividend cost varied more widely.

"These facts indicate the difficulty of applying to companies generally any definite statement of costs and the necessity for a careful analysis of local conditions before attempting to determine the fair and reasonable cost per unit of these items in any particular company. These suggestions, we trust, explain our inability to reply to the inquiry as specifically as we would wish and as may have been expected when the order was passed."

Automobile Lecture.

The Library Committee of the Automobile Club of America announces the following lectures to be delivered at the new clubrooms, Fifty-fifth Street and Eighth Avenue, on the dates named. The lectures will begin promptly at 9 p. m. Members are at liberty to bring one friend with them, but not more than one to these lectures: Feb. 26, 1901, by Mr. J. A. Kingman, on "How to Operate and How to Care for a Steam Automobile"; March 12, 1901, by Mr. C. J. Field, M. E., on "How to Operate and How to Care for a Gas Engine Automobile"; March 26, 1901, by Mr. A. L. Riker, on "How to Operate and How to Care for an Electric Automobile."

Development of Motor Fans.

By Alton D. Adams.

EARLY FAN MOTORS.

SMALL motors appear to have been used during some years for other purposes before disk fans were extensively mounted on the armature spindles. Machines of one-eighth nominal electrical horse-power and smaller were first designed to operate with battery currents, and at pressures of a few volts. Gradually as electric service with constant current and incandescent lines at constant pressure extended, the small battery motors were wound or remodeled for the higher voltages.

These small motors are mentioned in the very early electrical publications as suited to furnish small powers to sewing machines, dentists' tools and even for belt connection to ventilating fans. In the first issue of the *Electrical World* in 1884 occurs one of the first accounts in public print of an electric motor with a disk fan mounted on its shaft. That this innovation was not considered of any great importance at the time is sufficiently shown by the fact that the columns of the *World* contain no further description of equipment in this line until 1887, during which year several fan motors are shown and briefly described. The use of fan motors evidently remained quite limited up to and through 1890, as very little is said in the catalogues and advertising matter sent out by the leading electrical manufacturers prior to 1891 concerning them.

The early battery and fan motors were in most cases made by small concerns, which have since gone out of business. Looking back at the construction and probable efficiency of the machines they made, the greatest wonder seems to be that they were ever able to exist at all. Among the very early fan motors were one or two exceptions to the generally poor construction, but these were in a sad minority. Some of these early motors had the Siemens shuttle armature with a solid core of cast iron and a two-part commutator. Others were provided with pole armatures, a coil being wound on each pole. The magnet frames and cores were cast iron in almost every case. After the solid Siemens and pole armature cores came the Gramme ring. These Gramme coils were a great improvement over those they preceded, because they provided lamination of some sort, either by means of fine iron or thin wrought iron disks. With the Gramme ring came commutators with six, eight or more segments, and there were no longer "dead points" at certain positions of the armature

A difficulty that clung to the fan motor during some years lay in the high magnetic resistance of the air-gap. The fine wire with which armatures were wound required a relatively thick covering of insulation, and the great number of layers on some of the armatures made matters worse. To offset this disadvantage magnet coils with a watt consumption too large for their radiating surface were not uncommon, so that in certain once prominent makes of fan motors the destruction of the magnet coils from too high a temperature was much more common than a burned out armature.

After 1890 the importance of the fan motor as a means of air movement and ventilation gained rapid and increasing recognition from both manufacturers and the public. About this time some of the largest electrical manufacturers turned their attention to the production of fan motors and the output increased rapidly. It had long been the general practice to call any small motor, that operated a fan on its spindle, ⅛ hp. This was probably because such motors usually consumed ⅛ hp or more of electrical energy; what mechanical energy they actually imparted to the fan no one seemed to know. With the rapidly extending application of fan motors, that preceded by one or two years the World's Fair at Chicago, there was a decided movement to better their construction and lower their cast. These efforts have not ceased up to the present time, and their result is seen in the comparatively cheap and efficient fan motors of the present day.

Thus far mention has only been made of motors for direct current, of which perhaps all of those brought out before 1890 were examples. Since that date alternating-fan motors have developed.

THE DESIGN OF FAN MOTORS.

Good fan-motor design must combine three conflicting properties: very small capacity, moderately good efficiency, and low cost. It may be fairly said that the difficulty with which low cost is added to efficiency in electrical machinery grows at a rapid rate as capacity decreases. Reasons for this fact in connection with fan motors are evident on consideration of their several parts.

Take first the motor for direct current. The laminated armature core of soft iron should be slotted to provide room for the coils, and at the same time keep the gap from iron of armature to iron of poles very short. So short must this air-gap be that slots with parallel sides are impracticable, because their width would lead to uneven armature torque, local current in the poles, and low efficiency. Not only must the slots in a fan-motor armature be much narrower at the periphery than they are nearer the center, but the size of these slots, compared with that of the core, shows a great increase over the case of larger machines. A large part of such increase is due to the proportion that insulation bears to the diameter of very small wires. For a No. 10 magnet wire, B. & S. gauge, of .1019-inch diameter, the ordinary total thickness of .01 inch for double cotton insulation adds only one-tenth to the diameter of the bare copper. Quite different is the case for a No. 30 wire, B. & S. gauge, such as might properly be used to wind the armature coils of a 220-volt fan motor. Selecting silk instead of cotton as the insulation of this No. 30 wire, because the double silk covering can be put on with a total thickness of only .005 inch instead of the .01 inch necessary for double cotton, it appears that even this thin insulation adds 50 per cent to the diameter of the bare copper. If the silk-covered No. 30 wire is wound so that no space is lost—that is so that each convolution lays close to those on each side of it—the coil space, leaving out that occupied by air between the round wires, is taken up by copper and insulation in the proportion of $(.01)^2 : (.015)^2 - (.01)^2 = 1 : 1.25$. In other words, the copper alone takes up less than one-half of the actual space occupied by the insulated wire. These fine wire coils must be wound on the core by hand, so that the cost of the fan-motor armature, as to both material and labor, is large in proportion to its size.

Another element of necessary expense, large compared with the selling price of a fan motor, is the magnet coils. These coils are necessarily of very fine wire, and while the use of silk insulation may in some cases be avoided, the cost of the wire for motors to operate at 110 or more volts is large per pound with only cotton covering. To build the small commutator required for a fan motor, having the segments few enough to keep the cost low, and their number large enough to prevent injurious sparking, so that all the parts are rigid and the insulation high, is a nice problem in engineering.

Unless reduced to their simplest forms the magnet frames, bearings and connections of fan motors are sure to require a total labor expense that is prohibitive. With these general difficulties in mind, the essential features of successful fan-motor design may be considered.

In the design of a fan motor, as in that of any other, it is usually most convenient to start with the armature core and coils. The minimum speed of revolution with no external resistance in the armature circuit is known at the start. A certain portion of the line pressure is allowed for the drop in the armature coils when the maximum current is flowing, say, 10 per cent in the case of a fan motor for a 110-volt circuit, or 11 volts, and this voltage must be deducted from that of the line to determine the pressure available to overcome the counter electromotive force of the armature coils and the resistance of the magnet winding. Another portion of the line pressure, perhaps again 10 per cent, must be deducted to cover the drop with full current between the terminals of the magnet coils. These two deductions, to provide for the ohmic resistance of the armature and magnet coils leave that portion of the total line pressure which must be equalled by the counter electromotive force of the motor armature. This counter electromotive force is the voltage that must be set up in the armature coils, by their revolution at the predetermined speed and by the magnetic flux passing through the armature core. Since an increase of either the number of times in the armature coils, or an increase in the armature flux reduces the speed where other factors remain constant, the problem of armature design is largely that of the best combination of these two elements.

Bipolar construction is decidedly superior to multipolar for fan motors. Owing to the small capacity of such motors, their parts for even bipolar machines are too numerous and multipolar design would increase the number of and the labor on these parts beyond any possible compensating advantage.

The iron of the armature core and its coils should therefore be proportioned for a bipolar magnet. The number of slots in the armature core and of segments in the commutator will obviously be smaller, for satisfactory operation in a bipolar than in a multipolar fan motor. As the armature coils must be wound upon the core by hand, it is usually better for the sake of safe insulation, in the case of a drum armature, to wind one coil into every slot before winding the second coil into any of them. If a ring armature core is used, it is probably cheaper and safer to wind only one coil into each slot, though some prefer to employ a very large slot and bring out a loop when one-half of the wire is in, so that each slot holds two coils.

Relative advantages of drum and gram armatures for fan motors have received much attention at the hands of designers, but there now seems to be little doubt as a general rule that the drum armature is cheaper and more desirable for the purpose. The ring core is necessarily larger in diameter than a drum core of equal section, it must be mounted on a bronze spider that is in turn fitted to the shaft, and, in winding, a bobbin must be used to pass each turn of wire through the central opening, unless the ring core is divided into two or more parts. A drum core, on the other hand, being mounted directly on the shaft without the intervention of a spider, there is no reason to divide the core, but the coils are wound into the slots with wire as it comes from a suitably mounted reel. The commutator of a fan motor should be constructed with the same regard to high insulation and rigid mechanical properties that prevails with larger machines. Mica alone is the material that has proven satisfactory for commutator insulation, and it should be exclusively employed for that purpose in fan motors. The segment may be of either drop-forged or drawn copper, but the cast variety is not desirable for the purpose. Various inferior methods of construction, common a few years ago in the commutators of fan motors, cannot now be tolerated. Among these may be mentioned a commutator, made by the insertion of round copper wires in a block of hard fiber, so as to form a circular group, the copper and fibre being subsequently turned to a bearing surface for the brushes. The number of segments in the commutators of fan motors varies from 8 to about 20, the tendency being toward the larger number in machines of the better class and those for the higher voltages.

Practice has quite generally settled on two types of bipolar magnet frames for fan motors. These are the simple U-magnet, with an armature at the top, and the iron-clad magnet with two inwardly projecting poles. The U-magnet possesses the advantage of smaller weight for a given sectional area and length of winding space for the magnet coils, it also raises the center of the armature high above the base of the motor, so that a fan wheel can swing clear, though no pedestal is employed. On the other hand, the iron-clad motor is more easily and cheaply enclosed to protect it from dirt and mechanical injury than is the U type, and some prefer it for this reason. The section of the magnet frame in any case should be large enough to supply the magnetic flux necessary in the armature core, plus one-third to one-half of that amount lost as leakage.

Wrought iron in the form of drop forgings, or stampings of wrought iron or soft steel, are the materials most suitable for the magnet frames of fan motors. Steel castings are the next best material, but they are not so desirable because of the greater labor required to finish and their somewhat lower permeability. The outer casing, in which the magnet frame and armature of a fan motor are often contained, and also the base or pedestal that serves to elevate the motor shaft so that the fan will swing free, is most easily and cheaply made of cast iron. Carbon is, of course, the only suitable material for the brushes of fan motors, and the square or rectangular form, sliding automatically through holders of similar shape, is most suitable and least apt to give trouble. Brush holders may well be mounted rigidly in suitable extensions on the bearing nearest the commutator or in the iron end plate that not only supports the bearing but also encloses the motor at the commutator end. Shaft bearings are perhaps best lubricated by a wick, held in position by a spring and dipping into a small cylinder of oil attached to the lower side of the bearing.

For enclosed fan motors the end plates, and for open motors some part of the cast-iron base or frame usually offers the best support of the binding posts, which should, of course, be mounted with suitable washers and bushings of insulating material. One of the prime requirements in a fan motor is durability, and to this end the total number of parts should be reduced as much as practicable, and each part given ample strength. As the fan is constantly attached to the fan motor, the magnet windings may be and usually are connected in series with the armature without any danger that an excessive speed of revolution will ever be reached. The revolution of the fan dos not require a constant torque, but the necessary turning effort, small at first, increases more rapidly than the speed, which is thus checked when the predetermined flow of current in the magnet coils takes place.

Speed regulation for fan motors may be readily effected by changes in the magnet coil connections, or by the use of a separate resistance in series with the armature and magnet windings. Three different speeds may be obtained, where two magnet coils are used, by means of a switch that connects the coils to the armature and line in three different ways. For the lowest desired speed the two magnet coils should be in series with each other, so that the entire armature current flows through each. In this case the ampere-turns on the magnet frame are at their maximum, and consequently the magnetic flux through the armature is greatest. The armature speed is now at its lowest point, not only because of this maximum magnetic flux, but also on account of the drop in volts between the magnet coil terminals. For a medium speed one of the series magnet coils is cut out of the circuit. This reduces the loss of pressure in the magnet winding, raises the volts at armature terminals and decreases the ampere-turns on and the flux in the magnets and armature core, hence the speed rises. When the highest speed is wanted the switch is turned to a third position which corresponds to the connection of the two magnet coils in multiple with each other, and in series with the armature.

By this connection the ampere-turns on the magnet frame are increased somewhat, because the motor current is somewhat larger than at the lower speeds, but as the resistance of the circuit through the magnet coils is only one-quarter of what it was when the two coils were in series with each other the volts at the armature terminals reach their highest point, and the maximum speed results.

If speed regulation is accomplished by an external resistance, the connection of the armature and magnet coils remains constant, and the amount of resistance in series with them is varied by the movement of a switch so as to give different voltages at the free terminals of the armature and magnet coils.

The necessary capacity of a fan motor, of course, depends on the size and character of the fan to be operated, as well as on its maximum speed of revolution. Electric motors generally have their capacities stated as their actual rates of delivered work, but fan motors are commonly rated by the diameters of their fans. Brass fans 12 to 16 inches in diameter and with four blades each are the sizes most common with fan motors, and about 1500 r. p. m. is about the usual maximum speed. The work absorbed by each of these fans at the stated speed, as well as the volume of air moved per minute, depends, to a large extent, on the shape of the blades and on the angle at which they are set with the plane of revolution. The best way to determine the power necessary for any particular fan is to measure the watts consumed by the motor operating it, find out the efficiency of the motor for that particular load and speed, and then calculate the power delivered to the fan itself from this data.

A fan of the ordinary variety, having four blades, and 12 inches in diameter, can be driven by a good fan motor that consumes not over 60 watts direct current. A fair efficiency for a motor that consumes energy at this rate under maximum load is 30 per cent. On the basis of these figures the motor delivers to the fan mechanical energy at a rate equivalent to $60 \times .30 = 18$ watts. With motors that operate 16 or 18-inch fans, having blades so shaped that as much as .1 or .125 actual horse-power is necessary to drive them, efficiencies as high as 50 per cent may be obtained.

Fan motors for use with alternating currents of single phase are mostly of the induction type. In these machines the armature core may be said to constitute one part of the magnetic circuit of a transformer, and the magnet frame of the other part. The primary winding, that is, the one connected to the supply line, is represented by the magnet coils; the secondary circuit is made up of copper rods embedded in the armature core and put into good electrical connection with each other by riveting them into brass or copper-end plates. When the primary or magnet coils are supplied with alternating current, a current is induced in the rods and plates that make up the secondary circuit. The mutual reactions between the several parts of the secondary circuit, represented by the circle of copper rods embedded in the armature core, and the magnet poles operate to give the armature a continuous torque. It should be noted in this construction that the revolving armature has no electrical connection whatever with the supply line or the magnet coils. It follows that no commutator or sliding contacts of any kind are necessary with these motors. The armature cores for these alternating motors must be of laminated iron or steel, as in those for direct current, and the required amount of iron is so small in comparison with the diameter that the disks should be mounted on spiders. Slots in the core to receive the copper rods are of about the same form as would be used in an armature for direct current, but they are usually more numerous. The electromotive forces induced in the copper rods of the armature cores are so small that insulation between these rods and the disks of the cores is not considered necessary.

As the magnet coils of these alternating motors take current from the line, the magnet frames must be laminated like the armatures, to prevent serious loss from the local currents that would result in a solid mass of metal. Unlike the direct-current magnet frames, those for the alternating motors should have four or more poles each. This construction is readily adapted to enter a circular cast-iron core having a diameter two or three times as great as to thickness, which is now the prevailing outline for alternating fan motors. The magnet coils must be designed not only for the voltage of the circuit for which they are intended, but also for its rate of alternations or cycles per second. At present motors of 60, 125 and 133 cycles per second are the ones generally demanded. Means by which a speed of about 1000 as well as a maximum of 1500 r. p. m. should be provided, and this result is usually attained by a three-contact switch in the base of the alternating motor, that combines the magnet coils in two ways.

PRESENT FAN MOTORS.

Perhaps no class of electrical machinery has made greater advances as to pleasing outline, internal construction and efficiency than fan motors during the last few years.

The great variety of shapes given these little machines in past times, each usually claimed to have some special virtue, has mostly given way to a not unpleasing uniformity that includes protection to the working parts of the motors, a compact arrangement of parts and not unsightly proportions. The old shuttle armature with its dead points and the more common Gramme ring with its smooth core and surface winding have almost entirely disappeared. With the surface windings have gone the long air-gaps that made magnet coils heavy in copper and expensive in current consumed. For direct-current fan motors the slotted drum armature core now holds the leading position. In magnet frames cast iron has given way to drop forgings and to stampings of thin wrought iron or steel. Magnet coils, once wound directly on their cores, are now made complete and insulated before they are applied to the machines, thus rendering the parts interchangeable. Carbon brushes and well-constructed commutators do away with any attention at these points for weeks and even months at a time. Oiling devices of the most crude pattern have been replaced by automatic supplies that often last during a season. Efficiency has risen from an unmentioned and often an unmentionable quantity, to a respectable figure for machines of such small capacities. Alternating-current fan motors, little heard of until the latter half of the present decade, are now doing an enormous amount of work in places where direct current is not available. Various methods of mounting fan motors make it possible to operate them when placed upright on a desk or counter, to turn the axis of the fan so that the movement of air is directed toward any part of a room, support them from side walls and even to suspend them from ceilings. Meantime, the demand for these machines has so increased that their manufacture requires an important department in the works of the largest companies.

A New York State Electrical Laboratory.

A bill is before the New York State Senate for the establishment of a laboratory of electric engineering in connection with Union College in Schenectady. It proposes an appropriation of $150,000 for the erection and equipment of the laboratory and $25,000 a year for its maintenance. In consideration of this appropriation—which is the equivalent of $30,000 a year—the State is to have the title to the land and 25 four-year free scholarships annually in electric engineering at the college. The selection of Union College is determined by the fact that the works of the General Electric Company are situated at Schenectady, and from them extraordinary facilities are to be obtained.

Pacific Cable.

A start towards constructing the cable from San Francisco to the Philippines was made recently by Mr. Perkins offering, in the House of Representatives, an amendment to the sundry civil bill for an appropriation of $500,000 to secure terminal rights for the United States.

European Types of High Tension Alternators—VII.

By C. F. Guilbert.

BOUCHEROT ALTERNATOR.

A BOUCHEROT alternator exhibited at Paris (Figs. 69, 70 and 71) by Breguet et Cie, was driven by a high-speed Delaunay-Belleville engine and, as in the case of the Grammont alternator, was supplied with a special exciter designed to maintain the voltage at the terminals constant whatever the current output or phase relation. While, however, the Grammont alternator is an ordinary machine with a low drop, the Boucherot alternator has been designed with a special view to its application as an asynchronous generator, and consequently involves some special features. It is, in brief, as in the case of induction generators, analogous to an asynchronous motor and consequently its fields and armature are analogous to the field and armature of an induction motor.

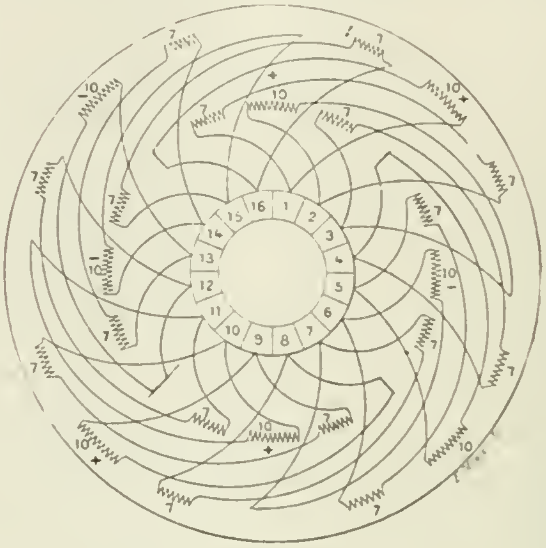


FIG. 67.—WINDING FOR K = — 2.

The fixed armature (which would be the field of an asynchronous motor since it is connected to line) has an ordinary three-phase winding. The field (analogous to the armature of an asynchronous motor) is wound two-phase and consequently comprises two identical circuits in quadrature, of which only one was utilized at the Exposition though both will be employed when the alternator is permanently installed. In addition to these features the alternator presents a special interest from the manner in which it is excited.

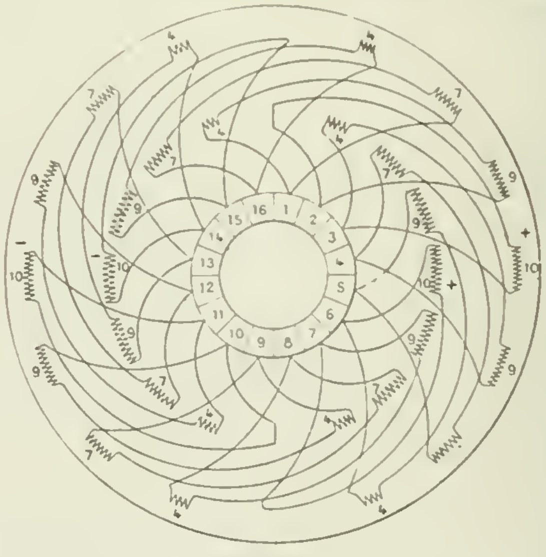
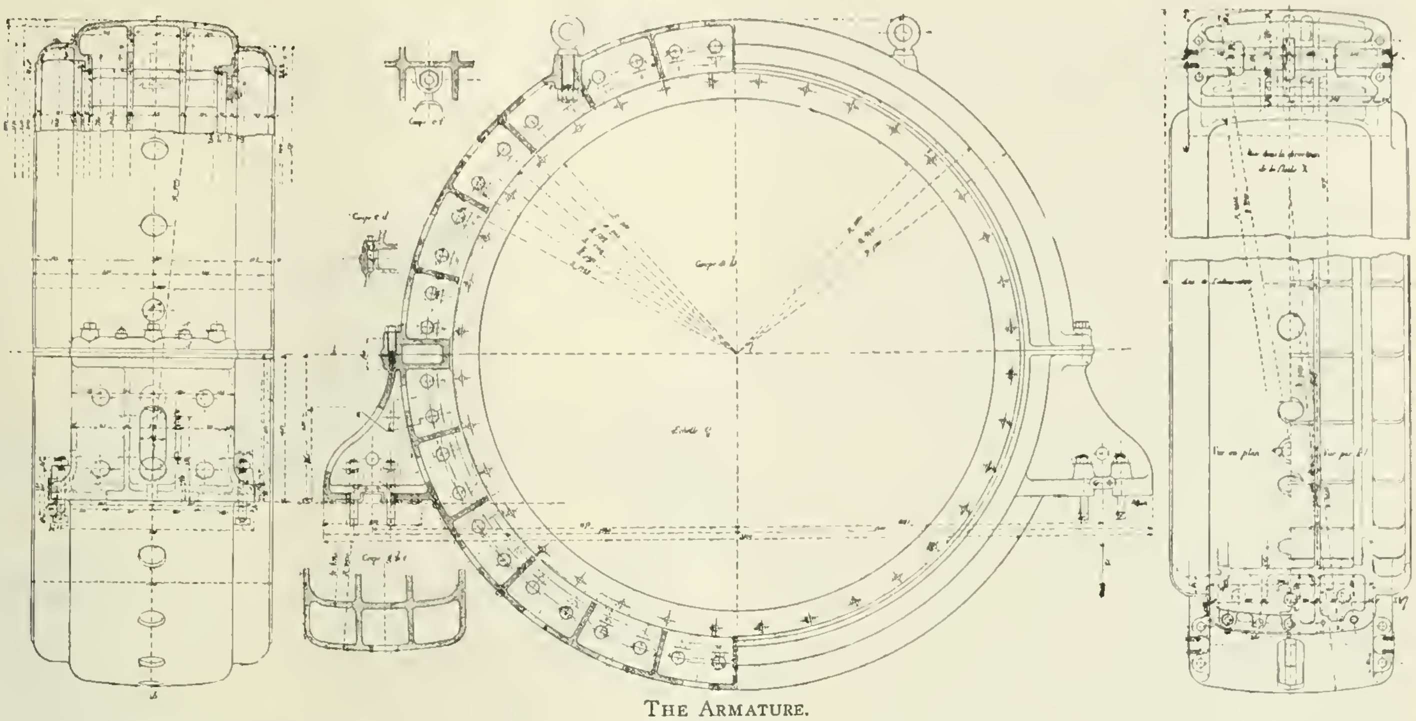
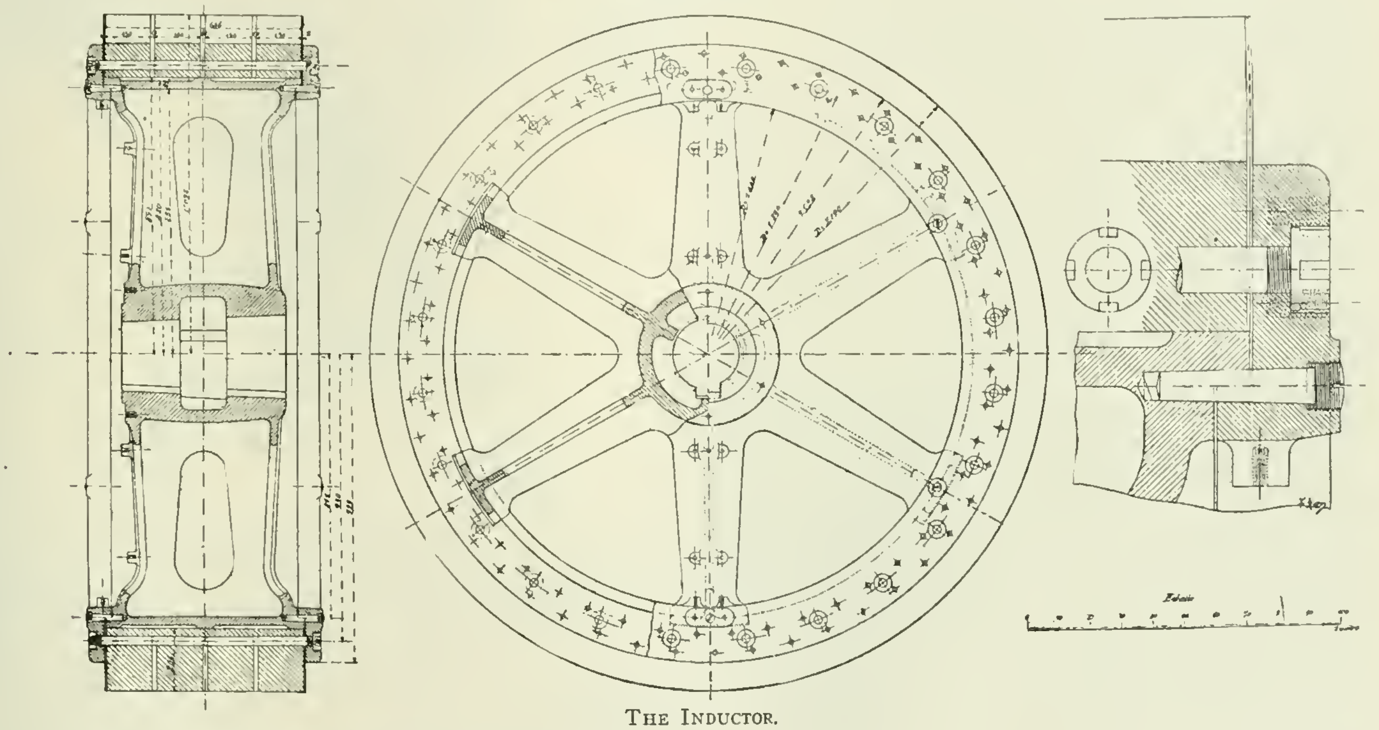


FIG. 68—WINDING FOR K = 1.

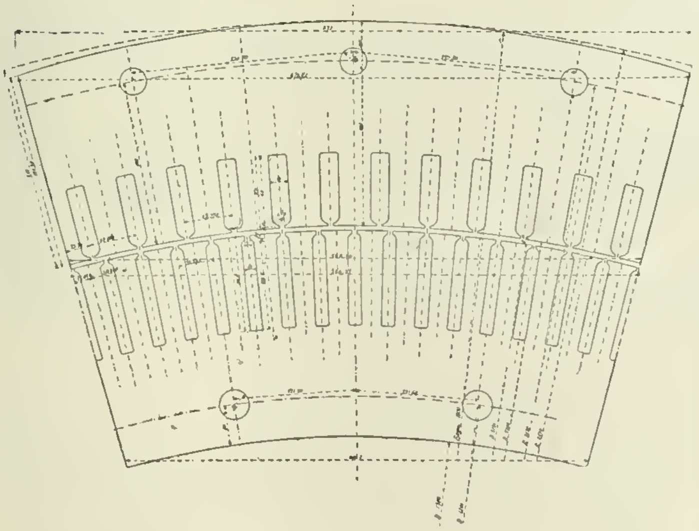
In the account of the Leblanc exciter we have seen that the condition of compounding is the proportionality of the voltage at the terminals of the exciter to the voltage induced in the alternator, on the supposition of non-saturation of the magnetic circuit of the latter, which also applies to the present case.



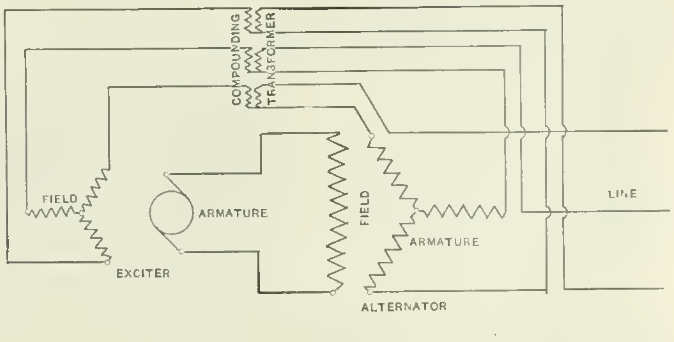
The Armature.



The Inductor.



Section of inductor laminations.



General connection of alternator and exciter.

Figs. 69 to 72.—Boucherot Alternator.

While in the Leblanc exciter the flux in the field is the resultant of two fluxes of appropriate amount and phase relation, in the Boucherot exciter the field flux, which is also rotary, is obtained by impressing on the terminals of the field circuit of the exciter a voltage equal to the resultant of the voltage at the terminals, and another proportional to the current and shifted in phase with respect to the first by an angle equal to an appropriate function of the phase difference. This voltage is obtained as in several methods of compounding converters by a transformer in series with the line and called a compounding transformer (Fig. 75).

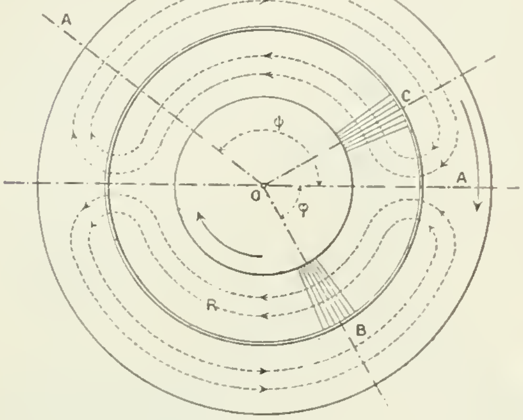


FIG. 73.—PRINCIPLES OF SINUSOIDAL DYNAMO-WINDING.

The exciter of M. Boucherot, like that of M. Leblanc, is so designed that it does not require the number of field poles to be equal to that of the alternator if the exciter is mounted on the same shaft with the alternator; or to have a ratio equal to that of the angular speed of the two machines if they are not on the same shaft. The means employed by M. Boucherot to give to the number of poles any simple ratio is based on a principle quite different from that of M. Leblanc, and is as follows:

Let us consider (Fig. 73) a machine, bipolar, for example, composed of a fixed part having the winding of a polyphase motor and a moving part consisting of a ring identical with that of a direct-current machine, but which, instead of having a distributed winding, as in the case of a Gramme ring, carries two windings, the sections of which have a variable number of turns along the periphery of the armature following a sinusoidal law.

If we connect the sections among themselves and to the segments of the commutator in such a manner that between two consecutive segments of the commutator we have in series a section, *B*, having a number of turns equal to $n = \cos k\varphi$ (φ being the angle of the section with any section taken for origin and *n* and *k* any numbers); and a section, *C*, at an angle of 90 degs. from the first and having a number of turns equal to $n = \sin k\phi$. The connections, as a whole, will present, according to one of the diagrams given, figures corresponding to values of 1 and —2*nk*. Calculation will show that if the commutator is supplied with brushes regularly spaced such that consecutive ones of different polarity have between them an angle ψ defined by the relation

$$\psi = \frac{\pi}{k+1};$$

the e. m. f.'s induced in the circuits in parallel coming under the brushes are equal and have for an expression

$$E = \frac{2ne}{k+1}(a-\omega)\cos(\omega - ka)t,$$

where *e* is a constant depending upon the field flux, ω the angular speed of the rotary field turning in the direction of the arrow, and a that of the exciter armature, turning also in the direction of the arrow. In the particular case where the speed of the field flux and of the armature satisfies the relation, $\omega + ka = O$, the expression for the voltage at the brushes becomes $E = 2nea$, and is consequently continuous.

Two values of *k* are more particularly to be considered, namely, 1 and —2. The value of $k = 1$ corresponds to the diagram of Fig. 67,

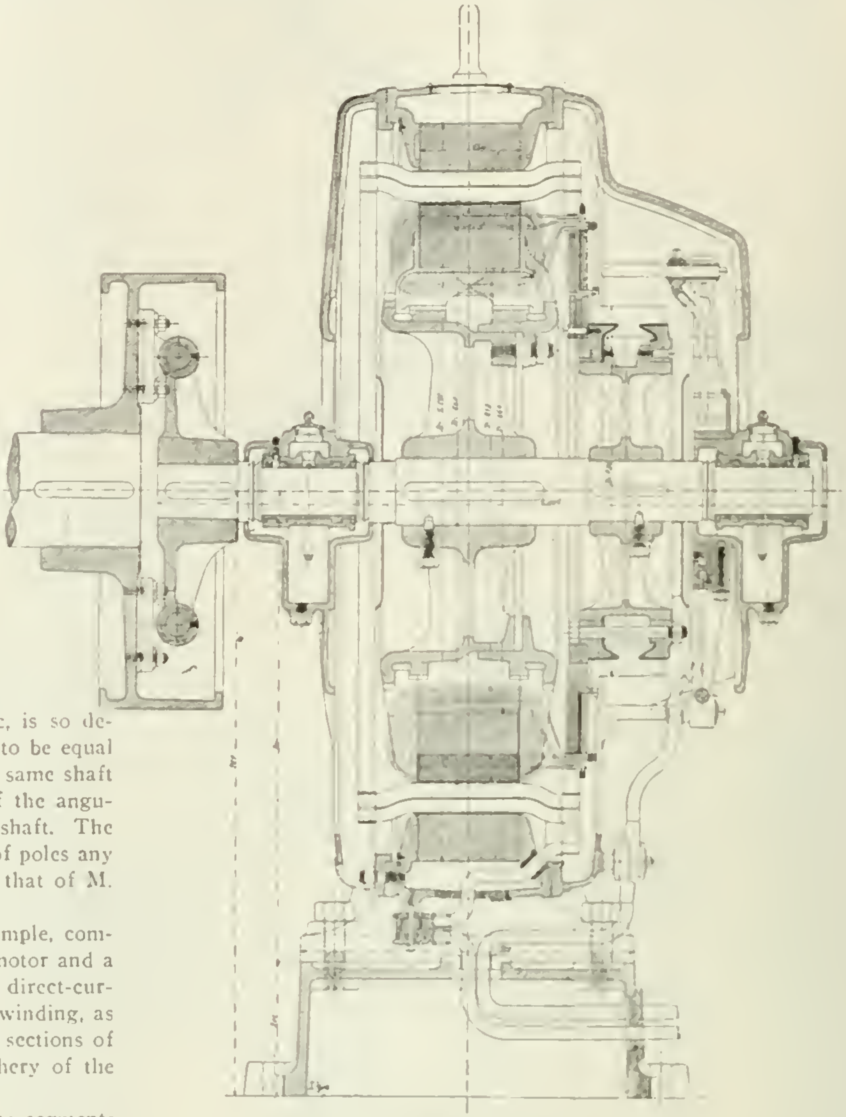


FIG. 74.—BOUCHEROT EXCITER.

and indicates the possibility of exciting the alternator with a single-alternating current. Every single-phase field can, as has been pointed out by M. Leblanc, be regarded as the resultant of two fields turning in opposite directions with velocities equal to ω. One resultant has the same speed as that of the armature, and since $\omega = -a$ it will introduce no e. m. f., and consequently the condition will be as if there were only one field turning with the speed 2ω with respect to the armature.

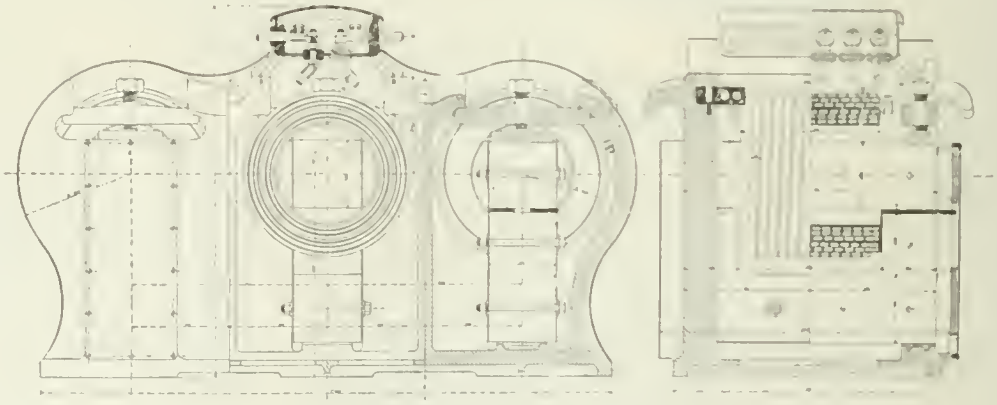


FIG. 75.—BOUCHEROT COMPOUNDING TRANSFORMER.

In this case, for a bipolar exciter, there will be four brushes placed

90 degs. apart. The value, $k = -2$ (Fig. 68) is interesting, because it indicates that the exciter can turn with the same angular speed as the alternator and have half the number of poles. In this case we have ω equal to a; that is to say, the field turns in the same sense as the armature and with a double speed.

The angle of the brushes of different polarity is here $-\pi$. There are consequently but two brushes, or one per pole. This latter is the method of connection adopted for the exciter of the alternator here described. Before giving the principal dimensions of the exciter and of the compounding transformer we will say several words concerning the operation of the machine as an asynchronous generator.

We have found for the voltage between two brushes of different polarity the expression

$$E = \frac{2\,n\,e}{k+1}\,(a - \omega)\cos(\omega + k\,a)\,t$$

If we had placed the second series of brushes in the middle of the interval separating those of the first series we would obtain between the brushes of different polarity of this new series, a voltage having for expression in function of time

$$E^1 = \frac{2\,n\,e}{k+1}\,(a - \omega)\sin(\omega + k\,a)\,t.$$

That these currents may excite the alternator as an induction generator it is known that the machine should have a slip of $-\frac{\varepsilon}{\omega}$ and the exciting currents have a frequency $\frac{\varepsilon}{2\pi}$ and furnish a flux rotating in opposite direction from that of the fields with the speed ε. The direction of rotation depends on the connections.

As to the first condition, we will obtain it if we can satisfy the relation, $\omega + k\,a = -\varepsilon$, for then we will have

$$E = 2\,n\,e\left(a + \frac{\varepsilon}{k+1}\right)\cos\varepsilon\,t$$

$$\text{and } E^1 = 2\,n\,e\left(a + \frac{\varepsilon}{k+1}\right)\sin\varepsilon\,t.$$

Now, this relation is satisfied if the speed a of the armature of the exciter corresponding to asynchronism in the ratio, $\frac{\varepsilon}{\omega}$. The new speed of excitation is then $a = a_1\left(1 + \frac{\varepsilon}{\omega}\right)$ and we will then have, if we substitute the relation to satisfy

$$\omega + k\,a_1\left(1 + \frac{\varepsilon}{\omega}\right) = -\varepsilon,$$

an expression which is an identity when in asynchronism we have

$$\omega + k\,a_1 = O$$

This machine can thus operate according to a new method which M. Boucherot calls "panchronic." The machine is no longer an induction machine properly speaking, since all the e. m. f.'s of induction developed in the field by the resultant field flux are annulled. In this case the current output of the machine is no longer a function of the slip, and the power output is practically independent of the speed—consequently the name panchronic. The variations of speed, whatever the cause, have no influence on the current furnished as in an ordinary asynchronous machine, where perturbations have an enormous influence on account of the small variation of speed corresponding to the passage from no-load to full-load. The balancing of induced e. m. f. in the field by the resultant flux from the armature and the field is obtained by M. Boucherot as follows:

First, by the introduction of self-inductance variable with the slip by means of a mechanical arrangement. Second, by the introduction in the field circuit of the exciter, e. m. f.'s proportional to the slip, and obtained from a small auxiliary machine. Third, by the introduction of condensers of variable capacity into the exciter field circuits.

The exciter of the Boucherot alternator (Fig. 70) has a fixed field consisting of a cast-iron box frame carrying on the interior two cast-iron rings cast in the frame and between which are held the laminations. On the face of this frame are two projections which carry the bearings of the exciter. The exterior diameter of the field frame is 48 inches (120 cm), and its witdh 22 inches (55 cm). The diameter of the bore of the field ring is 34 inches (86 cm), the width 6 inches (15 cm), and the radial depth 5 inches (12.5 cm). The field core has 72 slots, or 6 per pole. The field winding is a 12-pole three-phase winding composed of bars of 110 mm section. The number of conductors per phase is 48, or 4 per pole. There are two bars placed one above the other in each slot. The three circuits are grouped in star and the three terminals of the field connected with a compounding transformer.

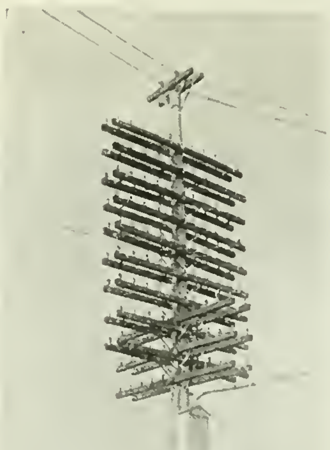
The armature ring, mounted on a spider and held by a cast-iron ring, is formed of laminations having an exterior diameter of 34 inches (85.8 cm), a width of 6 inches (15 cm) and a radial depth of 4 inches (9.9 cm). The air-gap is 1/25 of an inch. The surface has 288 slots, which receive the two sinusoidal windings, each slot carrying a coil of each winding. The number of slots per pole is 12, which is also the number of sections of windings, the turns varying from 1 to 8; the sections are connected to 288 commutator bars, according to the diagram above indicated; a connector reduces the number of brushes to two of each polarity, for each of the two circuits, or 8 sets of 4 carbon brushes each. The commutator has a diameter of 22 inches (55 cm), and a useful width of 4 inches (10 cm). The wings of the commutator are of German silver. The exciter is coupled to the shaft of a steam engine. The machine is calculated to deliver a maximum current of 180 amperes at 250 volts.

The compounding transformer (Fig 75) is formed of three single-phase transformers, one disposed alongside the other in a single case. These transformers are of the type having a single primary and a single secondary coil, both disposed concentrically and horizontally. The core is former of U-shaped laminations, connected by a straight section carrying the windings. The dimensions of the U-shaped laminations are 22 inches (56 cm) wide and 12 inches (29 cm) high. The widths of the lower part of the vertical legs are, respectively, 6 and 5 inches (15 and 12 cm). The thickness of the body of the core is 6 inches (15.4 cm).

The core forming the magnetic circuit has a width of 22 inches (56 cm), and a height of 6 inches (15 cm). There is an air-gap, adjustable by means of wedges, between the top section and the branches of the U. The primary winding is placed inside the secondary and consists of 39 turns of a copper bar of rectangular section. The secondary winding comprises the same number of turns and the same number of sections as the primary. The turns of the exterior layer are bare in order that connection with the circuit may be made on any turn to facilitate adjusting the compounding.

Telephone Pole Line Construction.

Illustrated herewith is one of the handsomest telephone cable poles it has been our fortune to see, and attention is directed to the "crow-foot" guy as a very neat piece of construction. It was erected by the Massillon, Ohio, Telephone Company, which has just been rebuilding its system, and will soon add $5,000 of cable for immediate use. The present cable capacity is 600, and will be 800 when the new cable is up. The company has also 500 miles of country lines, metallic circuit, No. 10 iron wire, connecting all of the nearer small towns from their centrals. The company has also special toll lines running to the small towns, and is further connected with the U. S. Long-Distance Telephone Company, being able to reach, all told, some 100,000 subscribers of various independent exchanges in Ohio, Indiana, Illinois, Michigan, Virginia, West Virginia, Pennsylvania and a few other States.


TERMINAL POLE.

We are indebted to Mr. W S. Holloway, manager of the company, for these details, as well as a few others in regard to the exchange itself. The main board, made by the American Electric Telephone Company, has 600 drops, and there are already 570 subscribers. The long-distance board, with 30 drops, was furnished by the North Electric Company. The exchange has increased 200 subscribers within the last six months, and it is expected to reach 1000 this year.

Electric Railways in Tokyo, Japan.

By Phillip Jaisohn, M. D.

SINCE my last article on "Electrical Possibilities in Japan," the Electrical World and Engineer has published data as to the contracts placed in this country for the new electric railway work in Japan. I am now glad to be able to supplement that information.

The question whether the work of providing and managing improved means of street transit in Toyko should be left to private enterprise or reserved to the municipality, has been settled by a sort of compromise between the contending principles involved in the controversy. The discussions of the question during the past two years have shown that the weight of opinion in official and academic circles in Japan is strongly and decidedly in favor of the municipal ownership and management of all works partaking of the nature of a monopoly. But in deference to the plainly expressed desire of the practical section of the public, the municipal and imperial authorities have consented to waive the point and allow private companies to build and work street electric railways for a number of years under very stringent regulations relating to the reversion of these railways to the municipality and other matters.

These regulations are embodied in the instructions issued to the Tokyo Street Electric Railway Company (by which name the amalgamated concerns have come to be known), and the Tokyo Tramway Company, whose present horse tramways are to be converted into electric lines. The documents given to these companies differ in some respects, so we shall first examine that served upon the newly established concern, namely, the Tokyo Street Electric Railway Company. The company is permitted to construct altogether 27 lines, whose total mileage, I believe, is somewhere between two and three hundred miles. The work is to be commenced within six months from the date on which official permission shall have been obtained for the plan of construction which, in turn, is to be submitted within six months from the date of the charter. The work should be completed in five years from the date of its commencement, which period may be extended by two years in case the progress of the work shall have been delayed by causes beyond human control. The gauge is to be 4 ft. 6 in. between the inner sides of the rails. The whole space included within the rails as well as a space of 2 ft. along the track is to be paved with stone, wood or asphalt, in such a manner as to keep the top of the rails on the same general level as the rest of the road.

The minimum width of streets should be 36 ft. for single and 48 ft. for double tracks. Where the streets are narrower than these limits, the company has to widen them at its own expense. But the expense required for this purpose will not be prohibitory in the case of the company under consideration, for it is provided that, in case the widening of such streets is undertaken by the city as part of its improvement scheme, long since decided upon, only one-half of the expense incurred for the necessary extension shall be borne by the company, and the routes selected by the latter happen to run principally through streets included in the above mentioned programme. The posts for the support of the electric conductors should be of iron, at least 18 ft. high and 120 ft. apart, and they should, moreover, be provided each with an electric lamp, which must be lighted from sunset to sunrise. The maximum speed is fixed at eight miles per hour, and it is provided that cars must never be joined one to another—no trailers. A provision which will perhaps be regarded with satisfaction in scientific circles, is that, within the radius of 1300 metres from the site of the new Physical Laboratory at the College of Science of the magnetic measurement room of the Central Observatory, the strength of electric current should never exceed 1000 amperes. Besides these regulations, there are minute and very strict provisions about the supervisory power of the imperial and municipal authorities over the construction and maintenance of the railways and the rolling stock, as well as over the method of business management. These provisions are so comprehensive and elaborate that it is hard to conceive the possibility of any case wherein sufficient and prompt official pressure could not be brought to bear upon the company in the benefit of the public order or interests.

As to the reversionary interests of the state or the city in the railway to be constructed by the company, it is provided that all the tracks, rolling stock and other property necessary for conducting the business shall revert to the state or city on the expiration of the charter, which is to take place on the 30th of June, 1952. But even before the expiration of the charter, the state or the city reserves the right at any time of purchasing or running the concern in whole or part. The purchase price in such case is to be determined by capitalizing the average amount of net profit during the preceding five years at an interest of 7 per cent per annum. For instance, taking the average amount of profit at 700,000 yen, the purchasing price would be 700,000 ÷ .07 = 10,000,000 yen. In case the lines are to be worked by the state or the city, the company shall be entitled during the period its lines are worked in that way to a compensation whose amount is to be determined on the basis of the earnings of the previous month or year. However, during the month of July 1, 1932, and during the corresponding month of every fifth year thereafter, the state or the city will have the power to demand the handing over of the company's property in return for a sum of money equivalent to the latest valuation of the property. During the time the lines are worked by the company 10 per cent of the net profits is to be set apart as reserve, and after paying out of the remainder a dividend of 7 per cent per annum, one-third of the residue, if any, is to be paid to the city. Besides, the whole property is to be forfeited in the event of the company's failure to fulfill the more important conditions specified in the document. Finally, to completely guarantee the reversionary rights of the state and city in the undertaking, the company is prohibited from mortgaging or alienating any portion of its property necessary for the conduct of its business.

The instructions given to the other company for the conversion of its horse tramways into electric lines, are substantially the same as in the document thus far reviewed. The principal points of difference are that the work of conversion is to be finished in two years, instead of five as in the other case, and that the clause relating to the widening of narrow streets, though worded exactly alike, will in practice entail a heavier tax upon this company than on the other one. It has already been pointed out that the railways of the other company will run through streets which are included in the city improvement scheme, and that, consequently, it will only be necessary for the company to bear one-half the expense. But in the case of the Tramway Company, it happens that the streets passed by its lines are outside the scope of the scheme, and consequently the company has to bear the whole expense, which will be especially hard, seeing that its routes traverse the most important business centers of the capital. On the other hand, it has to be remembered that the company's profits are enormous, its latest rate of dividend, which is not unusually high, being 35 per cent per annum. Unless, therefore, one has an accurate knowledge of the actual expense entailed by the observance of the provision in question, it is impossible to pronounce any opinion as to the justice or injustice of the provision. The company, however, thinks it unjust and unbearable, and it has decided to return the charter, and conduct the present concern till the end of its term which will be about ten years hence. These facts furnish an interesting insight into trolley railway conditions now existing in Japan.

Unrewarded Inventors.

Discussing the life and recent death of Dr. Elisha Gray, and his relation to the telephone, the *Iron Age* in a recent issue says: "It is natural, no doubt, to feel a great deal of sympathy for the clever and industrious inventor who benefits the world in large ways without profiting therefrom save in the sense in which all progress ameliorates the conditions of living for all who live. It is a question, however, whether such sympathy is not in great degree wasted—not because the poor inventor does not deserve it, perhaps, but because, if he is a true inventor and not a mere adapter with keen commercial instincts that for which he has least use in life is pecuniary profit. He lives in a more rarefied atmosphere than other men. Success would probably more often spoil than benefit him. He has none of the "instinct of self-preservation" which a man needs to make his stewardship of wealth of advantage to himself or to society. If able to pursue the idea which is always materializing and dematerializing just ahead of him, and which seems the one object worth pursuing, he is probably happier than he could possibly be if gifted with the Midas touch of the successful promoter. The best we can wish these richly endowed geniuses is not sordid gains, but the posthumous fame for which any one of them would sacrifice temporary and purely selfish advantage." As a matter of fact, Dr. Gray received large sums of money for many of his inventions, though not for the telephone.

The Evolution of the Electric Sign.

By E. Trier.

As if it were heralding its own future, a huge electric sign mounted on the front of New York's City Hall recently flashed forth a hearty welcome to the twentieth century at the moment the old year was drawing to a close. It meant to all who have watched its evolution and growing popularity a new and important era for the electric sign, which is destined to become an important factor in the business world, serve as the herald of new commercial products and amusements, and open a large market for the electric current. The fixed, dumb sign of old is to become a living, talking bulletin, which, by means of its kaleidoscopic changes holds the attention of every passer by—a "Sign of the Times."

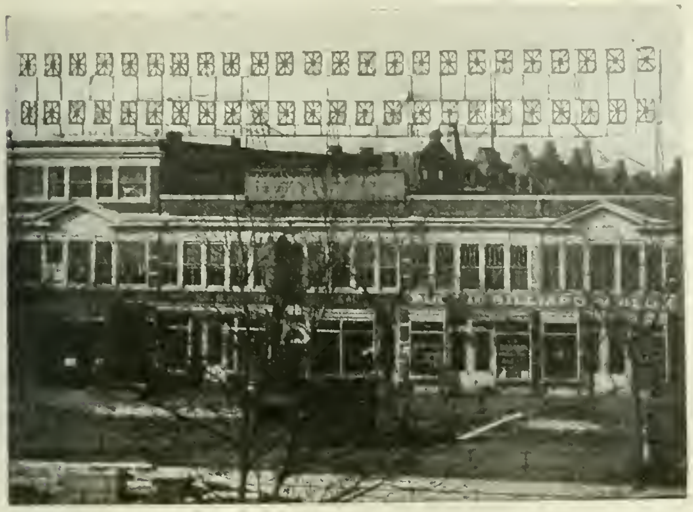


FIG. 1.—THE SIGN AS SEEN BY DAY.

It may almost be said that the electric sign has changed the nocturnal aspect of our larger cities where hundreds of signs composed of thousands of incandescent lamps are displayed against the sides of and in front of stores, places of amusement, restaurants and newspaper offices, as well as on the tops of buildings in prominent locations. As an example Broadway, between Thirty-eighth and Forty-first Streets, may be cited (shown in Fig. 2), where no less than 310 letters are displayed, composed of over 4600 incandescent lamps. At another location in New York, an electric sign is displayed for which one advertiser pays the enormous sum of $24,000 per year, which includes rental of the space and the current consumed by the lamps and the motor which drives the mechanism used for lighting and extinguishing the various rows at definite intervals.

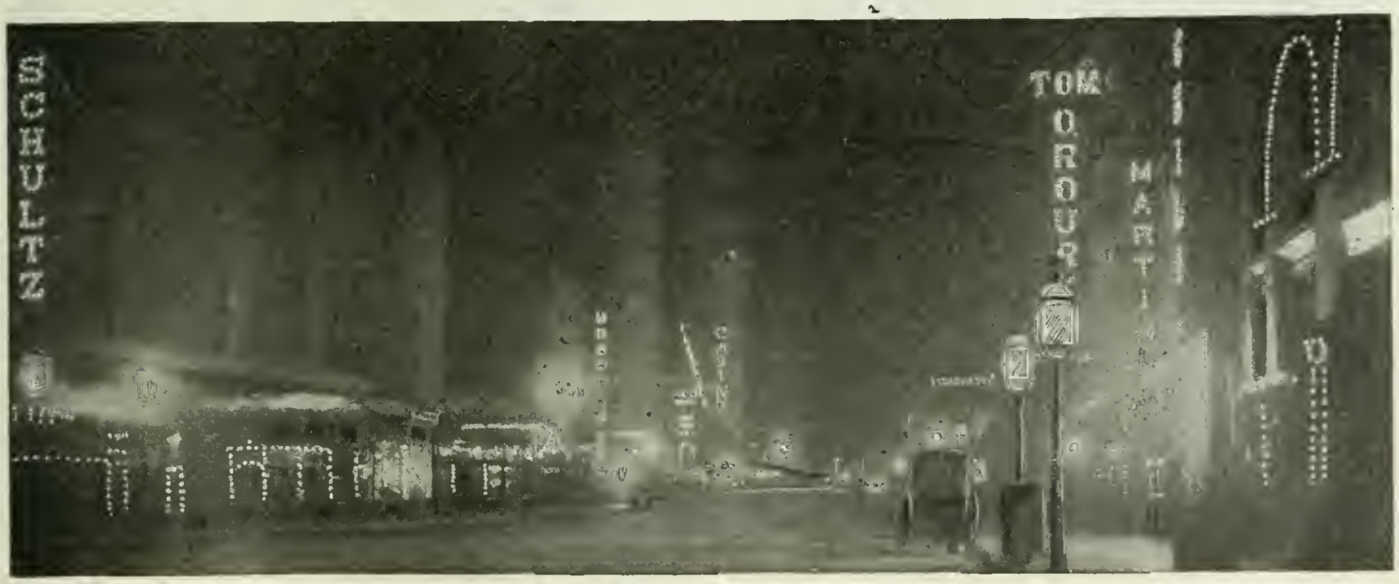


Fig. 2.—Night View on Broadway, New York.

It is nevertheless this enormous cost of operating an electric sign of this type, which in turn limits the advertiser to a short, universal announcement, which has been responsible for the fact that heretofore advertisers have considered an electric sign a great luxury and not as good paying an advertising medium as the newspaper, the billboard or the magazine. A sign, like the salesman or the editor, must talk to the people, who want to hear a new story, a new fact, as quickly as the eye and mind can grasp them. It is the talking sign which appeals to the public and sweeps aside all the old limitations. In order to understand more fully the functions of the sign about to be described, let us divide all electric signs into the following classes:

1. Non-changeable or fixed signs.
2. Signs in which the separate lamps or letters are turned on and off successively.
3. Signs which are lighted and extinguished at definite intervals.
4. Signs consisting of several rows of letters, which are successively turned on and off.
5. Signs combining two or more of the above features.
6. Signs on which each letter may be changed to any other letter of the alphabet, thus changing the entire sign at definite intervals; the signs being operated by a constant attendant.
7. Signs identical with the last-named, with the exception that they are operated automatically.

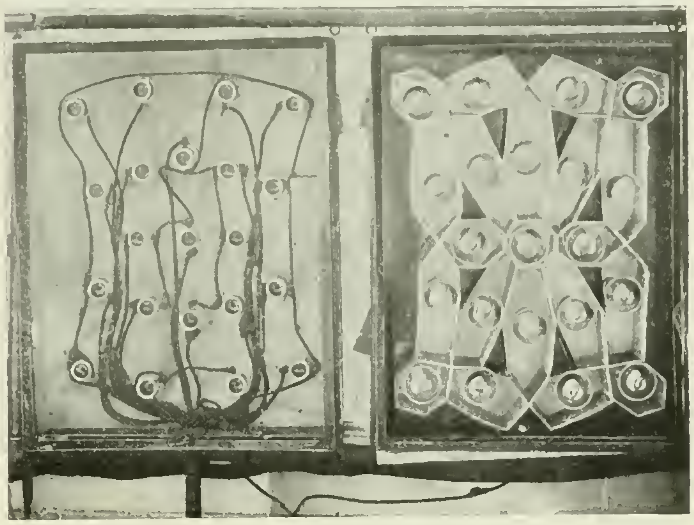


FIG. 3.—ONE OF THE MONOGRAMS.

It is upon this last named principle that the successful electric sign must be constructed, for it not only combines the advantages of an ordinary electric sign, but it enables one to tell a story of any number of words and sentences, as quickly as one wishes, automatically. And if all these conditions are realized in addition to the fact that the sign consumes only one-half of the current required for any fixed sign it seems as if the ideal has been reached.

Such a sign is in existence, and is located over the roofs of the two-story buildings at the northwest corner of Sixty-fifth Street and Broadway, New York. This is one of the most prominent corners in the metropolis, as it is a transfer point for the surface cars, and is passed by all the Sixth and Ninth Avenue elevated trains. It is estimated that from 250,000 to 300,000 persons pass this point daily on cars alone. The sign is owned by the Mason Monogram Company, of New York, who work under the patents granted to Mr. George L. Mason, Mr. Max Osterberg being the consulting engineer for the company. The sign, shown in Fig. 1, consists of two rows of boxes or "monograms," each row being 128 ft. in length. There are in all 48 monograms on the sign, each 3 ft. wide and 4 ft. high. The total length of the sign therefore is 256 ft. making this the largest electric sign in the world. It may be of interest to state that before this sign was erected the company constructed a single monogram on the Palisades 36 ft. in height, which could be plainly read all over the island of Manhattan and for some distance down the Bay.

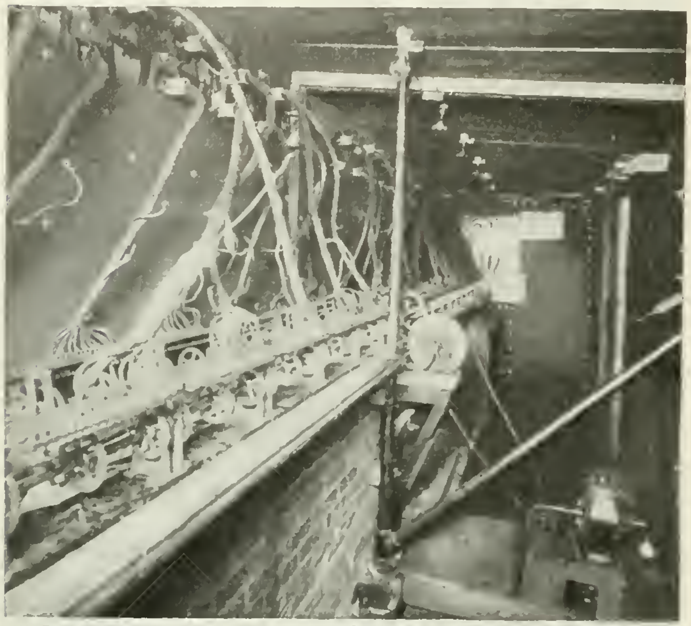


FIG. 4.—INSIDE OF OPERATING ROOM.

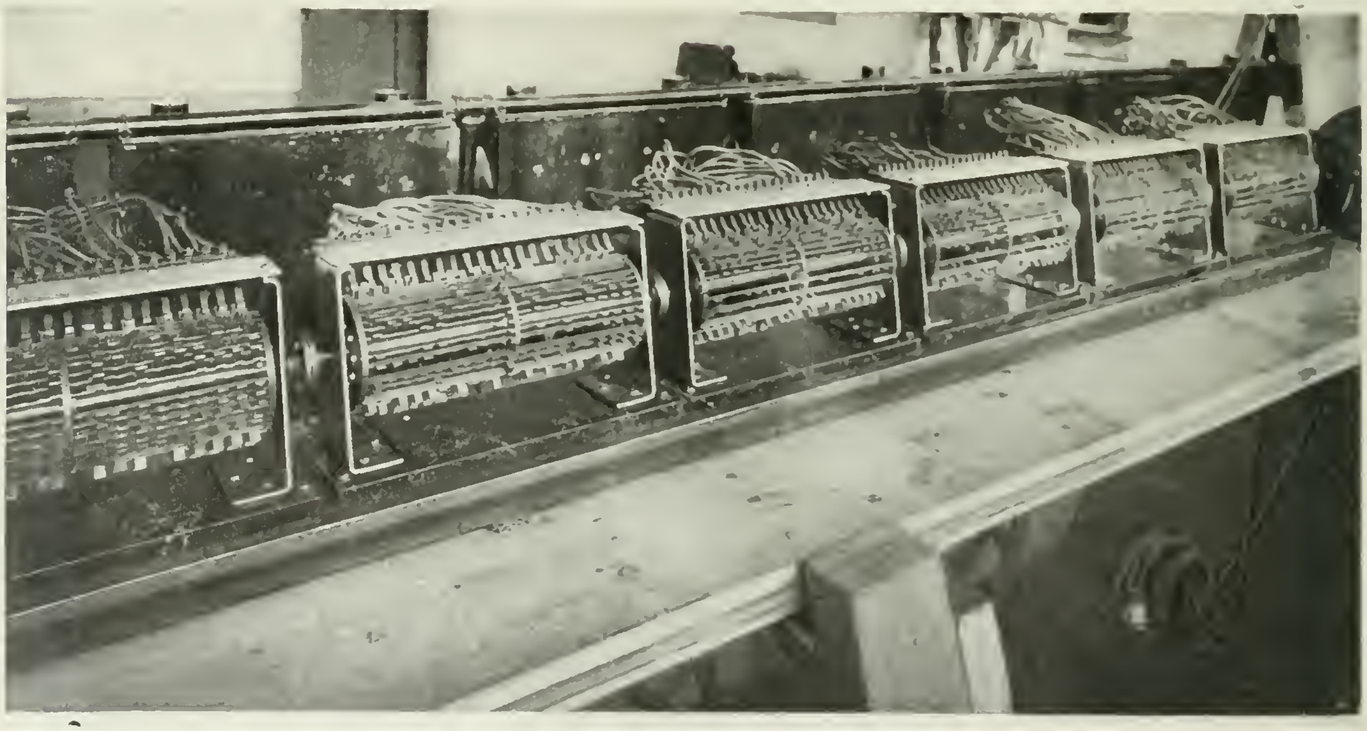


FIG. 5.—VIEW OF THE COMMUTATORS OF ELECTRIC SIGN.

Each monogram or box (shown in Fig. 3) consists of a number of tin boxes or troughs, united in such a manner that any letter of the alphabet or any number may be formed. Within each trough is an incandescent lamp—in this sign of 8 cp—and each trough is enameled white on the inside, the troughs thus acting as reflectors.

It will be seen that a letter constructed on this principle will need a smaller number of lamps than an ordinary letter studded with lamps, and furthermore that the light is concentrated along certain sharp lines, obviating the blur which makes the ordinary sign so illegible at a distance; in fact, it appears as if these monogram letters can be distinguished twice as far as the old form of electric letter. There are 21 spaces or troughs to each monogram, and naturally the same number of lamps. The largest number of lamps used for the formation of any letter, however, is only 13, and the average number for any letter of the alphabet is 8. This is about half the number of lamps needed for the formation of the ordinary 4-foot letter, so that the cost of operating this sign is only one-half that of operating the old style. The sockets protrude through the bottom of the troughs and behind the plate supporting the troughs the wiring is hidden, as shown in Fig. 3. As the two lamps in the two bottom troughs are always used together they are wired on one circuit so that there are 20 circuits of one polarity leading from the box besides one common return for all the lamps, making a total of 21 wires. These are bunched together into a cable, as seen in Figs. 1 and 3, and are led down to the booth in which the commutators are located. As there are 48 monograms composing this sign, there are a total of 48 × 21 = 1008 wires.

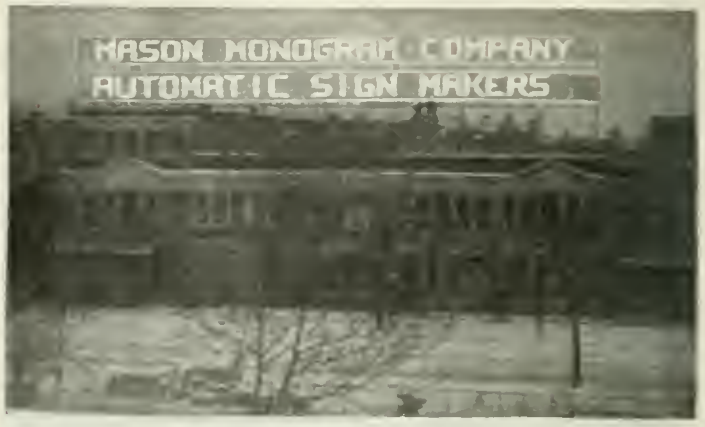


FIG. 6.—THE SIGN AT NIGHT.

Inside of this booth, shown partly in Fig. 4, are the two rows of commutators, one for each monogram, all connected by a shaft and separated from each other by means of an insulating coupling. The commutators, shown more plainly in Fig. 5, are each 14 inches in length, and consist of a revolving drum on the periphery of which, and insulated therefrom, are mounted the copper selecting bars, each having as many projections as it is intended to light lamps in a monogram. Each bar takes care of the lamps in one monogram, and as in this sign it is the intention to have 40 changes on the sign for one complete revolution of the drum there are 40 bars on the periphery. Mounted above the drum is a plate which supports 20 springs or fingers, making contact with the projections left on the bars. To these 20 springs the 20 wires from the box are connected while the ones, representing other letters, and which are kept in stock. This common return is directly connected to one side of the main circuit, thus placing the commutators in series with the main feeders and monograms. If it be desired after the 40 changes have been prepared for all the monograms, to change a complete sentence, it is only necessary to take out one set of 48 bars and replace them by new ones, representing other letters, and which are kept in stock. This operation takes but little time, and can be accomplished without stopping the machinery.

The commutators are revolved by means of a ¼-hp motor, which, after its speed has been reduced by means of worm gearing is connected by belt to an intermittent gear having 40 teeth. This is of such a diameter and so adjusted that each time the one-tooth pinion enters its space on the gear the commutators are revolved so as to present a new sentence on the sign. It is so timed that the change is gradual, the sign never being in entire darkness, and a new sentence is shown every 10 seconds, 2 seconds of which may be said to be taken up by the gradual change.

Fig. 6 shows a night picture of the sign, which gives a good idea of the shape of the letters, which are legible as well as ornamental. While this sign is used for general advertising purposes, the company are making signs for individual users, who are enabled to talk to the public all the evening on any subject on which they may care to address them, changing the subject matter the next evening if they so desire. In conjunction with a keyboard, the sign may be used for announcement purposes, such as the signalling for carriages, or between ships, the results of contests and elections, and many other purposes. The colors of the monograms may be altered by affixing plates of colored glass in front of the boxes.

In view of the numerous advantages combined in such automatic changeable electric signs, they seem destined to open a new era in electric light advertising, and become an important factor in the business and electrical world.

Government Telegraphs and Telephones in England.

A critical review of the conditions of the telegraph and telephone in England is contributed to the latest issue of the *Nineteenth Century and After* by Prof. J. A. Fleming, who, in the fact of Government control or burdensome conditions imposed by legislation, finds an explanation for what he regard as the very backward state of electrical enterprise in England. His views are quoted in part below:

Now it is a curious coincidence that just at the dawn of this period of electrical activity—viz., in 1870—the Government of this country set themselves up in business as electricians, and proceeded to create a gigantic Government monopoly in one large department of electrical invention which has exercised a most undoubted control over the supply and demand for invention in a wide area of electrical work. Prior to 1870 the chief practical use which had been found for the electric current was in the electric telegraph. Public telegraphy was conducted by competing electric telegraph companies covering various areas of the country, just as the various railway companies do at present. Their development created a demand for electrical inventions in telegraphy, and the records of the Patent Office show how prolific were some inventors in supplying the need. The Government of that day thought it right in the public interest to buy up all these companies for a capital sum of £10,000,000, with the object of bringing the benefits of telegraphy within the reach of all. But in order to protect the capital thus invested from injury by competition, they passed acts of Parliaments in 1868 and 1869, giving the Post Office exclusive rights, with certain exceptions, to transmit messages and information by electricity when practiced for profit. When the telephone made its appearance in 1877, and telephone exchanges began to be devised in 1879, the question arose whether a telephone was a telegraph within the meaning of the act. The Government telegraph officials feared that their monopoly was threatened; hence with the assistance of the crown lawyers they proceeded to stake out a big claim, and to obtain an interpretation of the Telegraph acts, passed to legalize the purchase of the old electric telegraph companies, which was equivalent to an authoritative statement that the Post Office possessed the sole right to transmit intelligence by electrical means in return for payment, not merely as the art was then known, but by all and every method which the wit of man could or might throughout everlasting ages devise. Two judges, not the very strongest who have ever sat upon the bench, gave judgment in this sense against the United Telephone Company. Unfortunately the case never went to appeal, far less to the House of Lords. The victorious Post Office said to the vanquished telephone company, "Don't let us fight any more. Give us 10 per cent of your gross receipts and we will give you a license to work your invention."

The story of the relations of the Post Office and the telephone is a long one; some simple facts can only be mentioned here. The 10 per cent royalty paid by the National Telephone Company to the Post Office amounted in 1898-1899 to £123,061; in the past year probably to about £130,000. The proper telegraph business of the Post Office is conducted, as is well known, at a loss. * * * The total royalty paid by the National Telephone Company and its predecessors up to Sept. 30, 1900, has been £1,081,490. This has been a tax imposed by the Post Office on a new industry barely 20 years old. When the telephone first made its appearance the technical experts of the Post Office laughed at it as a toy. It was only when they were convinced of its utility by hard facts that they set in motion the legal machinery which enabled them to bring it within the grasp of the Telegraph acts. Yet the claim of the Post Office to finger this million of sovereigns depends only on a single decision in a Court of First Instance, and has never been confirmed by the higher legal tribunals.

The officials in the Government Telegraph Department were at once exalted into a position of paramount power over all electrical invention in land telegraphy. It is pure waste of time for an inventor to spend days and nights over a telegraphic invention, or invest capital in patenting it, unless he can get it tried, and if it succeeds, market his invention to a purchaser. He is not generally a philanthropist, but is spurred to work by the hope of reward. But in electric telegraphy he can try nothing and market nothing unless he first persuades or pleases the permanent officials of the State Telegraph Department. He has to overcome their inertia, opposition, or it may be ill will, before he can even get a trial of his telegraphic apparatus, and when at last he demonstrates an important advance, he is entirely at their mercy whether it shall be adopted or not, and, if so, what price he shall receive for it The permanent official in any Government department is not, as a rule, eager to introduce improvements from outside. He loves his departmental routine, his habits of mind are slow, methodical, cautious, and he does not want radical reforms. If there is to be any invention at all, he generally likes it to proceed from himself, doubtless at the expense of the nation, so that he may keep before the public eye, and convince his chiefs that he is a clever and important person. A young man bursting with new ideas does not generally enter the civil service, he prefers the greater freedom—if more risk—of a career outside; hence we should hardly expect a State telegraph official to be a prolific and original inventor The most effective method of afflicting any department of applied science with creeping paralysis is to constitute it a Government monopoly.

Prof. Fleming discusses the work of Marconi, and argues that the Post Office has been very inert; and "has continued to experiment deliberately with its own inductive system, a system which would be totally inapplicable to lightships and to very many lighthouses."

Protecting Railroads Against Burglars.

The Southside Alley Electric Elevated Road, Chicago, has put in a system of electric gongs to head off the men who have been robbing its stations. The ticket seller can, by a slight movement of foot or hand, spring the alarm by means of a projecting button of comfortable size, which is placed on a level with the seat of his high chair. Instantly a huge gong on the station platform outside the ticket office is set to thundering, and the sound, it is said, will penetrate the air for a distance of nearly a mile. At the same time, and by the same motion of foot or hand, similar gongs in every station will be set off, the nearest police station notified, private detectives summoned, and any persons who may be on the streets will be told to look out for fleeing burglars. "Our system," the company officials explain, "is not protected by patents, but it will not be duplicated readily. From the tests we have made it seems absolutely certain that any further attempts to burglarize our stations or to 'hold-up' the ticket sellers will fall short of successful execution."

Electricity in Switzerland.

By H. L. Geissel.

ELECTRICITY is making, like all other industries, steady progress in Switzerland. During the last five years especially a considerable number of electrical enterprises have sprang up, either in the form of individual undertakings, or as joint stock companies. The latter predominate, and were formed, not so much for the purpose of engaging in the manufacture of electrical machinery and appliances, as with the object of developing electricity in general. Thus it comes that we find to-day the headquarters, or at least the financial headquarters, of many a Spanish, French, Italian and Russian electrical company in Switzerland. On the other hand, the manufacture of electrical machinery within the country is assuming larger proportions every year, which is best evidenced by the increasing exports and decreasing imports of electric machinery. In 1899 the exports of electrical machinery from Switzerland amounted in value to 12,257,081 francs, as against 8,941,211 francs in 1898. Swiss-made electrical machinery has always enjoyed a high name. Firms like Escher, Wyss & Co., the Oerlikon Company, Brown, Boveri & Co., etc., ship their machines and turbines to all parts of the world. In 1899 the exports were divided up as follows: To Russia, 2,769 754 francs; Germany, 1,928,874; France, 1,860,414; Scandinavia, 1,099,494; Spain, 827,771; Austria, 722,641; Great Britain, 522,167; Belgium, 494,048; East Africa, 115,575; Egypt, 81,235; Central America, 79,340; Netherlands, 68,862; Brazil, 53,000; Colombia, 42,400; Balkan States, 34,485; United States, 19,000; West Africa, 8,300; Portugal, 8,000; Dutch East Indics, 2,800; Algeria, 2,790; Argentina, 2,070; Chili, 1,920; Greece, 1,200.

The imports of electrical machinery into Switzerland amounted only to 650,720 francs, as compared with 847,475 francs in 1898. Germany supplied 509,250 francs worth, whilst 56,165 francs worth came from France, and some quantities from Italy, Austria and the United States, our share having amounted in value to 22,090 francs.

A short review of the Swiss electrical joint stock companies, having a capital of more than 2,000,000 francs (about $386,000), will doubtless be of interest, as it gives a clearer idea of the important position which Switzerland occupies both as regards the manufacture of electrical appliances and the control of electrical companies. The Société Franco-Suisse Pour L'Industrie Eléctrique, in Geneva, is the largest electrical enterprise in Switzerland. The company, though only formed in July, 1898, is interested in a large number of prominent foreign undertakings. The company is more of a financial than of an industrial character, as it chiefly promotes electrical enterprises at home and abroad. The capital amounts to 25,000,000 francs, divided into 50,000 shares of 500 francs each. So far, 50 per cent of the nominal capital have been paid up. During the first year of its operation the company yielded 660,431 francs profits. The company is especially interested in the following electrical enterprises: St. Petersburg Tramways, Grenoble (France) Electric Light & Power Company, Paris; Neuilly Electric Company, Neuilly, France; St. Gervais (France) Electric Company, Twer (Russia) Tramways & Electric Power Company, Southern Electrical Company, of Naples (Italy); The Volta Electrochemical Company, of Rome (Italy), and the Russian Syndicate for Electrical Enterprises in Russia. Mr. James Odier, in Geneva, is president of the company.

The Rheinfelden Power Transmission Plant is partly a German, partly a Swiss undertaking. In 1898 the Baden Government granted a concession to the company for the purpose of utilizing the water powers of the Rhine near Rheinfelden for industrial purposes, and at the same time the administration of the Canton of Aargau in Switzerland, granted a similar concession. The nominal capital of the company is 6,000,000 marks, and up to the end of the year 1899 the amount of 4,500,000 marks had been paid up. So far, some 9,000,000 marks have been expended for the construction of the central power plant, hydraulic works and transformers at Rheinfelden. State Councillor Dr. Emil Frey, of Rheinfelden, is president of the company.

The Alioth Electrical Company, of Arlesheim, near Basle, was founded in 1895, with a capital of 6,000,000 francs, which, since Feb. 28, 1900, has been entirely paid up. The company is chiefly interested in the manufacture of electrical machinery and appliances, and has extensive workshops at Minchestein (Switzerland) and Lyons (France), in which some 800 operatives are employed. The dividends paid by the company amounted to 6 per cent in 1897 and 1898, and to 7 per cent in 1899.

The Motor Company, of Baden, founded in 1895, has a nominal capital of 6,000,000 francs, of which 3,000,000 francs have been paid so far. This company is especially interested in all lines of electrotechnical and electrochemical enterprises. The company owns and operates the electrical power plants of Grindelwald, Kander, Beznau (Switzerland), and that at Bingen (Germany), and is financially interested in various Swiss, Italian and German electrical companies. The dividends paid so far were 5 per cent in 1896, 5 per cent in 1897, 6 per cent in 1898 and 7 per cent in 1899. The well-known electrical firm of Brown, Boveri & Co., of Baden, Switzerland, is largely interested in this company.

The Hageneck Electrical Company, of Biel, was founded in 1898, with a nominal capital of 2,500,000 francs, divided into 5000 shares of 500 francs each. The company erected during the years 1898-1899 a large electric power plant on the Aare River near Hageneck, for industrial and lighting purposes.

The Company for Electrical Enterprises in Geneva was formed in 1895, with a capital of 2,000,000 francs, divided into 500 shares. So far 50 per cent of the capital has been paid. The company is interested in the central power plants of Belluno and Feltre (in the province of Venice, Italy); the Electric Light Works, of Faenza (Province of Ravenna, Italy); the Belgian Electric Light Company; the Electrical Works of Monte Albano (Italy); the Franco-Italian Industrial Company; the French Tudor Accumulator Company, and in several Spanish and other foreign electrical enterprises.

The well-known Oerlikon Company, of Zurich, has a capital of 6,000,000 francs, and paid a dividend of 10 per cent in 1899. Escher, Wyss & Co., of Zurich, also a stock company, have a capital of 5,000,000 francs, and paid a dividend of 6 per cent in 1899. The firm owns and operates the famous works at Zurich and Ravensburg.

Electrolytic Production of Phosphorus.

THE production of phosphorus by electrolytic means has been the subject of experiments by Dr. F. J. Machalske in his laboratory at Long Island City, N. Y., and it is stated that such satisfactory results have been obtained from the process developed from these experiments that a company, called the Anglo-American Chemical Company, has been formed to produce yellow and red phosphorus on a commercial scale. The following details of the system have been supplied by the inventor:

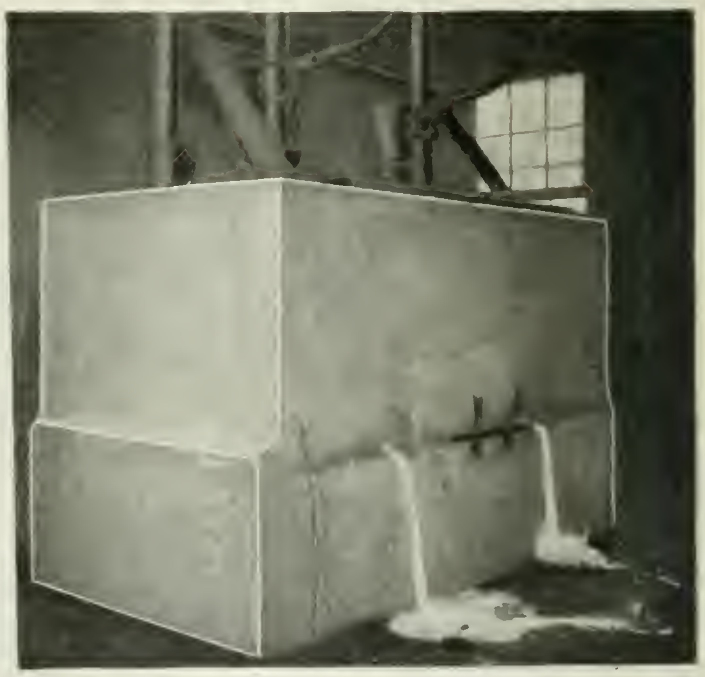


FIG. 1.—VIEW OF FURNACE.

The raw material consists of the ordinary phosphate rock used generally as a fertilizer. At present two electrical furnaces are installed, as illustrated in Figs. 1 and 3. The furnace is shown in section in Fig. 2. Each furnace has a chamber 12 ins. by 18 ins. in area with a carbon bottom and sides lined with calcined magnesia, the cover being composed of fire clay and red brick. Each furnace has an aperture on top for feeding the phosphate rock, and an aperture for inserting an electrode 8 ft. long and 4 ins. in diameter. It is

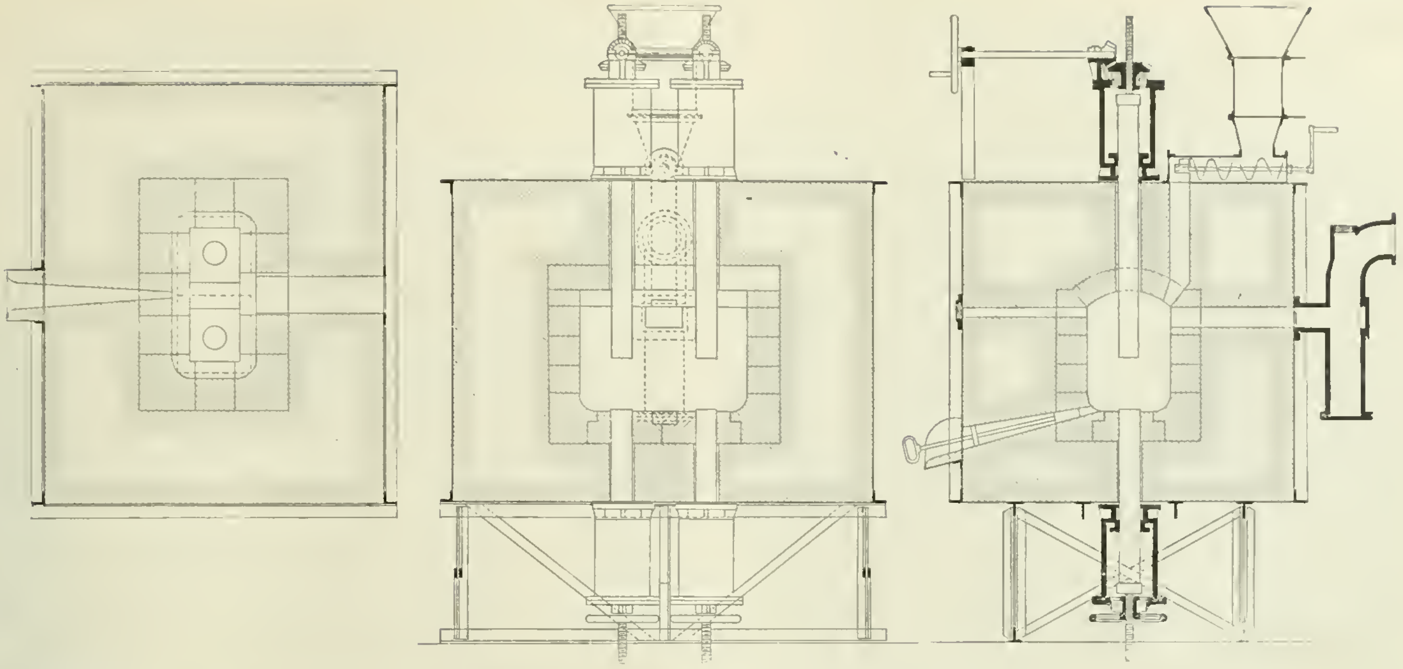


FIG. 2.—DETAILS OF ELECTRIC FURNACE FOR PHOSPHORUS PRODUCTION.

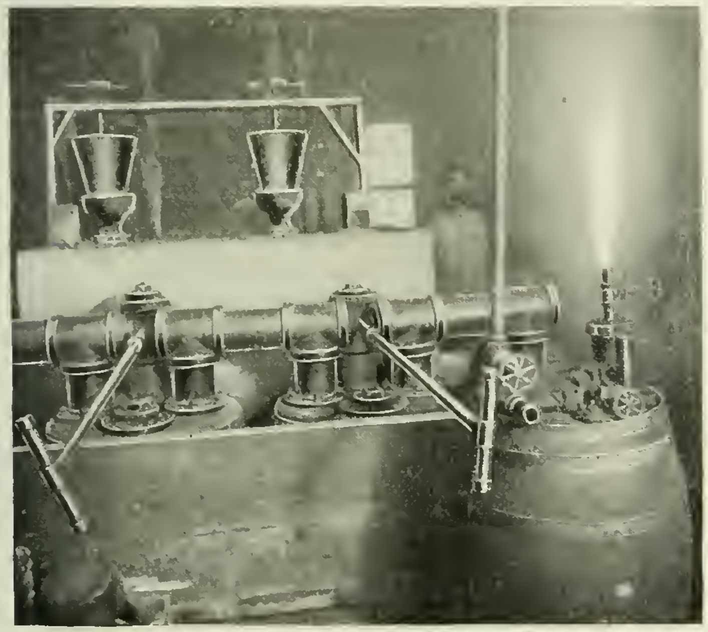


FIG. 3.—FURNACE, SHOWING ELECTRODES, FEEDERS AND CONDENSERS.

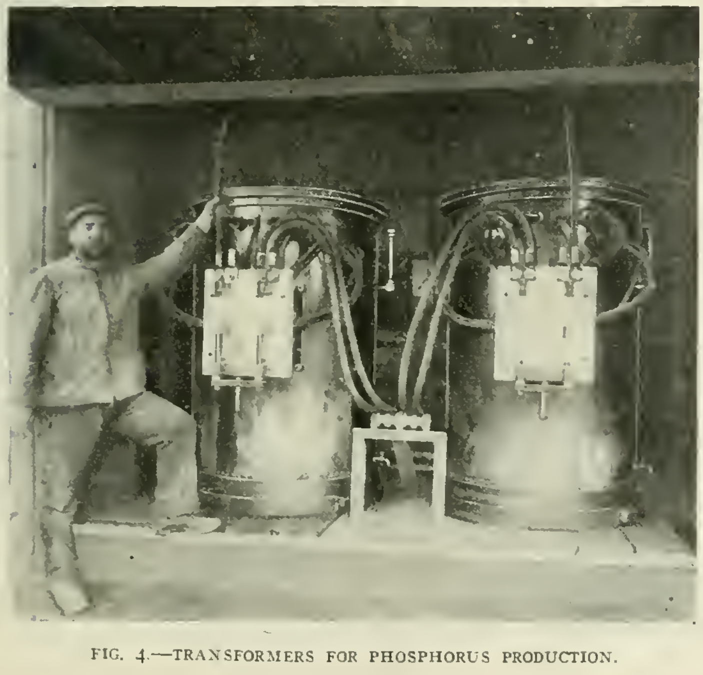


FIG. 4.—TRANSFORMERS FOR PHOSPHORUS PRODUCTION.

stated that five minutes after current is turned on a temperature of 7000 degs. F. is produced, which will reduce in 15 minutes 150 lbs. of phosphate rock. The phosphorus vapors set free are condensed under water and the residual slag allowed to run off, as shown in Fig. 1. The operation is a continuous one.

In Fig. 3 a double electric furnace is shown in the background with its feeding hoppers and carbon electrodes. Fig. 4 shows the two large Wagner transformers used with the reduction plant, each transformer being of 2000-amperes capacity. Current for the plant is furnished from the circuits of the New York & Queens Electric & Power Company, of Long Island City. It is claimed that yellow phosphorus may be produced by this method at a rate of 7 cents per lb., the cost of electric power being 3 cents per horse-power-hour.

Dr. Machalske claims to have separated by means of the electric furnaces a new metallic compound which has the appearance of silver, and is not affected by sulphuric or hydrochloric acid, though slightly attackable by concentrated nitric acid. The metal has a specific gravity of 10.02, and is a good conductor of electricity at common temperatures, but a non-conductor at temperatures at 100 degs. and above.* He also claims that in the course of his experiments he found that by means of an electrical furnace connected with a properly constructed condensing apparatus chlorides of carbon and especially carbon tetrachloride may be produced by treating in an electric furnace a mixture of common salt, carbon and sand.

Underground Roads in London.

The Baker Street & Waterloo Railway Company which it was supposed had been sold by the London Globe Financial Corporation weeks ago to Tom L. Johnson, of Cleveland, Ohio, appears to be still doing business under the old directorate. Its latest achievement is to purchase the booking offices of the London & Northwestern Company at Oxford circus for a station. In a few days the process of demolition of the buildings will begin before a shaft is sunk to connect with the tunnel. This tunnel has already pierced as far as the end of Regent Street and under the river to Waterloo Station. At Oxford circus connection will be made with the Central London tube, on the north side of Oxford Street. This will complete the triangular route between Oxford circus, the Bank and Waterloo.

It is expected to be fully 12 months before the road is ready to run trains. The company in the meantime is calling in an additional £2 ($10) a share to continue the operations.

Mr. Benjamin F. Cable, of Illinois, who has been in London for several weeks negotiating for the purchase of the road on behalf of the Johnson syndicate, left for Paris last night. His presence in England is regarded as certain proof that the deal is not yet consummated.

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* A test of the so-called new metal does not bear out these claims.—EDS.

Patent Expirations for 1901.

By Wm. A. Rosenbaum.

Some years ago the *Electrical World* for a time published weekly a list of the contemporaneously expiring electrical patents, but owing to the fact that by far the greater number of patents granted never become of interest to the public, it was found that a large amount of space was being devoted to a subject which did not particularly concern the readers of the paper, and the publication of such lists ceased. Nevertheless, among the many patents expiring from week to week there are some which have proved useful and are of interest to those concerned with electrical affairs; therefore I have attempted to give below the identifying data and hints as to subject and scope of those patents expiring in the current year which, by current report or the writer's special knowledge, have to an extent controlled the electrical business. Doubtless there are some important patents expiring during the year which are not included in this list, but those given are of importance, and no attempt has been made to accurately discriminate. In all probability a number of the patents cited expired several years ago by reason of the expiration of prior foreign patents, but this point has not been investigated.

Jan. 1.—C. S. Bradley. System of Electrical Distribution. No. 291,141. Feeding different points of the system from independent sources and regulating sources independently of each other.

Jan. 1.—Charles McIntire. Wire Joint. No. 291,211. A double socket with openings for solder.

Jan. 8.—C. J. Vandepoele. Current Regulator for Electric Motors. No. 291,650. Centrifugal governor adapted to bring a larger or smaller number of the field sections into operation.

Jan. 15.—J. Wenstrom. Dynamo-Electric Machine. No. 292,079. Iron clad field; tunneled armature.

Jan. 29.—E. Weston. Electric Circuit. No. 292,718. Metallic circuit, partially overhead and partially in conduits; latter provided with junction boxes.

Jan. 29.—E. Weston. Fusible Safety Strip for Electric Circuits. No. 292,713. Strips having protecting ends of harder metal.

Jan. 29.—E. Weston. Electrical Indicator. No. 292,714. Armature with curved ends turning between curved polar faces, retractile spring and indicator arm.

Feb. 5.—E. T. Gilliland. Driving Gear for Magneto-Electric Machine. No. 293,160. Rotation of the driving crank automatically closes the circuit from armature to line.

Feb. 12.—J. Bergmann. Socket for Electric Lamps. No. 293,552. Shade holder detachably connected to lamp socket.

Feb. 26.—V. Himmer. Electric Device for Synchronizing Clock Pendulums. No. 294,132.

Feb. 26.—W. Hochhausen. Double Electric Arc Lamp. No. 294,042. Means for tripping the second mechanism when the first has acted to its limit.

Feb. 26.—F. L. Pope. Electrical Conductor. No. 294,148. Steel core coated with copper.

Feb. 26.—A. G. Waterhouse. Regulator for Dynamo-Electric Machines. No. 294,169. Regulation by shifting the poles of the field magnet.

Feb. 26.—E. Thomson. Dynamo-Electric Machine. No. 294,094. Axis of field magnet and armature in line, one pole of the field magnet being formed in the base of the machine and the other extending directly from the core of the field coil.

March 4.—F. M. Lytle and J. A. McCoy. Telephone Central Office Apparatus. No. 294,482. Switches arranged to connect subscribers' cords with either of two signaling keys.

March 4.—Z. T. Gramme. Commutator for Dynamo. No. 294,613. Brushes mounted on a single carrier and adjustable together.

March 4.—L. Stieringer. Combined Gas and Electric Fixture. No. 294,697. Wires covered by the ornamental portion of the fixture.

March 11.—Profs. Ayrton and Perry. Telpherage System. Electric motor traveling on a cable and pulling a load behind it.

March 11.—R. C. Stone. Telegraph Wire Supporter. No. 295,073. Copper wire suspended from steel wire, split insulators surrounding each.

March 18.—J. Absterdam. Automatic Telegraph. No. 295,219. Stylus traverses drum in which characters are set with non-conducting material.

March 25.—E. Thomson. Double Carbon Arc Lamp. No. 295,836. Shifting mechanism.

April 1.—C. L. Buckingham and H. C. Townsend. Automatic Cut-Out for Electric Lamps. No. 296,125. Lamps in series. Shunt around each. Secondary circuit including magnets for closing each shunt.

April 8.—J. A. Maloney. Telephone Transmitter. No. 296,421. Iron filings between carbon electrodes.

April 8.—H. Flad. Electromagnetic Air Brake. No. 296,546. Electromagnets arranged to operate the valves in an automatic air-brake system.

April 15.—E. Thomson. Dynamo-Electric Machine. No. 296,799. Storage battery in a shunt around the field magnet to maintain the polarity of the field.

April 29.—T. A. Edison. Incandescent Electric Lamp. No. 297,581. The globe contains a residual atmosphere of carbon monoxide.

April 29.—T. A. Edison. Dynamo-Electric Machine. No. 297,583. A belt-driven machine having endwise movement provided for the armature.

May 6.—E. Weston. Incandescent Lamp. No. 298,325. A zigzag filament.

May 13.—T. B. Doolittle. Telephone Exchange Apparatus. No. 298,559.

May 13.—C. J. Van Depoele. Dynamotor. No. 298,431. An armature with two independent windings.

May 20.—H. E. Waite. Telephone Transmitter. No. 298,923.

May 20.—T. A. Edison. Mode of Operating Dynamo-Electric Machines. No. 298,956. Dynamos of different capacity connected in multiple with the same circuit, and means for regulating their electromotive force.

May 20.—R. P. Sellon. Apparatus for Charging Secondary Batteries. No. 299,021. An engine, dynamo and battery with mechanism for coupling and uncoupling the engine and dynamo according as the battery is charging or discharging.

May 27.—E. Jones and A. E. Jones. Electric Arc Lamp. No. 299,397. Current shunted around lamp if carbons break.

June 3.—H. B. Lytle and J. J. Carty. Method of and Apparatus for Individualizing Telephone Time Signals. No. 299,561

June 3.—W. J. McCausland. Printing Telegraph No. 299,664.

June 10.—F. W. Hazazer. Electric Bell. No. 300,263. Box in one piece, closed front, open back. Box forms back yoke of magnet.

June 17.—C. L. Buckingham and W. B. Vansize. Printing Telegraph. No. 300,341.

June 24.—F. W. Jones. Static Compensator for Telegraphs. No. 300,781.

June 24.—Wellington Adams. Electric Motor. No. 300,827. An annular field magnet forms the rim of a car wheel.

June 24.—W. S. Johnson. Electric Valve for Regulating Temperature. No. 301,059. For application in steam and water heating.

July 1.—A. W. Hall. Electric Railway Signal Apparatus. No. 301,361. Circuits normally closed and signals at safety. Train breaks circuit and de-energizes a magnet, which locks, when energized, the armature of another magnet in position to close a circuit controlling spring in the signal circuit.

July 8.—W. A. Jackson and W. R. Cole. Telephone System. No. 301,603. Test bars and talking bars arranged on opposite sides of a series of line plates.

July 8.—C. L. Clarke. Transmitting Device for Primary Electric Clocks and Means for Actuating Secondary Clocks Thereby. No. 301,805. A revolving-circuit closing point and a revolving-contact point against which said circuit closer is periodically caused to impinge.

July 22.—H. K. Goodwin. Telephone Switch. No. 302,330. Connecting cord containing switch to connect in either calling generator or operator's telephone.

July 22.—F. W. Jones. Quadruplex Telegraph. No. 302,410. Two transmitters, a main battery grounded at its middle through the back contacts of the transmitters, and connected at its terminals to the front contacts of same, a normally closed connection from line to earth through a resistance equal to that of the whole battery, and resistances in the two grounds from the middle of the battery equal to the resistances of the two sections of battery.

July 29.—E. T. Starr. Electric Motor. No. 302,793. The brush holder movable circumferentially and longitudinally relatively to the commutator.

Aug. 5.—E. Thomson. Focusing Arc Lamp. No. 302,961.

Aug. 12.—L. D. Hamilton. Double-Acting Relay for Electric Circuits. No. 303,570.

Aug. 19.—E. Thomson. Electric Arc Lamp. No. 303,762. Telescopic support for globe holder.

Aug. 26.—G. M. Phelps. Means for Rotating the Printing Wheels of Printing Telegraphs. No. 304,025.

Aug. 26.—T. A. Edison. Electrical Conductor. No. 304,087. Guard wires placed parallel and above conductor.

Sept. 9.—E. Weston. Electrical Recording Meter. No. 304,881.

Sept. 9.—E. Weston. System of Electric Lighting. No. 304,882. Series incandescent system with automatic lamp cut-out.

Sept. 9.—E. A. Sperry. Electric Arc Lamp. No. 304,966.

Sept. 9.—C. E. Scribner. Multiple Switchboard. No. 305,021. Normally open test circuits with means for connection while line is in use.

Sept. 16.—Fleeming Jenkin. Telpherage System. No. 305,194.

Sept. 23.—W. H. Knight. Electric Railway. No. 305,731. Sectional line, the sections being in series and cars on each section in parallel.

Sept. 30.—T. L. Dennis. Electric Arc Lamp. No. 306,005. Sectional adjustable magnet coil.

Oct. 7.—S. H. Bartlett. Telephone Switch. No. 306,050. A conducting cord having a switch contained therein.

Oct. 7.—C. G. Burke. Printing Telegraph. No. 306,055.

Oct. 7.—E. T. Gilliland. Telephone Circuit and Apparatus. No. 306,238. Trunk system.

Oct. 14.—M. G. Kellogg. Conducting Cord for Telephones. No. 396,495. Method of braiding double cords.

Oct. 14.—F. Van Rysselberghe. Combined Telegraphic and Telephonic Apparatus. No. 306,665. Arrangement of inductances and condensers whereby telegraphic and telephonic messages may be sent simultaneously over the same circuit.

Oct. 21.—Edward Weston. Process of Making Incandescent Lamp Filaments. No. 306,980. Building on a core by rendering incandescent in a carbon vapor.

Oct. 21.—A. A. Ripley and J. Bridgeford. Magnetic Ore Separator. No. 306,778.

Oct. 21.—W. Baxter, Jr. Enclosed Arc Light. Air Tight Arc Lamp. No. 306,998.

Nov. 4.—J. E. Smith. Electromagnetic Pole Changer. No. 307,498.

No. 11.—E. Thomson. Cut-Out for Electric Lamps. No. 307,819.

Nov. 11.—C. J. Vandepoele. Apparatus for Operating Tools by Electricity. No. 307,884. Reciprocating electric drill.

Nov. 11.—L. J. Phelps. Communicating to and from Moving Trains by Electricity. No. 307,484. Train telegraphy by induction.

Nov. 18.—M. G. Kellogg. Multiple Switchboard for Telephone Exchange. No. 308,315. A fundamental multiple switchboard patent.

Nov. 25.—C. H. Pond. Electro-Mechanical Clock. No. 308,521. Motor periodically set in motion to wind spring.

Dec. 2.—J. H. Vail. Electric Light Fixture. No. 308,712. Incandescent lamp and socket inside of globe.

Dec. 9.—F. J. Sprague. Adjustable Resistance for Electrical Circuits. No. 309,167.

Dec. 23.—W. K. Freeman. Regulator for Electric Generators and Motors. No. 309,536. Opposing coils connected to be thrown into series with field coils.

Dec. 23.—C. Selden. Means for Overcoming Static Disturbances in Telegraphy. 309,571. Auxiliary magnet in local current acts upon relay armature in opposition to relay magnet, simultaneously with flow of the discharge or return current.

Dec. 23.—E. Gray. Telephone Call Box. 309,617. Shunt around magnets held open during operation of calling.

Dec. 23.—John D. Lyle. Telephone Switch. No. 309,791. Detail of a hook switch.

Dec. 30.—J. H. Rogers. Telephone Transmitter. No. 310,151. Hinged electrode resting upon button.

Electrical Barge Canal for New York State.

A very important system of State canals, the boats to be run by electricity and to be 150 ft. long by 25 ft. wide, with a draft of 10 ft., and to travel in fleets, going from Albany to Buffalo in less than three days, is the plan presented by State Engineer Bond and a board of prominent engineers to Governor Odell. The system is to be built for $7,000,000 less than proposed by the Canal Commission appointed by Governor Roosevelt. The canals will be able to carry 15,000,000 tons of freight in a season of seven months. For building an Erie barge canal on the route favored by State Engineer Bond, $49,000,000; for deepening the Oswego Canal to 9 ft., $859,026; for deepening the Champlain Canal to 6 ft., $5,472,000; total cost of canal improvement, $55,331,026. These are figures, in round numbers, presented by State Engineer Bond to Governor Odell. They are figures that are surprising because it has been intimated that the figures of the Canal Commission of $62,000,000 would be far exceeded when a careful survey is made. The figures for the Erie Canal are $9,008,000 less than those of the Commission, while the figures for the Champlain Canal are three times the amount asked for by the Commission.

The estimate of $49,000,000 is for a canal of a size suitable for barges of 10 ft. draft, 25 ft. width and 150 ft. length. The canal, as planned and estimated for by these routes, is first class in every respect, with locks of the most modern type, capable of passing two boats at once, with recent improvements and methods for filling and emptying the locks, with power generated to pull the boats into and out of the locks, operate the gates and valves and furnish electric light. In the river and lake channels the minimum width is 200 ft. Both the bottom and sides of the canal are to be thoroughly puddled. Guard locks are provided wherever required, and in the canal sections guard gates are provided at distances apart not exceeding 10 miles, so that any section can be shut off for repairs. A full complement of first-class new bridges is provided wherever required.

In the navigation of the proposed canals only steam, electric or other mechanical motors have been considered, consequently the towing path will be a thing of the past. The estimate covers the marking of the channels of the canalized rivers by spar buoys, anchored to the bottom of the river and easily distinguished. Each lock is equipped with four arc lights on the lock proper and one on each approach. Besides these, incandescent lighting will be furnished for the lock houses. A large expenditure for water supply, not contemplated by the Canal Committee, has also been provided for in the estimate. This question of water supply is a very important one, and in making the plans provision is made for safety and surety, and at all times, in the dryest season, passing 10,000,000 tons of freight a year and at the same time fully conserving all existing water power and protecting corporate and municipal interests.

Water Power Development in Minnesota

The Highland Canal & Power Company, of Duluth, Minn, proposes to construct in St. Louis and Lake counties, Minn., a water power canal able to deliver to consumers 100,000 24-hour electrical horse-power. The water shed covers an area of more than 2500 square miles, taking but a proportion of the annual storm flow, and impounding it in reservoirs, while the nature of the ground and the extent of swamps, lakes and streams to be crossed makes particularly easy the 100,000 horse-power that can be uniformly maintained through a far longer period of drought than has ever been known in the region. The open canal brings water to a point within the city limits of Duluth, and some 776 ft. above the level of Lake Superior. The drop will be through a series of steel pipes to the power house located in the center of the manufacturing district along the Duluth-Superior harbor. It is stated that nowhere else in this country can power be generated and sold so cheaply, on account of favorable conditions for ease and cheapness of construction, maintenance and operation, with an abundant and reliable supply of water, an available fall of 776 ft. and short-distance transmission. It is expected by the projectors of this company that they will sell power on a graduated scale much like that of the Cataract Construction Company, and at about two-thirds the price charged by that company. The estimates show that the cost of the entire system of canal and installation of plant will be not greatly in excess of the cost of the tail race of the Cataract Co. at Niagara Falls. The chief promoter of the enterprise is Mr. F. A. Cokefair, a New York engineer. Mr. T. J. Fanning, of Minneapolis, has passed on the estimates.

Annual Report of the Westinghouse Company.

The annual report of the Westinghouse Electric & Manufacturing Company, says: On Dec. 31, 1900, the surplus balance amounted to $4,693,197, against $2,401,664 March 31, 1897, after having in the meantime from current earnings written off $2,786,719, and in addition there has been paid:

Interest on debenture certificates, collateral trust bonds, dividend script and other indebtedness	$891,293
Dividends on preferred stock	1,049,122
Dividends on assenting stock	605,512

The net shipments or sales have been as follows for the years ending March 31:

	1900.	1899.	1898.
Sales	$11,963,646	$6,901,760	$4,378,060

The figures for 1900 will be considerably exceeded during the fiscal year ending March 31, 1901.

President Westinghouse says: "It is believed that the foregoing record of progress will be satisfactory to all stockholders, and if some should be surprised that more complete statements have not been previously submitted to them, it can only be said that the directors, as well as the stockholders who own the largest amounts of stocks, have believed that in view of the existing keen competition and the general attitude toward industrial enterprises, the interests of all would be served by avoiding, to as great an extent as possible, giving undue publicity to the affairs of the company.

The greatly increased demand for electrical apparatus has necessitated large additions ot the works and machinery at East Pittsburg, with a corresponding increase in capital requirements. The company's interests abroad have also assumed large proportions, it having in addition to its ordinary shares in the British Westinghouse Electric & Manufacturing Company, Limited, a cash investment of $750,000 in the preferred shares of that company, besides a considerable sum in the company's other European business.

The rapid development in the use of electrical machinery warrants the belief that even the present large facilities of the company will be insufficient to meet the demands, and therefore it is the intention of the directors and managers to further increase the facilities of the company as rapidly as circumstances warrant.

Of the $3,500,000 of the company's debenture certificates $150.000 have already been retired and a further $150,000 have been purchased for retirement July 1, 1901. The annual charge of $150,000 for sinking fund or retiring purposes will be cared for by the earnings, without other provision in regard thereto.

To meet the already increased capital requirements of the company, which cannot be cared for from the earnings without hardship to the shareholders, $3,000,000 of assenting stock, sold at the best price obtainable, but not less than par, will suffice.

CURRENT NEWS AND NOTES.

HOLLAND TORPEDO BOATS.—A San Francisco correspondent informs us that the Union Iron Works in that city are making good progress on the construction of two Holland submarine boats for the United States Government, to cost about $170,000 each.

ELECTRIC LIGHT CONVENTION.—Secretary G. F. Porter, of the National Electric Light Association, informs us that the twenty-fourth annual convention will be held at Niagara Falls, N. Y., on May 21, 22 and 23, and that headquarters will be at the International Hotel, which opens early that month. The Pan-American Exposition at Buffalo will also be open.

STREET CAR FARES.—A bill has been jointly introduced at Albany by Senator Marshall and Assemblyman Wilson, providing that passengers in surface and elevated railroad cars in Brooklyn who are not provided with seats shall be carried and transferred for a fare of 2 cents, while from those who are seated 5 cents may be exacted. It would be interesting to see how such a law could be carried into practical effect.

WIRELESS OCEAN TELEGRAPHY.—A cable dispatch from London of Feb. 21 says: "Mr. James Galbraith, an agent of Mr. Nikola Tesla, left London to-day for Lisbon to establish a receiving station on the Portuguese coast at the fortieth parallel of latitude, which will be in communication with a Tesla transmitter located on the New Jersey coast." Reports from Boston assert that a station is being put up there for this end of the "line."

THE CANADIAN ELECTRICAL ASSOCIATION.—A meeting of the Executive Committee of the Canadian Electrical Association took place at Montreal on Feb. 12, at which arrangements were made for the annual convention to be held at Ottawa. It was decided that the dates of the convention should be June 19, 20 and 21. A committee was nominated to arrange for "Papers and Topics for Discussion," and also to make the necessary arrangement for the meeting which gives promise of being a most successful one in every respect.

EDISON STORAGE BATTERY.—For some time past it has been known to a few friends of Mr. Edison that he had effected important improvements on the storage battery, as to weight, endurance, etc., but the technical papers had been asked to allow the first publicity in the matter to come in the shape of a paper on the subject to be read by Dr. A. E. Kennelly before the American Institute of Electrical Engineers. On Sunday last the New York *Journal* printed a sensational article concerning this battery, containing, however, no information whatever as to its principles. In the course of the article a member of a firm of lawyers is quoted at length. We are informed by this gentleman that the remarks credited to him are a pure fabrication.

GOVERNOR WALLACE, OF INDIANA.—A "true" historical story of former Governor Wallace and Prof. Morse is being told to the effect that on Dec. 14, 1842, Morse appeared before the Committee on Appropriations of the United States Senate to ask for an appropriation to construct a line between Baltimore and Washington. After wrangling and bitter talk on squandering public funds. the committee announced that it had decided to give the "crank" a chance. The matter passed the Senate and went to the House. There the members had another hot fight. The matter was referred to the House Committee on Appropriations, and only through the deciding vote of David Wallace, of Indiana, afterward Governor, it was decided to grant the appropriation. Wallace returned home, but was badly defeated in his attempt to return to Congress on the ground that he had squandered the people's money by indorsing a visionary scheme.

ELECTRIC MARINE RAILWAY.—There has recently been installed, at Liverpool, Nova Scotia, an electric marine railway of a novel character. The equipment of this railway consists of a 30-hp induction motor, the motor shaft being geared to a heavy worm shaft and wheel; the worm wheel shaft carrying a pinion, which gears into another large wheel, on the shaft of which is placed a large, heavy sprocket wheel; over this sprocket wheel the heavy two-inch chain meshes into heavy sprocket teeth. This chain hauls the vessel upon a cradle over a track projecting out into the River Mersey to a distance of 500 ft. on a grade of ½-inch to the foot. The track and cradle are built of heavy pine timbers. It formerly took from four to five hours to haul up a vessel by the motive power hitherto supplied by horses, whereas the same work is now performed by electricity in 20 minutes. The present railway is the first one in America, and probably in the world, operated electrically.

ELECTRIC CONSOLIDATION IN MONTREAL.—An important option, involving several millions of dollars, is said in reliable Montreal financial circles, to have passed between the syndicate at the head of the proposed lighting and heating combine in Montreal and the majority of the shareholders of the Lachine Rapids Hydraulic & Land Company. This latter company is the only one outstanding which has not been reckoned with in connection with the establishment of the proposed combine, legislation for which is now pending before the Quebec Legislature. The Lachine directors have declared that they would not go into any amalgamation scheme, and it would have to be a straight buy-out, or nothing at all. They have accordingly been holding out for a big price, and it is claimed the figures represented in the option given to the combine people, for a short time, involve a handsome return to the Lachine company for the expense it has gone to in making the Lachine rapids a success.

THE CUP DEFENDER, it is stated from Bristol, R. I., will be an all-metal boat to be electrically riveted, welded, etc.

PNEUMATIC TUBE SYSTEM.—Postmaster Van Cott, of New York City, states that, as he understands it, the compromise appropriation of $225,000 agreed to by the Senate Committee on post offices and post roads would allow the continuance of the present pneumatic tube service in this city, but would provide for no extensions whatever. When the existing contract expires in July a new one will be made with the company operating the tubes, but, as the New York appropriation is greatly reduced by the compromise arrangement, they will have to accept a lower figure than in the past. This is considered by business men to be far better for the mails than the proposed discontinuance of the system.

MASSACHUSETTS ELECTRIC EXPRESS.—A bill has been filed by W. A. Twombly and others with the Massachusetts Legislature to incorporate the Massachusetts Electric Express Company. This company seeks authority for the making of contracts with electric lines to carry express matter and baggage. The Massachusetts Electric Express Company will furnish special cars, patterned after the mail cars now running over electric lines, paying the carrying company for service rendered on a mileage basis. A saving of 33 per cent is claimed for this method of express delivery over the present wagon delivery system. The various electric companies now have to petition for special legislation every time they desire to carry express matter. Under the present scheme much of this special legislation will be avoided.

HEATER FOR NERNST LAMPS.—In Nernst lamps it is usually undesirable to make the glowers of any very considerable length—that is to say, for higher voltage than, say, 220 volts. For voltage beyond this it is best to connect the glowers in series or multiple series, which arrangement, moreover, conduces to economy in manufacture and operation. A patent was issued Feb. 19 to Alexander J. Wurts for such an arrangement of glowers. In one form illustrated there are two groups in series, each group consisting of six glowers placed vertically. The two groups of six are separated by a porcelain plate and the heater wire is wound back and forth upon the sides of this plate and held in place by any suitable insulating enamel. The compensating resistances are in the forms of coils, each coil connecting a glower of one group in series with a glower of the other group on the opposite side of the plate.

LIMITING AUTOMOBILE SPEED.—The New York Assembly Committee on Internal Affairs has reported favorably S. W. Smith's bill giving a Board of Supervisors of any county authority to regulate the rate of speed of any vehicle ridden or driven on a public highway; also Mr. Doughty's bill giving that right to the Board of Supervisors of Nassau County. Both bills are aimed at automobiles. Mr. Doughty's bill is on the order of third reading in the House, having been recommitted for a hearing. The automobile advocates did not appear in opposition, but sent Mr. Smith a substitute bill. This regulated the speed of the automobiles much after the French law, an automobile being permitted to attain whatever speed the driver desired, but being compelled to slow down upon the approach of a driver of a horse, providing the driver holds up his hand to indicate that the auto is to slow down. Mr. Smith refused to accept the substitute bill.

SELECTIVE RELAY.—In automatic telephone exchanges the practice has been to employ two relays to close independent local circuits at the central station, including respectively a selecting magnet and a connecting magnet. To produce the intermittent current necessary for the exclusive operation of the lighter relay armature, a rhythmical circuit breaker at the sub-station is introduced into the main circuit, which also includes the central battery, and the requisite succession of current impulses is thus created. These in due season are followed by the establishment in the circuit of a steady current, and this is brought about when the sub-station telephone is removed from its switchhook, the circuit being thereby closed through the telephone, and the heavy relay armature is operated by the steady current. In a patent granted Feb. 19 to A. M. Bullard and L. A. Falk, a relay and circuit is described, the object of which is to provide a single relay capable of responding to either intermittent or continuous electric currents, and which under the influence of these currents is capable of selectively controlling either or both of two independent local circuits, for the operation of the apparatus associated with them. The relay has two independent armatures of different inertia; the heavier of these is irresponsive to interrupted or intermittent currents, but responds to the passage of a continuous or steady current. The lighter armature is arranged to be responsive either to a steady or to a rhythmically interrupted current.

LONDON'S NEW TELEPHONE SYSTEM.—The officials of the General Post Office expect that the new telephone system of London will begin operations in about six months, first in the city and the business district and later in the West End. Heretofore the conduits laid in the city and to the westward were sufficient to carry 60,000 miles of wire. Parliament voted £1,250,000, which is sufficient to cover a considerable area, but much more money will be required for general service throughout London. The National Telephone Company has heretofore held a monopoly of this business. This company has now decided to increase its stock by £1,000,000 in order to compete with the Post Office. A special dispatch of Feb. 23 from London says: Londoners have grown accustomed to the inconvenience of torn-up streets, which have been open so long that the bus drivers and cabmen have almost forgotten the short cuts across town, never knowing whether they can return by the same route between two points. Still, the chaos has not been without compensation in the number of historic relics turned up by the pickaxes of the workmen digging the telephone trenches. Not long ago at Charing Cross an old sewer pipe of the hollowed trunks of oak trees was unearthed. These were evidently of the pre-Roman period. This week the foundations of two towers, believed to be portions of the old London wall, were unearthed in Aldgate High Street. The gate between the towers is known to have been demolished in 1606, but the discovery of a lot of Roman coins, as well as of curious arches resembling the cloisters of an ancient abbey, gives the researches almost a Pompeiian character. Another piece of buried London has just seen daylight through the telephone trenches in the old burial ground of Farringdon Street, near the site of the old Fleet Prison. The young poet, Chatterton, is known to have been buried there after his suicide in Holborn.

A MARCONI PATENT.—A patent was issued Feb. 19 to Marconi on an improvement to his wireless telegraph system. A previous patent, described in these columns, provided for an arrangement whereby the aerial conductor, instead of being in direct connection with the coherer, is connected with one end of the primary of a transformer of which the other end is grounded, the secondary of the transformer being in the coherer circuit. According to the present patent this secondary is broken in the middle and the inner ends connected to the local battery circuit which includes the relay for working an ordinary telegraphic receiver, while the outer ends are connected direct to the coherer. It is stated to be advantageous also to place a condenser across the inner ends, in which case the local battery circuit is connected to the condenser. Details of one form of transformer are given as follows: The primary, which is in circuit with the aerial conductor, is wound on a core ¼ in. in diameter and consists of 100 turns of No. 27 copper wire insulated in single silk and coated with paraffin wax. The secondary is of No. 32 copper wire insulated with a single silk covering and wound over the primary, commencing in the middle and in the same sense as the primary. Each half of the secondary is wound with a decreasing number of layers, beginning with 77 in the first layer and ending with 3 in the seventeenth, making 500 turns in all. In another form described, the primary is wound on a core 1 in. in diameter and consists of 50 turns of No. 21 copper wire insulated with single silk covering. The secondary is of No. 40 copper wire insulated by a single silk covering and is wound over and in the same sense as the primary. Each half of the primary consists of 160 turns in a single layer. These coils are stated to give the best results when the length of the aerial conductor at each station is 150 ft. When using coils in which the secondary winding consists of one layer only, the best results have been attained when the length of the secondary winding is approximately equal to the length of the aerial conductor employed at the transmitting station.

HAWAIIAN CABLE.—An amendment to the Civil Appropriation bill now before the United States Senate authorizes a contract for building a Government cable from San Francisco to Hawaii and appropriates $500,000 for the purpose.

WIRELESS TELEGRAPHY ON SHIPBOARD.—A dispatch from London states that the British steamship Ophir, on which the Duke and Duchess of Cornwall and York will sail for Australia, is being fitted out with a system of wireless telegraphy.

MASSACHUSETTS STREET RAILWAYS earned gross in 1900 no less than $21,387,641, and net $8,227,694. The charges on this were $5,190,192, and the dividends $2,409,874, leaving a surplus of $627,628. The gross assets were $98,700,075, or nearly double what they were in 1893. There are 118 roads, and they carried 395,000,000 passengers.

A NOVEL BANK RUN was caused at Pittsburg, Pa., last week, by the visit of telephone linemen to the roof of the German National Bank, and their rapid movements caused some wag in the street to exclaim that there was a "run on the bank." The joke spread as a rumor and was soon converted into an ugly reality, causing heavy withdrawals.

A TROUBLESOME SPANISH MARRIAGE.—The recent marriage of the Princess of Asturias, of Spain, was so distasteful to some Spanish factions that it resulted in much popular disturbance. As a means of heading off a possible revolution the Government closed the telegraph and telephone service to the general public. A dispatch from Madrid a few days ago conveyed the intelligence that "the telephones are again working." They had been "busy."

COMBINED CIRCUIT BREAKER AND MOTOR STARTER.—A patent issued Feb. 12 to H. B. Cutter on an application dated Feb. 24, 1899, contains several claims covering the use of an automatic circuit breaker in series with an automatic motor starter. One of the claims is on the combination of a spring-actuated motor starter, electromagnetic means for normally restraining the same, and an automatic circuit breaker, the coil and switch of which carry the motor-actuating current.

SUGAR BY ELECTRICITY.—At the Congress of Applied Chemistry at the Paris Exposition, M. Dupont described a new sugar-making process wherein the juice of the beet or cane is placed in the middle compartment of a wooden vat fitted as an electrolyzer, and the albuminoidal matter of the juice is coagulated and precipitated under the action of the current. The salts are decomposed and the soluble bases separated. The sugar remains intact in the positive liquid. With a current of 15 volts, it takes an hour and a half to treat a solution containting 15 per cent of sugar.

ELECTRICAL NUT CRACKING.—It is stated that the industry of nut cracking gives employment to several thousand persons in St. Louis. Three plants have been established in that city. The output of the largest is some 1500 tons annually, representing 125 carloads of nuts. The work is done by machinery principally, electricity being the motive power. The process is slow, each nut having to be fed to the crusher by hand lengthwise. After the shell is cracked the nut falls into a receptacle, from which it is taken and winnowed by an air blast. The meat is picked from the crushed shells by hand, women and girls being employed in this work. The machinery employed in cracking nuts is expensive, it is said, and covered by patents. It is closely watched to prevent any invasion of the rights of the inventor, and access to the workroom is jealously guarded. The daily output of an electric machine is said to be 75 lbs. of nut meat.

ELECTRICITY AND THE PHYSICIAN.—Dr. John W. Coolidge, of Scranton, Pa., writes as follows to the newspaper named: "I have read with much interest and great profit the remarkable series of articles published in the *Sun* on "The Past Century, Its Progress in Great Subjects, etc.," the last of which, and the eighth in the series, is from the pen of Prof. Elihu Thomson and deals with the subject of electricity. Prof. Thomson says that 'electricity is finally to be one of the most potent agencies in the treatment of disease and the alleviation of human ills.' It is not fair to the medical profession that the lay reader of the *Sun* should draw his inference of the status of electricity in medicine to-day from the statements which I have quoted. While it was true that electricity for many years was used principally by those not trained in medicine, its use as a therapeutic agent has passed out of the hands of the 'quack' into those of the regular profession. The physics and the therapeutic application of electricity have advanced hand in hand in the foremost ranks of progressive medicine. I desire, with your permission, to amend the statement of Prof. Thomson that 'electricity is finally to be one of the most potent agencies in the alleviation of human suffering' by saying that electricity is to-day the most potent agent in medicine providing the doctor's skill controls its results. For with the same apparatus one physician may be a 'day laborer' and another an artist, and to recognize this distinction is the first step into the light."

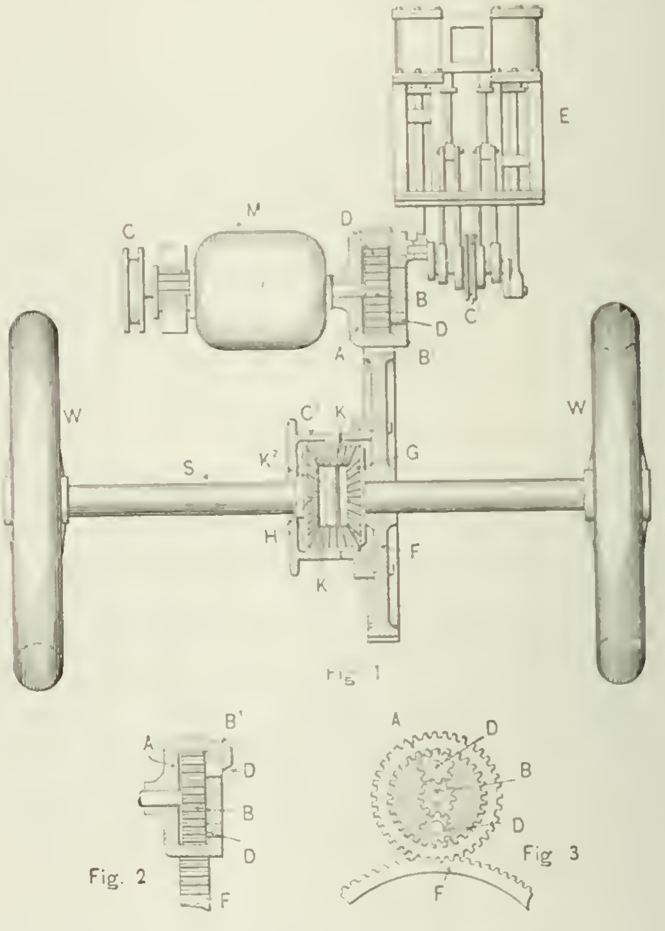
LETTER TO THE EDITORS.

Automobile Driving Mechanism.

To the Editors of Electrical World and Engineer:

Sirs:—In automobiles the requirements are a vehicle which may be run by a lady or children in the city, which may be recharged at home in the suburbs, and which may be taken to the parks and the mountains, the vehicle being driven by a reciprocating engine or by an electric motor, or by both working together.

In the accompanying illustration, *C* represents a friction clutch pulley, which is connected to the armature shaft. C_1, represents another clutch pulley, which is connected to the engine driving shaft, while C_2 represents a third clutch pulley, which is connected indirectly to the vehicle axle, which is used to brake the vehicle. If the clutch, *C*, is held, the armature remains stationary, while the engine transmits motion to the planetary gear pinions, D_1, driving the combined external and internal gear, *A*, and the vehicle to which the latter is connected. In this case the speed of the engine will be 250 r. p. m., while the vehicle wheels will be revolving at the rate of 100 r. p. m.; if the engine is held by the clutch, C_1, and the armature is free to rotate at a speed of 1000 per minute, the vehicle wheels will revolve at a reduction of 10 to 1, or at a speed of 100 per minute. If both the engine and the motor are allowed to revolve at those re-



FIGS. 1, 2 AND 3.—AUTOMOBILE DRIVING MECHANISM.

spective speeds, no motion is transmitted to the vehicle axle. If, however, by independent regulation the motor is driven, for instance, faster or slower than its engine, the gear, *A*, turns differently. By varying the difference between the speeds of the separate powers the vehicle may be moved very slowly with a tremendous leverage, or very fast with a small leverage.

The motor is of the shunt-wound regenerative class, and ordinarily takes its current from the storage batteries carried on the vehicle. When it is desired to recharge the battery the vehicle is held by the clutch brake applied to the friction wheel, C_2, and the engine is then run, driving the motor as a dynamo, and recharging the storage battery. The voltage is controlled by the ordinary vehicle controller.

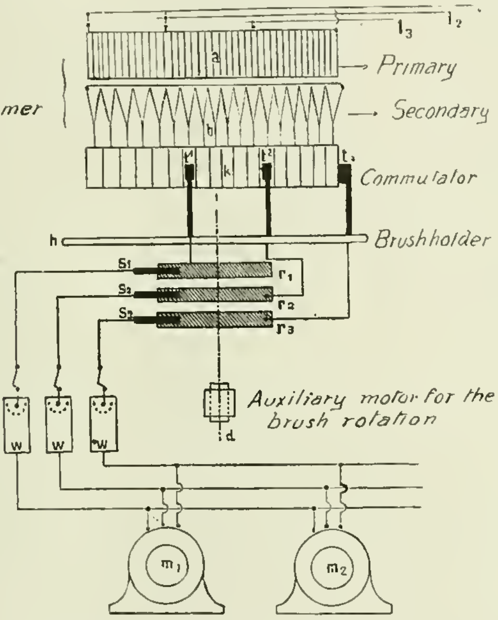
Instead of the steam engine shown, it is proposed to use a simple form of gas engine which would not require the ordinary starting machinery for igniters. JOHN. C. HENRY.

DENVER, COLO.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Starting Three-Phase Motors.—KREBS.—An article on a controller which may be used in a three-phase traction system, in which 12,000 volts, three-phase currents are transmitted and supplied to transformers on the cars, transformed down to 1000 volts and supplied to the three-phase motors. The arrangement suggested is shown in the adjoining diagram. *a* are the primaries, *b* the secondaries, of the transformer; the latter are, as in a continuous-current armature, connected to a commutator, *k*, on which three brushes, t_1 t_2 t_3, which form together angles of 120 degs. can rotate. The brushes are mounted on a disk, which is coupled with a three-part collector ring contact, r_1 r_2 r_3, the three brushes, t_1 t_2 t_3, being connected each with one of the slide rings, r_1 r_2 r_3. By means of a small auxiliary motor, *d*, the disk and the sliding rings can be revolved. The three slide rings are connected by means of the sliding contacts, S_1 S_2 S_3, with the motors, m_1 m_2. Rheostats may be inserted in these connections. Let the auxiliary motor be started so that the brushes revolve in the direction of the rotation of the rotary field. When the brushes revolve with synchronous speed, the motors rest; when the speed of rotation of the brushes decreases the motors run up until they have nearly synchronous speed, when the brushes rest. When the brushes rotate in a direction opposite to that of the rotary field, the speed of the motors is increased above synchronous speed. The motors are therefore started by decreasing the speed of the brushes from synchronous speed to zero. The motors are stopped by running the speed of the brushes up from zero. The brushes are not used when the motors are running at normal speed. They may then be disconnected.—*Elek. Rund.*, Feb. 1.



STARTING THREE-PHASE MOTOR.

REFERENCE.

Modern Manufacture of Machines.—BOOTH.—An article on the methods of wholesale manufacture of electric machines, and on the machine tools and outfit used for this purpose.—Lond. *Elec. Rev.*, Feb. 8.

LIGHTS AND LIGHTING.

Osmium Filament for Incandescent Lamps.—A long abstract of a recent paper by Scholz on the new incandescent lamp with osmium filament invented by Auer von Welsbach. A source of light is the more economical the higher the temperature. A material which can stand well very high temperatures is osmium, which has the highest melting point of all metals. To use osmium for incandescent lamps, has become possible by an invention of Welsbach by which osmium wires can be made. An osmium wire is an electric conductor, so that the osmium filament is lighted directly in the same way by the current as an ordinary carbon filament. Experiments have shown that osmium lamps, which consumed 1.5 watt per candle had a long life, which was often 700 and sometimes 1000 or 1200 hours. One of these lamps, which consumed 1.45 watt per candle in the beginning, burned 1500 hours and consumed then 1.7 watt per candle. When osmium lamps become darkened by use, they can be brought back into a useful condition by a simple, inexpensive way, without renovation of the filament or globe. This regeneration can be repeated several times if the filament is intact. The process of regeneration is not described. Osmium lamps are made for pressures from 25 to 50 volts. In 100 to 220-volt installations several lamps must, therefore, be connected in series. After the paper had been read, demonstrations were made for the comparison of osmium lamps with ordinary incandescent lamp. It was shown that for the same candle power osmium lamps consumed only 40 per cent of the current of ordinary incandescent lamps at the same voltage, which means a saving of 60 per cent. When an osmium lamp and a carbon filament lamp consumed the same energy, the former gave 3½ times the number of candles of the latter.—*Zeit. fuer Beleucht.*, Jan. 30.

POWER

Transmission Plant in Sumatra.—An illustrated description of a water-driven three-phase power transmission plant, supplying current to the Redjang-Lebong gold mine of Sumatra. The power used is 66 hp for the stamps, including the rough crushing stamps, and separators for separating the coarse from the fine material coming from the stamps themselves; 37.5 hp for the extension of the stamping equipment; 37.5 hp for the compressor to produce compressed air for working the drills; 10 hp for the workshop; 10 hp for the pumps for the cyanide solution, and 10 hp for lighting. Two 37.5-motors and a number of smaller motors are used. The water-power plant is two miles from the mine, and contains three 100-kw generators, giving three-phase currents at 2200 volts. The smaller motors and lighting are provided for on low-pressure circuits through transformers, but some of the larger motors are supplied directly at 2000 volts.—Lond. *Elec.*, Feb. 8.

Electricity in Coal Mining.—MOUNTAIN.—A long, illustrated article, in which he first gives some examples in which the adoption of electrical machinery not only enables one to obtain a considerable economy in working, but also a good return on capital expended. He says that it is best in all cases to provide for the plant being of ample size, because if it works satisfactorily, it is generally found that extensions are quickly made. The best type of machinery should always be adopted. He briefly discusses the installation of the plant and the use of electric power for pumping, hauling and coal cutting. Regarding the choice of system, he says that direct-current working, particularly when the machinery is well designed and of large enough capacity, is very satisfactory, and "the only advantage which the advocates of the three-phase system can bring forward is that they have no commutators, but in the writer's opinion, this is a somewhat misleading way of looking at it, as there is no reason why commutators should give any trouble if well designed and looked after." With a power plant at a great distance the three-phase transmission is preferable.—Lond. *Elec. Rev.*, Feb. 8.

Gas Engines for Central Stations.—HUMPHREY.—A reply to some critical remarks in the editorial noticed in the Digest, Feb. 16. He thinks that a hydrocarbon gas, supplied by existing town gas works, is far too valuable a product to consume in gas engines. Mond gas is much cheaper. He claims that the exhaust gases from stations with gas power, are of less volume and less obnoxious than from stations with steam power. He also says that the starting of large gas engines is now a matter of great simplicity. Compressed air is used for the purpose in the ordinary cylinder, and its action is quick and certain. These statements are again criticized in some editorial notes, where it is said that in spite of its many glaring elements of inferiority, the steam engine has a firm hold on the first place. A gas engine is essentially not a self-starting engine, whereas a steam engine is. Even compressed air is not always satisfactory for starting gas engines. A 100,000-hp gas-driven station in a residential district is thought to be an intolerable nuisance, especially if the gas producer were to be annexed to the station.—Lond. *Elec.*, Feb. 8.

TRACTION.

Three-Wire System on a French Railway.—LEGRAND.—An illustrated description of the electric tramway from Grenoble to Chapareillan, where the three-wire system is used. The length of the line is 26 miles. The power house, where water power is utilized, is on the road, 7 miles from Grenoble. There are two turbine-driven direct-current dynamos, each giving 417 amp. at 600 volts. They are connected in series so that the free terminals have the potential + 600 and — 600 volts. There are three groups of two feeders, which supply the double overhead line, divided into three independent parts. The terminals of these parts being Grenoble, Les Drogeaux and Chapareillan. The voltage drop to Grenoble is 250 volts, that to Drogeaux is 150 volts, that to Chapareillan 225 volts. To compensate for this drop of voltage, for each feeder a booster is used, so that in the most unfavorable case the loss in the line is not more than 60 volts. The rails are the neutral in the three-wire system, while the two motors on each car are supplied with current from two overhead wires over the track, with two trolley poles. These two wires form the outers of the three-wire system. The motors are thus always connected in series at 1200 volts. (It seems, therefore, that it is merely a double trolley system with 1200 volts. The neutral circuit comes into action only when the two motors on the same car are unequally loaded. It can, therefore, hardly be termed a three-wire system, as usually understood.)—*L'Eclairage Elec.*, Jan. 26.

Rating Tramway Motors.—MUELLER.—An article in which he shows that it is not sufficient to characterize a tramway motor by its horse power. He advocates the following notation: A motor No. 100/15 is a motor which, during a certain time, without being heated over the temperature of the surroundings by 65 or 75 degs. C., yields a tractive force of 100 kg., giving to the car a speed of 15 kilometers per hour, a certain voltage and a certain wheel diameter being supposed. He recommends making experiments to determine the best value of the time upon which such rating should be based. This value depends, of course, largely upon the form of the discontinuous service to which the motor is put. He believes, however, that one hour, as assumed by American companies, is too small, and that two hours would be more correct.—*Elek. Zeit.*, Jan. 24.

REFERENCES.

Lewiston.—FAIRCHILD.—An illustrated description of the Lewistown, Brunswick & Bath St. R'y Company in Maine. The lines comprise 55 miles of track. Current is generated at both steam and water-power stations by double-current machines. The direct-current end gives current at 550 volts, while the alternating current is transformed up to 10,000 volts and transmitted to sub-stations—*St. R'y Rev.*, Feb.

Sioux City.—An illustrated description of the system of the Sioux City Traction Company, which comprises 41 miles of track. The trolley system is used. The power plant contains two 400-kw generators.—*St. R'y Rev.*, Feb.

Wannsee Railway.—BORK.—A long abstract of his paper on this German electric railway which has been mentioned repeatedly in the Digest.—Lond. *Elec. Eng.*, Feb. 8.

Polyphase Traction.—PERKINS.—Brief illustrated descriptions of polyphase electric locomotives, manufactured by Ganz & Co., as offered for the Metropolitan District Underground R'y, of London; the Oerlikon Company, as used on the Jungfrau Railway, and Brown & Boveri, as used on the Burgdorf-Thun R'y.—*West. Elec.*, Feb. 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capacity in Alternating-Current Work.—DE HOOR.—A communication referring to the paper of Mordey, abstracted in the Digest, Feb. 9, 16. He first summarizes our present knowledge of dielectric hysteresis. "The dielectric constant of all those bodies in which the existence of an electrostatic hysteresis can be proven, varies with the polarizing e. m. f. At small e. m. f.'s, for instance, from zero to 30 volts cm, this variation can—on account of the disturbing influences of other phenomena—as a rule be examined only with great difficulty. However, there are types of dielectric bodies—eg, layers of plant fibre dielectrics, at which the experimental proof can be brought without difficulty at e. m. f.'s between 30-100,000 volts cm. Measurements executed with alternating e. m. f.'s alone cannot give a clear picture regarding the variation of the dielectric capacity with the e. m. f., and can be used only in combination with the results of static methods. The much-mentioned experimental fact that in a given dielectric the capacity current rises proportionally with the effective impressed e. m. f., is not a proof for the constancy of the dielectric capacity." There are cases in which the dielectric capacity varies, and yet the capacity current, calculated by means of the various values of dielectric capacity and the known curve of the e. m. f., and agreeing within large limits with the measured values, is proportional to the e. m. f. The separation of the electrostatic and viscous hysteresis work (the value of the latter is very low in the materials used for cables) by measuring the capacity currents at different periods, can easily be effected. The electrostatic hysteresis work increases at low e. m. f.'s nearly proportionally with the second power of the e. m. f.– at higher e. m. f.'s with the 1.7 to 1.6 power of the e. m. f. Referring to Mordey's experiments, he remarks that a power factor of 0.124, as found by Mordey, is an extraordinarily high one, and if there has been no mistake, it must be due to the cable having been made of a material of extremely high specific hysteresis. He gives numerical results of experiments made by him and others, which show that the cables generally used have a considerably lower power factor and hysteresis loss per unit of volume In a network of 200 kilometers of 3000-volt cables, he finds that the electrostatic hysteresis loss will be only about 1.45 per cent of the total loss. Regarding the choking coils proposed by Mordey, he remarks that the motors and the not-fully-loaded transformers of a modern alternating-current plant, are the "natural chokers." He would like to call them, in the sense of Mordey, even "supernatural," as in consequence of their action the current always lags behind in modern central stations working for light and power, and the average power factor hardly surpasses 0.8, so that the electricians would rather be inclined to increase than to decrease the capacity. Even supposing that in consequence of the action of the capacity the current would be leading by 45 degs., he could not derive any technical difficulties from this circumstance. With regard to the efficiency and armature reaction of generators, he would decidedly prefer a current 45 degs. in advance to one 45 degs. lagging behind. The only technical difficulties in the use of great capacities are those arising from resonance phenomena, and those arising from the switching in or out of great cables, and the burning out of fuses, and these can be easily made harmless by the use of suitable and relatively cheap safety devices. (The author is consulting engineer with Ganz & Co., of Budapest.)—Lond. *Elec.*, Feb. 8.

Systems of Charging.—An anonymous communication, in which the Wright maximum demand system is first discussed. The writer says that the maximum demand indicator does not indicate in any way the number of hours a consumer has made use of the supply. He also claims that the maximum demand system of charging is most unfair to a customer who turns on all his lights for a quarter of an hour one day in a quarter of 91 days. He agrees, however, that the system improves the load factor of a station. He thinks that the Wright system of charging is on the right basis, but that the maximum demand indicator does not in any way assist the engineer to ascertain that which he wishes to know, i. e, the number of hours each consumer is in the habit of using the light. He recommends the following system: The indicator, which is a very simple piece of apparatus and is shortly to be put on the market, marks directly on the scale the average number of hours per day a consumer uses above a certain percentage of his total capacity, which percentage can be varied by moving a set hand in the instrument. It is proposed to charge according to a basis like the following: One hour per day, 16 cents per unit; 2 hours, 14 cents; 3 hours, 12 cents, etc.; 7 hours, 6 cents, 10 hours, 5 cents.—*Lightning*, Jan. 31.

Quite a number of communications, by Tuckett, Ram, Steinmetz, Jones, Ingram and Boot, on this subject. The general opinion is not favorable to the new system. The meagre description of the improved apparatus, mentioned in the anonymous letter, is criticized. Tuckett says that one valid objection to the Wright demand indicator is that it fails to record at what hour the maximum demand is made, i. e., whether it coincides with the peak. But this deficiency affects a very small proportion of the consumers, and can be provided for, if necessary, by means of a time switch. Moreover, the suggested new apparatus is equally subject to this objection. Where the higher maximum demand is quite abnormal and exceptional, the supply company is usually willing to short-circuit the indicator for the occasion. Where, however, the higher maximum demand is merely irregular—and this is the case in 90 per cent of the cases—the Wright system properly bases the charge on such maximum demand. Ram denies that the maximum demand indicator does not in any way assist the engineer to ascertain the number of hours each consumer is in the habit of using the light. A table showing half-yearly the average number of hours per day that each individual consumer uses his average maximum demand, can be made from the readings of the maximum demand indicator in conjunction with the readings of the meter.—*Lightning*, Feb. 7.

Glasgow Exhibition.—Young.—A lecture on the engineering and and electric work of the Glasgow exhibition, 1901. Direct current will be used throughout. The plant contains 12 sets of combined steam engines and dynamos, with an aggregate output of 4200 hp. Five of the dynamos are working at a pressure of 500 to 530 volts, and seven at a pressure of 250 to 265 volts. The lighting is done by 10-ampere arc lamps of various types, and incandescent lamps of various powers. Many exhibitors will show machinery in motion driven by electric motors, ranging from ¼ to 150 hp.—Lond. *Elec. Rev.*, Feb. 8.

REFERENCES.

Automatic Cut-Out.—Mueller.—A long illustrated description of his automatic cut-out, which was described in the Digest, Oct. 20.—Lond. *Elec.*, Feb. 8.

Lighting Plant.—An illustrated description of the power plant for lighting a twine mill in Chicago. There are three 250-volt, direct-current machines of together 280 kw.—*West. Elec.*, Feb. 16.

Motherwell.—An illustrated description of this new British direct-current plant. The capacity of the machines is 170 kw, there is also a battery giving 40 amperes for 5 hours.—Lond. *Elec. Eng.*, Feb. 8.

Russia.—Baker.—The first part of an illustrated article on electrical work in Russia. He gives some historical data on electric lighting plants in St. Petersburg.—*Lightning*, Feb. 7.

Wires, Wiring and Conduits.

Joining Alumium Cables.—An article, in which it is said that by carefully cleaning and tinning the surfaces to be joined and using some one of a number of special alloys for the solder, joints are now made which in tensile strength and conductivity exceed the aluminum wire itself. Several solders for this purpose are successfully used the majority of them having as a basis pure in with a little phosphor tin added. The successful experiences of the Northwestern Elec. Rev. Company, of Chicago, the Am. R'y Company, of Philadelphia, and the Southern Ohio Traction Company, of Hamilton, are quoted, and the methods used by these companies for joining aluminum cables are described. The method of Herneus, which has been already described in the Digest, is also noticed.—*St. R'y Rev.*, Feb.

REFERENCES.

Insulating Varnish.—An article on the "Armacell" insulating varnish, made by a British company. Excellent insulating properties and permanence at higher temperatures are claimed for it. Some results of tests made in the German Reichsanstalt are given.—Lond. *Elec. Eng.*, Feb. 8.

Three-Phase Transmission—Stojsavljevie.—An article, illustrated by diagrams and numerical examples, in which he shows how to calculate a high-tension three-phase transmission scheme.—*Zeit. f. Elek.*, Jan. 20, 27.

Electro-Physics and Magnetism.

Influence of the Wave Form Upon the Iron Losses.—Benischke.—An illustrated account of an experimental investigation. The results are summed up as follows: At varying magnetization the Steinmetz co-efficient depends not only upon the value of the magnetic induction, but also upon the wave form. It is the smaller, the more pointed the curve of the lines of induction is. The usual formula for calculating the iron losses as sum of the hysteresis and eddy current losses is only approximate. The approximation is the better, the smaller the eddy current losses. Nevertheless, the values of the Steinmetz co-efficient of hysteresis, found in this way, may be regarded as sufficient for estimating sorts of iron. He also gives a formula for calculating the co-efficient of the eddy current loss in sheet iron.—*Elek. Zeit.*, Jan. 17.

Discharge Through a Gas.—Willows.—An account of experiments on the effect of a magnetic field on the discharge through a gas. At a pressure below 5 mm the effect of the magnetic field is to decrease the electric force near the cathode. This decrease depends on the strength of field and current used. At higher pressures the magnet increases the electric force. If the magnet causes the column to striate, it also causes the electric force to show periodic variations. The magnet generally causes the electric force at the anode to increase.—*Phil. Mag.*, Feb.

Positive and Negative Ions.—Townsend.—A long paper on "The conductivity produced in gases by the motion of negatively charged ions." He produces experimental evidence to show that positive and negative ions have very different physical properties. For a large range of forces, the positive ions do not contribute to the generation of ions, but it is probable that positive ions may produce ionization in stronger fields.—*Phil. Mag.*, Feb.

Change of Magnetic Moment by Shocks.—Kruese.—An account of experiments in which bar magnets were subjected to violent treatment and the resulting change of magnetic moment measured. The results are given in tables. Among other things, it is found, in bumping the magnets, that the greatest decrease is after the first fall, and that only in isolated cases does the moment remain unchanged after frequent falls from the same height. The total decrease of moment varies between 1.6 per cent and 25.6 per cent. The changes due to pulling the magnets from contact with a soft iron bar are very slight, being an increase after the first separation, changing to a decrease after 10 separations. Drawing a magnet off a soft iron plate sometimes diminishes the moment 28 per cent.—*Akad. Wiss. Wien. Sitz. Ber.*, Jan. to Mar., 1900; abstracted in *Science Abstracts*, Jan.

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Refraction of Electric Waves.—Pierce.—An illustrated account of measurements of indices of refraction of paraffine, hard rubber and woods for electric waves by means of a modified radio-micrometer.—*Phil. Mag.*, Feb.

Self-Inductance and Electric Inertia.—Schuster.—His British Phys. Soc'y paper in full, an abstract of which was noticed in the Digest, Jan. 12.—*Phil. Mag.*, Feb.

Electro-Chemistry and Batteries.

Internal Resistance of the Lead Accumulator.—Dolezalek and Gahl.—An account of an experimental investigation of the variation of the lead accumulator during the charge and discharge. This internal resistance is very small, and is some 10,000ths of an ohm in the cells used in practice. The resistance increases gradually during the discharge. It decreases during the charge. In spite of its small value, the internal resistance is greater than it ought to be if calculated from the conductivity of the electrolyte. It must, therefore, exist in certain transition resistance at the plates, due to films of non-conducting lead sulphate on the spongy lead and lead peroxide, or due to variations of concentration of the acid at the plates. The results of their investigation are given in diagrams. They find that in practice the increase of the resistance of the negative electrodes during discharge is entirely negligible. There is practically only an increase of resistance of the positive plate during discharge. But of greater importance in practice are the drop of voltage due to variations of the concentrations at the electrodes and to the resistance of the support of the active mass, especially of the negative plates. In comparison to these essential factors, the real internal resistance, which consists of the resistance of the electrolyte and the transition resistance between acid and plate, is negligible. *Zeit. f. Elektrochemie*, Jan. 24, 31.

Nickel Plating.—Pfanhauser.—While the production of satisfactory deposits of nickel from solutions of the sulphate or chloride salts of nickel and ammonia is comparatively simple, generally low-current densities had to be used, 0.3 to 0.4 ampere per square decimeter, so that considerable time was required. He claims to have invented a process which is much quicker, the current density being about 10 amperes per square decimeter. Only direct-current dynamos are used as sources of current. A layer of nickel of 1 mm thickness is obtained in 8 to 9 hours. A homogeneous and adherent deposit of nickel can be obtained in 2 to 3 minutes. It is thought that this will lead to a very extended use, especially in electrotyping and type-casting works, as copper or type metal faced with nickel will stand longer use than the unprotected metals.—*Metallarb.*, 1900, 25, 310; *Elektrochm. Zeit.*, Jan.

Some editorial remarks on this subject. Reference is made to a former investigation of Foerster. The above article is criticized for the lack of details concerning the improvements. It is thought that possibly the process depends for its success upon the use of some double salt of nickel which has hitherto been overlooked by practical electrochemists.—Lond. *Elec.*, Feb. 8.

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Electrolytic Process of Making Parabolic Reflectors.—An illustrated description of the Cowper-Coles electrolytic process for the manufacture of parabolic reflectors, as used by the Search Light Syndicate.—Lond. *Elec.*, Feb. 8.

Electrolytic Bleaching.—Oettel.—A reply to the criticism of Engelhardt of his former paper, already noticed in the Digest.—*Zeit. f. Elektrochemie*, Jan. 31.

Electrolytic Analysis.—Arth.—An account of some new investigations; by Ost and Klapproth on the estimation of antimony; by Kahlenberg, on solutions in a solvent other than water; by Paweck, on the use of cathodes of amalgamated brass.—*L'Eclairage Elec.*, Jan. 26.

Electrolytic Analyses.—Holland.—A summary of the principles of electrolytic analysis. He first gives the laws for the minimum e. m. f. required to get a deposit of a metal from a salt solution, and the influence of the concentration upon this e. m. f. The current, the current density, and the electrodes are also discussed.—*Rev. Gen. des Sc.*, Jan. 30.

Autoxidation.—Haber.—A theoretical paper on "Autoxidation and its connection with the theory of the ions and of the galvanic cells." Autoxidation is such a process in which a body, liable to oxidation, has a tendency to react with water and oxygen of the air in such a way that it combines with two atoms of both oxygen and hydrogen.—*Zeit. fuer Elektrochemie*, Jan. 31.

Electrolytic Dissociation of Solutions.—Arrhenius.—The first part of a general historic review of the development of the electrolytic dissociation theory.—*L'Ind. Elec. Chim.*, Nov.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—Mizuno.—An illustrated account of some experiments concerning the function of self-induction in the Wehnelt interrupter. In the conclusion, he gives the following interesting comparison of an induction-coil and a Wehnelt interrupter: "In an induction coil the suppression of sparks due to the extra current is indispensable, so that a capacity of a certain requisite value must be inserted across the interrupter. The deficiency of capacity diminishes the oscillations in the primary circuit in consequence of the spark due to the extra current and therefore the latter spark must be avoided as much as possible. On the other hand, in Wehnelt's interrupter the spark due to the extra current is necessary in order to keep up its action. Without such spark the vapor at the active electrode cannot be got rid of, and consequently sufficient current cannot be established anew. The actions of capacity and self-induction are thus directly opposite to each other in the two cases."—*Phil. Mag.*, Feb.

Obtaining Alternating Currents and Voltages in the Same Phase for Fictitious Loads.—Duddell.—A communication, referring to the methods of Campbell of using a transformer to obtain a fictitious alternating non-induction load for tests; also for use in a method for the measurement of power in an alternating-current circuit. (Digest, Dec. 16, 23.) In both cases it is assumed that the waves of p. d. between the terminals of the primary and of the secondary are practically similar curves and in phase. Duddell shows that the existing phase difference introduces negligible errors in the first case, but might cause considerable errors in the second case when the power factor of the circuit to which the supply of power is being measured is low. He also makes some critical remarks regarding Campbell's "Phase-turning device."—Lond *Elec.*, Feb. 8.

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Magnetic Tests of Iron—Kamps.—An article in which he gives formulas and describes a method for determining the error in magnetic measurements, due to the film on the surface of iron sheets, which chemically consists of a mixture of ferric oxide and ferrous oxide.—*Elek. Zeit.*, Jan. 24.

Instruments for Cable Tests.—Edelmann.—An illustrated description of portable sets of apparatus for use in cable tests.—*Elek. Zeit.* Jan. 24.

TELEGRAPHY. TELEPHONY AND SIGNALS.

A Tuning System for Wireless Telegraphy.—Bull.—An illustrated description of a system, in which the signals are conveyed from the transmitters to their corresponding receivers exclusively by the aid of series of impulses, each series consisting of a certain number of short-wave impulses following each other at predetermined intervals of time. By a suitable choice of these intervals, the impulses can be arranged in various series of different form. Now it is possible to tune each transmitting and receiving pair for its own special series in such a way that the transmitter only dispatches the series of this special form and the corresponding receiver only responds to a series of the same form. In the transmitter, a paper tape passes first a perforating device; a number of contact brushes are arranged adjustable for various distances apart, and they press lightly against the tape. When a brush passes a hole in the tape, contact is made By various adjustment of the brushes the form of the series can be altered. In the receiver the same number of brushes as in the transmitter are used The various series are formed in such a way that the time intervals between any two impulses in them are all different The system is said to be especially suitable for the type-printing apparatus of Hughes.—Lond. *Elec.*, Feb. 8

Wireless Telegraphy.—Blochmann—An illustrated paper read last June before the Union of German Elec. Eng. He considers the medium between the transmitting and receiving station, and develops the idea that in wireless telegraphy there are no Hertzian waves propagated, but the action is based upon disturbances of the equilibrium of the electrostatic equi-potential surfaces which surround the earth. The action in wireless telegraphy is a disturbance of the normal conditions of atmospheric electricity and may be compared with water waves. From this he concludes that it is impossible in principle to make any arrangement of the transmitting and receiving apparatus, as used at present, in such a way that the disturbances generated by a transmitting station are directed so that they reach only one certain receiving station and no other in the neighborhood. —*Elek. Zeit.*, Jan. 24.

Submarine Telegraph Cables.—Casevitz.—A paper giving a large amount of statistical information on submarine telegraph cables, especially those laid by France. From 1889 to 1900 the length due to France has increased 125 per cent, against an increase of only 19 per cent for England; but the English total length at the present time is more than six times the French, while to England in addition are due both the laying and the maintenance of all the cables for the United States, amounting to more than one-fifth of the total length belonging to England. There are 41 cable ships now in use throughout the world. Some information is also given regarding new French cable schemes and some suggestions are made.—*Mem. de la Soc. des Ing. Civ. de France*, 1900, p. 365; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 143, pt. 1.

Insulated Telephone Wires.—Hackethal.—A communication referring to his system of using insulated wires for telephone lines. He replies to the criticism which has been raised that this system would increase the capacity of the line and thus be harmful in long distance telephony. He denies this, and gives the results of tests made by Heim on two lines, each of 2½ miles length, one of bare wire, and the other insulated by his system. The result was that the capacity of both lines is nearly equal.—*Elek. Zeit.*, Jan. 24

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Rowland Telegraph.—Robichon.—An illustrated description of the system of multiplex telegraphy invented by Prof. Rowland and shown at the Paris Exposition, as noticed before in the Digest.—*Jour. Teleg.*, Jan. 15.

Grand Rapids.—An article on the co-operation telephone system at Grand Rapids, Wis., where 300 instruments are now in use.—*Eng. News*, Feb. 14.

Norway.—An illustrated article giving "A few notes on the construction of telephone lines in Norway," especially on the appearance of the poles, etc.—Lond. *Elec. Rev.*, Feb. 8.

Statistics.—A statistical review on telegraphy in Europe in 1900; also the conclusion of an article on telegraphy and telephony in France; also a continuation of the article on telegraphy and telephony in British India in 1898, 1899.—*Jour. Teleg.*, Jan. 25.

MISCELLANEOUS.

Paris Exposition.—Reyval.—A well illustrated description of a 750-kilovolt-ampere Boucherot compound alternator, exhibited by Breguet, which has already been described in the Digest.—*L'Eclairage Elec.*, Jan. 26. Illustrated description of a 350-kw single-phase alternator, the voltage being 2000, the frequency 42.5, the number of poles 36, the speed 142 r. p. m.; also a 460-kilovolt-ampere, two-phase alternator of a Geneva company, the voltage being 5000, the frequency 46.66, the number of poles 16, the speed 350 r. p. m.; also an automatic regulator for installations of the Thury system.—*L'Eclairage Elec.*, Feb. 2.

Lavezzari.—A description of self-acting electrical signals, used on the electrical railway at the Paris Exposition.—*Mem. de la Soc. des Ing. Civ. de France*, 1900, p. 436; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 143, pt. 1.

Sander.—An illustrated article in which he makes some general remarks on large alternators exhibited at the Paris Exposition.—*Zeit. f. Elek.*, Feb. 3.

De Morsier.—An illustrated description of the small motors exhibited by Lecoq & Co.; they are built for them 1/20 to 4 hp.—*Rev. de l'Elec.*, Jan. 31.

Hausegger.—The first parts of a long and well illustrated description of the exhibits of Ganz & Co.—*Zeit. f. Elek.*, Jan. 20, 27, Feb. 3

New Book.

Leçons D'Electrotechnique Générale. Professées A L'Ecole Superieure D'Electricité, par P. Janet. Paris: Gauthier-Villars. 614 pages, 307 illustrations. Price, 20 francs.

This volume is a remarkably useful addition to the literature of electrotechnics. It fills a real gap in the treatment of the subject, discussing, as it does, the practical topics of applied electricity in the clear-cut academic fashion in which our Gallic friends excel. Most books, perhaps all, in our own tongue belong either to the so-called practical type, surcharged with details of machines which will adorn the scrap heap in four or five years, or to the class stigmatized as theoretical, which runs to elaborate mathematical proofs of theories which nobody disputes or puts to any useful purpose.

Books which take up and discuss simply and clearly the theoretical basis of the practice of designer and engineer are rare, and M. Janet is to be congratulated on having produced one of the best of this class. One feature is to be especially commended—the addition to each chapter of a brief bibliography of the subject-matter as found in the chief French electrical journals of the last decade, which is most convenient for the student who desires to go carefully into any particular topic.

Another admirable innovation is a long and very interesting chapter on the materials of electro-technics, a topic too often treated in a desultory and careless manner.

The larger half of the volume is taken up with alternating currents and their applications, discussed on the whole in a very clear and satisfactory way, and brought thoroughly up to date. In the chapter on asynchronous motors the author is perhaps rather less satisfactory than elsewhere, holding too closely to the ordinary mathematics of the rotary field, and thereby missing the more finished and really simpler treatment introduced by Steinmetz and the German writers on the subject. But this is a small flaw in a book in other respects remarkably up-to-date and satisfactory.

British Transformer Practice.

It is perhaps in Great Britain, more than in any other country, that the single-phase alternating current system of electric lighting continues to be most generally favored, and consequently British manufacturers may be expected to give to other countries some of their experiences in this direction.

It cannot be doubted that their labors meet with very much criticism, but at the same time, on comparison with the work of other countries, there is a great deal in their designs which will prove beneficial to the electrical world in general. The particular conditions with which they have had to deal, and the difficulties they have had to overcome, have given them unique opportunities to indicate the lines on which future practice should run.

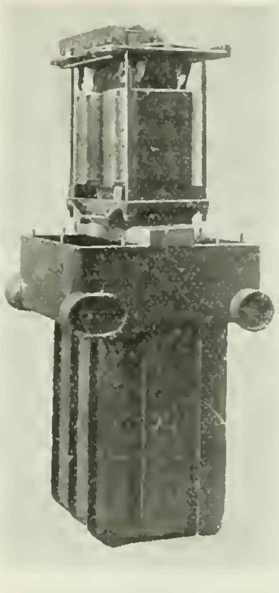


FIG. 1.—TRANSFORMER AND TANK.

In the early days of electric lighting the single-phase system was well received on account of its extreme simplicity of working, compared to the direct current method, and at the outset made such headway that in spite of all opinions to the contrary in Great Britain it still stands unrivaled as the ideal system of supply. The existence of an opponent in the shape of direct current, however, has only acted as a stimulant to manufacturers of single-phase apparatus, who, with the examples of failures before them, have done all in their power to improve the particular attributes of the system they advocated. A glance at some of the large single-phase stations recently erected in England, at the vast number of extensions carried out to some of the older plants, will serve to show that the labors of constructors have not been in vain, and that single-phase apparatus has been vastly improved since its first beginning. Probably the greatest change of all can be said to have taken place in the design of the transformer. This heretofore abused adjunct of single-phase working has passed from the sphere of "burn outs" and "short circuits" to that of reliability and efficiency; and whereas it was an expensive item of the supply to buy and maintain, it can now be procured at low cost while its up-keep is a negligible quantity.

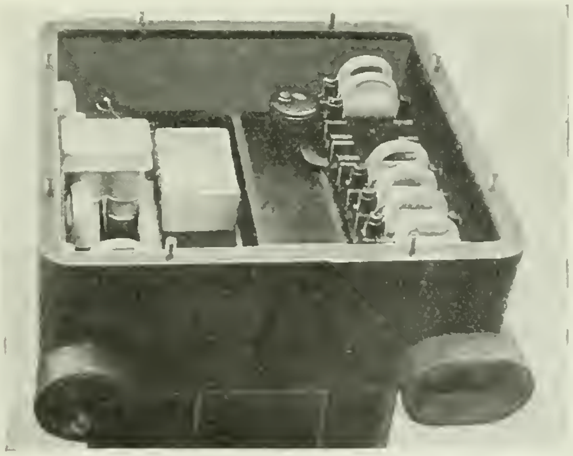


FIG. 2.—TRANSFORMER CONTACTS.

The general practice of placing all cables beneath the street (as enforced by Board of Trade regulations) has had considerable influence on the design of transformers—so much so, indeed, that attempts have been made, and with considerable success, to confine all transformer operations to the roadways in which the feeders are laid.

The work of Messrs. S. Z. de Ferranti, Ltd., Hollinwood, in this direction is worthy of notice, insomuch as they are the pioneers of single-phase working in England, and have done much to place the transformer on a more efficient basis. In fact, it is chiefly due to their efforts that single-phase systems generally have been able to maintain their own against strong opposition.

As to street transformers, a glance at some of Messrs. de Ferranti's designs for this purpose will serve to illustrate the manner in which they have dealt with the subject. It must be remarked here that the principle adhered to is the arrangement of the transformers in such a manner that expensive buildings and excavations are unnecessary, while the safety from contact with high pressure terminals is well assured. These desirable features are obtained by designing the apparatus in the following manner:

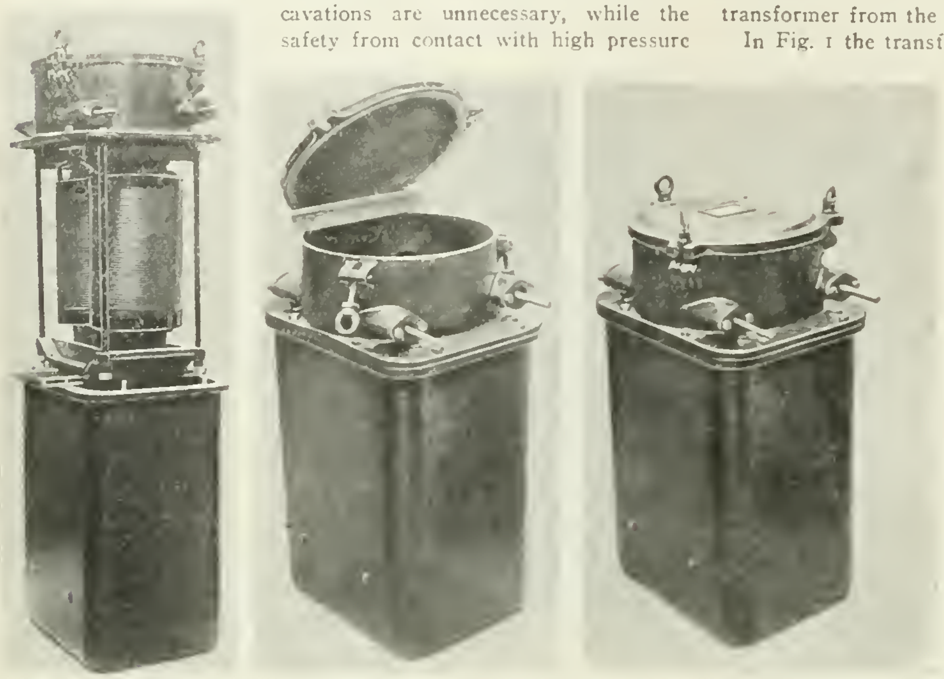


FIG. 3.—STATION TRANSFORMER.

A cast-iron tank, made in one size only, *i. e.,* to receive transformers up to 50 kilowatts, is sunk under the level of the pavement. This tank is provided on the one side with contacts and terminals for the high-pressure cables which enter from either end, and on the side are fixed the fittings for the low-pressure cables. Both primary and secondary mains enter the tank through water-tight glands, which reduce the possibilities of the entry of moisture to a minimum. Two glands are provided for the high pressure and four for the low-pressure feeders, the contacts of the former being so arranged that by the insertion of plugs the main will not be interrupted when the transformer is removed. The terminals above mentioned are fixed to the side of the tank, therefore permanently attached to it when sunk in the ground.

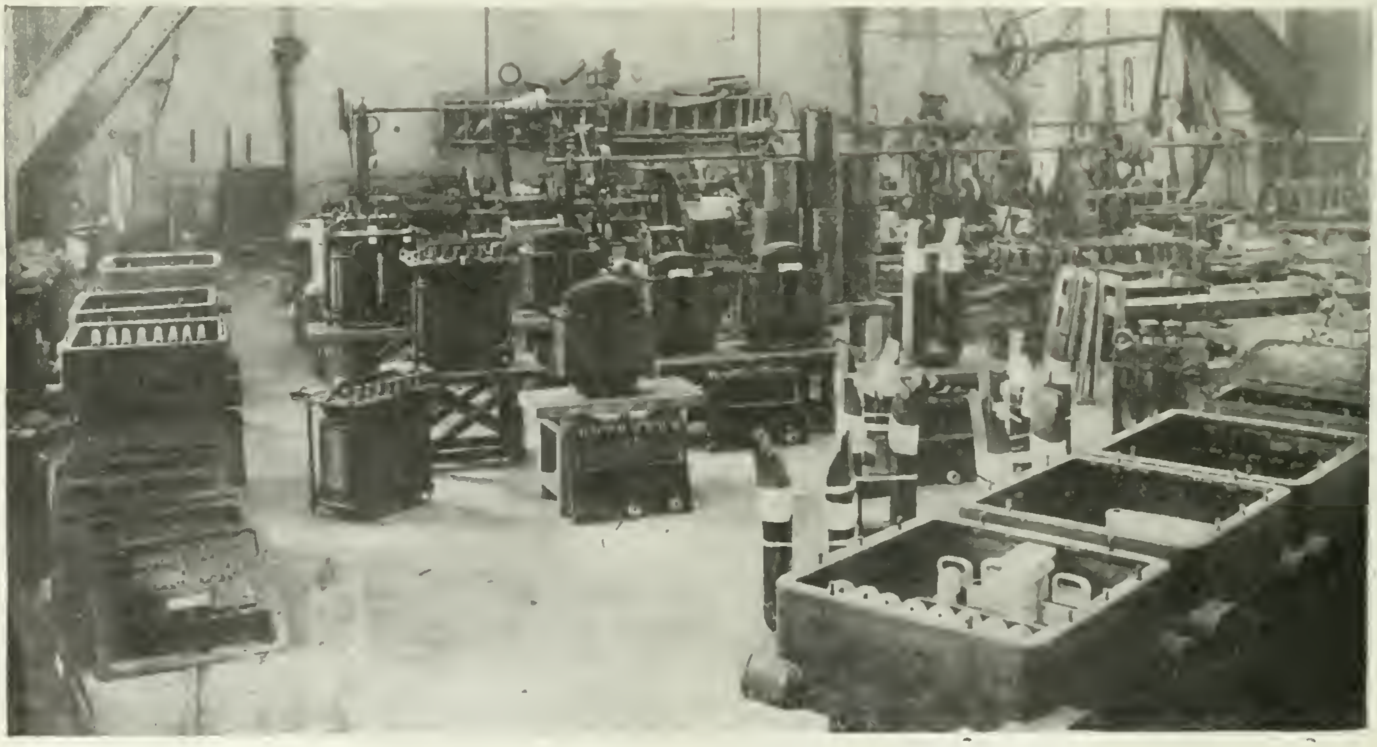


FIG. 4.—DE FERRANTI TRANSFORMER DEPARTMENT.

The transformer, which has a U-shaped core, is clamped between two plates, the upper of which carries the high and low pressure contacts arranged to come in line with the contacts of a similar nature fitted to the tank. This arrangement permits the removal of the transformer from the tank without interruption to the supply.

In Fig. 1 the transformer and tank can be seen, the former being ready for lowering into its place, while in Fig. 2 the general appearance of the transformer and contacts will be evident. On the right are the plug fuses connecting the low-pressure cables to the secondary winding, together with a Cardew earthing device to protect the same winding in the event of connection with the primary.

On the left will be seen the high-tension oil-break fuse placed on the inner conductor of the cable, and the outer connection of the transformer being made by means of a solid plug, while similar plugs are provided to maintain the continuity of the primary main when removing the transformer. In the left centre of the tank will be seen a porcelain tray which contains chloride of calcium for the absorption of all moisture which may condense inside the tank. Reference to the diagram shown by Fig. 6 will make the connections of both high and low tension cables quite clear. It must be noted that concentric mains are provided for. In this illustration *P* are low-tension plug fuses; P^1, high-tension fuses; *F*, high-tension oil-break fuses; *C*, Cardew earthing device; *PW*, primary windings; *SW*, secondary winding. From the above it will be seen that the de Ferranti street converter meets almost all the requirements of the case. Transformers varying in size from 5 to 50 kilowatts can be placed in the one tank, which, when once buried in the ground, need not be disturbed. The transformers can be handled with safety while the supply is being maintained, and no interruption need take place should it be necessary to remove a transformer at any time. That the high pressure contacts are well guarded will be seen from Fig. 5, in which *A* is the high-tension oil-break switch; *B* the high-tension inner plugs; *C*, porcelain ferrules covering the high-tension inner terminals; *D*, high-tension inner terminals; *E*, high-tension insulator case.

When it is considered that so many lives have been lost on transformers which have been insufficiently guarded, the advantages which proper protection affords will become evident. The manufactures of Messrs. de Ferranti in the direction of transformers are, however, not confined to street transformers.

Without alteration to the cores or windings, their transformers can be adapted for central station use by being placed in a special cover. The contacts with this type are arranged in wells at each side of the base, where all terminals are carefully protected and each cable sealed.

Another adaptation is found in the type suitable for sub-station use, the transformer in this case being lowered into a cast-iron tank placed on the floor of the sub-station. The cables enter at the upper part of the tank and are connected to suitable contacts inside the case, the high-pressure terminals being carefully guarded, as before. An exterior view of this arrangement is given in the photographic reproductions which make up Fig. 3.

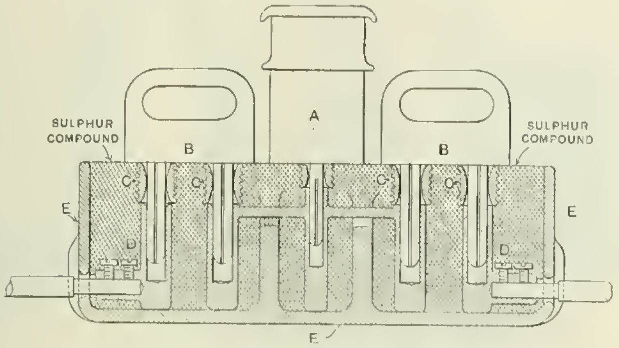


FIG. 5.—HIGH-PRESSURE CONTACTS.

From the foregoing it should be evident that the transformer designs of Messrs. de Ferranti are well suited to almost every requirement, the standardizing of the converter proper making it possible to meet special circumstances which necessitate departure from standard types. It is needless to remark that the best material is used in the construction of these transformers, no pains being spared to render them thoroughly efficient, while the price is also kept down. With manufactures of this description it is very difficult to strike the middle course between cheapness and good material, combined with efficiency and reliability, but it can be said that Messrs. de Ferranti have been successful in their efforts, and can produce apparatus which is second to none on the market. Such a circumstance is but the outcome of their lengthy experience in the construction of this class of appliance for the equipment of alternating current stations, and they can be said to have maintained in every way the lead which they established as the pioneers of single-phase systems, by the all-round excellence of their manufactures.

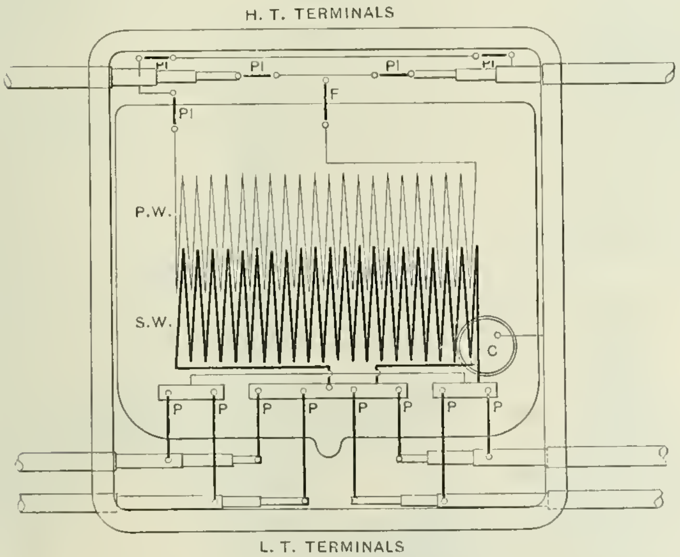


FIG. 6.—DIAGRAM OF TRANSFORMER.

Some idea of the extent of the work now being done by Messrs. de Ferranti, Limited, in the manufacture of transformers, can be gathered from Fig. 4, which illustrates a portion of the winding shop, and it will be seen from the number of street tanks dotted about that their efforts in this particular are widely appreciated.

Sectional Third Rail System on the Baltimore Belt Line.

In August, 1895, the Baltimore & Ohio Railroad Company put in service a system whereby all trains on the section known as the Belt Line were hauled electrically. This section comprises a tunnel going directly under the heart of Baltimore, and a curve and grade which the steam locomotives found very difficult to traverse. In addition to this, the puffing of the locomotives in the tunnel under the severe load imposed by heavy grade caused the atmosphere inside the tunnel to become practically unbearable, a disadvantage which electricity has eliminated. The method of conveying current to electric locomotives was a serious and costly undertaking, and after much study a system of overhead conductors was decided upon. This system was exhaustively described by the technical press at the time of its installation, and it is sufficient to say here that it was very expensive, costing in the neighborhood of $400,000 for the three odd miles of equipment; and while it served its purpose with a moderate degree of satisfaction, the depreciation and cost of maintenance was so heavy that the Baltimore & Ohio Railroad Company has made a change to an improved third-rail system.

The installation of the simple third rail was a matter not to be thought of, for in front of the Camden and Mt. Royal stations the live conductor would be in so exposed a position that it would constitute a serious source of danger to passengers. In many portions of the Camden yard similar objections obtained, since trackmen walking back and forth might suffer severe injury. The escape from this difficulty was plainly to sectionalize the third-rail in the places where it was desired to secure safety, and to control each section by an automatic switch.

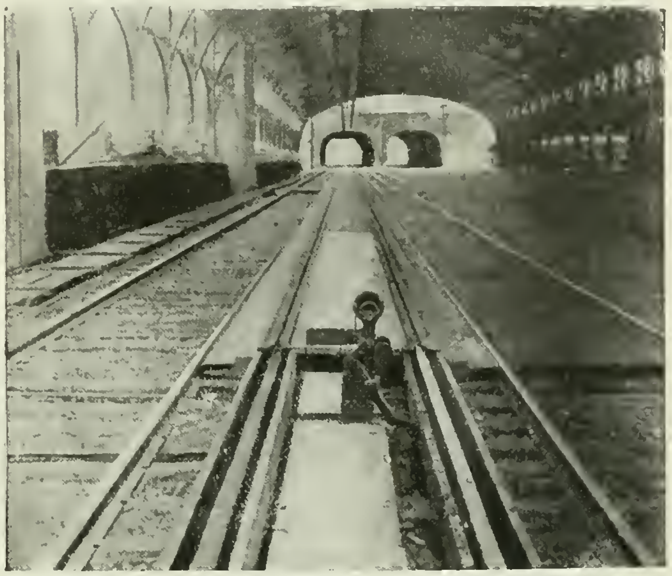


FIG. 1.—MT. ROYAL STATION.

The selection of this switch was by no means an easy matter. There was at that time nothing on the market to handle currents of 1000 amperes at 650 volts, and the problem was presented for solution to various companies exploiting sectional-conductor systems. The Murphy Safety Third-Rail Electric Company submitted drawings which met the approval of the Baltimore & Ohio engineers, and switches were made in accordance therewith and duly installed. The system is just now going into service, and the preliminary tests made upon the same have demonstrated that it will operate to the entire satisfaction of those concerned. Among the most important of these was the hauling of 22 steel freight cars loaded with coal through the tunnel and around the curve at the top of the hill, which was done with the greatest of ease. All trials have been successful and have proven the efficacy of the system, which possesses features of considerable interest.

There are at present installed at Baltimore 22 switches controlling a corresponding number of third-rail sections. Eleven of these are in the Camden yard, and protect the entire yard from the power house to the tunnel. Through the tunnel the live rail is used, and the sectional system begins again within the tunnel about 200 ft. from the Mt. Royal portal and continues past the Mt. Royal station to what is known as the twin tunnel some 2000 ft. beyond. At Huntington Avenue a grade crossing is protected by still another section. The switches are operating so satisfactorily that negotiations are now being made to cut up the rest of the live third rail and equip the same with switches.

The most important detail of a sectional third-rail system is the switch which automatically makes the rail alive while the car is passing and immediately cuts it out of circuit as soon as the collecting shoe leaves the section. This has, in fact, long proved the stumbling block in the practical operation of systems of this kind and until now has been the chief obstacle to their introduction. The large currents for which they must be built and yet the positiveness with which they must remain closed when but a small fraction of the maximum current is being used, necessitate a combination of strength and delicacy which has for years baffled inventors and prevented the successful solution of the problem.

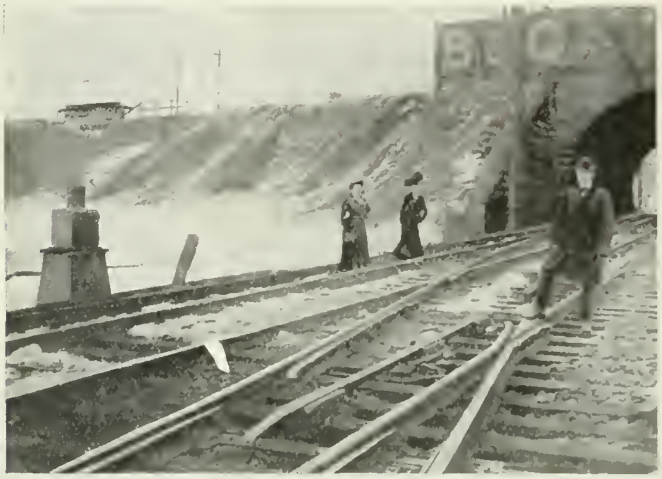


FIG. 2.—HUNTINGTON AVENUE CROSSING.

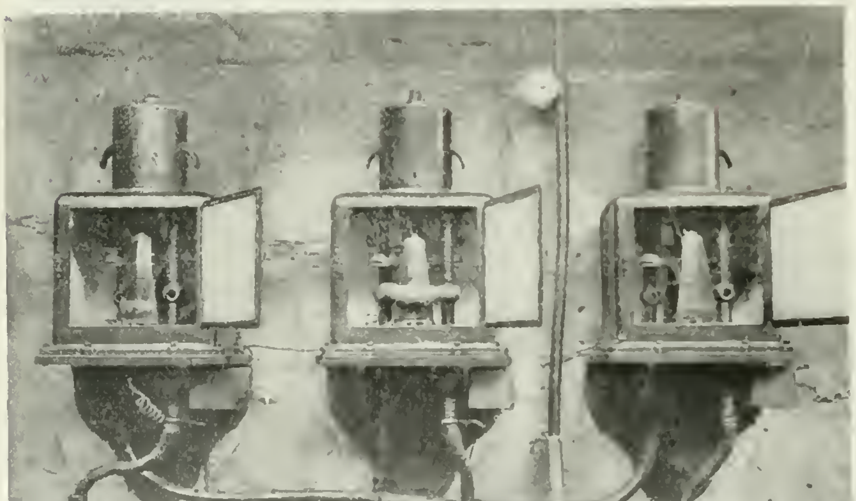


FIG. 3.—GROUP OF SWITCHES.

The illustrations of the switch used in Baltimore which are presented herewith give an excellent idea of its appearance, but a few words of explanation will be required to show how the various difficulties in its construction have been overcome. From the base to the top of the cast-iron case the apparatus is about 2½ ft. high. The weight is about 500 lbs. and to facilitate its transportation and the placing of it in position the switch is provided with a heavy lug on each side, as shown in the engravings. Access to the interior is provided by means of a large opening in the front, which is closed by a solid cast-iron door. This door can be securely fastened to prevent malicious tampering with the working parts, and when closed it makes a weather-proof seal to the interior. As the case is made of a single casting with no openings except the doorway and the holes in the bottom for leading in the electrical conductors the switch can be placed in the severest climate without fear of the elements preventing its satisfactory operation.

The principles upon which the system works are as follows: The locomotive contains an air-storage tank connected to an air engine and dynamo. One terminal of this dynamo is connected to the truck and the other to the collecting shoe so that when the locomotive reaches a dead section current tends to flow from the third rail to ground. In the normal (open) position of the switch a shunt coil of fine wire is connected to the third rail by means of the main feeder connections, the other end of the coil being grounded. The current from the dynamo on the locomotive, therefore, as soon as the shoe touches the section or the motorman turns on his controller energizes this shunt coil. Within the coil is a large iron plunger from the lower end of which branch out arms supporting the main switch jaws, and surrounding it is a massive copper series coil made of a single casting which is in the main circuit. The magnetic pull of the shunt coil lifts the plunger and throws the switch jaws together, thus connecting the feeder with the section of rail controlled by the switch. The locomotive now receives current from the feeder, which current, flowing around the series coil, holds up the plunger and keeps the switch closed. As soon, however, as the collecting shoe has passed from that section the current ceases and the plunger dropping from its own weight the circuit between the feeder and rail is again opened. The shunt circuit passes through carbon contacts at the base of the plunger, the plunger itself forming part of the

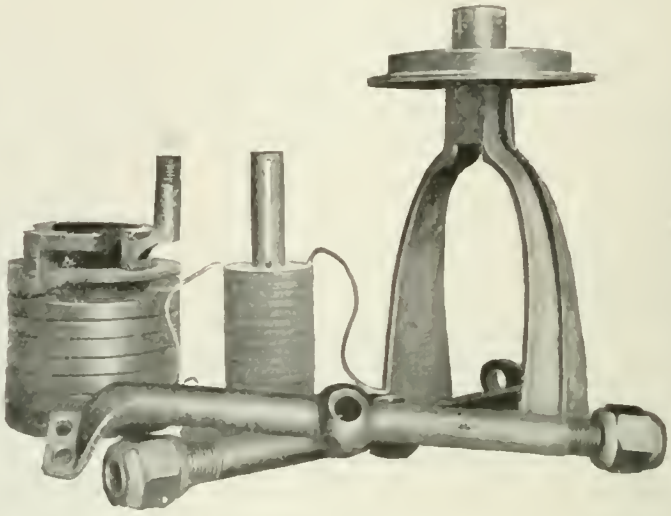


FIG. 4.—HEAVY PARTS OF SWITCH.

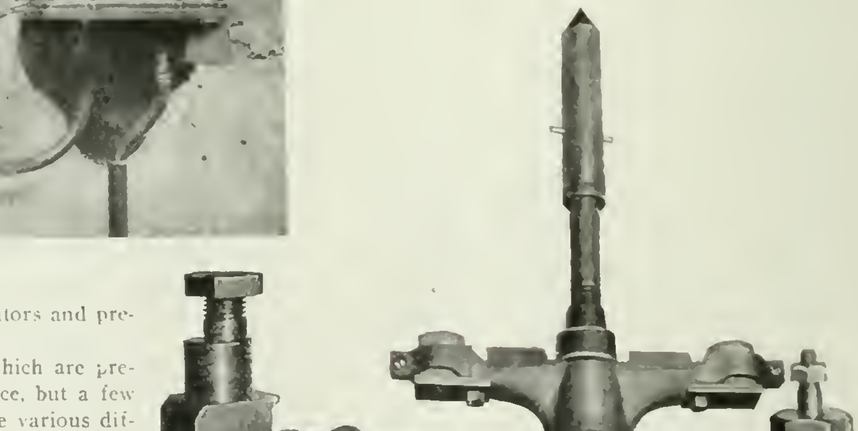


FIG. 5.—PLUNGER AND SWITCH DETAILS.

circuit. When it is lifted by the shunt coil, therefore, the shunt circuit is broken at the contact points and the plunger held up by the action of the series coil alone. As small a current as 25 amperes is sufficient to maintain the switch closed. Should no current be taken from the third rail after the shunt coil has raised the plunger the latter will drop back to its normal position, again closing the shunt circuit and again being lifted, continuing to oscillate thus up and down until the shoe leaves the rail or current is taken from it of sufficient strength to energize the series coil.

The locomotive is provided with two collecting shoes placed about 28 ft. apart and electrically connected. When the forward shoe reaches the dead section in front of the train current immediately flows from the rear shoe, which is on a live section, to the dead section and operates the switch in the same manner as did the auxiliary dynamo current described above. On the other hand, when the rear shoe leaves a section the forward shoe is taking current from its rail so that the current is not interrupted as the rear shoe slides over the insulation between the sections. As soon, however, as it has left a section that section ceases to supply current, the series coil of the switch controlling it is no longer energized, the plunger falls and the section becomes dead. Before the main jaws can open there will be practically no current on the switch, and, therefore, no arcing; but large carbon breaks are provided which remove all possibility of injuring the jaws and interfering with the smooth action of the device in continuous service.

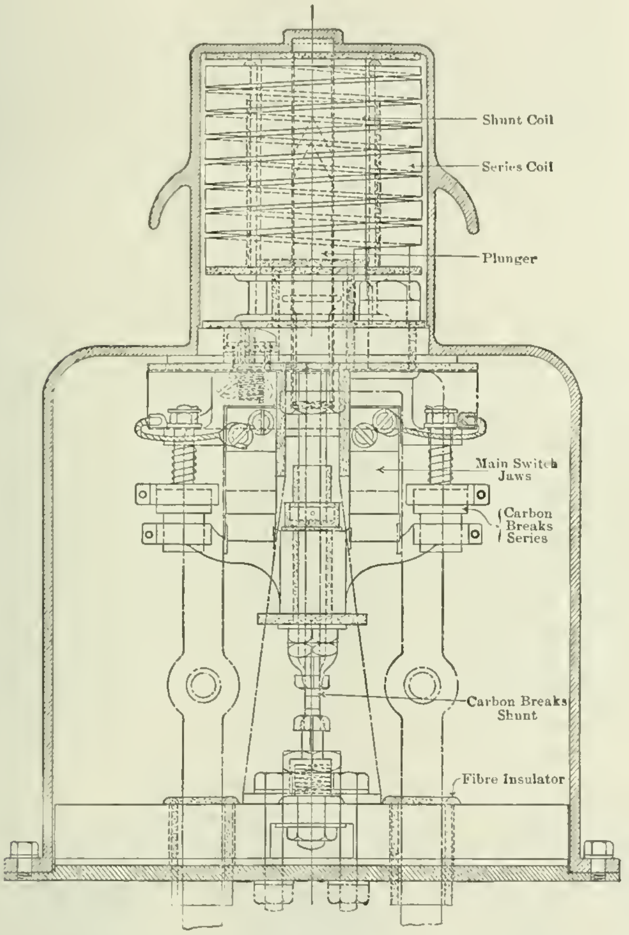


FIG. 6.—CROSS SECTIONAL VIEW OF SWITCH

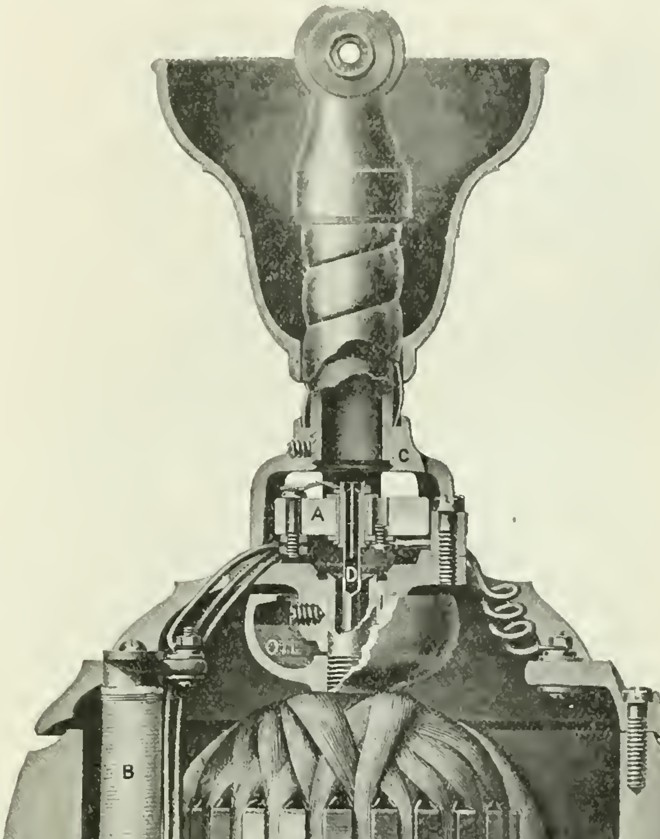
While the locomotive is receiving current from the third rail the dynamo on the engine runs as a motor storing air in the receivers and holding it in readiness for the next stop. Specially designed pneumatic valves are arranged so as always to provide a supply of air so that a locomotive is always ready to pick up the plunger in the switch and connect this third rail with the feeder.

The Pennsylvania's New Power Plant.

The plans for the new electric light plant and power house which the Pennsylvania Railroad Company is erecting in connection with a new depot at Pittsburg have been turned over to the contractors. The building for the plant will be 312 by 47.1. The material will be stone and terra cotta. The smoke stack will be 253 ft. high. There will be Babcock & Wilcox boilers of 2500-hp capacity, with Roney stokers and Hunt conveyors for the handling and consumption of fuel. In the engine room there will be four marine-type Westinghouse engines direct-connected to the same number of Westinghouse alternating-current dynamos of 350 kw. There will also be one steam-driven and one motor-driven exciter.

"Standard" Ceiling Fan.

The accompanying illustration shows the construction of the 1901 model direct-current "Standard" ceiling fan manufactured by the Robbins & Myers Company, Springfield, Ohio. The bearings are supported by and centered in end plates which, together with the yoke ring, form a spherical case which encloses the armature and field. The company has adopted a new system of fitting these plates which, it claims, secures absolute alignment of bearings with-

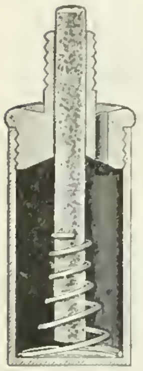


CROSS SECTION OF CEILING FAN.

out resorting to swivel sleeves. This improvement, it states, increases rigidity of construction and eliminates noise.

The illustration shows the disposition of the regulating resistance and porcelain switch. These parts are connected up independently, and may be placed in position or removed without disturbing any of the mechanism of the fan, as there are no wires leading through the shaft as in previous models. The oiling system is also shown in the illustration. The company makes a line of desk and bracket fans besides the ceiling fan above described.

Improved Oil Cup.

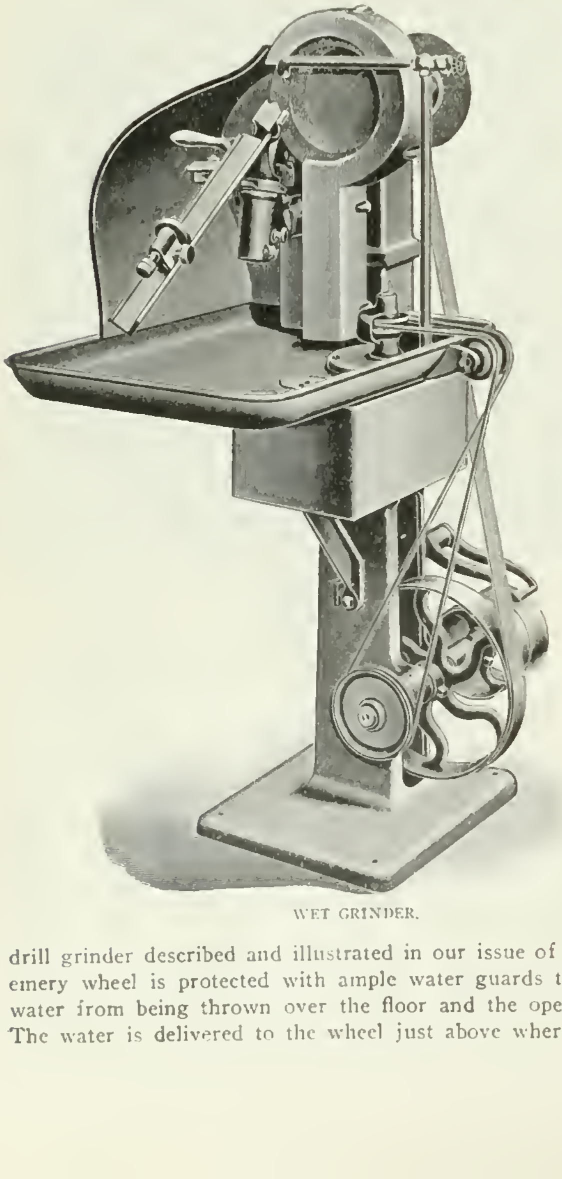


5-H OIL CUP.

The oil cup illustrated herewith is used on fan motors, motors and other high-speed machines, when it is desired to feed the oil steadily to the lower side of the shaft only when it is in motion. When the shaft is not running the cup will not feed any oil. The wick is made of hard felt and the cone-shaped spring to which it is attached keeps it upright. The flow of oil is regulated by the pressure of the wick against the shaft, an increase of pressure increasing the flow. The wicks are furnished in lengths required to obtain the proper pressure. As an example, by having a pressure of 4 ozs. the flow of oil will be so regulated that a 5-H cup once filled will lubricate a ⅛-hp motor 50 to 60 days. The cup holds 50 drops and the bearing uses at the rate of 1 drop per day of 10 hours. The device is manufactured by the Bowen Manufacturing Company, of Auburn, N. Y., which also manufactures felt washers, wicks, strips and special shaped pieces of felt of any kind or size.

The "New American" Wet Grinder.

This new wet grinder has for its foundation the regular style of drill grinder described and illustrated in our issue of Jan. 26. The emery wheel is protected with ample water guards to prevent the water from being thrown over the floor and the operator as well. The water is delivered to the wheel just above where the work is being done, and in this way the full benefit of the water supply is obtained. A large water pan is provided from which the water drains into a reservoir with two compartments, one for a settling chamber and the other containing clear water in which the centrifugal pump, which furnishes the water supply, is submerged. This centrifugal pump is mounted on a vertical axis, which is claimed to be an advantageous arrangement. It is driven by a round belt coming up in the rear of the machine from a pulley on the countershaft over idler pulleys to the vertical shaft of the pump. The supply of water may be regulated by the valve shown in the angle of the pipe and may be shut off entirely when it is desired to use the wheel dry.



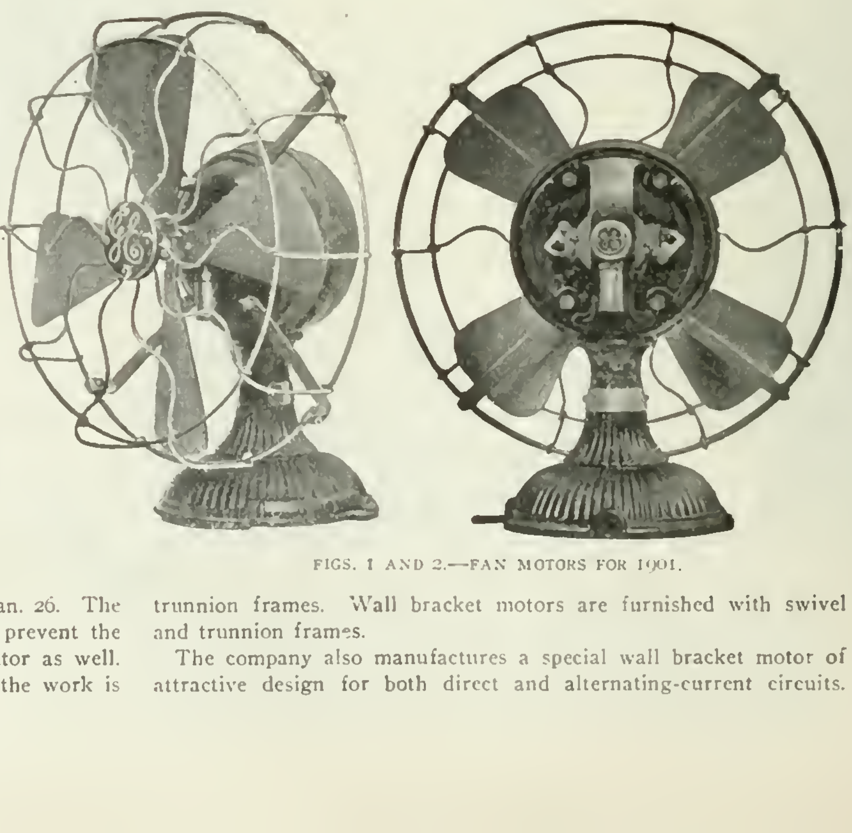
WET GRINDER.

This wet grinder, which is manufactured by L. S. Heald & Son, Barre, Mass., is a satisfactory machine where the majority of the drills are of large sizes. There is less danger of drawing the temper when the wheel is provided with abundant supply of water

General Electric Fan Motors.

For the season of 1901 the General Electric Company is offering a complete line of fan motors for both alternating and direct-current circuits. The alternating-current motors have no moving contacts. The cast-iron frame surrounds the armature of laminated soft iron with bare copper conductors—the field coils being mounted on a laminated iron frame. The regulating device includes a three-point switch which is placed in the back of the desk motors and in the base of the wall and bracket motors, and operated by a projecting key, so that no additional switch is required. These motors will run at two different speeds. They are furnished for circuits of 60, 125 or 133 to 140 cycles and 52, 100 to 108 and 108 to 115 volts. They can be supplied for 220 volts. The motors are finished in standard black enamel with four-blade polished brass fans and polished brass guard and trimmings. They are furnished in three sizes, with 12, 14 and 16-in fans.

The direct-current fan motors are made with elliptical bodies, and are dust-proof with a removable shield over the commutator end, which permits access to the brushes and brush holders for examination and cleaning. The brush holders have been designed so as to insure a uniform pressure of the rectangular brushes against the commutator and to prevent them from turning and presenting a sharp edge to its surface. These motors are provided with a four-point regulating switch placed in the base of the motor, which allows three different speeds. The bearings are lubricated by oil fed by a wick pressed against the shaft by a light spring. The direct-current motors are furnished with 12 and 16-in. fans. The desk motors are furnished with solid frames, with swivel frames or with swivel and trunnion frames. Wall bracket motors are furnished with swivel and trunnion frames.



FIGS. 1 AND 2.—FAN MOTORS FOR 1901.

The company also manufactures a special wall bracket motor of attractive design for both direct and alternating-current circuits.

This is furnished with either black japan iron suspension frame or where more elaborate finish is desired, with brass arm and trimmings. As a convenience for persons desiring to use one wall motor in several different rooms, the company supplies separate wall brackets on which the motors of a certain size and capacity are interchangeable.

The ceiling fans furnished by the General Electric Company are for use on direct-current circuits and furnished with either two, four or six blades, either slow or high speed.

Telephone Wood Work.

The Gilliland Electric Company, Adrian, Mich., has resumed on a large scale the manufacture of telephone and electrical specialties. The Gilliland Company, which was organized in 1887, for many years manufactured the pins and brackets for some of the largest telephone and telegraph companies in the United States. Mr. James F. Gilliland, the manager of the company, is one of the best-known telephone men in the business. He comes of a family of well-known telephone men, and himself has invented and patented large numbers of electrical and telephone dvices. The Gilliland Company has installed complete wood and metal working machinery for making all forms of cabinet work, pins and brackets, and is also equipped to manufacture many specialties which ordinary manufacturers could not handle. The plant of the Gilliland Company is stated to have a capacity to employ 1000 men.

Universal Motors for Factories.

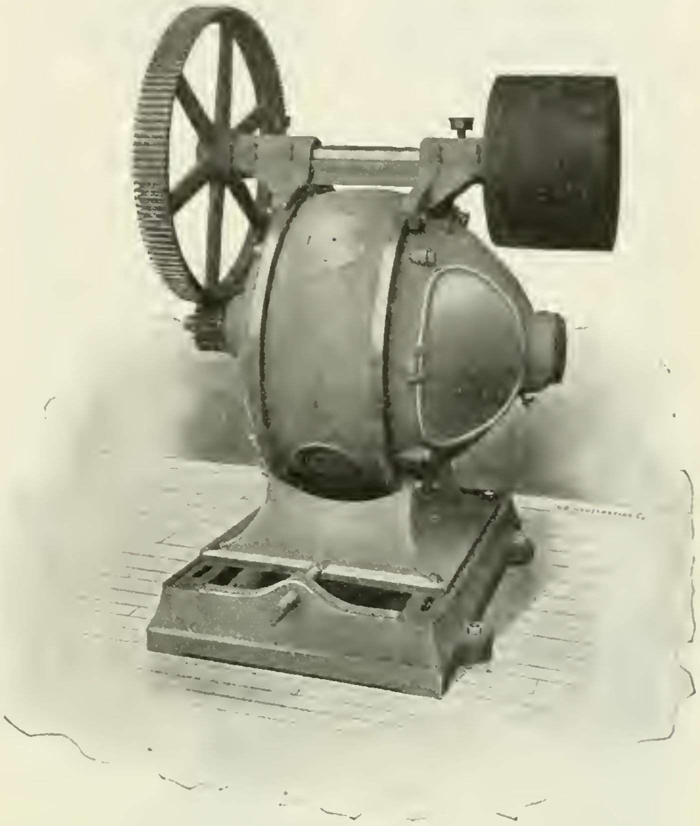
The Jenney Electric Manufacturing Company was a pioneer in the construction of direct-current motors for power purposes, and has maintained a reputation for the excellency of its product. A careful study of the conditions existing in manufacturing establishments and long experience resulted in the design of the "Universal" type of motor. The success of this form of motor was so immediate that a full line of machines from 1-3 to 75 hp has been placed on the market. The motors can be direct connected, geared or belted to any machine, and the designs contemplate such a full variety of speeds. Each size is wound for three standard voltages, 125, 250 and 500, and three standard speeds, slow, intermediate and moderate. To fulfil requirements of very slow speed, a reducing gear is attached to the motor frame, diminishing the speed to approximately one-fifth.

The arrangement of the base and back gear is such that the motor can be placed on the floor, wall, ceiling, or upon a support on the machine driven. When the motors are exposed to dust, moisture or flying particles they should be entirely encased. Access to the commutator and brushes is obtained through hinged doors, with dust-proof lining which enables the motors to be used in mills, mines and factories where there are explosive vapors or excessive moisture. Only the best materials and workmanship are employed, and the works in Indianapolis are equipped with every facility for manufacturing these machines in quantity.

The new and extensive works of the United States Playing Card Company at Cincinnati have electrical equipment throughout. After careful investigation and exhaustive tests, an order for over 150 motors was placed with the Jenney Electric Manufacturing Company. Among this number 40 1-3-hp slow-speed were directed connected to punch presses, and 4 2¾-hp compound-wound motors, with ventilated heads to prevent flying particles from getting into the armature and commutator, drive Cottrell printing presses. The other motors are direct connected, geared and belted or connected through reducing gear and attached in nearly every different manner to machines requiring every kind of duty.

Another extensive plant recently equipped is that of J. P. Mathieu & Co., of Philadelphia, one of the largest tanners of fine hides in the country. The Jenney Company has supplied and has an order for three 225-kw, 250-volt, 3-bearing generators for power purposes and one 100-kw, 115-volt lighting dynamo. In service these machines have carried overloads of between 50 and 60 per cent for five hours continuously without serious heating or sparking. The machinery is operated by 24 motors ranging from 5 to 60 hp. Most of these motors are running where the atmosphere is surcharged with moisture, so that it was necessary to make them practically water proof. This was accomplished by a solid back head and hinged doors on the front head.

During the past six months the Marsden Company, of Philadelphia, has equipped three plants, at Linden, Ind.; Peoria, Ill., and West Point, Va., for the manufacture of cellulose. Each plant requires one 125-kw, 230-volt direct-connected generator, and 75 and 50-hp motors. As cellulose under certain conditions is one of the most powerful explosives, it is essential that the motors be entirely dust-proof. The Jenney machines have successfully performed the unusual service here required. It has been very gratifying to the company to have additional or duplicate orders follow the first installations in large plants in nearly every instance. This is the most convincing testimony of the excellent service rendered by the Jenney motors under all conditions.



UNIVERSAL MOTOR.

Portable Testing Set.

Messrs. Queen & Co., of Philadelphia, Pa., have made some recent improvements in their Acme portable testing set, by which the range and accuracy of measurements are greatly increased, and at the same time the mechanical construction has been improved. An important change has been made in the construction of the metal blocks of the Wheatstone bridge and rheostat. Usually the block is merely held to the rubber plate by the threaded end of a small rod screwed into the block. A disadvantage of this method is the small area of contact between the block and rod, and in time the threads are liable to become oxidized and a poor contact ensue. In the new construction, however, these objectionable features are obviated by using part of the block itself to extend through the rubber plate and take the check nut below. A small rod, to which the end of the wire comprising the resistance coil is soldered is also soldered into the bottom of the brass block. There is therefore a complete soldered circuit from the plug contact through one block and rod with its resistance coil, back through the end rod and block and suceeding plug contact. It is only necessary to keep the plug contact clean and bright to be positive that there will be no change of resistance in the interior of the set. Furthermore, the bottom of the metal block is provided with a knurled surface, as shown at *K*, so that the little corrugations will be tightly forced down into the rubber plate, securely fastening it and preventing the block from turning when the plug is inserted. The ordinary construction has a smooth lower surface and slipping is liable to occur.

The galvanometer is of the D'Arsonval type, which is uninfluenced by external mechanical or magnetic disturbances. The coil is long and light, and swings in an intense magnetic field, so that the sensibility is high. The system is so well balanced that the set can be used in any position, and, it is stated, will give as accurate indications on the top of a telephone pole as on a laboratory table. The system is very deadbeat, and has a uniform scale which can be calibrated so that the instrument can be used in insulation measurements, the deflection on the scale representing the insulation resistance.

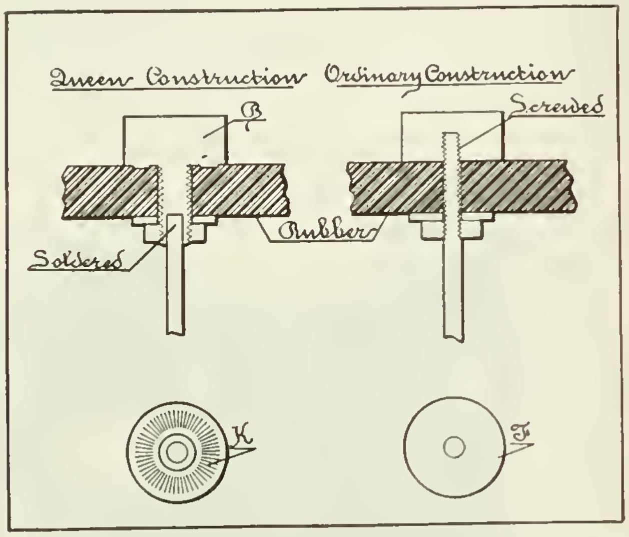


FIG. 1.—IMPROVED METAL BLOCKS.

The battery consists of four special dry cells, any one or any number of which can be used as desired. They have a large current capacity and a high e. m. f., and are found to give much better results than the old silver chloride type which heretofore have been universally used.

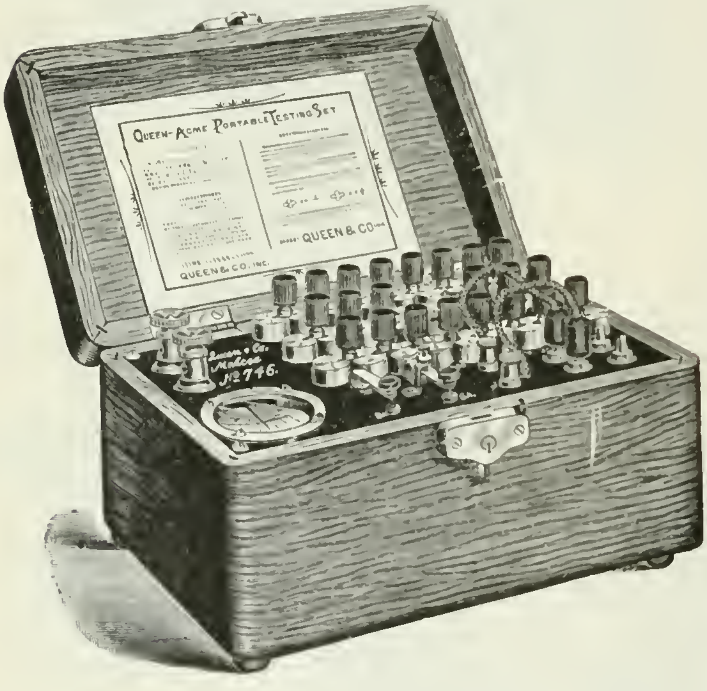


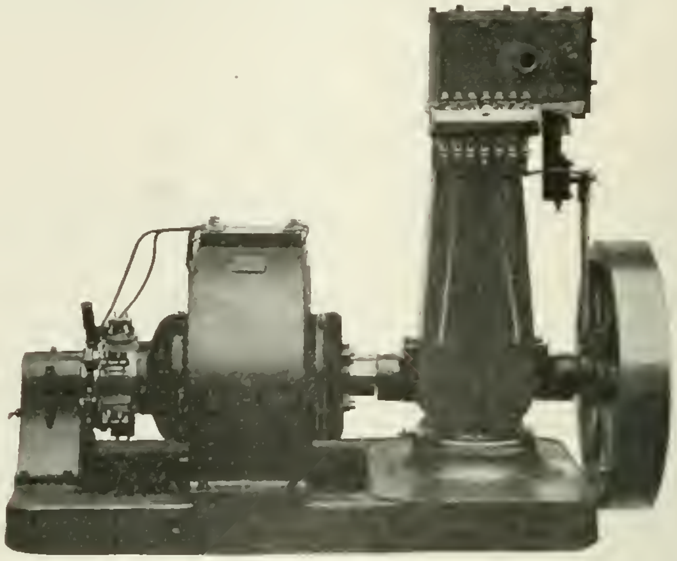
FIG. 2.—PORTABLE TESTING SETS.

The set is enclosed in a substantial and well finished oak case.

A Compact Electric Generating Outfit.

In designing the outfit illustrated herewith the builders, Engberg's Electrical & Mechanical Works, St. Joseph, Mich., have aimed to produce a machine that may be operated with the least consumption of steam and requiring the smallest amount of attention. These lighting outfits are made in outputs equivalent to from 25 to 500 incandescent lights, and in plants where steam boilers are in use for other purposes it is stated that light can be furnished by one of these outfits cheaper than current for the same amount of light could be purchased from service mains.

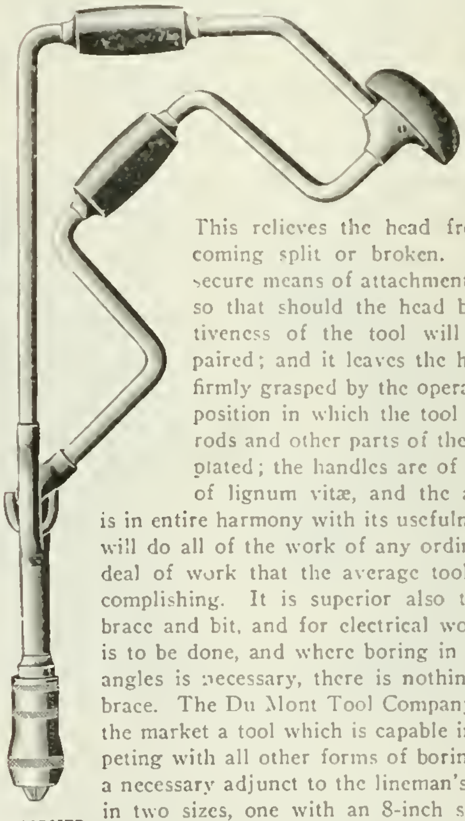
The general features of these outfits, as pointed out by the manufacturers, are compactness, perfection of mechanism and durability, reliability, freedom from vibration and low first cost. All of the principal bearings are oiled from one source of supply, and as the connecting rod is enclosed there is no spattering of the lubricant. The armature is said to run cool, even when considerably overloaded. The engines for the direct-connected units are constructed with short stroke and relatively large diameter of cylinder. This design gives an outfit that is at once economical and adapted for marine use.



DIRECT-CONNECTED OUTFIT.

Corner Brace for Electrical Wiring.

The Du Mont Tool Company, Buffalo, N. Y., has brought out a corner brace for which it is stated there is a large demand because of its particular adaptability to electrical work. The new style consists of a malleable iron socket in which the end of the sweep or crank turns and to which the head is secured. This relieves the head from the danger of becoming split or broken. It forms a rigid and secure means of attachment for the angular frame so that should the head become split, the effectiveness of the tool will not be seriously impaired; and it leaves the head entirely free to be firmly grasped by the operator, irrespective of the position in which the tool is operated. The steel rods and other parts of the tool are heavily nickel plated; the handles are of cocobola and the heads of lignum vitæ, and the appearance of the tool is in entire harmony with its usefulness. This corner brace will do all of the work of any ordinary brace, and a great deal of work that the average tool is not capable of accomplishing. It is superior also to the ratchet form of brace and bit, and for electrical work where much boring is to be done, and where boring in corners or at awkward angles is necessary, there is nothing so good as a corner brace. The Du Mont Tool Company claims to have put on the market a tool which is capable in every respect of competing with all other forms of boring tools, and is in itself a necessary adjunct to the lineman's kit. The tool is made in two sizes, one with an 8-inch sweep, measuring 22 by 12 by 6 inches, while the other is a 10-inch sweep, measuring 23 by 13 by 6 inches.



CORNER BRACE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money during the week ranged between 1¼ and 2 per cent, most of the loans being made at the latter figure. Time money was higher, the rates being 3½ per cent for 30 to 90 days; 3¾ per cent for four months and 4 per cent for six months. The rates for prime indorsed bills-receivable closed at 3¾ per cent. In the stock market, speculation was quieter. Sales of speculative holdings, induced by the lack of further deals, reacted on railroad share values; the uncertainty regarding the steel combination also contributed to check activity. Steel stocks and other industrials showed some strength, but afterwards reacted. Public interest in the general market seems to have diminished, and the professional interest is of a bearish nature. With one exception, the electric and traction securities have partaken of the general quietness, the exception being General Electric. This stock closed with a net gain of 2 points, the only gain in the list. The sales were less than half of what they were the week previous, being 6550 shares, but the price reached 218. The quotations at no time during the week fell as low as 200, the lowest figure being 204. It is interesting to note that this stock has in three weeks made a net gain of 22½ points. The remarkable speculative outburst in Western Union, which was noted in last week's issue, has subsided, the reaction last week more than offsetting the gain of the previous week. It closed with a net loss of 2¼ points—¼ of a point less than the gain of the week before. Prices kept fairly steady, however, fluctuating between 88⅝ and 86¾; the sales were 18,680, as against 112,340 shares the week previous. Metropolitan Street Railway kept quite steady throughout the week, the sales and prices being about normal, the stock closing with a net loss of ½ point. The same may be said with reference to Brooklyn Rapid Transit, which lost ⅜ of a point on the week's transactions. The following are the closing quotations:

NEW YORK.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
Gen. Electric	211	213	Elec. Veh.	15	14½
Bklyn Rap. Tran.	77⅛	76¾	Elec. Veh., pfd.	30	30
Met. St. Ry.	163⅜	162⅞	Gen. Car.	2⅛	2¾
Am. Tel. & C.	97	—	Ill. Elec. Veh. Tran.	¾	¾
West. Un. Tel.	89	86¾	Hud. Riv. Tel.	120	117
Am. Dist. Tel.	36	35	N. E. Elec. Veh. Tran.	3	—
Com. Cable	160	—	N. Y. Elec. Veh. Tran.	4½	4½
Elec. Boat.	27	24	Tel. & Tel. Co. of Am.	4	4
Elec. Boat, pfd.	52	52	N. Y. & N. J. Tel.	174	175

BOSTON.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
New Eng. Tel.	—	—	Erie Tel.	*62	57
Mex. Tel.	2½	2⅝	Gen. Elec., pfd.	160	175
Westing. Elec.	—	60	Am. Tel. & Tel.	162	161
Westing. Elec., pfd.	—	—	Boston Elec. Light.	210	212

PHILADELPHIA.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
Elec. Stor. Bat.	70	68	Phil. Elec.	7⅜	6¼
Elec. Stor. Bat., pfd.	75	68	Pa. Elec. Veh.	2	—
Elec. Co. of Am.	8⅞	—	Pa. Elec. Veh., pfd.	1	—
Gen. Elec. Auto.	—	—	Am. Rys.	35½	—

CHICAGO.

	Feb. 16.	Mar. 2.		Feb. 16.	Mar. 2.
Chicago Edison	150	150	Chicago Telep. Co.	260	260
Chic. City Ry.	256	255	Union Traction	12	13¾
Nat'l Carbon	18	17	Union Traction, pfd.	55	53
Nat'l Carbon, pfd.	83	83	Northwest. Elev. Com.	33	34

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* Asked.

TROLLEYS IN OHIO.—The Cincinnati Traction Company has at last been incorporated, with a capital stock of $2,000,000. It was organized for the purpose of leasing and operating the entire street railway system of Cincinnati, now controlled by the Consolidated Company. The incorporators are: Randall Morgan, Philadelphia; W. C. McGowan, Philadelphia; Jacob C. Schmidlapp, Cincinnati; William T. Irving, Cincinnati; and Charles T. Prior, Cincinnati. For the first year the new company is to pay the Consolidated 5¼ per cent on its capital stock, 5½ per cent the second year, 5¾ per cent the third year, 6 per cent the fourth year, and 6 per cent each year thereafter, during the lease. An ordinance to extend the franchises of the Little Consolidated Street Railway for 25 years has been introduced in the City Council. It provides for six tickets for a quarter for 12 years, and seven tickets for the remaining 13, universal transfers, when the rival company, the "Big" consolidated, agrees thereto, and a percentage of the gross receipts for the city, as follows: Two per cent for eight years, 3 per cent for five, 4 per cent for five, and 5 per cent for the last five years. Use of tracks by suburban lines must also be granted. At the annual meeting of the Northern Ohio Traction Company, of Akron, E. W. Moore was elected president to succeed Henry A. Everett. The past year has been one of prosperity for the company. The capital stock will be raised from $2,000,000 to $2,500,000. The construction of electric lines to Canton and Rowena was decided upon. The gross earnings for the past calendar year were $425,890. In the fiscal year ending last June, they were $388,059.

NATIONAL CARBON.—The National Carbon Company reports as follows for the year ended Jan. 31, 1901:

	1901.	1900.	Changes.
Net earnings	$508,739	$451,687	Inc. $57,052
Pref. divs.	315,000	315,000	....
Balance	$193,739	$136,687	Inc. $57,052
Depreciation	151,456	100,742	Inc. 50,714
Surplus	$42,283	$35,945	Inc. $6,338

President Parmelee says that the business of the first year has shown a steady and gratifying increase in all of its branches, except that of molded carbons for open-air lamps, which is made up of gains in another class of carbons. The remarkable growth of the telephone business has increased the business in batteries and telephone specialties to a very great extent. About $67,000 have been expended on the company's plant out of earnings. The company has no bonded floating indebtedness.

TELEPHONY IN THE SOUTH.—It is stated by the *Boston News Bureau* that the Southern Bell Telephone Company (owned by the Western Union Telegraph Company and the American Telephone & Telegraph Company, the latter owning a control), operating 70 exchanges and a valuable long distance system in Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama and Florida, contemplates an extensive development this year to head off competition which exists quite extensively in Virginia, Georgia, Alabama and Florida. All important points will be connected with the long distance service which may be extended into Florida to meet the contemplated Cuban connection. The East Tennessee Telephone Company, operating under the Bell franchises 40 exchanges in Tennessee, has passed into the hands of the Cumberland Telephone Company (40 per cent of the stock of this company being owned by the American Telephone & Telegraph Company and 11 per cent by the Western Electric Company.) The capital stock of the East Tennessee Telephone Company is $300,000. Bonds $200,000.

CANADIAN GENERAL ELECTRIC COMPANY.—The annual meeting of the Canadian General Electric Company, of Toronto, Ont., was held on Feb. 20. The report showed that the net profits on operating accounts amounted to $262,903, and the premiums on the new stock to $75,000. These items, with the $58,437 balance from last year, making a total of $396,340. The dividends 10 per cent on the common stock and 6 per cent on the preferred stock, amounted to $127,623; $125,000 has been added to the reserve, making that fund now $265,000, and a further sum of $12,600 has been placed at the credit of profit and loss, making $71,038 carried forward. The prospects for the new year, it was stated, were excellent. Directors were elected as follows: W. R. Brock, president; H. P. Dwight and Frederic Nicholls, vice-presidents, with the latter as the managing director.

WESTINGHOUSE STOCK.—At a special meeting of the stockholders of the Westinghouse Electric & Manufacturing Company, at Pittsburg, on Feb. 20, a vote was passed for an increase of several million dollars in the capital stock. The plan of the directors is to issue the new stock as second preferred or assenting stock. The outstanding stock of the company at present is $3,996,750 preferred, $8,227,476 second preferred, and $146,700 common stock. It was decided to make the new issue $10,000,000, of which $3,000,000 will be put out. The total authorized stock is now $25,000,000. The company shows a surplus of $4,693,000.

KETTLE RIVER POWER.—A company, called the Kettle River Power Company, has been incorporated in London, England, with a capital of $1,000,000, to acquire the rights of the Cascade Water Power & Light Company, of British Columbia, and to adopt an agreement with the London & British Gold Fields Company. The last-named company has, for some time, been doing preliminary work to develop the water power of Kettle River at the falls, Cascade City, and it is the intention to supply power and light to towns, mines, etc., throughout the boundary country.

TWIN CITY RAPID TRANSIT, of Minneapolis and St. Paul, reports $2,839,355 gross for the year, net $1,534,666, charges $1,279,075, including dividends on common stock, and $255,591 surplus. During the year the company reported uniformly steady increases in earnings, no month having shown a loss. During the year interest on funded debt was reduced 4.16 per cent. The surplus applicable to common stock dividends is equivalent to 4.90 per cent on common stock on which was paid 3 per cent in 1900 and 2½ per cent in 1899.

Commercial Intelligence.

THE WEEK IN TRADE.—Viewed as a whole, trade showed some expansion last week in spite of the tendency of severe weather to check it at some Northern and Western markets, and in face of the unsatisfactory conditions in cotton manufacturing, brought about by dullness in cotton goods at first hands. *Bradstreet's* points out that iron and steel in the cruder forms have been very strong at central and Eastern markets, and considerable advances are reported in pig iron and steel billets. Building material showed notable strength. Reports from many cities indicate that a large amount of building will be done during the spring. The relatively best trade advices come from the Central West and the Southwest. Export trade in iron and steel is slack, foreign markets are steadily going lower and the fear of discriminating duties against American iron and steel is evident, although the first manifestation, that in the case of Russia, involves a small amount of business. Weather conditions were unusually favorable to the railways, and returns for the second week of February are likely to be even better than those for the first week, which were 6.4 per cent better than a year ago. The business failures for the week, as reported by *Bradstreet's,* were 221, as against 226 the week before; 168 in the same week last year and 220 in 1899. In the metal market copper was unchanged, little buying being done, particularly in large lots. The tone, however, is a trifle stronger. Lake Superior ingot is quoted at 17 cents, and electrolytic and casting stock at 16⅝ cents. The exports of copper for the first three weeks of February do not show up well. It is estimated that they were below 5000 tons, while last year the total for the month was 13,653 tons.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Feb. 20: Antwerp—15 packages electrical machinery, $250; 51 packages electrical material, $11,317. Argentine Republic—30 packages electrical material, $1,088; 1 package electrical machinery, $200. Brussels—8 packages electrical material, $178. British Australia—32 packages electrical material, $1,033; 5 packages electrical machinery, $1,004. British Guiana—19 packages electrical material, $399. British East Indies—2751 packages electrical machinery, $301,350; 9 packages electrical material, $485; 9 cases motor vehicles, $713. Bradford—95 packages motor trucks, $6,525. Bremen—3 cases electrical material, $1,082. Bristol—2 crates trolley wagons, $263; 38 cases electrical material, $3,540. Brazil—46 packages electrical material, $2,708; 65 packages electric railroad material, $2,688. British West Indies—3 packages electrical material, $75. Copenhagen—1 package electrical machinery, $30. Chili—4 cases electrical material, $60. Central America—21 cases electrical material, $373. Cuba—29 cases electrical material, $398; 1 crate auto vehicles, $300. Christiania—1 package electrical machinery, $89. Danish West Indies—1 package electrical material, $8. Dutch West Indies—2 packages electrical material, $70. Ecuador—6 packages electrical material, $200. Glasgow—118 packages electrical machinery, $17,286; 10 packages electrical material, $297; 56 reels electric cable, $20,873. Gibraltar—6 packages electrical material, $1,300. Hayti—1 case electrical material, $17; 130 packages electrical machinery, $15,339; 46 packages electrical material, $2,750. Ipswich—18 cases electrical material, $2,500. London—208 packages electrical machinery, $4,185; 128 packages electrical material, $8,037; 7 cases motor vehicles, $5,000. Liverpool—13 cases electrical machinery, $2,750; 11 packages electrical material, $400. Manchester—3 packages electrical material, $300. Mexico—224 cases electrical material, $4,844; 9 packages electrical machinery, $5,000. Newcastle—8 cases electrical machinery, $1,600; 37 packages electrical material, $5 583. Odessa—26 cases electrical material, $290. Rotterdam—1 case motors, $52. Southampton—2 cases electrical material, $132. Trieste—1 case electrical material, $75; 3 cases motor vehicles, $850. Vienna—3 cases electrical material, $231. Venezuela—62 cases electrical material, $988.

ELECTRICAL APPARATUS IN BRAZIL.—Discussing the work of the General Electric Company in foreign countries and in Brazil, the *Brazilian Review,* an English publication, says: "The most important works executed here are the Jardin Botanico, Tijúca and Santa Thereza tramways and the light and power station on the Tieté; a number of smaller lighting installations all over the country, at Bello Horisonte, Manáos, Petropolis, Juiz de Fóra, São João del Rei, Piracicaba, Jacaréhy, Cravinhos and Bagé, in addition to a number in this city. From Manáos to Rio Grande do Sul, the country is an evidence to American skill and enterprise in this particular branch. What steam was to this century electricity will be to the next. The race to-day is to the swift even more than to the strong, and unless the English wake up and apply their energies and capital betime to the substitution of steam by electricity they will inevitably fall out of the race altogether. It was steam and the development of steam power the world over that enriched England and made her so powerful abroad; will Englishmen be content to see their place taken by Americans without a struggle, and sink to the state of Spain, to be a discontented island in the German Ocean. Those who run may read from Dan to Bersheba the signs and portents crying aloud: Awake, awake, or be forever fallen!"

THE CROCKER-WHEELER COMPANY, Ampere, N. J., report the following sales for month ending Feb. 15: Direct-connected generators to Schwartzchild & Sulzberger, two 250 kw; United States Mint, Philadelphia, Pa., two 200 kw, one 150 kw, one 75 kw; Brown Shoe Company, St. Louis, Mo., one 200 kw; Hahne & Co., Newark, N. J., two 200 kw, one 100 kw; E. I. Du Pont de Nemours, Wilmington, Del., one 200 kw; Navy Yard, Washington, D. C., two 150 kw; National Electric Supply Company, Washington, D. C., one 50 kw; Bement, Miles & Co., Philadelphia, Pa., one 50 kw; Toledo Bridge Company, Toledo, Ohio, one 50 kw; White Star Line, one 50 kw. In addition to these, the following motors have been sold: To Philadelphia Engineering Works, Philadelphia, Pa., 46 motors, aggregating over 700 hp. This makes upwards of 3000 hp already sold to that company. Pencoyd Iron Works, four motors, aggregating 60 hp, making over 4000 hp already sold to them. Schwartzchild & Sulzberger, two 75 hp, two 50 hp, seven 25 hp, 14 motors aggregating 160 hp, in addition to 500 hp already sold to them. Various smaller sizes of motors have been sold: To the Link Belt Machine Company, Philadelphia, Pa.; Howard Iron Works, Buffalo, N. Y.; Maris Bros., Philadelphia, Pa.; Richmond Locomotive & Machine Works, Richmond, Va.; National Tube Works, McKeesport, Pa.; Kansas City Electrical Manufacturing Company; Armour & Co., Chicago, Ill., who have already bought over 1300-hp motors and generators; New York Ship Building Company, Monesen, Pa.; Hilles & Jones, Wilmington, Del.

UTILIZING THE SUSQUEHANNA.—The proposition to generate electricity on the Susquehanna River and transmit it to Philadelphia and Baltimore, which is being worked out by Baltimore interests, has not yet reached a stage to permit of a statement as to when actual work on the project will be begun. The Susquehanna Electric Power Company, formed by the promoters of the plan, has $12,000,000 capital. At the start an issue of $4,000,000 bonds is contemplated from an authorized issue of $8,000,000. The Susquehanna Electric Power Company has purchased rights-of-way and water privileges on the Susquehanna River. The first development is to be near Peach Bottom, Pa., and is to be 40,000 horse-power. A contract has been made with the United Railways & Electric Company, of Baltimore, for 40 years to take 20,000 horse-power. Mr. S. Davies Warfield, president of the Continental Trust Company, of Baltimore, is working out the details of the project. All the engineering work has been done. Alexander Brown & Sons made the preliminary plans, which are now in the hands of the trust company..

ORDERS FOR BULLOCK APPARATUS.—Among the foreign orders received recently by the Bullock Electric Manufacturing Company, of Cincinnati, are one 30-hp teaser equipment for the *Aberdeen Journal,* Aberdeen, Scotland; three motor-generators for the *London Daily Express,* and three motor-generators for the *Glasgow Evening News,* Glasgow, Scotland. The Bullock Company has also sold to the Montreal Water & Power Company, Montreal, Canada, one 400-hp three-phase motor; the Carnegie Steel Company, one 25-hp three-phase motor (the fifth or sixth order from that concern); Greumer & Co., Johnstown, Pa., one 30-kw ("I.") engine-type generator; Brown & Sharpe, Providence, R. I., four type N motors; Weir Frog Company, Cincinnati, one 10-hp type N. generator and two special motors; the Pullman Company, Pullman, Ill., two 150-kw type H generators; Mosler Safe Company, one 50 hp motor, type H; Susquehanna Valley Electric Type Company, Sydney, N. Y., one 65-kw single-phase alternator, and the Central Lard Company, New York, one 65-hp engine type generator.

EXHAUST FANS FOR RUSSIA.—President J. B. Dill, of the Specialty Manufacturing Company, of Indianapolis, writes us as follows: "We wish to enter a protest against the American and Russian entanglement. We this morning received an order from a Russian city for 18 Triumph exhaust fans, belted-fans running from 18 in. to 42 in. diameter. Now, this order you well know cannot be filled, it being dated Feb. 9. this being previous to the Russian edict against the United States. Now, this is just what we have been paying you our money for, and so far as Russia is concerned our money and efforts avail nothing. We hope that every effort will be made to settle this matter, so the business of this country can proceed without interruption, and it behooves you people and every merchant and manufacturer to act energetically and promptly in this matter." It seems to us that Mr. Dill, as he says, has a good incentive to do active work of the kind he suggests so vigorously.

JOHN STEPHENSON & CO.'S AFFAIRS.—Creditors of the John Stephenson Company, Limited, street car builders, now in liquidation, met at the office of Sullivan & Cromwell, the attorneys for the receiver, last week. A statement showing the condition of the firm gave the liabilities as $488,000, and assets in this State, $34,000, and the assets in New Jersey, $176,000. The concern is expected to pay from 30 to 33 cents on the dollar.

NEW RAPID TRANSIT CONTRACT.—The contract for the rapid transit tunnel section in Forty-second Street and Broadway, New York City, has been awarded to the Degnon-McLean Construction Company, which has also the contract for building that part of the road between City Hall Park and Great Jones Street. The Forty-second Street section was awarded several weeks ago to Benezette Williams, a Chicago engineer, but some complications arose and Mr. Williams failed to qualify. The Degnon-McLean Company has already begun preliminary work in Forty-second Street, and before long the thoroughfare will again be torn up. The work will require a large force of men, and, although the strip is one of the most difficult to handle along the entire route, the contractor says he expects to finish it on time.

AMERICAN ELECTRIC PLANT IN INDIA.—Consul Fee reports from Bombay, Jan. 10, 1901, that the steamship Buceros, sailing direct from the port of New York, has arrived with an electric plant and outfit and a party of engineers and electricians, representing the General Electric Company, of New York, and destined for the Kolar gold fields, near Bangalore, the capital of the native state of Mysore. The Cauvery River, adds Mr. Fee, is to be used as the source of generating the electric power, which will be conducted across the country to the Kolar gold fields. It is expected that this new power will increase the production of the mines and also lessen the cost of working. This plan is attracting considerable attention, not only from the fact that it is American, but also because it is a new departure in gold mining in India.

TROLLEY CONTRACTS.—It is stated that contracts to complete Mr. Tom Johnson's trolley road from Philadelphia to New York have been awarded to Craig & Fell, railroad contractors at Trenton, and the line is expected to be in operation by June. Mr. Johnson already has a complete line in operation from Philadelphia to Lawrenceville, N. J. The new contract is for building the road from Lawrenceville to New York, and work will be begun immediately. The service between the two cities will be express time, and the cars will be heavy, with double trucks, geared for unusually high speed. The terminal at Philadelphia will be at Frankford, at which point connection with the center of the city will be made over the Fifth and Sixth Street line.

ELECTRIC TRACTION IN GREAT BRITAIN.—The Tramways Department of Brighton will shortly install a duplicate power plant at the North Road electricity works. The equipment will include engines, dynamos, switchboard complete, steam apparatus, boilers, etc. Extensions and improvements will be made on the tramways systems of Derby and Shipley, for which adequate sums of money will be borrowed by the corporations. An electric railway is to be built between Middletown and Ballycotton, near Cork, Ireland, at a cost of about $250,000. It is stated that the Irish Electric Railway Company will complete a line from Kenmare to Bantry, to cost in the neighborhood of $3,500,000.

THE VAN DORN-ELLIOTT ELECTRICAL COMPANY, of Cleveland, has been incorporated by J. H. Van Dorn, H. H. Hodell, F. Schneider, W. A. Dutton and W. H. Elliott. Capital stock, $50,000. The new company takes over the electrical repair, armature winding and manufacturing business heretofore carried on by Van Dorn & Dutton, also the electrical repair business carried on by W. H. Elliott, of that city. The gear manufacturing business carried on by Van Dorn & Dutton will be continued as heretofore under the old name. The new company will occupy a portion of the Van Dorn & Dutton plant. J. H. Van Dorn will be president.

TROLLEY CARS FOR RUSSIA.—In a communication to the State Department Consul-General Holloway at St. Petersburg says that the municipality of that city, which at present has three of the car lines under its control, anticipates the possession of the remaining lines before March 1, when the authorities will advertise in the leading newspapers of the world for bids for the conversion of the lines to the electrical system. The underground system will be used in the center of the city, and the overhead trolley in the outskirts. The present lines are single track. The fare is about three cents for inside seats and about two cents for outside or top seats.

MR. FRANCIS E. RAINEY, of London, England, representing a big importing company of that city, and dealing in American-made machinery, was one of a party of capitalists and manufacturers who spent 10 days early in February touring Southern cities. Mr. Rainey is impressed with some new American types of machinery for electrical power transmission, and will purchase some motors and generators ere his return to his home. The visitor was also impressed with the growing evidences of appreciation of electrical transmission as seen in the South.

THE SEOUL ELECTRIC COMPANY, Corea, which concern operates the first electric traction system in that part of the world, is placing some substantial contracts for additional equipment for its generating station as well as making fair-sized purchases for cars, etc. The General Electric Company is furnishing a number of rotary transformers and car equipments, while the J. G. Brill Manufacturing Company, of Philadelphia, is to ship some half dozen cars. The orders are being obtained through Frazar & Co., of Japan, whose New York offices are at 63 and 65 Wall Street.

AN ENGLISH ELECTRICAL SUPPLY COMPANY, situated in Birmingham, wishes to open up correspondence with American manufacturers of electric accessories. The request is made by Consul Marshall Halstead that letters, catalogues, circulars, etc., be addressed to him, and he will pass them on to the supply company in question. Letters should be addressed to Electric Supply Company, in care of the Hon. Marshall Halstead, Consulate of the United States, Birmingham, England.

ELECTRIC LIGHTING IN HOLLAND.—The Commercial Council at The Hague, Holland, is advertising for a contract for the erection and equipment of an electric plant for the lighting of the city. The contract closes March 25. The supply and installation of the complete central station plant for the Municipal Electricity Works, of Amsterdam, Holland, is now being advertised for. The contract closes April 1, and particulars of the same can be obtained of the secretary, Achtenburgwal, Amsterdam.

TRACTION CONTRACTS.—The corporation of Bournemouth, Eng., is asking for tenders and specifications for the supply of 42 electric cars. The forms of the tender and specifications can be obtained by addressing F. W. Lacey, Borough Engineer, Bouremouth. The contracts close March 2 and a deposit of $250 must accompany each tender, which will be returned to those whose tenders are not accepted.

EXPORTS OF ENGINES.—Recent export shipments of the Ball Engine Company, Erie, Pa., are: One 40-hp simple engine, one 75-hp compound direct connected engine, to Japan; two 125-hp tandem compound engines to Russia; one 50-hp simple engine to Honolulu, H. I.; one 60-hp direct connected engine to Vera Cruz, Mexico; one 150-hp cross compound engine to British Columbia, and one 400-hp direct connected engine to England.

NEW POWER-HOUSE PLANS FILED.—George H. Pegram, chief engineer for the Manhattan Railway Company, New York City, has filed plans for a new two and three-story brick station to be used for storing and distributing electric power for the new third-rail system with which the elevated road is to be equipped. The station will be erected on the west side of Third Avenue, 33 ft. north of 161st Street, at a cost of $31,000.

BALL ENGINE CONTRACTS.—The P. R. Mitchell Company, Cincinnati, Ohio, is installing an electric power plant, the engine, which is 175-hp, self-oiling type, being furnished by the Ball Engine Company, Erie, Pa., which is also installing five 300-hp self-oiling engines in the new electric light plant of the Lacombe Electric Light Company, at Denver, Colo.

M. OSHIMA, Director-General of the Imperial Government Steel Works of Japan, has arrived from Europe with a view to placing some important contracts for electrical equipment for his plant, which is the largest in the Far East. He left New York last Tuesday for the West, where he will visit the principal industrial centers. His visit will be about a month's duration.

RUSSIAN SUGAR.—The National Association of Manufacturers has taken up the subject of the countervailing duty on Russian sugar and the Russian retaliatory duties on American machinery, and is moving to have the United States Government rescind its action.

ENLARGEMENT OF PLANT.—The Cincinnati Edison Electric Company has ordered new dynamos and engines of a capacity equivalent to about 80,000 lights. Much outside construction will be necessary, both overhead and underground. The new work will be completed during the summer.

ELECTRIC METERS.—The Corporation of Launceston, Tasmania, is advertising for 500 electric meters. The contract will be closed on April 22 next. Specification, etc., may be obtained from John Terry & Co., 7 Great Winchester Street, London. Mr. William Corrin is the city electrical engineer of Launceston.

ELECTRIC CRANES FOR ENGLAND.—It is announced that the Ship Canal Warehouse Company, of Manchester, England, desires to receive bids on 22 electric jib cranes, and foreign tenders are invited.

MUNICIPAL PLANT EQUIPMENT.—Mr. S. C. Lancaster, city engineer of Jackson, Tenn., is in the market for an engine and a boiler of 125 hp and a 200-hp condenser, together with other apparatus for a municipal lighting plant.

STOKERS.—Westinghouse, Church, Kerr & Co. have been awarded the contract for Roney mechanical stokers at the new Waterside station of the New York Gas & Electric Light, Heat & Power Company. The order calls for 32,000 hp.

NEW SOUTH WALES.—The American Bridge Company has received a contract for the steel work for the electric power plant to go to Ultimo, New South Wales, Australia.

General News.

THE TELEPHONE.

CADOTT, WIS.—The local telephone company has been granted franchises to place exchanges in Boyd and Stanley.

SANDUSKY, OHIO.—The Sandusky Telephone Company has installed 200 new telephones during the past month.

GRAND RAPIDS, WIS.—The Wood County Toll Line Company will extend its telephone line to Babcock from Pittsville, a distance of eight miles.

FINDLAY, OHIO.—The Findlay Home Telephone Company has secured a franchise to install an exchange in the neighboring village of Benton Ridge.

GALLIPOLIS, OHIO.—The Gallipolis Telephone Company has increased its capital stock from $30,000 to $50,000. F. M. Bow is secretary of the company.

MONTGOMERY CITY, MO.—The People's Telephone Company has been incorporated with a capital of $3,100 by H. Ellis of New Florence and T. Marlow of Americus.

NEW LONDON, OHIO.—The Tri-County Telephone Company of this city has been incorporated with $25,000 capital stock, to operate exchanges in New London and Greenwich.

LEXINGTON, KY.—The Fayette Home Telephone Company has been incorporated with a capital of $25,000 by J. R. Allen, T. W. Bullock, J. H. Shouse, Chas. Kerr and L. G. Coe.

ALBANY, N. Y.—The Genesee Valley Telephone Company, of Rochester, has been incorporated; capital, $100,000. Directors: J. Foster Warner, G. R. Fuller and E. M. Higgins, Rochester.

LADOGA, IND.—The Ladoga Telephone Company uses apparatus of the Electric Appliance Company, has a 100-drop board and 69 subscribers, with a large expected increase in number.

ST. CHARLES, MO.—The Kinloch Telephone Company has its toll exchange completed and the line is now ready for use between St. Louis and St. Charles. The local exchange will be completed by April 1.

ASHLAND, KY.—The Hanover & Henrico Telephone & Telegraph Company has been chartered with capital stock of $5,000, by W. C. Saunders, E. S. Campbell, M. D. Hart, E. L. C. Scott and John G. Pollard.

RICHMOND, VA.—The Long Distance Telephone Company of Richmond will soon have a number of important cities of Virginia connected, among them Staunton, Roanoke, Lexington, Lynchburg and Harrisonburg.

MURPHYSBORO, ILL.—The Southern Illinois Telephone Association held a conference in this city Feb. 15 and decided to accept a proposition to make telephone connection with St. Louis, but whether with the Bell or Kinloch Company has not yet been determined.

NEWTON FALLS, OHIO.—The Newton Falls Telephone Company has elected directors as follows: C. M. Rice, C. E. Fenton, F. W. Corey, H. H. Porter and C. E. Gardner. Arrangements have been made to connect with the Garrettsville and Ravenna exchanges.

HIGHER WAGES.—General Manager C. E. Schaff, of the Big Four Railroad system, has issued an order advancing the salary of every telegraph operator in the employ of the road 12½ per cent. The change will affect between 700 and 900 men, and will increase the pay-roll of the company about $100,000 yearly.

ST. LOUIS, MO.—Stockholders of the Bell Telephone Company of Missouri have re-elected the old officers and directors, with the following exceptions: Alexander Cochran was elected president to fill the vacancy caused by the death of John E. Hudson, and P. C. Moffett director to fill the vacancy caused by the death of C. C. Moffett. Edwards Whitaker was chosen vice-president.

ROCHESTER, N. Y.—Hearings have been had before a referee in the action on the part of the city to force the local Bell Telephone Company to put its wires into the conduits of the Gas & Electric Company. The telephone people have objected, alleging that it is not safe to put their circuits into such proximity to the high tension light and power circuits. The dispute is being actively fought out.

CHARLOTTE, N. C.—The Queen City Telephone Company of this city has gone into the hands of a receiver. The amount of the failure is $28,000. Dr. J. F. Robertson has been appointed receiver and the plant will be sold March 18. Capt. J. H. Wiley, of Salisbury, N. C., is president of the company and J. A. Helvin general manager.

TUB, PA.—The Mutual Telephone Company has a 10-drop switchboard, and the exchange is wired for 20. Its party lines run through the county. The company has 100 subscribers, 25 of whom were added during the last year. The apparatus of the Keystone Telephone Company and that of other companies is used. The company is contemplating building a line about 15 miles long. G. D. Miller is manager.

FORT MARION, PA.—The Farmers' Telephone Company was organized during the past year. It hopes to reach Pittsburg shortly by way of the lines of the Tri-State Company. The business office of the company is Van Voorhis, W. Va. The company has a 50-drop switchboard and 60 subscribers, using American Company apparatus. Mr. E. J. Moore, with headquarters at Van Voorhis, W. Va., is secretary of the company.

INDIANAPOLIS, IND.—A bill of much interest and concern to telephone companies is pending in the Legislature. It provides for maximum charges for long-distance telephone companies. The distances are divided into 10 classes, and a maximum charge for each class is made, which is about one-half less than now charged. The Central Union and New Telephone companies have combined and are presenting a powerful lobby against the passage of the bill.

NOBLESVILLE, IND.—A telephone rate war has been inaugurated in this city. The Central Union Company announced that it would give free communication to its subscribers with every town in the county, and offers the same privileges to farmers having telephones placed in their homes. A rate of 50 cents a month has been made for residence and a 10-cent rate between this city and Indianapolis. The other companies will meet the competition. The cutting on the part of the Central Union is said to be due to the fact that the new company, which recently established a plant in this city, is getting the lion's share of the business.

CLEVELAND, OHIO.—The Everett interests of this city have secured an option on the telephone franchise secured a short time ago from the city of Detroit, Mich., by J. W. Martin. It is stated, however, that the Cleveland people are unwilling to build the Detroit exchange on the exact terms mentioned in the Martin franchise, as it is claimed the rates offered are too low. The Everett interests already control the independent long-distance lines in Michigan, as well as a number of the most important exchanges in that State, so that the Detroit exchange would be a great acquisition. If Mr. Martin can secure the desired amendments to the franchise the deal will probably be closed in the near future.

ELECTRIC LIGHT AND POWER.

TAMPA, FLA.—The city contemplates erecting a lighting plant.

LIVE OAK, FLA.—C. Y. Byrd will establish an electric light plant.

VALDOSTA, FLA.—C. Y. Byrd, of Live Oak, Fla., will erect an electric light plant.

PINE BLUFF, ARK.—The Bluff City Lumber Company has applied for a lighting franchise.

NORFOLK, W. VA.—The Norfolk Light, Heat & Power Company is to build a large power plant.

TULLAHOMA, TENN.—The establishment of electric light plant and water works is contemplated.

ELLISVILLE, MISS.—The city will issue $15,000 of bonds for the erection of an electric light plant.

WINCHESTER, TENN.—The city is investigating the cost of constructing electric light and water plants.

HAMPTON, VA.—A committee will be appointed to investigate the advisability of erecting an electric light plant.

SOMERVILLE, TENN.—The city will issue bonds for the erection of an electric plant and construction of water works.

KANSAS CITY, MO.—The Spring River Electric Power Company has been incorporated with a capital stock of $50,000.

TITUSVILLE, PA.—The Titusville Iron Company has added to its boiler department and put an electric traveling crane in it.

TARENTUM, PA.—The Allegheny Steel & Iron Company is putting in two gas engines of 150 and 100 horse-power for electric lighting in its new sheet plant.

CANTON, GA.—Capt. T. M. Brady will install an electric plant for lighting his marble works, and probably install a plant large enough for lighting the town.

HUNTINGTON, ARK.—The Huntington Electric Light & Power Company has been incorporated, with capital of $8,000, by Wm. Harper, J. H. Thompson, H. Mayer, H. F. Rogers and others.

NILES, OHIO.—The Niles Boiler Company has closed contracts for a 125-hp engine, a 100-hp generator, seven electric motors, and these, with two 100-hp boilers, will be at once installed in a new power house.

COLUMBUS, GA.—The Columbus Power Company is harnessing the Chattahoochee River in the outskirts of the city at the base of a 150-ft. fall. Present outlined operations will entail an expenditure of $300,000.

FAIRFAX C. H., VA.—The Southern Incandescent Lighting Company, of Virginia, has been chartered, with R. C. L. Moncure, president, and James P. Machen, Jr., secretary and treasurer; capital stock, $5,000.

WILMINGTON, N. C.—The House Committee has reported favorably on bills to charter the Yadkin Falls Electric Company, the Clinton & Dunn Telephone Company and the electric railway from Asheville to Weaverville.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company, which has the contract for city lighting, is arranging to make gas in case the city decides to adopt that system at the expiration of the contract, two years hence.

GALION, OHIO.—F. C. Gwynne, of the Delaware (Ohio) Light, Heat & Power Company, has applied for a franchise for a lighting and heating plant similar to that which has recently been placed in operation in Delaware.

NEWARK, N. J.—An order for two 200-hp and two 100-hp engines for the new department store of Hahne & Company, of Newark, N. J., has been given to the Harrisburg Foundry & Machine Company. The engines are to be coupled to Crocker-Wheeler generators.

RAVENNA, OHIO.—The Portage County Commissioners have awarded a contract to the Howe Engine Company of Indianapolis for the installation in the county infirmary buildings of an electric lighting and water supply plant. The company placed a bid of $3,690.

CINCINNATI, OHIO.—Representatives of a new company at Wise, Va., have purchased, in Cincinnati, machinery and other apparatus for an electric light and power plant at that place. W. E. Kilgore, president of the company, said operations will be commenced in 60 days.

OTTAWA, ONT.—For the past few weeks a deal has been going on at St. Catharines, Ont., which means the consolidation of the electric power and light generating establishments of the city, and ultimately placing them in the control of the Cataract Power Company of Hamilton, Ont.

MIDDLETOWN, CONN.—Wilcox, Crittenden & Company, manufacturers of castings, etc., and hardware, have installed an electric plant which is supplying the entire works with power and light. Each department has an independent motor. A new 250-hp cross compound engine is being put in.

OTTAWA, ONT.—The Stave Lake Power Company, of British Columbia, is negotiating with a view to securing certain privileges as to the construction of poles and wires. The company agrees to expend $400,000 in building dams, power houses and other works, and in transmitting power from Stave Lake to Vancouver.

HUNTINGTON, ARK.—The Huntington Electric Light & Power Company has been incorporated. The capital stock is $8,000. The incorporators are Wm. Harper, M. Hayes, J. H. Thompson, H. Mayer, H. F. Rogers, S. T. Mottley, O. B. Young, J. T. Redding, J. A. Finney, John Degen, W. W. A. Curry and H. E. Cunningham.

COLUMBUS, OHIO.—The Council committee on lighting has been instructed to have prepared detailed plans and estimates showing the cost of building, engines, boilers, generators and other necessary apparatus for a lighting plant sufficient to furnish light for the entire city. The present lighting contract will expire in a few months.

INDIANAPOLIS, IND.—The Gamewell Fire Alarm Telegraph Company of New York was the only bidder for the construction of the new electric fire alarm system for this city. The Council appropriated $65,000 for the work, and the Gamewell's bid is $63,500, with extras making the entire cost $69,700. The board has taken the bid under advisement.

CHARLESTON, S. C.—The Twin City Power Company, capital $1,000,000, has been granted the right by the House of Representatives, in a bill passed, to construct a dam across the Savannah River near Parksville, S. C. Congress has granted the same right, provided the dam will not interfere with navigation and fisheries. Samuel Saylor, of New York, and others are the incorporators.

COLUMBIA, S. C.—The State of South Carolina may install an electric plant in the public buildings here. The contract with the local electric light company expires soon. The Columbia Electric Street Railway & Power Company has, in view of the expiration of its contract, made two propositions to the State, looking either to a purchase by the State of certain machinery and power belonging to the company, or to a new contract between the company and the State.

CINCINNATI, OHIO.—Jas. C. Ernst, president of the Cincinnati, Newport & Covington Street Railway Company, has been offered the presidency of the new lighting combine backed by the North American Company, which seeks control of all the electric light and gas companies of Covington, Newport and vicinity. The acceptance is conditioned upon the taking in of all the local interests and they are permitted to control the board.

WOODSTOCK, ONT.—Although the rate payers of this city voted for the purchase the electric light plant of the town in November last, the plant has not yet been taken over. A quantity of the electric light company's bonds has been missing, and up to the present there are $2,000 worth yet to be located. These are thought to be in Ohio. If these lost bonds could be found, the city would take over the plant in twenty-four hours. It is said that the long delay may bring the matter into the courts.

CINCINNATI, OHIO.—A number of the large cotton mills of the South are changing to electrical transmission. The new mill of Capt. E. A. Smyth, at Pelzer Mills, North Carolina, has 68,000 spindles and obtains its power by electrical transmission from a point four miles distant. The only belting is from overhead shafting to looms and spindles, and the loss in transmission from point of generation to point of utilization is only 15 per cent. In Southern mills a general average of 22 per cent is lost in steam power transmission.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company has elected directors for the ensuing year as follows: George Bullock, William Nelson Cromwell, J. B. Foraker, Maurice J. Frieberg, James J. Hooker, M. E. Ingalls, A. Marcus, J. G. Schmidlapp, George P. Sheldon, C. A. Spoffard, C. W. Wetmore and Wm. F. White. The new officers are: President, George Bullock; vice-president, C. W. Wetmore; general manager, Wm. F. White; secretary and treasurer, Silas W. Burt; assistant secretary-treasurer, Alfred Knight.

BALTIMORE, MD.—All overhead wires of electric lighting, telegraph and telephone companies are to be placed in the municipal subways within seven months after the order is signed by the Mayor. The feed wires of the United Railways & Electric Company will be excepted. The companies to use the city's conduits are the United Electric Light & Power Company, Chesapeake & Potomac Telephone Company, Maryland Telegraph & Telephone Company, Postal Telegraph Company, Western Union Telegraph Company, all of the railway companies which operate wires within the subway belt, and the wires of the police and fire alarm telegraph system.

THE ELECTRIC RAILWAY.

MARION, IND.—An electric railway is proposed between Celina, Ohio, and this place.

BEDFORD, IND.—The City Council has granted a franchise to the Bedford Street Railway Company.

PINE BLUFF, ARK.—W. H. Langford is interested in a company to build an electric line in Pine Bluff and suburbs.

TIFFIN, OHIO.—The Tiffin & Southwestern Railroad Company has been incorporated with $50,000 by local people.

TUSCALOOSA, ALA.—It is reported that a number of improvements will be made to the Tuscaloosa Belt Railway Company.

NEWCASTLE, IND.—The interurban line between Anderson & Muncie and other gas-belt towns will be extended to this city.

BALTIMORE, MD.—The United Railways & Electric Company has decided to construct a branch at West Arlington, in the suburbs.

NEW HAVEN, CONN.—The power house of the Winchester Avenue Railroad Company was destroyed by fire on the morning of Feb. 16.

SAVANNAH, GA.—The Savannah Street Railway Company is considering the building of an electric line to Montgomery, in the suburbs.

COLUMBUS, OHIO.—Thomas Kerr, of Columbus, is securing right of way for an electric railway line from Columbus to Richwood by way of Dublin.

RAVENNA, OHIO.—The Northern Ohio Traction Company has asked for a city franchise which will enable it to extend its line from Kent to Ravenna.

BIRMINGHAM, ALA.—The Birmingham Railway & Electric Company will be in the market for eqipment to change its 30-mile steam line to electric, with 60-lb. rails.

OMAHA, NEB.—Fire on the night of Feb. 8 destroyed the interior of the power house of the Omaha Street Railway Company, including cars, machinery, etc. The loss is placed at $200,000.

RICHMOND, VA.—The contracts for the grading on the 40-mile electric railway between Petersburg and Richmond, Va., have been let to A. L. Phillips, H. H. George, Jr., and Carpenter Bros.

BELLEVILLE, ILL.—The differences existing between the St. Louis & Belleville Traction Company and its employees have been amicably adjusted and cars are now running on all city lines.

LAFAYETTE, IND.—The Lafayette, Purdue & Northern Traction Company has filed articles of incorporation, with a capital stock of $800,000. The board of directors is headed with James R. Rock.

KENTON, OHIO.—The Wapakoneta & Kenton Traction Company has been incorporated by W. G. Brorein, H. C. Settgage, S. A. Hoskins, J. H. Goeke and C. T. Kolter. Temporary capital stock, $5,000.

MAUMEE, OHIO.—The Toledo, Napoleon & Defiance Railway Company and the Toledo, Waterville & Southwestern Railway Company, rival projects, have submitted bids for a franchise through this place.

LAFAYETTE, IND.—The first step in a consolidation of electric railways in Southern Michigan, Northeastern Indiana and Northwestern Ohio has been taken by the purchase of the street railways of Lafayette, Ind.

NASHUA, N. H.—The Boston & Maine Railroad and a party of New Hampshire capitalists, headed by Charles Collins of this city, are both seeking a franchise for an electric railway between this city and Concord.

BROOKLYN, N. Y.—The new Flatbush depot of the Brooklyn Rapid Transit Company, which is to be erected on the site of the one recently burned, will include up-to-date club rooms for the motormen and conductors.

ELYRIA, OHIO.—The Elyria, Grafton & Southern Railway Company has been incorporated by Sumner B. Day, J. B. Faxon, George Chamberlin, Charles E. Wilson and Arthur B. Taylor. Temporary capital stock, $10,000.

WABASH, IND.—The Fort Wayne & Southwestern Electric Railway Company has secured the right of way and will extend its line from Huntington to this city. The company also expects to build a line southwest to Marion.

SEATTLE, WASH.—The Seattle-Tacoma Electric Railway now in the control of Fred E. Sander, has been granted a right-of-way along the county road in Pierce County, Wash., extending through the Puyallup Indian Reservation.

SANDUSKY, OHIO.—At a meeting held a few days ago the directors of the Sandusky, Norwalk & Southern Railway Company voted an appropriation of $50,000 for the improvement of the roadbed between Norwalk and Sandusky.

EAST LIVERPOOL, OHIO.—The East Liverpool & Rock Springs Railway Company has filed petitions in Hancock County, W. Va., asking for a franchise to extend its line from Chester to New Cumberland, a distance of 12 miles.

DANVILLE, IND.—The Western Indiana Electric Railway Company has been granted a franchise over the Rockville road by the Hendricks County Commissioners for a term of 50 years. There was strong competition for this grant.

ELKHART LAKE, WIS.—The Village Board has granted a 75-year franchise to J. M. Salmann and associates for an electric street car line. The line will be extended from Sheboygan Falls through Plymouth and Cedar Lake to this place.

KOKOMO, IND.—The Central Traction Company announces officially that all details have been arranged and ample Eastern capital secured to begin at once the construction of the electric road between this city and Indianapolis by way of Noblesville.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Southwestern Railroad Company has asked for franchises on several city streets to give an entrance to the city for its proposed line to Yellow Springs, Clifton, Cedarville, Jamestown and Xenia.

BOSTON, MASS.—The Legislature has been petitioned by the Southbridge & Sturbridge Street Railway Company for the right to build extensions of that line from Fiskdale to Brimfield and Wales. This will give direct connection between Worcester and Hartford.

CRESTLINE, OHIO.—The Ohio Central Traction Company has asked for a franchise for a line from Galion to this city, and the grant will probably be given by the County Commissioners. The company has already placed contracts for rails and other materials for the extension.

CINCINNATI, OHIO.—Randall Morgan, the representative of the Weidner-Elkins-Daly-Brady combination, announces that the new interests in control of the Cincinnati Street Railway will build up an inter-urban system that will attract people to Cincinnati from every direction.

DURHAM, N. C.—The Durham Traction Company has completed arrangements for the building of its system. The gentlemen behind the company are Col. J. S. Carr and R. H. Wright of Durham, Samuel Register of Richmond, Va., and Col. A. B. Andrews of the Southern Railway.

FINDLAY, OHIO.—The Findlay & North Baltimore Railway Company has been incorporated by James P. Bope, Charles F. Smith, Ed. V. Bope, Wm. Norris and Nat V. Nemeyer. Capital stock, $150,000. The company will build an extension of the Findlay Street Railway to North Baltimore.

CIRCLEVILLE, OHIO.—The Circleville Council has agreed to grant a franchise through the village to the Columbus & Southern Railway Company providing the company will agree to locate its car barns and power house within the village limits. The company objects to this stipulation.

TRENTON, N. J.—It is reported here that the Johnsons, of Cleveland, are at the head of a syndicate which has purchased the right of way for a trolley road from New York to Philadelphia. The syndicate, it is stated, holds the key to the entire system necessary for a through line between the two cities.

DAYTON, OHIO.—The Dayton & Northwestern Traction Company has asked for the franchise grant of the Richmond & Eastern Traction Company which was rescinded a few days ago by the commissioners of Wayne County, Ind. If the grant is secured the road will be extended from Eaton to Richmond, Ind.

NEWTON, MASS.—The Newton Board of Aldermen has granted the Boston & Worcester Street Railway a Newton location. The provisions of the franchise require that the company first file a bond for $100,000 and the widening of the street for a distance of three and one-half miles at the expense of the road.

TWO RIVERS, WIS.—The inter-urban electric railway between Manitowoc and Two Rivers, for the construction of which a franchise has been granted to Thomas Higgins, of Neenah, will be extended northward to Mishicott, provided a franchise can be obtained, thence to other towns beyond, and probably to Green Bay.

ALBANY, N. Y.—The Yonkers & White Plains Railroad Company has been incorporated with a capital stock of $50,000. The directors are Freeman H. Merrett and W. Jay Wilson of White Plains, R. J. Bellew, B. B. Riley, H. D. Lent, W. J. Fisher, H. C. Merrett and J. E. Lattimer of Tuckahoe, and Charles Husenberry of Yonkers.

CINCINNATI, OHIO.—The Cincinnati Traction Company, an outgrowth of the Consolidated Street Railroad Company of Cincinnati, is preparing to experiment with compressed air for motive power. A central power station is to be built which can afterward be used for an air station. The main station will generate alternating current.

COLUMBUS, OHIO.—The Columbus, Findlay & Toledo Electric Power, Fuel, Light & Railway Company, of La Rue, has been incorporated by A. J. Jones, J. H. Leonard, R. W. McWay, J. D. Miller, G. W. Kemp, M. J. Gootschalk and A. M. Harth. Temporary capital stock, $10,000. The company proposes to build an electric railway from Columbus to Toledo.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company is experimenting with a new illuminated car sign. The sign has the names of the different car lines printed on a strip of cloth which is moved in front of a row of incandescent lights. The rollers upon which the sign is wound are turned until the name wanted comes before the lights.

TOLEDO, OHIO.—Stockholders of the Ohio Northern Railroad Company have perfected the organization with the following officers: W. H. Cummer, president; G. W. Kurtz, vice-president and general manager; J. W. Cable, secretary and auditor; A. C. Van Driesen, treasurer. The road will extend from Alverton to Toledo, and much of the right of way has been secured.

LANCASTER, PA.—A consolidation of the Conestoga Traction Company, the Lancaster Railway Company, the Lancaster Gas, Light & Fuel Company and the Edison Electric Light Company has been practically effected. The aggregate capital represents over $50,000,000. The company controlling the combined plants will be incorporated under the name of the Lancaster County Light & Power Company.

CINCINNATI, OHIO.—General Manager C. E. Hooven, of the Cincinnati, Lawrenceburg & Aurora Electric Railway Company is canvassing the villages of Delhi, Home City, Cleves, Fernbank and North Bend with a view to securing franchises for electric lighting. If the franchises can be secured, an independent lighting company will be formed and the present railway power house at North Bend will be enlarged to furnish all the towns with the required number of lights.

CINCINNATI, OHIO.—An electric road is projected from Harrison, Ohio, through Brookville, Ind., completing the interurban line from Cincinnati to Indianapolis, a total distance of 120 miles. With the completion of the Miami Valley Inter-urban Electric Railway Company, which operates a road from Troy to Piqua and a new branch to Minster to connect with the Western Ohio electric road now being built from Lima, there will be a complete line from Cincinnati to Detroit, Mich.

ASHTABULA, OHIO.—At the annual meeting of the stockholders of the Pennsylvania & Ohio Electric Railway Company, held a few days ago, it was voted to increase the capital stock from $100,000 to $600,000. New officers were elected, as follows: Thomas Fricker, president; W. F. Stanley, vice-president; B. W. Baldwin, treasurer; Thomas McGovern, secretary. Material has been received for the extension of the road from Conneaut to Ashtabula, and construction work will start March 1.

NEW INDUSTRIAL COMPANIES.

THE AUTO-DYNAMO CAR COMPANY of New York has been incorporated to manufacture electrical machinery; capital, $200,000.

THE CURTISS CONSTRUCTION COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $10,000. It will make a specialty of equipping electric and steam railways.

ALBANY, N. Y.—The Adams Construction Company of Buffalo has been incorporated to manufacture electrical equipments; capital, $5,000. Directors: H. S. Wasson, J. O. Munroe and W. J. Jamison, Buffalo.

THE MILLER LIGHTNING CONDUCTOR & MANUFACTURING COMPANY, of St. Louis, has been incorporated; capital stock, $10,000. Incorporated by August F. Miller, George A. Miller and Louis E. Miller.

THE H. E. LINDSEY ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., capitalized at $5,000, has filed articles of incorporation. The incorporators are H. E. Lindsey, James F. Coyle, P. E. Chapman, D. W. Oviatt and James F. Coyle.

THE MERCANTILE ELECTRIC COMPANY of St. Louis, Mo., capitalized at $50,000, as a branch house of the Western Electric Company of Chicago, has leased a building in the Cupples Block, Spruce Street. The building has five stories and basement.

THE ELKHART ELECTRIC COMPANY of Goshen, Ind., has been incorporated; capital stock, $100,000. The incorporators are Martin V. Berger, Charles H. Tenney, J. S. Dodge, Charles Hewitt and James Dushane. The company will purchase the Home Electric Company and expend a large sum on improvements.

OBITUARY.

MAYO G. SMITH.—Dr. Mayo G. Smith died at Colorado Springs, Colo., last week at the age of 85. He was born in Newburyport, Mass., and was one of the first graduates of Oberlin College. He started life as a preacher, but later turned to journalism, becoming a reporter on the New York *Tribune* under Horace Greeley, whose friend he was. Dr. Smith went to California in 1849 and was part owner of the first ship that sailed from San Francisco to Australia. He became wealthy. Dr. Smith was the author of two works on ether and chloroform and was, it is said, associated with Morse in constructing the first telegraph line between Washington and Baltimore.

PERSONAL.

MR. T. A. EDISON left for the South on Feb. 24 on a long projected holiday, and expects to rest until April 1 if he does not get tired of resting before then.

MR. RICHARD CROKER, of Tammany, has bought a water power at Letcombe, his English estate, and is to use it for electric lighting purposes at the Moat House.

MR. H. WARD LEONARD has gone into the automobile field and is bringing out a very handsome gasoline three-passenger motor car, based on the latest French designs.

MR. W. C. MITCHELL, of Manchester, England, the manager of the British Westinghouse Company, has been in Cincinnati meeting bidders on new equipment and purchasing a number of machines for the English branch.

MR. H. S. SUMMERHAYES informs us that he and Mr. B. Heinrich are starting in business as electrical engineers at 625 Howard Street, San Francisco, under the style of the Pacific Electric Company, with himself as secretary of the company, and his associate as president.

MR. ALEX. DOW, general manager, etc., of the Edison Electric Illuminating Company of Detroit, has been a visitor in the East, attending the meeting of the executive committee of the Association of Edison Companies. About $250,000 was spent last year in Detroit on Edison improvements.

MR. HENRY GORDON STOTT, head engineer of the Buffalo General Electric Company, has been appointed superintendent of motive power of the Manhattan Railway Company. Mr. Stott is a Scotchman who has been for some years in this country, doing excellent professional work, especially in handling Niagara power.

MR. CHARLES W. WASON, who is closely identified with Henry Everett in numerous telephone and street railway enterprises in Cleveland and vicinity, was married on Feb. 12 to Miss Breckenridge, of Hamilton, Ont. Mr. and Mrs. Wason sailed a few days ago on a European wedding trip of three month's duration.

MR. PAULDING F. SELLERS has been appointed electrical engineer of the Buffalo General Electric Company. He is a graduate of the Pennsylvania State University, and has been latterly with the Cataract Power & Conduit Company, but now returns to the other concern, for which he was engaged on cable and conduit work some three years ago.

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, has taken a personal interest in the development of the water power resources of the South, and on a recent trip of manufacturers and capitalists through that section for the purpose of investigating conditions, received some valuable orders for power equipment.

MR. W. M. MALLETTE, for 13 years manager of the Bell Telephone Company at Rochester, N. Y., and for 10 years previous manager for the Western Union Telegraph Company at Syracuse, N. Y., tried to end his life last week by cutting his throat. The attempt was made in New York City. Prospects of recovery are slight. Mr. Mallette's mind had become affected by business affairs, it is said.

MR. LEVI TEAL, who for a number of years has been associated with the S. S. White Dental Manufacturing Company, of Philadelphia, Pa., was married on Feb. 26, 1901, to Miss Annie E. Haas. This journal joins with their many other friends in congratulations and best wishes for a very happy future. Upon returning from their wedding trip through the South Mr. and Mrs. Teal will reside at 2109 North Twelfth Street, Philadelphia.

MR. H. H. VREELAND, president of the New York Metropolitan Street Railway Company, addressing a large audience last week at a church in this city, remarked that "there are no elevators in the house of success." Every man had to do his own climbing. Mr. Vreeland made reference to the club now maintained by the Metropolitan Company, and gave some hints to conductors and motormen. He said that the company was carefully watching the men who attended the club and used the books in the library, and these men would obtain preference in promotions.

Trade Notes.

THE MACOMBER & WHYTE ROPE COMPANY, Chicago, has increased its capital stock from $2,500 to $60,000.

OIL FILTERS IN ITALY.—The Burt Manufacturing Company, Akron, Ohio, has recently shipped an oil filter to the Société Secula Tramways Omnibus, Palermo, Italy.

FACTORY EQUIPMENT.—Messrs. Keelyn & Smith, Milwaukee, Wis., have the contract for the power and lighting plant for the new factory of the A. Y. Lindemann-Hoverson Company. The contract includes generators, motors, switchboard and construction work.

THE YURGAE SIGNALPHONE MANUFACTURING COMPANY, Milwaukee, Wis., has secured the contract for a 20-station telephone exchange for the Wisconsin Central Railroad Company, to be installed in the new shops at Fond du Lac, Wis. The Yurgae Company has received various other contracts for telephone work in that city and has a full line of instruments and apparatus.

THE LEA-HOOVEN ARC LIGHT & ELECTRIC COMPANY and the Anderson Tool Company, of Indianapolis, Ind., have consolidated. The capital stock will be increased and the plant enlarged.

MR. G. CURT KASTNER has opened offices at 149 East Fourteenth Street, New York. He is prepared to do all kinds of repairing, wiring, etc., and is making a specialty of electrical effects and decorations.

THE CAHILL & HALL ELEVATOR WORKS recently moved into the new three-story building, 133-135 Beale Street, San Francisco, where they have increased facilities for manufacturing electric and hydraulic elevators.

THE PAN-AMERICAN EXPOSITION has issued a new and most tasteful booklet in green cover with a reduction of the beautiful Niagara poster attached. It is full of cuts and information about the great coming show.

CONSUMERS' CARBON COMPANY.—The plant of the Consumers' Carbon Company at Lancaster, Ohio, is being equipped with new machinery, and a portion of it has commenced operation. Within the next two weeks all departments will be in operation and 100 men will be employed.

HEATING AND VENTILATION OF A ROUND HOUSE.—The B. F. Sturtevant Company has published a pamphlet giving extracts from the proceedings of the Central Railway Club relating to the construction of round houses. It is of special interest to railway men.

JOHN SCOTT MEDAL.—The Acme Machine Screw Company, Hartford, Conn., informs us that the committee on science and arts of the Franklin Institute, Philadelphia, has awarded it the John Scott legacy premium and medal for its automatic multiple spindle screw machine.

THE WESTERN ELECTRIC COMPANY, Chicago, is carrying a large stock of lead-covered and braided rubber covered cable; also waterproof cable and wire, from the largest to the smallest commercial sizes. This company is offering these goods at very attractive prices and prompt delivery.

EXTENSION CIRCUIT RINGER.—The Garton-Daniels Company, Keokuk, Ia., is sending out to the trade an eight-page pamphlet illustrating and describing its extension circuit ringer and extension circuit closer, both of which devices were described and illustrated in these columns Feb. 2 last.

MR. EWING McLEAN is manufacturing telephone apparatus at Greencastle, Ind. The McLean plant turns out over 200 complete telephones per month, and its instruments are said to be among the best made. Most of them are used in the country and by the local lines. Mr. McLean fits out exchanges complete.

LUSTRAL.—The H. W. Johns Manufacturing Company is presenting to the trade a line of fine finishes (varnish) known as "Lustral" finishes. These goods are manufactured for the finish of interiors, exteriors, floors, etc. They possess merits which commend them to the consideration of all who desire a superior finish in woodwork.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., will send a copy of its 1901 calendar to any one on application. The calendar possesses the merit of being clear and distinct, large figures being used. The card on which it is mounted shows Uncle Sam on the aggressive with reference to Steward's lava burners and tips.

THE "WOOD" TYPE-A OIL TRANSFORMER manufactured by the Fort Wayne Electric Works, Fort Wayne, Ind., is described and illustrated in Bulletin No. 1013, recently issued by the company. The illustrations used are very clear and show the parts of the transformer and the transformer complete. There are numerous diagrams besides.

SPRAGUE APPARATUS.—The Guger Lithographing Company, Milwaukee, Wis., has contracted for Sprague machinery for operating its presses. The Sprague Company has the contract for a 60-kw generator and press motor outfits of the direct connected and belted type. The contract for the switchboard and construction work has been secured by Mr. Geo. F. Rohn. The Guger Company contemplates operating its entire plant electrically.

COLUMBIA LAMP CALENDAR.—Central stations, isolated plants, etc., are receiving from the Columbia Incandescent Lamp Company, of St. Louis, Mo., an attractive calendar for the first four months of 1901. It shows illustrations of the various styles of lamps made by the company. In the reference to this calendar recently the types gave the company a slightly changed name, but the real name was obvious, as it is too well known to be so easily obscured.

THE VAN DORN-ELLIOTT ELECTRICAL COMPANY, of Cleveland, Ohio, has been incorporated by J. H. Van Dorn, W. H. Elliott, H. H. Hodell, F. Schneider and W. A. Dutton. Capital stock, $50,000. The company takes over the electrical repair and manufacturing business of the Van Dorn & Dutton Company and W. H. Elliott. The gear cutting business of Van Dorn & Dutton will be continued as heretofore. J. H. Van Dorn will be president of the new company.

LIST OF STEEL AND IRON PRODUCTS.—The American Steel & Wire Company has issued in pamphlet form a list of products. This list is comprehensive in detail only to the extent necessary to give a clear idea of what the company makes. Many of the products cannot be briefly listed, but the pamphlet shows enough to indicate the general lines. The list includes all iron and steel manufactures, electrical wires and cables, rail bonds, springs, etc. The pamphlet contains 26 pages.

DR. TOSHI SUZUKI, mining geologist of the Government Imperial Steel Works, Japan, was a recent and interested visitor to the International Correspondence Schools. Dr. Suzuki is an educated Japanese gentleman, who has been visiting in the interests of the mining department of the Imperial Steel Works, at Tokio, several European countries and the United States. He returns to Japan with a fund of valuable practical information, which will be used in the development and working of the mines under his control.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports an exceptionally good month, particularly in the line of orders for small machines. Some late contracts include an order for one 75-kw direct connected generator for the town of Versailles, Ohio; a 50-kw direct connected generator for the plant at Perham, Minn.; a 125-kw belted generator, together with several small motors, for the Jamestown Electric Light Company, Jamestown, N. D.; a 100-kw belted generator for the plant at Devils Lake, N. D., and a large direct connected generator for a new hotel at Sioux City, Ia.

THE NATIONAL AUTOMATIC TELEPHONE COMPANY, 153 West Jackson Boulevard, Chicago, Ill., has sold a great many of its party line telephones throughout the States of Kansas and Kentucky. Business in its party line instruments is very flattering. The company believes that this particular system is one of the most easily introduced of any of the telephone systems which have been put on the market, because of the readiness with which it has been accepted, and the reception which it has received would seem to prove that its belief is well founded. One outfit has been shipped within the past few days to the city of Weston, Mo.

MECHANICAL DRAFT.—A unique mechanical draft arrangement consisting of two fans was recently installed at the works of the Diamond Rubber Company, Akron, Ohio, by the B. F. Sturtevant Company of Boston, Mass. Of its operation the owners write that, "with the forced draft at one end and the induced draft at the other, we are enabled to produce a terrific draft and can make steam very rapidly indeed. We have been able to produce a pressure of 1.7 oz. by the forced draft fan and maintain a 2-in. water column at the extremity of our underground breeching or at the inlet of the fan. The construction of the fans is neat, strong and workman like, and the engines run cool and practically noiseless. Taking all into consideration, we are very well pleased."

McROY CONDUITS.—Fifteen million feet of underground conduit is a record that the McRoy Clay Works may well be proud of. In a very handsomely gotten up catalogue for 1901, just issued, the McRoy Clay Works give a very interesting account of their products and the method of installing the same, some very artistic illustrations scattered throughout the catalogue showing the process. The illustrations are half-tone, the views of the conduits themselves being of a buff color to represent the actual color of the same. The catalogue has a very handsome cover on which are embossed representations of Tanagra, and it is certainly one of the most artistic of recent productions in this line. The McRoy Clay Works are in Brazil, Ind., and office at 302 Broadway, New York.

MESSRS. LOWE & LEVERIDGE, 183 Greenwich Street, New York, are handling two very serviceable devices in the L. & L. ceiling switch and the L. & L. showcase lighting fixture. The ceiling switch is operated by a pendant. It has a positive action, and when the blades are once started they cannot be stopped until they reach the limit of action. Alternate pulls on the pendant open and close the switch. This switch is made for 15 amperes, at 250 volts, and has been approved by the National Board of Fire Underwriters. The showcase lighting fixture is so designed that it throws all the light down upon the contents of the case and none into the eyes of the observer. It is attached to the top of the showcase inside. It is a very handy device and is stated to be meeting with a very large sale.

BELT TYPE MACHINES.—The Crocker-Wheeler Company, Ampere, N. J., is introducing a new line of machines, to be known as form F. They are of the multipolar, direct-current belt type, and are intended for service in situations where power must be furnished continuously, and where work must be done in a reliable and satisfactory manner. These machines are at present being built in sizes giving 3, 5 and 7½ horse-power at low speeds, and 4, 6 and 9½ horse-power at moderate speeds. In Bulletin No. 10, just issued by the Crocker-Wheeler Company, these machines are described and illustrated. The illustrations show the application of these motors to the driving of printing presses, milling machines, a vertical pump and an embossing press. Tables and diagrams of dimensions are also included in the bulletin.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has moved its Eastern sales office to new and larger quarters at 136 Liberty Street, New York. With this additional room a full and complete line of samples can be shown, and each size, finish and voltage of the "Standard" ceiling, desk and bracket fan motors made by this company will be on exhibition. The company will also show a neat little plant, consisting of a motor operating a dynamo, switchboard with various instruments, bank of lamps, etc., for the purpose of demonstrating the high efficiency of its motors and dynamos. The Robbins & Myers Company makes a specialty of small machines from 1-16 horse-power to 10 horse-power in motors, and ¼ kilowatt to 10 kilowatts in dynamos. It reports a large volume of business from the Eastern district, Mr. Wm. B. Van de Water being in charge of this branch of its business.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 19, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

668,151. TROLLEY SWITCH; M. D. Baron, New York, N. Y. App. filed May 15, 1899. Levers arranged near the junction are struck by the trolley wheel to throw a connecting conductor section into line with the conductor over which the trolley is traveling.

668,170. ELECTRIC RAILWAY SYSTEM; E. W. Farnham, Chicago, Ill. App. filed Oct. 17, 1900. The working sections traversed by the contact shoe are hung on parallel levers, so as to be depressed by the shoe to make the connection with fixed contacts; springs return the sections to their normal position.

668,194. ROTARY MAGNET FIELD FOR ELECTRICAL MACHINES; Benjamin G. Lamme, Pittsburg. App. filed July 14, 1900. A form of construction of a rotating field magnet for alternating current generators, and adapted for rotation at high speed.

668,213. ATTACHMENT PLUG; W. T. Pringle, Lansdowne, Pa. App. filed Dec. 18, 1899. Details of construction for connecting the contact clip with the body of the insulating plug.

668,215. GALVANIC BATTERY ELECTRODE; C. J. Reed, Philadelphia, Pa. App. filed Sept. 14, 1897. The method of forming battery electrodes which consists in applying to the surface of a conducting body a coating of insulating wax or cement and subsequently forcing finely divided granular carbon into said coating and into contact with the conducting body.

668,233. BRAKE FOR ELECTRIC RAILWAY CARS; E. W. Stull, Johnstown, Pa. App. filed Dec. 12, 1899. When the motors are thrown together in a short closed circuit, to act as generators, a small motor is included in said circuit, which winds up the mechanical brake and sets the shoes against the wheels.

668,235. RHEOSTAT; N. H. Suren, Needham, Mass. App. filed June 29, 1899. Details.

668,246. ELECTRIC LIGHTING APPARATUS; A. J. Wurts, Pittsburg, Pa. App. filed Aug. 19, 1899. (See Current News and Notes.)

668,248. AUTOMATIC COPYING TELEGRAPH; I. Zabinski, Milwaukee, Wis. App. filed Dec. 18, 1899. Certain details whereby the tube or spurter of a syphon recorder is rendered operative or inoperative in connection with the bobbin thereof, to trace the message.

668,257. ELECTROMAGNET; G. L. Foote, Brooklyn, N. Y. App. filed Oct. 19, 1900. Means for adjusting the position of the armature without changing the position or stroke of the vibratory bar used on sounders and relays.

668,260. ELECTRICAL MEASURING INSTRUMENT; K. Lehner, Frankfort-on-the-Main, Germany. App. filed Feb. 16, 1899. Two wires through one of which the current flows, act differentially by their tension to move the index. The flow of current through the one wire heats and expands it, which disturbs the balance and moves the index.

668,282. AMALGAMATOR; C. G. Collins, Woodmere, N. Y. App. filed Jan. 4, 1899. Details.

668,283. AMALGAMATION OF ORES; C. G. Collins, Woodmere, N. Y. App. filed Jan. 13, 1900. Details.

668,284. SEPARATOR FOR BATTERIES; L. W. Collins, Chicago, Ill. App. filed July 7, 1899. The separator consists of V-shaped strips with the apex against one plate and the base edges against the other.

668,293. FUSE BOX; J. F. Lyons, Bridgeport, Conn. App. filed April 17, 1900. The destruction of one fuse releases a lever which will carry a second fuse into position to re-establish the circuit.

668,295. STORAGE BATTERY PLATE; H. M. N. Muhle, Dayton, Ohio. App. filed Oct. 22, 1900. A plurality of battery plates are united by strips of such shape that they can be bent to give the plates a parallel position and the strips then used as the connecting plugs between them.

668,296. TROLLEY SWITCH; E. J. Parker, Worcester, Mass. App. filed Nov. 16, 1899. A block fixed at the junction and containing grooves through which the wheel runs.

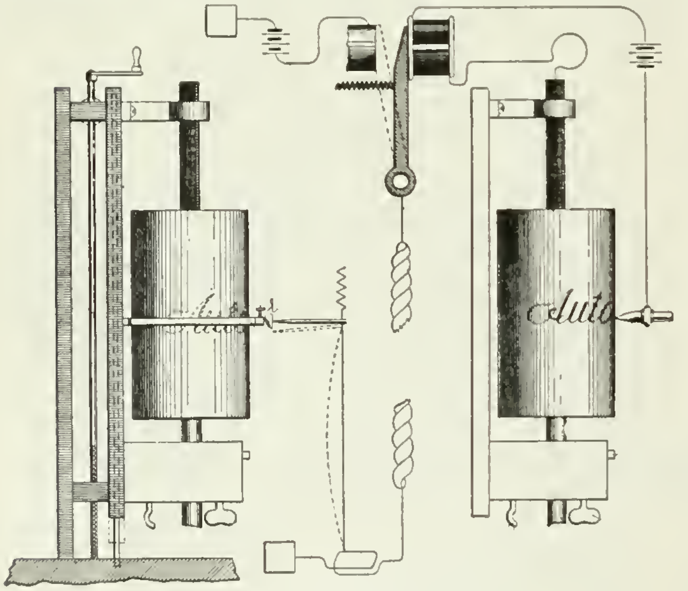
668,300. INSULATING SUPPORT FOR ELECTRICAL CONDUCTORS; H. E. Waite, San Francisco, Cal. App. filed Nov. 16, 1900. The conductor is fastened to a plug of hard rubber which is embedded and supported by a socket of insulating material, which prevents the plug from becoming distorted by the heat.

668,315. RECEIVER FOR ELECTRICAL OSCILLATIONS; G. Marconi, London, Eng. App. filed July 17, 1900. (See Current News and Notes.)

668,345. ELECTRIC ARC LAMP; T. F. Barrett, Chicago, Ill. App. filed Oct. 15, 1900. Details.

668,356. ELECTRICAL ACCUMULATOR BATTERY; P. E. Placet, Paris, France. App. filed Nov. 14, 1899. The plate is composed of a support of fibrous material coated with a protective substance surrounded by conducting coils and incased with a composition of glycerine and oxide of lead.

668,359. ELECTRIC BATTERY CONTACT; A. L. Stevens, New York, N. Y. App. filed July 26, 1900. Electric battery terminal and motor lead-contacts, connecting a vehicle battery and motor in circuit and accessible from outside the vehicle body.



668,248.—Automatic Copying Telegraph.

668,389. ELECTRIC SWITCH; W. F. Richards, Buffalo, N. Y. App. filed Nov. 23, 1899. Details.

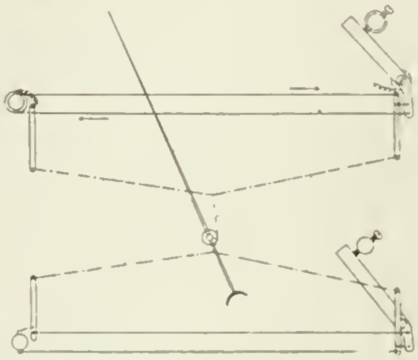
668,419. MACHINE FOR INSULATING OVERHEAD WIRES; O. Russell, Sycamore, Ill. App. filed Aug. 21, 1900. A box adapted to contain insulating material in liquid state and suitable trucks and wipers by which the material can be applied to wires after they are strung.

668,426. TESTING APPARATUS FOR ELECTRIC CIRCUITS; N. H. Suren, Needham, Mass. App. filed June 24, 1899. An instrument provided with a plug and two jacks by which the current and voltage on a circuit can be obtained at once.

668,429. SYNCHRONIZING SYSTEM FOR ALTERNATING CURRENT GENERATORS; H. W. York, New York, N. Y. App. filed June 16, 1899. This patent and the two which follow it relate to means for and method of automatically or manually varying the steam admission to the driving engines so as to bring their generators into synchronism. The specific means used to control the engine is a block adapted to slide along a crank arm on the valve shaft of the engine. The position of the block which determines the stroke of the crank is altered by a small motor mounted upon the arm and rotating a screw in one direction or the other.

668,430. SYNCHRONIZING APPARATUS FOR ALTERNATING CURRENT GENERATORS; H. W. York, New York, N. Y. App. filed May 11, 1900. See the preceding brief.

668,431. METHOD OF SYNCHRONIZING ALTERNATING CURRENT GENERATORS; H. W. York, New York, N. Y. App. filed May 11, 1900. See No. 668,429.



668,260.—Electrical Measuring Instrument.

668,438. ELEVATOR SIGNAL SYSTEM; M. H. Cullom, Denver, Colo. App. filed April 9, 1900. Details.

668,442. RESISTANCE COIL; A. C. Eastwood, Cleveland, Ohio. App. filed Dec. 13, 1900. A resistance coil wound on a tubular insulator, a conductor being connected to one end of the coil and extending through the tube so as to bring the two terminals of the coil at the same end thereof.

668,453. TROLLEY HEAD; H. A. Nettleton, Manchester, Conn. App. filed Dec. 20, 1900. The axle of the trolley wheel is set in open slots and held in place by latches.

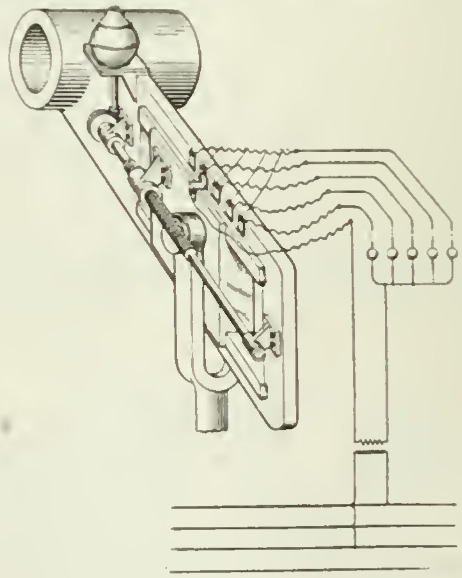
668,472. HOLDER FOR TELEPHONE RECEIVERS; H. M. York, Kennebunk, Maine. App. filed April 30, 1900. Details.

668,517. STORAGE BATTERY PLATE, J. Hewitt, Chicago, Ill. App. filed June 12, 1900. Detail construction of the grid.

668,538. TROLLEY WHEEL; C. R. McAdoo, Indiana, Pa. App. filed Dec. 1, 1900. A detent lying across the top of a wheel to hold the wire in place, but removable when the pole is lowered.

668,554. ELECTRICAL RELAY AND CIRCUIT; A. M. Bullard, Somerville, and L. A. Falk, Boston, Mass. App. filed Dec. 3, 1900. (See Current News and Notes.)

668,555. RESISTANCE COIL; F. Comminge, Pittsburg, Pa. App. filed Dec. 11, 1900. The wire of the coil is wound successively over layers of asbestos or other insulating material.



668,431.—Method of Synchronizing Alternating-Current Generators.

668,581. TROLLEY WHEEL AND BEARING; O. B. Marton, Akron, Ohio. App. filed July 30, 1900. Details.

668,613. AIR BRAKE; Niels A. Christensen, Milwaukee, Wis. App. filed June 12, 1899. Electrical appliances for maintaining the same pressure in the reservoirs throughout the cars of a train.

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ILLUMINATED ELECTRIC SIGNS.

The electric sign is a characteristically modern feature of city decoration. While much of it is distinctly advertising in character, yet it contributes in no small measure to illumine city streets and render them attractive to the passer-by. In spite of the progress that has been made in the electrically illuminated sign, as set forth in our last week's issue, we think that great room still exists for improvement in this direction, and that the future will witness electrically illuminated signs of beauty and elaboration far beyond what has yet been witnessed. There is much room for development in this direction. For example, the present system of summoning vehicles to the doors of a theater after the conclusion of a performance, and which consists in shouting numbers as indistinctly as is conveniently possible through a megaphone, is but a poor makeshift, and a barbarous survival of primitive methods. A far better plan would consist of an electrically operated sign on which the successively required numbers should be conspicuously displayed, and from which the orders, as canceled and completed, could be instantly expunged by the attendant at the operating board. Such an installation would readily become an æsthetic piece of apparatus, but would be a great boon to all the dwellers in the vicinity who retire at a reasonable hour. The operator would only require a keyboard of, say, eight rows, each row having ten numbers, any two of which could be displayed simultaneously. As fast as the tickets of the drivers were handed in a new number could be set up. These numbers could be seen at a greater distance up the street than they could possibly be heard from even the most brazen-lunged stentor.

It will be noticed that we publish in this issue a very interesting article pertinent to this subject, descriptive and illustrative of the illuminations for the second inaugural ceremonies of President McKinley in Washington. Not only was the purely decorative effect fine, but the lavish resort to electric lighting for purposes of advertisement was quite noteworthy. One shortcoming may be mentioned, however, namely, that the signs and decorations were chiefly stationary, whereas the use of electricity permits the fullest employment of change and motion. This advantage can be seen nightly availed of in New York, and was one of the elements of beauty and freshness in the illuminations of the Water Palace at the Paris Exposition last year.

THE BERLINER DECISION.

It is possible both to overrate and to underrate the effects of the decision invalidating the Berliner microphone patent, of which we gave a summary last week. The complete opinion of Judge Brown will probably not be handed down for some weeks, but it cannot differ in any essential respect from his rescript, with the essential points of which our readers are already familiar. While there may be different views on the subject, the general feeling in electrical circles as to the opinion is one of marked approval. It is not too much to say that a prolongation until 1908 of the exclusive rights under "variable pressure" patents enjoyed by the Bell system would have given a moral shock to the community, for there was nothing in the Berliner patent not already in the work of Bell and Edison, and this may be said without any reflection on the entirely original work of Mr. Berliner, whom we venture to regard as an inventor of a high order. His patent is, however, regarded as dead beyond resurrection, and perhaps nobody rejoices at this more than do some of the Bell telephonists themselves. They have had to endure for some years a campaign of scorn and obloquy, in which, at times and places, some of the worst features of socialism have entered; and the cry of "monopoly" and "fraud" has been worked against them for far more than it was intrinsically worth. Now that cry has lost its power to hurt. It is said by a well-known authority, once in the Bell ranks, that the company has acquired at least 2500 other patents. Some of those, like the Carty bridging bell or the Pupin "boosters" for long lines, have features of considerable importance, but on the other hand, the independent companies have among them all perhaps as many patents now, and patents covering features of intrinsic merit and novelty. Judge Thomas is authority for the statement that the independents have already won 60 patent contests, and are just aching for some more to begin, so that if warfare is to be pushed on "infringement" lines, there will certainly be some very pretty fighting.

But that is only one side of the effect of the decision. Mr. Tyler, whose ability as a telephone manager none will dispute, has put good service first and patents second, and we are fain to agree with him, without in any wise depreciating the value of good patents, or desiring to see them treated as unessential. In the great struggle now beginning, a struggle from which the telephone will emerge a few years hence as a universal rather than a restricted means of communication, the victory is going to rest on the whole with the system giving the best service at the cheapest rate. Hitherto the Bell service has generally been admirable, but the independents have cut the price, and in so doing, while they have often lacked in excellence, they have undoubtedly given the use of the telephone to thousands who could never have enjoyed it under the old régime, so that while the Bell system may now count about 750,000 subscribers, the independent claims 1,500,000, a figure we should be inclined to shade a little. All told, there are less than 2,500,000 subscribers in the United States. There ought to be 5,000,000, and there soon will be. In some territory, like that in which the indefatigable Glidden rolled up new subscribers daily by the thousand, it would really seem as though the immediate possibilities had been exhausted; but even there room exists for growth. No better business for expansion can be asked to-day than that of telephone manufacturing, and, of course, it is going to be overdone.

Where will this great jump in telephony leave the telegraph? That is by no means a small problem. With a telephone in every house the use of the telegraph, except for long-distance work and for press matter, would appear to be sadly limited, and this fact may account for the persistent weakness of Western Union all through these years of prosperity. It has been rumored that some of the independent telephone companies are proposing to develop machine telegraphy on their lines when dull at night. The contrary proposal would be for the telegraph companies to do telephoning by day and also to turn their district messenger systems into local telephone exchanges. There are elements of both strength and weakness in such a plan. At any rate, it is difficult to believe that hereafter the two branches of work can be kept as distinct as they have hitherto been; and the entire electrical community will watch with deep interest to see just what the actual developments may be.

Relatively to electric lighting and electric railway work, telegraphy and telephony have lagged behind in growth of investment and absorption of material. Unquestionably telephony will now make up a great deal of the ground thus unoccupied, and will make large calls for capital, the bulk of which can be profitably employed. In the same manner the new demand for apparatus will be noteworthy, including everything from telephones and switchboards to cables, conduits, storage batteries and generating plants. The interaction of electrical development has always been marked, and the present case is no exception. Indeed, it is one striking feature of the situation that just as a good many early winners in the telephone field put their gains into electric light and power, now many who have made fortunes in electric railroading are investing heavily in independent telephone work.

European Electrical Engineering.

The paper recently read by Mr. W. J. Hammer before the American Institute of Electrical Engineers enables some interesting comparisons to be effected between electrical engineering enterprises on the two sides of the Atlantic. One remarkable distinction in long-distance electric railway work is found in the adherence to the direct-current motors in the United States and the preference for three-phase motors in Europe. Here we maintain a direct-current car equipment at the expense of transformer sub-stations employing converters. It is the accepted American belief that the better behavior of the direct-current motor relatively to the induction motor, in regard to first cost, torque and efficiency, outweighs the disadvantage of converter sub-stations with their attendance and wear. In central Europe the three-phase system is carried all the way from generator to motor, at the expense of double, and even of triple trolley wires. It is certainly to be hoped that although triple trolley wires should be shunned, the bold example of the European engineers may be followed in this country, for we cannot bring ourselves to believe that the converter is a permanent institution for railroad work. There can be no doubt that the converter has its recognized place in mixed systems of distribution, and in established systems where direct-current equipments are already largely employed; but in cases where the engineer of the railway has a clear path to build a new railway, it seems a pity to have to hitch a direct-current motor service to an alternating-current transmission plant. It must surely be possible so to improve the three-phase motor that it shall be capable of responding to all demands upon it for railway service.

The trolleys themselves are characteristically different in many parts of Europe from those which are in well-nigh universal use in the United States. Here we press a wheel upon the nether side of the trolley wire. There they employ harps pressed against either the side or the bottom of the trolley wire, and the harp string of metal receives the wear and tear. Another plan is to press upwards a metallic groove like a piece of half tubing against the lower surface of the trolley wire, and let the laws of friction take their course. It would seem that where the trolley line construction is sufficiently precise, the trolley harps are less likely to fly off the wires than the trolley wheels. As to the frictional wear of the trolley wires opinions differ greatly, and it will probably be some time before experience will have brought about conviction in favor of one or the other system.

The pressures employed in trolley locomotives in this country rarely exceed 600 volts, and are usually about 500 volts. In Europe several thousand volts are in some cases tapped from the trolley wires to transformers carried on the locomotive. Provided that the weight of these transformers is not excessive, this seems to be a good plan, as the high-tension side of these transformers can be thoroughly safeguarded without difficulty. The systems of operating induction motors on electric railways seem to be divided between operating two induction motors in cascade, and operating them each with external secondary resistances. This is a question which engineering experience will no doubt ultimately decide in favor of one or the other of these two rival systems. The former has some advantage in efficiency, and the latter in simplicity and in torque capacity.

The use of SO_2 engines in connection with steam plants is interesting. We only hope, however, that the steam turbines may find commercial development before it becomes necessary to add this new complication to the already enormously complex plant of a large steam power house. Each new improvement in the economy of the steam engine is only attained at the expense of extra first cost and extra complication. First there is the multiplication of cylinders, then the condenser, then the economizer, then the feed-water heater. Now we have the sulphur dioxide engine. What may we not hope for next? If the same economy of steam can be attained or approached by the steam turbine, the simplicity and compactness of the latter should drive the enormously complex reciprocating steam engine out of the field for the purposes of electrical engineering. Rankine maintained that while the double-fluid principle might render an inefficient type of steam engine more economical, yet an equal economy could always be obtained with a properly designed single fluid engine. The double-fluid engine is almost as old as the steam engine itself, and crops up about every quarter century. The sulphur dioxide engine described in Mr. Hammer's paper does not appear to differ in principle from the many two-fluid engines that during the past century have for brief periods occupied the attention of the steam engineering profession and then passed into obscurity.

THE RASCH ARC LAMP.

We print in the Digest this week an abstract of a somewhat sensational paper which appears in the *Elektrotechnische Zeitschrift* for Feb. 14, detailing the results of experiments by E. Rasch on what may be regarded as a modified Jablochkoff candle. Rasch proposes to form the electric arc between pencils of refractory material of composition similar to the filaments of the Nernst lamp. It seems to be the logical step from the Nernst lamp in the direction of still higher incandescence, and the results reported are so extraordinary as to call for somewhat extensive comment. Briefly, Rasch claims to have obtained from such an arc an economy of 5.21 Hefner units per watt, at the melting point of the pencil tip, and working economies of 3 to 4 H. U. per watt, with a clear white light like sunlight, and at its best, 100 per cent luminous efficiency. To reach these results he forms the arc between pencils of one-tenth to one-fifth of an inch in diameter, the voltage across the arc being 45 to 60, and the current one-half ampere to as high as one ampere per square millimeter of cross section, or 300 to 600 amperes per square inch, as against 25 to 50 amperes per square inch in ordinary arcs. Obviously, such enormous current density should give a very high temperature at the arc, and since the light-giving efficiency of incandescent bodies increases with the temperature, a very large amount of light per watt. Such an arc should give a higher efficiency than the Nernst lamp just as an ordinary arc gives a better performance than an ordinary incandescent lamp. Moreover, at such a temperature as must be reached, a clear white light is to be expected.

If these claims can be substantiated and the lamp can be put in practical form one would expect a startling commercial revolution. The ordinary arc would stand a poor chance compared with such a light at, say, 4 candles per watt, and the incandescent lamp at 3 watts per candle would have but small chance in the competition. But an examination of Rasch's article disposes us to think that aside from all practical questions of construction, there is "something rotten in the State of Denmark." An efficiency of a net 100 per cent is, to say the least, suspicious in view of the known facts regarding the radiation from the substances which Rasch proposes to use. The energy spectrum of a Nernst filament assuredly extends far beyond the limits of the visible spectrum, as its efficiency bears witness, and while raising the temperature undoubtedly increases the proportion of visible and ultra-violet rays, there is not the slightest reason to suppose that it suppresses the infra-red radiation. Hence, until it is shown that the spectrum of Rasch's arc stops short at the red and the violet, one may say with absolute certainty that the agreement of his results with those of Tumlirz on the mechanical equivalent of light merely shows that one or both of these worthies may be in error. Very naturally Rasch does not vouchsafe any such proof as that suggested, and his statement that his arc gives a line and band spectrum besides the continuous one signifies nothing, since ordinary arcs do the same, which, moreover, constitute an exceedingly small part of the total energy spectrum. Broadly, the physical facts are squarely against a luminous efficiency of 100 per cent from any incandescent body, and unless Tumlirz is considerably in error, which is possible enough, there is something wrong with Rasch's efficiencies. It would be interesting to know how the photometric measurements on which the results depend, were made. There is chance enough for error in experiment, but a graver uncertainty surrounds the distribution. Rasch gives no illumination curves, and most if not all of his values of the luminous intensity are in terms of horizontal candle-power. A table of results from electrodes 2.5 mm in diameter worked with an arc length of about 1 mm gave a mean expenditure of 154 watts, an average of 556 English candles for the horizontal intensity or 3.61 candles per watt (0.277 watt per candle).

So far so good, but what was the relation of this horizontal intensity to the maximum and to the mean spherical intensities? The electrodes being without a crater, and with convex terminals at a distance apart less than the radius of the electrodes, one would expect a pretty strong horizontal illumination, perhaps even a maximum at the horizontal, while the mean spherical would be considerably less than this. Now, even the efficiency of an arc between the ordinary carbon pencils is a bit startling if reckoned in the direction of maximum intensity. A couple of 15-ampere arcs tested by Wybauw, unite in showing an economy of 5.11 candles per watt (0.195 watt per candle) when so measured, but their economy on the basis of mean spherical candle-power was about 0.5 watt per candle, which is a very different matter. In enclosed alternating arcs the horizontal candle-power is usually from 1.3 to 1.5 the mean spherical candle-power, and with a similar distribution of light the Rasch arc would show an economy of, say, .35 to .40 watt per mean spherical candle, which is sufficiently remarkable. Taking all the facts together it certainly appears that the Rasch arc probably has an efficiency from one and a half to two times that of an arc between carbons. Comparing arcs of equal candle-power, the latter figure would be probable. If the lamp can be made readily self-lighting and a lamp mechanism suited to the conditions can be obtained, it looks like an important addition to the resources of artificial lighting. With all due allowances for over-enthusiasm, it looks promising, and although the Jablochkoff candle, which involved essentially the same principles, was not saved from commercial oblivion by them, we trust its successor will have better luck. The truth to tell, it is not at all improbable that with a little careful engineering in the light of modern knowledge and methods, the Jablochkoff candle substantially modified could be made to give results of no small practical value. Assuredly both Nernst and Rasch are worthy followers in Jablochkoff's footsteps, and it is their fortune to work in a time riper for success.

February Meeting of A. I. E. E.

At the regular monthly meeting of the American Institute of Electrical Engineers on Feb. 28, Mr. W. J. Hammer read a paper on "Important European Electrical and Engineering Developments at the Close of the Nineteenth Century." The paper gives well-illustrated accounts of a number of recent interesting electrical and engineering developments in Europe. The telephonograph is described at some length, the author during his visit in Europe having had excellent opportunities to make a study of this interesting instrument. The paper gave an account of the Barmen-Elberfeldt suspended electric railway, the result of an investigation of the line by Mr. Hammer. The description given of the Nernst lamp is by far the fullest which has yet appeared. Mr. Hammer has seen the lamp in operation at Paris, Munich, Buda Pest, Gottingen and London, and gives the result of his observations. An account is also given of the Osmium lamp, which Mr. Hammer saw in operation in Vienna. This lamp, the invention of Dr. Auer, of gas incandescent mantle fame, is claimed to show an economy of from .9 to 1-watt per candle. A considerable portion of Mr. Hammer's paper was devoted to heat engines. Among the types considered were the gas engine now commencing to be widely used in Europe, which utilizes the gases from blast furnaces; the new Korting two-cycle gas engine and the Oechelheuser one-cycle gas engine; the De Laval and Parsons turbines, and a late type of sulphur dioxide engine. The final part of the paper dealt with electric traction and gave an account of a trolley omnibus and electric plow, and of the three-phase railway systems of Ganz and Siemens & Halske. The paper ended with a description of the Jungfrau railway.

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The Situation in Erie Telephone.

One of the recently elected directors of the Erie Telegraph & Telephone Company says: "I have had an opportunity of scrutinizing closely the earnings of the Erie system for the year 1900 and draw the following conclusions: Erie will earn in 1901 $6,500,000 gross. The cost of operation of the Cumberland (Bell) Telephone Company and the Pacific Coast Company operating a similar class of subscribers in territory of an open, treeless nature is 56 per cent of the gross, while that of companies operating in a coast-bound country, one heavily wooded and whose lines are built on highways like the New England Company, is about 70 per cent; the average of the country is in the neighborhood of 65 per cent, and this would be a very fair charge against the Erie Company's gross, leaving as net earnings $2,275,000; of this amount the Erie will receive 33 per cent and the American Bell and other minority stockholders in the Michigan and Wisconsin Companies 17 per cent.

83 per cent amounts to $1,888,250
Erie's fixed charges upon its $10,000,000 bond issue and $7,500,000 temporary loan, including commissions, etc., will amount to.. 1,000,000
Leaving a sulplus for dividends of.......... 888,250

or nearly 9 per cent upon Erie's $10,000,000 stock outstanding.

"Therefore, I see no reason why the usual rate of dividend should not be declared, although we may, from the fact that the company requires a considerable amount of money for extensions, pay dividend No. 70 in April at the rate of 4 per cent per annum."

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Automobilism at the Pan-American Exposition.

It is announced that to prepare and carry out the programme of the week of automobile sports in connection with the Pan-American Exposition, including the international race of 200 miles, from Buffalo to Erie and return, W. I. Buchanan, director general of the Exposition, has appointed a special committee of automobilists. The members of this committee, who will act in conjunction with the Sports Committee of the Exposition, were officially notified of their appointment. Mr. Malcolm W. Ford will be chairman of the special committee, and his associates will be Mr. J. M. Hill, who will represent the electric vehicle interests; Mr. Percy Owen, representing the gasolene vehicle interests, and Mr. S. T. Davis, Jr., representing the steam vehicle interests. All four are members of the Automobile Club of America, and Mr. Davis is also president of the National Association of Automobile Manufacturers. The fifth member of the committee is Dr. T. J. Martin, of Buffalo.

While this committee will prepare a list and conditions of all motor vehicle tests at the Pan-American Exposition, its attention will be particularly devoted to the conditions and arrangements of the international speed contest over the famous Buffalo-Erie course. It is intended that this race shall rank with the long-distance automobile competitions held annually in France. It is proposed to raise one large purse by subscription with which to reward the winner, while valuable cups will be presented by the Pan-American Exposition and the Automobile Club of America.

The decision to hold an international race at Buffalo is the culmination of a conference held in that city last week between a committee of the Automobile Club of America, the Sports and Transportation committees of the Pan-American Exposition and William I Buchanan, director general of the Exposition. The Automobile Club was then invited to take charge of the motor vehicle sports at the Exposition, and the proposition was made that a long-distance road race open to the world, be included in the programme.

Though the Automobile Club of America had placed itself on record as opposing high speed on the public highways, all parties concerned favored the idea of a race, particularly as it was promised that the course would be given over exclusively to automobilists on the day of the event. The Board of Governors of the Automobile Club gave its sanction to the project on this understanding

The week of automobile sports and tests at the Pan-American Exposition will immediately follow the conclusion of the endurance tour of the Automobile Club of America from New York to Buffalo, the dates being Sept. 16 and 21, inclusive. The club tour, the practical demonstrations of the utility of motor machines and the 200-mile race are calculated to remove all prejudice existing toward horseless vehicles.

◆

American Bell Telephone Finances and Licenses.

The recent decision against the Berliner patent has directed attention to the finances of the Bell organization. The perpetual contracts between the American Telephone & Telegraph Company and its licensee companies specifies that none of the licensees may borrow money or create a permanent debt without the consent of the parent—now the American Telephone & Telegraph Company

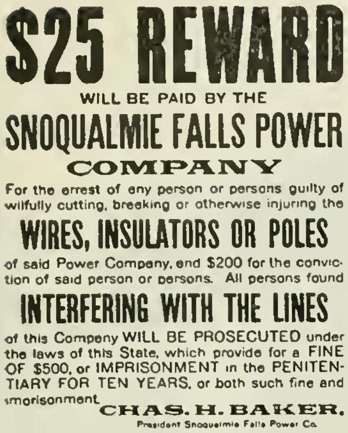
The question of funds for the expansion to meet the demands for telephone service has become an important factor, the requirements being greater than originally supposed. In sub-companies controlled by ownership the Bell must take 51 per cent of the increase to hold control. To relieve the parent company from furnishing so large a sum of money the "debt clause" in the perpetual contracts has to some extent been eliminated and many of the subsidiary companies have financed themselves. One plan has been by underlying bonds. While this in a degree might be considered as weakening the value of the stock held by the Bell Company, the money has been so well invested that no special depreciation of Bell assets is apparent Although the dividends of subsidiary companies have been materially reduced, still their earnings warrant a fair dividend on the money invested.

The Cleveland, Northwestern and Wisconsin subsidiary companies of the Erie system have never issued bonds. The bonds, however, of the following companies have reached the Boston market and have been absorbed principally in Massachusetts: N. E. Telephone & Telegraph Company, East Tennessee Telephone, Sunset Telephone & Telegraph, Duluth Telephone, Cumberland Telephone, Michigan Telephone, New York & Pennsylvania Telephone, The Pennsylvania Telephone, Central Union Telephone Company, Chesapeake & Potomac Telephone, Southern New England Telephone, New York Telephone Company of Canada, Empire State Telephone, Missouri & Kansas Telephone, Iowa Telephone.

Total outstanding bonds of the American Bell Telephone and American Telephone & Telegraph Company are $15,000,000, in addition to the bonds of the subsidiary companies above named.

The American Telephone & Telegraph Company completed the issue of $5,000,000 treasury stock Jan. 15 last. The recent sale of 527 shares at auction by order of the directors brought 161½ to 161¾. The company required five million more of money by March 1, which it will receive through the issue to bankers of five million of bonds, being the last of a ten million bond issue authorized. The bonds then outstanding will be $20,000,000, equally divided between the American Bell Telephone Company and the American Telephone & Telegraph Company.

Features of Operating the Snoqualmie Plant.



$25 REWARD
WILL BE PAID BY THE
SNOQUALMIE FALLS POWER COMPANY
For the arrest of any person or persons guilty of wilfully cutting, breaking or otherwise injuring the
WIRES, INSULATORS OR POLES
of said Power Company, and $200 for the conviction of said person or persons. All persons found
INTERFERING WITH THE LINES
of this Company WILL BE PROSECUTED under the laws of this State, which provide for a FINE OF $500, or IMPRISONMENT in the PENITENTIARY FOR TEN YEARS, or both such fine and imprisonment.
CHAS. H. BAKER.
President Snoqualmie Falls Power Co.

FAC-SIMILE OF POSTER.

THE power plant at Snoqualmie Falls for supplying power to Seattle, Tacoma and vicinity met with some unexpected delays in getting into regular and continuous operation, but is now settling down to steady business with a very bright prospect before it. This plant ranks among the greatest water power developments in the United States. The present maximum capacity of the station, with all the machinery running, is 6000 kw nominal, in four units, of 1500-hp each, for all of which there is a ready market.

The Seattle Electric Company, which owns the electric light and street railway systems of Seattle, is now building a station which will contain rotaries and transformers for supplying all of its properties with Snoqualmie power. Its alternating lighting circuits, both arc and incandescent, and part of its railway load are now carried by Snoqualmie. To this will be added the direct-current 3-wire network in the downtown district and 500-volt direct-current power service. The alternating lighting distribution is to be single-phase but connected to two-phase busbars at the station, so that two-phase motors can be run if desired. This company's maximum load, including railway and lighting, is about 4000 kilowatts. A steam plant will also be put in at this substation, and probably a storage battery to carry the peak of the load.

The transmission lines, which carry 30,000 volts, have been practically free from line troubles. Some solid aluminum conductors on one portion of one line had to be replaced with stranded aluminum cables, but aside from that the line has been very satisfactory. There are two pole lines, one to Tacoma and one to Seattle, each carrying two three-phase circuits. For part of the distance the pole lines run side by side, with a wagon road between. Before the lines were started the company secured the passage of a law by the Legislature making it a penitentiary offence to tamper with the transmission lines. Under the law a fine of $500 or imprisonment for 10 years are provided for. The accompanying poster, which is printed on cloth and stuck up along the line, has probably a deterrent effect on mischief-makers, who might otherwise shoot at insulators or throw sticks and wires across the lines.

At the present time the two lines to each city are run in parallel instead of keeping the lighting and railway load on different circuits, as in this way it is found the rotaries have less tendency to pump.

The distance to Seattle from the falls is 32 miles as the circuit runs, and 44 to Tacoma. Some experiments were recently made with transmission through the entire 153 miles of circuit. In these one of the generators was run as a synchronous motor, and it was found that the addition of a non-inductive load lessened considerably the tendency of the motor to pump.

The plant is, as shown in the accompanying cut, in the solid rock at the bottom of a shaft down which the penstock goes. The four 1500-kw Westinghouse generators are each coupled to a set of six tangential jet Doble waterwheels, each wheel with two jets. The speed is 300 r. p. m., which gives the rather high speed of 1½ miles per minute to the armature peripheries. Lombard governors are used. The Doble wheels govern in a peculiar and efficient manner by inserting and withdrawing a needle in the nozzle, which thereby changes the volume of water in the jet without interfering with its form or changing its velocity.[1]

A representative of the Electrical World and Engineer, by the courtesy of Charles H. Baker, president of the Snoqualmie Falls Power Company, recently spent a very enjoyable evening at the plant at the falls in company with Mr. Robert McF. Doble, consulting and constructing engineer during the installation of the water wheels and completion of the plant. At that time the power house was being operated by two men. The conditions are all favorable for cheap power production. The flow in the river is abundant and constant. There is no trouble whatever with ice. The pole lines are accessible and easily patrolled.

The switching of high-tension lines is a matter about which practice the country over has by no means become settled and is in a decidedly evolutionary stage at present. It is therefore of interest to note the arrangements Mr. Doble has completed for connecting transformers on different circuits. This arrangement consists of a plug board somewhat on the principle of a T.-H. arc-circuit switchboard. These plug switches are above the transformers in the transformer house. Running lengthwise of the transformer house over the transformers are 12 angle iron conductors mounted on porcelain insulators, such as are used on the high-tension line. To these the 12 high-tension line wires are connected through long-break switches. Below these line terminals are a set of angle iron conductors running at right-angles to the line terminals and to which the various transformer terminals are connected through high-tension long-break switches. Now it is evident that by a plug the line terminals and transformer terminals can be connected together at the crossing points of these angle iron conductors so as to get any transformer connected to any line. Of course, disconnections cannot be made with the plugs, but that is not necessary, because in such cases the circuit breakers are used, as there is one on each line and each transformer. The angle irons are drilled and bushed for plugs at only such points as will allow the transformers to be connected in the right combination.

THE SNOQUALMIE PLANT.

Some peculiar effects have been investigated by Mr. Doble in connection with the opening of high-tension circuits. As before stated there are two circuits running to Tacoma and two circuits to Seattle. It was found that upon opening the Tacoma circuits the circuit breakers on the primaries of the transformers supplying Seattle would always go out as if on a short circuit. Vice versa, if the Seattle circuits were suddenly opened out would go the circuit breakers on the primaries of the Tacoma transformers. Much theorizing as to induction, resonance, etc., was indulged in by those who saw the phenomena. The trouble, however, was conclusively proved to be caused by a short circuit on the line due to the discharge of the line through the lightning arresters. The instant the Tacoma circuit was broken the Seattle line current would jump across the lightning arresters to ground. Upon disconnecting the ground wires of the arresters, the phenomena disappeared, showing conclusively that the current jumping across the arresters was responsible for the effects produced. The Westinghouse-Wurts arresters are used, and the line voltage per gap is only about 300, which is extremely low, and makes the effect all the more remarkable.

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[1] See illustrated descriptive article, Electrical World and Engineer, Oct. 21, 1899.

At Tacoma preparations are being completed by the Tacoma Railway & Power Company for carrying the greater part of its load with Snoqualmie power and using steam for the peak of the load. The Tacoma Railway & Power Company controls the street railway system at Tacoma and furnishes current to the city for its arc and alternating incandescent lighting system. In this installation no rotary converters will be used, as it seems to be the prevailing opinion that 60-cycle rotary converters for railway load are to be avoided. An induction motor has already been installed for running the cable line, and two 700-hp motor-generator sets are going in to take the electric railway load. Each of these will consist of a 700-hp General Electric induction motor, driving a 500-volt generator. These will be among the largest induction motors in use. In addition to railway load, these 500-volt generators also supply power circuits. Considerable electric power is used along the docks for running conveyors and hoists. The foreign shipping from Tacoma is very large.

East Cleveland, O., Branch Telephone Exchange.

An exchange which exemplifies very strikingly all the latest departures and features in modern telephone work is that which has just been put into operation at East Cleveland as a branch by the Cuyahoga Telephone Company, of Cleveland, Ohio, situated on Lake Front Avenue about 8 miles from the main exchange. The building (Fig. 1), designed specially for its purpose, is of handsome, unique design, built of pressed brick and gray stone, with the operating room on the first floor.

The operating room will accommodate a switchboard of about 2000 lines capacity around three sides of the room. The distributing room is located in the basement directly under the exchange room, and affords space for the installation of two relay frames, with a capacity of 2160 lines and cut-off relays, two 1200-line distributing frames and two terminal frames for 24 100-pair Cook terminal heads. Only one frame of each type has thus far been installed.

Taking up the exchange room first, as seen in Fig. 2, it may be noted that two six-panel, three-operator sections have been installed. The frame work is of angle iron construction, rigidly braced and covered with moldings and panels of mahogany. The line lamp signals are mounted 20 per strip on ½-inch centers, the strips of lamps and answering jacks appearing alternately, as seen just above the key shelves. The first operator's position is not equipped. The second is used as an incoming trunk position. The trunk lines between this office and the 9600-line, 4-division Kellogg board, located at the main office end at this position in single cords. The third or last position of this section and the middle operator's position on the second section have each answering jacks and line lamp signals for 140 lines, while the first and last positions on the second section are equipped each for 160 lines, making a total of 600 subscriber's lines. Each subscriber's operator's position is equipped with 12 cord circuits, each consisting of a combined ringing and listening key with German silver springs, contacts of 98 per cent pure platinium, and two cords and plugs. Each cord has its own supervisory lamp controlled by individual dust-proof tubular supervisory relays, in a covered box on the rear of the legs of the section above the connecting rack. This box contains the condensers, two of which are associated with each cord circuit. The operator's equipment comprises a transmitter arm and solid back transmitter, suspended on two green silk cords, so arranged that the slack in these is automatically taken up as the transmitter is raised or lowered, together with a head telephone and green silk cord with plug attached and a head telephone jack which is located in the front of the keyshelf.

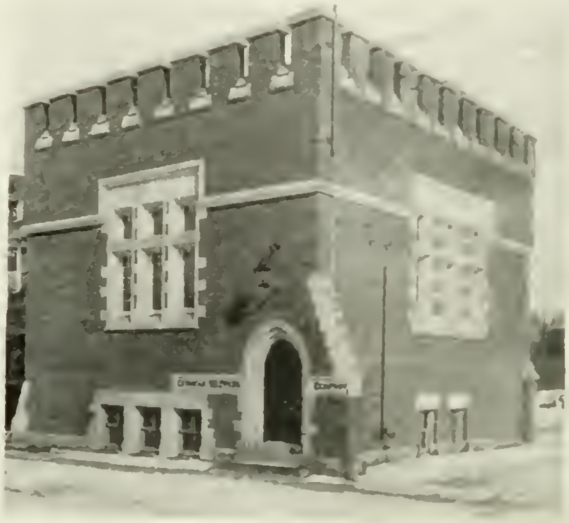


FIG. 1—EXTERIOR OF EXCHANGE BUILDING.

When the subscriber desiring a connection lifts his receiver from the hook his action operates the line relay above mentioned and causes the line lamp or signal to light, notifying the operator of the call. Associated with all the line signals at each operator's position is placed a common relay, known as a "line pilot relay," so wired that when any one of the line lamps is lighted the relay operates to light up a line pilot lamp having a white jewel lens, located in one of the blank multiple spaces, and it also operates the buzzer located in the box panel. The buzzer is used especially at night when but few operators are on duty so to attract attention to the fact that there is a call, when the line pilot lamp shows at a glance at which position it is.

The supervisory or disconnect signals at each position are also

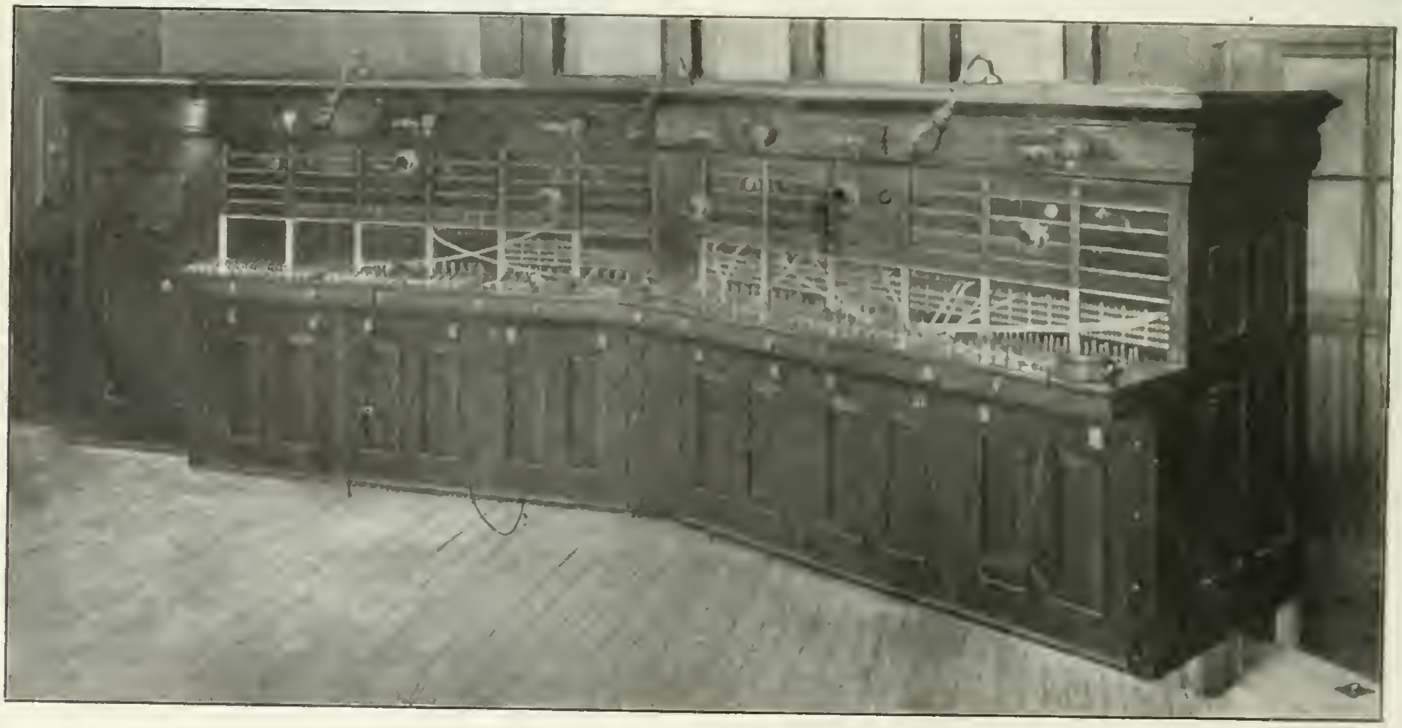


Fig. 2.—Board in the East Cleveland Branch Exchange

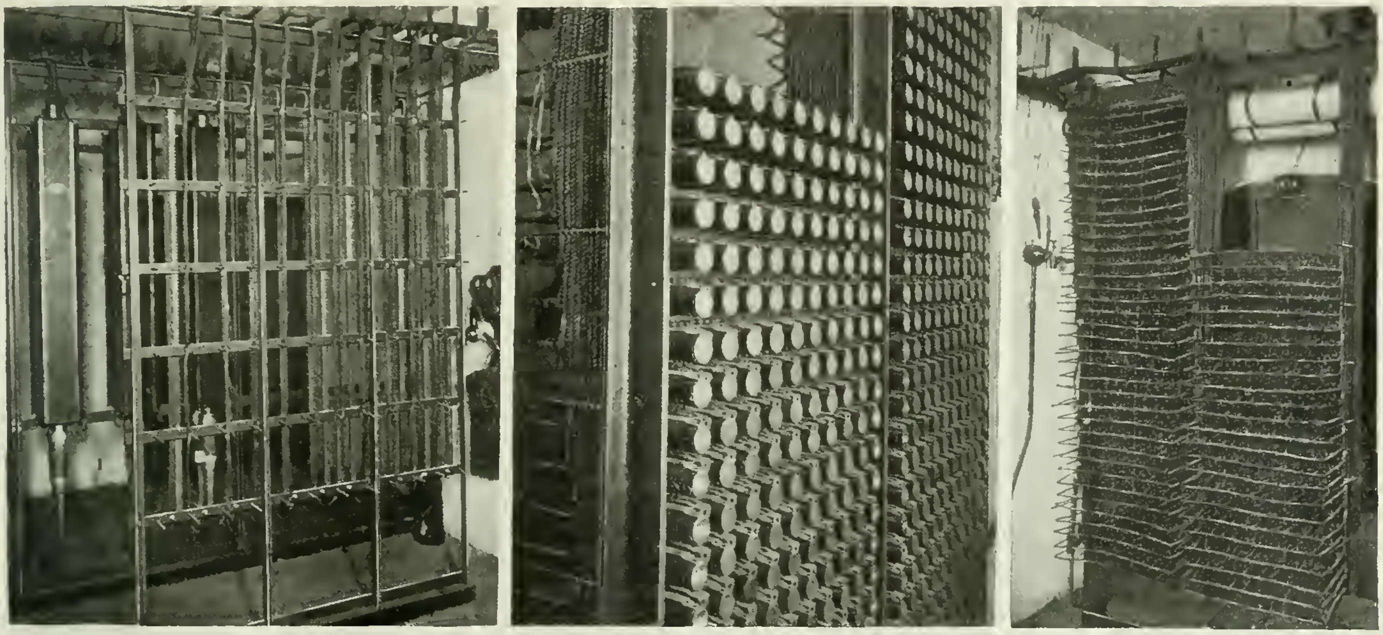
provided with a relay of the same kind which lights a red lens lamp. As soon as a call comes in the operator inserts in the corresponding answering jack one of the plugs of any pair of the 12 cord circuits with which she is provided, at the same time cutting in the corresponding listening key. The supervisory lamp associated with this cord and plug does not light, the receiver on the line plugged into being off the hook. As soon as the operator gets the number required by the calling subscriber, if it is for a similar line at the East office, she picks up the other plug of the pair, and with the listening key still cut in, tests the line desired by touching the tip end of the plug to the brass shell of the multiple jack. Should the line be in use by some other operator she receives a click in her head telephone, and tells the subscriber that the line is busy. Should no click come she inserts the plug and rings up the party called for by simply pressing forward the cam of the listening key above mentioned. When she inserts the second plug the corresponding supervisory lamp at once lights up, indicating that the receiver is on the hook, and when the called subscriber answers this lamp immediately goes out. As soon as the two subscribers finish talking and hang up their receivers the two lamps light up again. This is the signal for the operator to disconnect; this operation puts out both lamps.

If a connection has been established and one of the parties desires to make another call immediately, he can attract the attention of the operator by wiggling the receiver hook up and down a few times. This will flash the supervisory lamp and the operator will cut in on the line and get the desired number and proceed as before. By this method the operator has complete control of the connection, knows exactly whether the parties have answered or are still conversing without listening in on the line, and can handle more lines than she could with the old clearing-out drop system. Where a subscriber is wanted whose line ends on one of the four divisions in the main office, the operator tests in the usual manner and, if it is not busy, plugs into one of the 40 outgoing trunk lines, multipled in the third and fourth panels of each section leading to the incoming trunk position at the main office. By an order-wire key which goes direct to the operator's head telephone at the division wanted in the main office, she tells that operator the connection, and the main office operator designates the trunk. The act of plugging into the designated trunk by the main office operator signals the east office operator, when the latter rings up the main office subscriber called for in the same manner as if the connection were between two lines in the east office. When the main office subscriber hangs up his receiver after completing the conversation, the corresponding supervisory lamp is lighted at the east office, and when the east office operator receives both disconnect signals she pulls down the connection, thus lighting the disconnect lamp at the main office incoming trunk positions, and this operator pulls down for connection. Calls for East Cleveland lines originating in the main office are handled in the same manner at the incoming trunk positions at East Cleveland.

"Incoming trunk" operators have no occasion to cut in on the talking circuit of a subscriber, and have no occasion to use their listening keys, except to secure a busy test. They have no means for ringing subscriber's bells, as the originating operator does this. The latest practice limits an incoming trunk operator to receiving the orders over her order or call wires which are joined to her head telephone, establishing the connections ordered up, and disconnecting when she receives the disconnect signal. It is held that the originating operator is the one who should have complete supervision of the trunking connection, and in case of any special calls, such as calls from pay stations or nickel-in-the-slot machines, this operator is the one who should stay in on the connection to find out whether the calling party has succeeded in securing the party called for, and to see that he deposits his coin in the machine. The trunk circuits installed conform precisely with this rule. A busy back signal apparatus has been installed at both offices to obviate the necessity of the incoming trunk operator cutting in on a subscriber's line to inform him that the line is busy, for it is plain to be seen that she would necessarily lose many orders for connection while so doing. If a line tests busy she simply plugs into one of four busy jacks provided at her position, and pays no attention to that particular cord until she receives the disconnect signal from the other office.

Returning to the distributing room, the power plant and the hot-water furnace for heating the building are located on one side, while the other side has been fitted up as a retiring and locker room A kitchen and pantry, in which there are a gas range and a porcelain sink, adjoin the distributing room. These quarters contain many conveniences for the operators when not on duty, such as sofas, rockers, etc., and on the table may be found the latest magazines and papers. The Cuyahoga Telephone Company has always shown the greatest consideration for the comfort of its operating force. The underground cables, which were furnished by the Standard Underground Cable Company, of Pittsburg, leave the manhole about 150 ft. from the exchange, and enter the basement in a special cement duct 3 ft. wide and 2 ft. deep, covered with iron traps that can be easily taken up with flush rings. From this they are led directly to the 100-pair Cook heads, which are mounted on the terminal frame, as shown in the background on Fig. 3. Switchboard cables lead from these heads directly to the line terminals on the main distributing board, shown in the foreground of the same engraving. These cables are made of 102 pairs of No. 24 tin-copper wire, insulated with two windings of silk and one of cotton, the whole being wrapped with several layers of paper and sheathed in a braided covering. These are all treated previously with hot beeswax, which penetrates to the paper, leaving a dry core and thus providing a perfectly moisture-proof insulation.

All of the cable used in the installation of this office was made on this plan by the Kellogg Switchboard & Supply Company, Chicago, which also furnished the telephonic apparatus throughout. After being cross-connected or "jumpered" with No. 24 silk and cotton jumper wire from the line or terminal side to the relay side of the main dis-



FIGS. 3, 4 AND 5.—TERMINAL FRAME AND RELAY FRAMES.

tributing frame, the lines are carried in 21-pair cables on the cable rack at the top, to the line and cut-off relays at the relay frame, as shown in Figs. 4 and 5, mounted 20 of each per strip, there being space on the relay frame for 18 such strips, or 720 relays in each of the three panels or banks. The function of the line relay is to light the line lamp or signal on the switchboard when a subscriber lifts his telephone from the hook and the cut-off relay "cuts off" this line relay when the operator inserts the plug in answering the call, thereby putting out or restoring the line signal.

From these relays the lines are carried by 63-wire cable through a running box to terminals on the connecting rack located on the rear of the legs of the switchboard, and are thence carried in 24-pair cables through a box panel at the left end of the first section to the multiple jacks appearing in each section. From these terminals, on the inside or front of the connecting rack, 63 wire cables are carried to the answering jacks and line lamps.

In Figs. 6 and 7 are shown the power plant and battery room. The plant consists of two Roth motor-generators for charging the two 10-cell sets of storage batteries. These machines receive current from a 500-volt trolley circuit and deliver 30 amperes at 28 volts. There are also two Roth ringing machines to supply current for ringing the subscribers' bells, one having a 500-volt primary and the other being wound to take current from storage battery, both machines giving 100 volts, pulsating and alternating. The busy back signal apparatus is driven by a 1-6-hp Roth motor, which is also supplied from the storage cells. These machines are mounted on a specially designed iron frame work, which is covered with paneling stained to match mahogany. The power switchboard consists of an Italian marble slab, 60 by 60 by 1¼ inches, with polished surface and beveled face edges, mounted in an iron frame, at the right in Fig. 6. It carries a Weston round pattern, flush type voltmeter, double scale, reading from 0 to 600 and 0 to 60, and a Weston round pattern, flush type ammeter, with six shunts and 100-ampere scale. Each of these instruments is controlled by switches having copper-plated hand wheels with index plates stamped for eight and six circuits, respectively. Two copper-plated Midget, 28-volt under-load and overload I. T. E. circuit-breakers protect the charging circuits. Twelve all-copper back-connected jack-knife switches are also provided, eight on the charging and four on the discharging circuits. The above apparatus is back-connected, and is wired in a very neat and attractive manner. The battery plant consists of two sets of "American" storage battery, each set comprising 10 cells, in lead-lined tanks, and the capacity of 100 ampere-hours per cell, which is sufficient for the present line equipment. Large tanks have been provided, however, so that plates may be added as the exchange grows.

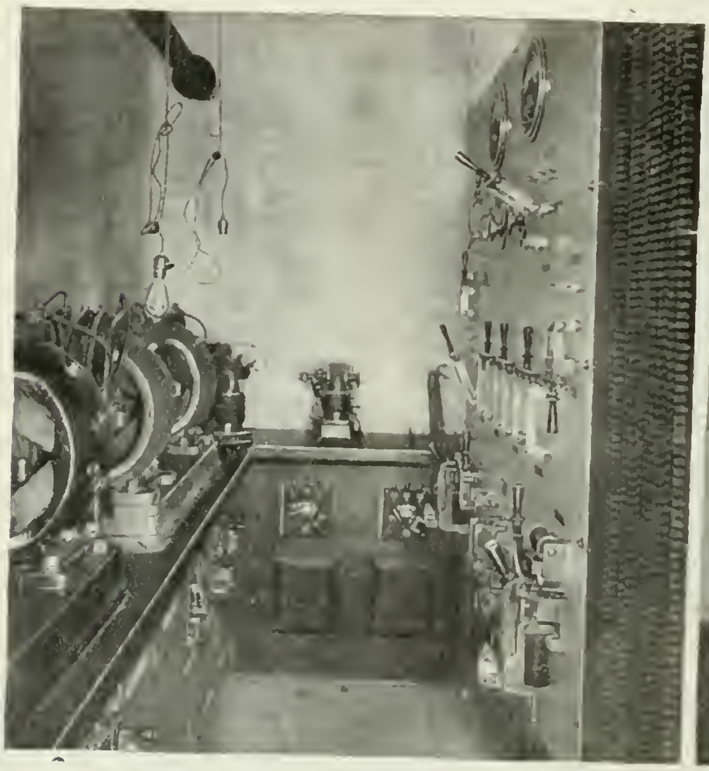


FIG. 6.—POWER PLANT.

From the batteries and from the power switchboard leads are carried direct to a fuse board which consists of a slate slab, 42 by 60 by 1¼ inches, mounted in an iron frame and located adjacent to the power board, as shown at the extreme right of Fig. 6. On this board are located fuses for all of the circuits. Individual rubber-covered wires, No. 20, B. & S. gauge, are brought from each strip of 20-line lamps, from each set of supervisory or disconnect signals and from each strip of 20-line relays. Each operator's transmitter is connected up by a twisted pair of No. 18, B. & S. gauge, rubber-covered wires. The battery connection is carried to each cord circuit for talking in 15-pair switchboard cable, each fused on this board. The connections are all soldered to the fuse studs on the rear, projecting through to the face, where each one is fitted with a cap screw, under which the fuse is held. No wiring whatever appears on the face of the board, and each set or group of fuses is numbered or labeled so that trouble may readily be located in any circuit.

The building is lighted throughout by electricity, the switchboard being illuminated on the front with three 110-volt, 16-cp lamps. The lamp brackets are finished in black and are provided with one-half green shades. On the rear each section has a porcelain base keyless socket and lamp located in the roof. The power and distributing rooms are equipped with an adequate supply of lamps.

We are indebted for the above details to Mr. George L. Burlingame, of the engineering staff of the Kellogg Company, who had charge of the installation of this interesting equipment.

Calculating a Battery for a Given Output.

By Dr. K. Norden

The calculation of storage batteries for given discharge rates has become to-day a matter of growing interest by reason of their increased application in lighting and power plants. Of course, nobody would select batteries just exactly corresponding to the given output, but for the purpose of determining a sufficient power reserve also, a reliable method is wanted.

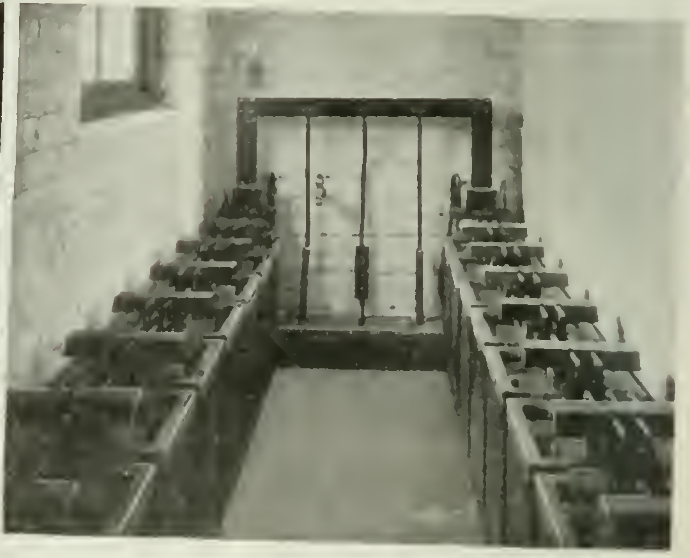


FIG. 7.—BATTERY ROOM.

Two papers have been published recently on this question in German journals, and were noticed in the Digest, Nov. 17, 1900, and Jan. 12, 1901. The difficulty of the problem is due to the circumstance that the capacity of a battery depends to a certain extent on the rate of discharge, so that it diminishes when the current increases. Thus, a certain amount of ampere-hours discharged represents a greater part of the total capacity if put out with a greater current, therefore one cannot simply add the ampere-hours consumed at different discharge rates without reducing them to a common basis. This reduction requires, of course, a knowledge of the relation between capacity and discharge current for the type of plates in question. Several formulæ have been suggested for this purpose, and, in fact, every method of solving the problem by mere calculation is based on their use. Thus one of the papers mentioned above (Rossander and Forsberg, *Elektrotechnische Zeitschrift*, Oct. 25, 1900), arrives at a rather inconvenient expression of the total capacity, applying the well-known formula, $TI^{1.4}=K$. The other paper, by E. Suchy (*Zeitchrift fuer Elektrotechnik*, Dec. 16, 1900), assumes a proportionality between capacity and current, and leads consequently to a very simple formula. But generally the hypothesis is only admissible for a dis-

Elements of Illumination.—XXI

By Dr. Louis Bell.

By far the most complete study of the properties of the enclosed type of arc lamps is that recently made by a committee of the National Electric Light Association. The investigation was upon the arc lamps both for direct and alternating currents, as customarily used on constant-potential circuits. The results of the work, however, are not materially different, so far as distribution of light goes, from those that belong to similar lamps for series circuits. Fig. 5 of article XX. is the composite curve of distribution obtained by this committee in the tests of direct-current lamps. The individual curves vary somewhat, although showing the same essential characteristics. Fig. 1 shows a typical example both with the outer globe opalescent like the inner globe and also with a clear outer globe. The effect of the former in reducing and also in diffusing the light is very conspicuous. The opalescent globe absorbed a little over 14 per cent of the light. This absorption is much less than would be given by a ground or milky glass shade, but it serves to cut down the intrinsic brilliancy to a useful degree. A clear globe absorbs about 10 per cent, so the total absorption of the opal globe is about one-fourth.

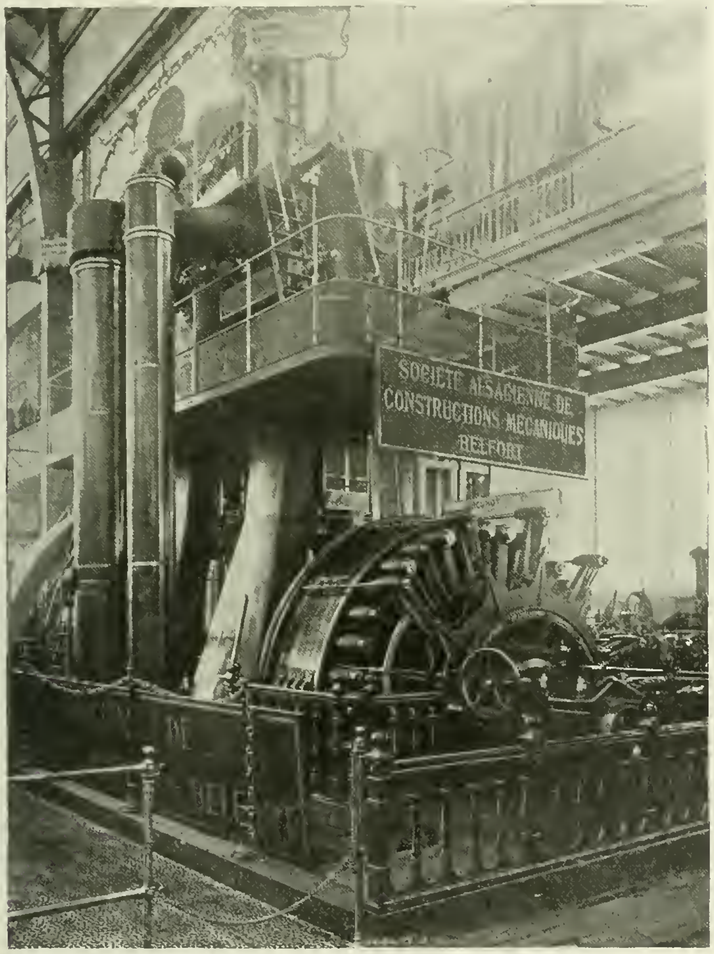


FIG. 72.—SOCIÉTÉ ALSACIENNE ALTERNATOR. (See page 398.)

The weak point of such lamps as efficient illuminants lies in the large amount of energy wasted in the lamp mechanism, including the resistance for reducing the voltage of the mains to that desirable for the enclosed arc. This loss amounts ordinarily to nearly 30 per cent of the total energy supplied, so that while the arc itself is highly efficient, the lamps as used are wasteful. No one but an American would think of working a 75-volt arc off a 120-volt circuit and absorbing the difference in an energy-wasting resistance, but the advantages of the enclosed arc are so great in point of steadiness and moderate cost of labor, that the practice has been found commercially advantageous, and the open arc has been practically driven from the field for all indoor illumination, and is being rapidly displaced for street lighting.

Foreign practice tends, as already noted, toward the use of two or even three open arcs in series on constant potential circuits. These can be fitted with diffusing globes to keep the intrinsic brilliancy within bounds, and obviously give a far larger amount of light for the energy consumed than is obtained here with enclosed arcs, but we have neither cheap high-grade carbons nor cheap labor, and as in the last resort the thing which determines current practice must be the total cost of light per candle-hour, it is likely that both methods are right when judged by their respective conditions.

At present alternating-current arc lights are being rather widely used, both on constant potential and on constant-current circuits, and such arcs present some very interesting characteristics. Evidently when an arc is formed with an alternating current there is no "positive" and no "negative" carbon, each carbon being positive and negative alternately, and changing from one to the other about 7200 times per minute, 120 times per second.

Under these circumstances no marked crater is formed on either carbon, and the two carbons are consumed at about an equal rate. As a natural result of the intermittent supply of energy and the lack of a localized crater the average carbon temperature is probably somewhat lower than in case of the direct-current arc and the real efficiency of the arc as an illuminant is also somewhat lowered. Tests made to determine this difference of efficiency have given somewhat varied results, but it seems probable that for unit energy actually applied to the arc itself the direct-current arc will give somewhere about 25 per cent more light than the alternating-current arc. But since when working the latter on a constant potential circuit the surplus voltage can be taken up in a reactive coil which wastes very little energy instead of by a dead resistance, which wastes much, the two classes of arcs stand upon a more even footing than these figures indicate. This comparison assumes enclosed arcs in each case, in accordance with present practice.

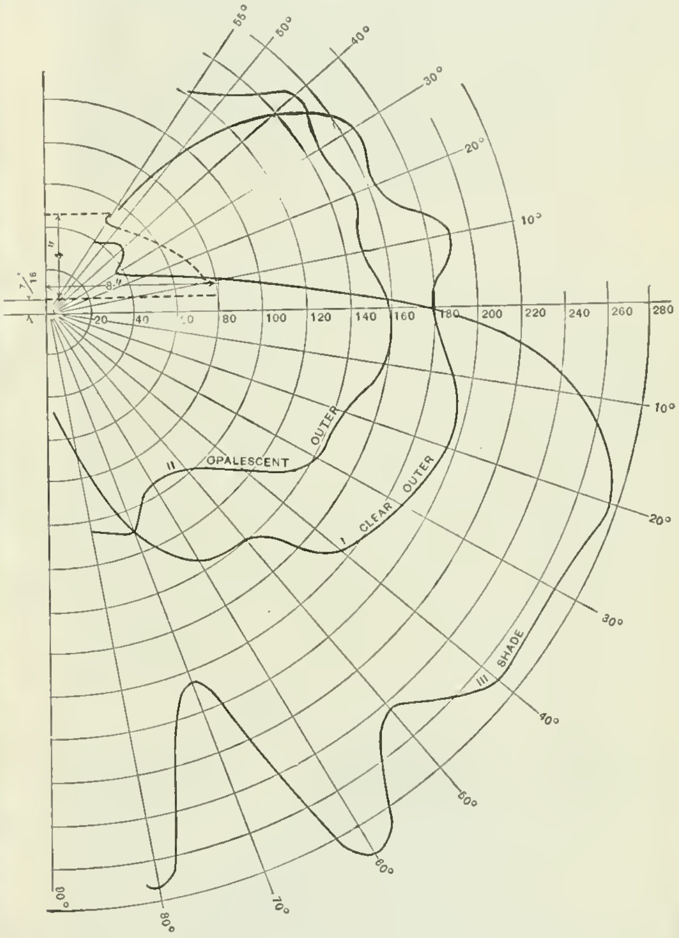


FIG. 1.—DISTRIBUTION OF LIGHT FROM DIRECT-CURRENT LAMP.

For street lighting, as we shall presently see, the alternating arc has certain advantages of considerable moment with respect to distribution, so that as practical illuminants they are often preferred.

The chief objection to the alternating-current arc has been the singing noise produced by it. This is partly due to the vibration produced in the lamp mechanism and partly to the pulsations impressed directly on the air by the oscillatory action in the arc itself. The former can be in great measure checked by proper design and manufacture, but the noise due directly to the arc is much more difficult to suppress.

Abroad where, for the reason already adduced, open arcs are commonly used, a specially fine, soft carbon is used for the alternating arcs, and the noise is hardly perceptible. These soft volatile carbons, particularly when used at a considerable current density, give such a mass of vapor in the arc as to endow it with added stability and to muffle the vibration to a very marked degree. The result is a quiet, steady, brilliant arc of most excellent illuminating power. But in this country such carbons are with difficulty obtainable, and even if they were to be had at a reasonable price could not be used in enclosed arc lamps on account of rapid smutting of the inner globe. Hence it is by no means easy to get a quiet alternating arc, and in a quiet interior there is generally a very perceptible singing pitched a shade over a semi-tone below bass C with noticeable harmonics, a kind of chorus not always desirable.

In selecting alternating-current lamps for indoor work great care should be exercised to get a quiet lamp. Some of the American lamps when fitted with tight outer globes and worked with a rather large current are entirely unobjectionable, but in many cases there is noise in the mechanism or the globe serves as a resonator. With a current of 7 to 7.5 amperes and a well fitted and non-resonant globe, little trouble is likely to be experienced. Out of doors, of course, a little noise does not matter.

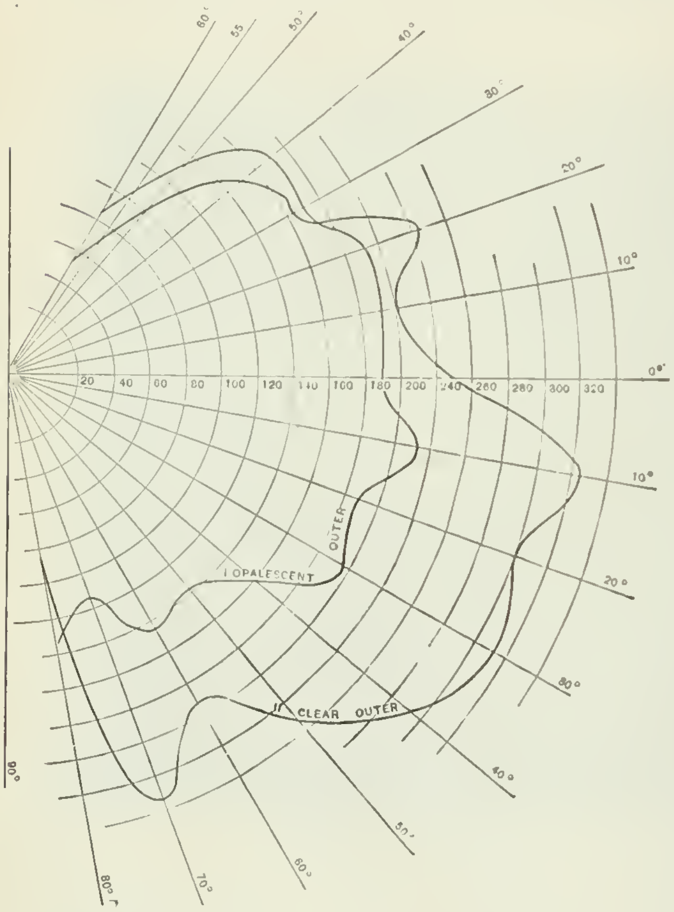


FIG. 2.—DISTRIBUTION OF LIGHT FROM ALTERNATING-CURRENT LAMP.

The chief characteristic of the alternating arc, as regards distribution of light, is its tendency to throw its light outwards rather than downwards like the direct-current arc; in fact, considerable light is thrown above the horizontal, which materially aids diffusion.

For this reason it is often advantageous to use reflecting shades for such lamps so as to throw the light out nearly horizontally when exterior lighting is being done. Indoors, diffusion answers the same purpose unless powerful downward light is needed, when the reflector is of service.

Fig. 2, from the before-mentioned report, shows the distribution of light from an alternating-current lamp, with an opalescent outer globe, with a clear outer globe and with no outer globe and a porcelain reflecting shade of the form indicated by the dotted lines in the figure. The abolition of the outer globe and the use of the reflector produces a prodigious effect in strengthening the illumination in the lower hemisphere, and this hemispherical illumination is for some purposes a convenient way of reckoning the illumination of the lamp. But a finer test is the spherical candle-power, since that takes account of all the light delivered by the lamp. Alternating arc lamps seem to work best at a frequency of 50 to 60 cycles per second. Above 60 cycles they are apt to become noisy and below about 40 cycles the light flickers to a troublesome extent. The light of the alternating arc is really of a pulsatory character, owing to the alternations. A pencil rapidly moved to and fro in the light of such an arc shows a number of images—one for each pulsation, and this effect would be very distressing if one had to view moving objects like quick running machinery by such light. A tale is told of a certain theater in which alternating arcs were installed for some gorgeous spectacular effects and of the extraordinary centipedal results when the ballet came on.

This pulsation is somewhat masked when the enclosed arc is used even with a clear outer globe, and is generally inconspicuous when an opal outer globe is used. It is also reduced when a fairly heavy current (7 to 8 amperes) is used, and when very soft carbons are employed, as they can be in open arcs.

An interesting comparison of direct current and alternating-current enclosed arcs, as used on constant potential circuits, is found in the following table, from the report already quoted:

		Watts Consumed.					Mean Intensity in H. U.			Mean Watts.		
							Spherical.		Lower Hem-spherical.	Spherical H. U.		Lower Hem-spherical.
D. C. Lamp.	Current.	In Lamp.		In Arc		Mech-anism.	Op. Outer	Clear Outer	Clear Outer	Op. Outer	Clear Outer	Clear Outer
1	5.01	551		401		150	172	235 256*	332 362*	3.10	2.37 2.18*	1.66 1.52*
3	5.08	559		406		152	195	216	282	2.85	2.60	1.99
4	4.76	524		381		143	127	139	208	4.12	3.76	2.52
5	4.16†	458		333		125	154	174	221	2.96	2.63	2.07
7	4.76	524		381		143	203	333	317	2.63	2.20	1.65
9	4.84	532		387		145	182	226	281	2.83	2.38	1.89
10	4.99	549		399		150	[illegible]	242	309	2.74	2.24	1.77
12	4.87	536		390		146	178	195	230	3.05	2.66	2.33
Mean	4.9	529		384		144	176	207	272	3.03	2.60	1.98
A. C. Lamp.			Power Factor Lamp.		Power Factor Arc.							
101	6.40	448	.63	340	.82	108	127	141	206	352	317	2.17
102	6.79	459	.61	375	.73	84	146	203 176†	236 266†	3.31	226 260†	1.94 1.72†
103	5.89	424	.65	344	.75	80	116	130	147	3.66	3.15	2.88
105	6.20	414	.61	382	.80	32	128	187	219	3.24	2.20	1.89
106	6.12	378	.56	298	.70	80	132	153 152†	169 254†	2.82	2.56 2.40†	2.23 1.45†
108	6.48	457	.64	383	.80	74.5	133	175	211	3.30	2.61	2.16
110	6.18	339	.49	276	.72	63	140*	126	143	2.41*	2.68	2.37
Mean	6.29	417	.60	342	.76	74.5	130	159	190	3.31	2.66	2.23

* Condition of no outer globe † Condition with shade on lamp.

NOTE.—All marked values not included in the mean.

It must be remembered that the results are in Hefner-Alteneck units. This unit is roughly 0.9 cp, so that the mean results reduced to a candle-power basis are for efficiency when using clear outer globes, as follows:

Direct-current arc	2.89 watts per cp.
Alternating arc	2.96 watts per cp.

These efficiencies are on their face but little better than those obtained from incandescent lamps. There is little doubt that as a matter of pure efficiency a given amount of energy applied to 3-watt incandescent lamps will give more illumination than if used in arcs of the types here shown. The incandescents lose a little in efficiency, but gain by the fact of their distribution.

But for many purposes the arcs are preferable on account of their whiter light, and the very brilliant illumination that is obtainable near them.

Both direct and alternating-current enclosed arcs gain by the use of rather large currents both in steadiness and in efficiency, and moreover give a whiter light. The same is true, for that matter, of open arcs in which the larger the current the higher the efficiency. Very many experiments on the efficiency of open arcs have been made with moderately concordant results. Their efficiency ranges in direct-current arcs from about 1.25 watts per candle in the smallest to about 0.6 or a little less in the most powerful. A considerable number of results by different experimenters have been consolidated into a curve giving the relation between current and efficiency, as based on mean spherical candle-power.

The data for forming a similar curve for alternating arcs are not available, but there is in this case the same sort of relation between current and efficiency as that just noted. There is generally accounted to be from 15 to 25 per cent difference in absolute efficiency in favor of the continuous-current arc.

Obviously the open arc has a greatly higher efficiency than the enclosed form, but the very great intrinsic brilliancy of the former is from the standpoint of practical illumination a most serious drawback. For all indoor use and for much outdoor use the open arc must be shielded by a diffusing globe, which to be effective should cut off about 25 per cent of the light. Taking this into account the working efficiency of the open arc in the sizes generally used is likely to range between 1.25 and 1.50 watts per candle-power. It cannot, however, be made a satisfactory illuminant upon any terms until better carbons are used than are now available at a reasonable price in this country.

Recently some very interesting experiments have been tried abroad with carbons impregnated with certain metallic salts. These composite carbons have given extraordinary efficiency, down to less than 0.5 watt per spherical candle-power, and give a light softer and less brilliantly white than usual. The product has not yet, however, been brought into commercial form, so that it is too early to speak with certainty regarding its merits.

We may now form some idea of the relative efficiency of different classes of arc lights. The annexed table puts the facts in convenient form for reference:

Kind of Arc.	Watts per Sph. c. p.	Remarks.	
Direct current, open	1.0	Medium power arc.	
Direct current, shaded	1.3	Medium power arc.	
Alternating current, open	1.7	Approximate.	
Alternating current, shaded	2.2	Approximate.	
Direct current, enclosed	2.4	No outer globe.	Constant Potential.
Direct current, enclosed	2.9	Clear outer globe.	
Direct current, enclosed	3.3	Opal outer globe.	
Alternating current, enclosed	3.0	Clear outer globe.	
Alternating current, enclosed	3.6	Opal outer globe.	
Alternating current, enclosed	2.5	No outer globe.	
Direct current, enclosed	1.9	Series lamp, approximate.	

In watts per horizontal candle-power the enclosed arcs particularly the alternating ones do relatively much better than is indicated in the table. And in comparing arcs with incandescents it must be remembered that the latter when rated like the above arcs on mean spherical candle-power will not do much better than 4 to 4.5 watts per candle. But it is suitability to the work in hand that must determine the use of one or the other illuminant.

Bell Telephone of Canada.

The annual meeting of the Bell Telephone Company was held at Montreal on Feb. 28. The item of particular interest in the annual report was the fact of an increase of capital from $5,000,000 to $10,000,000 is contemplated. The present capital has all been issued and additional money is required for construction and general extensions. An additional bond issue of $2,550,000 has also been authorized, and these bonds will be placed upon the market as the funds are required. The annual report, which was read and approved, contained the following interesting points: Three thousand, four hundred and thirty-seven subscribers have been been added during the year, the total number of sets of instruments now earning rental being 38,360; the company owns and operates 343 exchanges and 494 agencies; about 2430 miles of wire have been added to the long-distance system in 1900; the long-distance lines now owned and operated by the company comprise 21,350 miles of wire on 6525 miles of poles. There were $190,000 of 5 per cent bonds sold during the year, the net premium on which was $18,775, and 500 shares of stock were also sold at a net premium of $35,105. These premiums, aggregating $53,880, have been carried to the contingent account. There have also been $46,119 carried from revenue to contingent, making this account $900,000; $32,898 to the insurance reserve account, making it $100,000, and $50,000 written off the plant and patent account. The entire capital stock having now been issued and funds for construction being required, the shareholders at a special meeting held on Dec. 5 last, authorized application to Dominion Parliament for power to increase the capital fom $5,000,000 to $10,000,000, and the petition will be presented in due course. The gross revenue for the year was $1,614,262, and the expenses were $1,229,977, leaving a net income of $384,285.

Italian Turbines for a Canadian Power Plant.

By Guido Semenza.

The Hamilton, Ont., Electric Light & Cataract Power Company has just put in operation an installation at St. Catherines, Ont., that presents this novel feature, that the turbines come from Italy. It was a question of installing two 3000-hp turbines under 255 ft. of fall, and as the firms on this continent did not have a wheel answering these data in their practice, it was decided to invite tenders from turbine builders in Europe. Mr. W. Kennedy visited the principal turbine builders of Switzerland, Austria and Italy, and placed the order with Riva Monneret & Co., of Milan, who constructed the turbines for the Paderno plant, where they have made a great success.

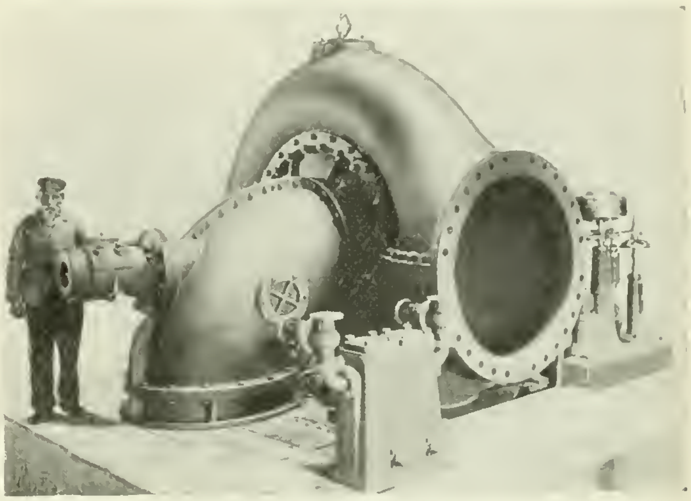


FIG. 1.—ITALIAN TURBINE.

The accompanying cuts give an idea of the principal features of these wheels and of the governor. The speed is 286 revolutions. This fact explains why they have such small dimensions with so large power developed. The wheels are of the Francis reaction type with horizontal shaft. The shaft is located 15 ft. over the discharge level so that the wheel works under draft. The regulation is effected by a ring interposed between the distributor and the revolving part. This ring by slight rotation screens more or less the inlet of the water.

The revolving wheel and the regulating ring are made of hard bronze. The wheel is so arranged with a hydraulic counterpoise that all axial pressure on the shaft and therefore on all ring bearings is avoided. The governor works on the regulating ring by hydraulic pressure, filtered water being used for this purpose.

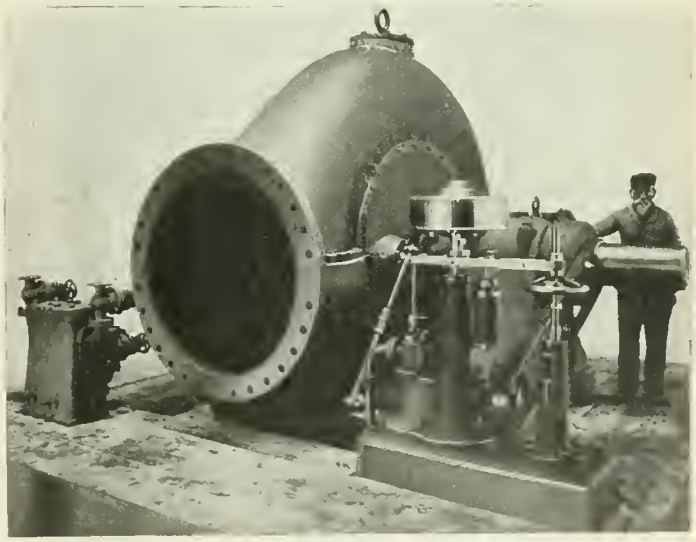


FIG. 2.—VIEW OF TURBINE GOVERNOR.

These turbines are the most powerful constructed up to date in Europe. Mr. W. Kennedy wrote about them as follows: "The limiting conditions imposed by the small available space, the power and speed of the turbines, the location of inlet and discharge pipes, etc., and the comparatively short time for the completion of the whole work contracted for, demanded superior skill in the preparation of the design and also in the construction, and I am pleased to say that in my opinion the whole has been accomplished so successfully and completely as to reflect great credit on Messrs. Riva Monneret & Co., as constructing engineers for hydraulic machinery of any capacity." And later on he published his opinion on the practical results, saying: "I feel satisfied that the results obtained in design, cost and efficiency justified the placing of the contract as was done."

Ferranti Alternating-Current Generating Unit.

The accompanying illustrations show a type of generating unit now being constructed at the Ferranti Works, Hollinwood, England. The half-tone illustration shows a 1200-kw machine of the revolving armature type as installed at the South London Electric Supply Corporation. The line drawing is a general arrangement in front and side elevation of a smaller machine of the same type, the capacity being 800 kw and the revolutions 167 r. p. m. From these illustrations a good idea may be obtained of the compactness of the combined Ferranti engine and alternator.

The Ferranti engines are almost exlusively of the vertical compound type, running at medium speeds, and they have several special features, particularly as regards the valve-gear. The object which it has been endeavored to attain has been the economy of Corliss engines, combined with the possibility of much higher speeds; the advantage of high speed being to reduce the floor space occupied to give more even turning moment, and to reduce the cost of the dynamo and engine. To obtain the economy of Corliss engines the system of four valves per cylinder has been adopted, and these valves are placed in the covers so as to minimize clearance surfaces and spaces. The valves are of the grid-iron type, and have a very short movement, and, as the valve-gear is only worked at half the speed of the engine, the surface speed of the valve faces is very low, consequently making the wear and tear low.

The valves are actuated directly from cams, the cams being so designed as to give a constant distance between the cam rollers, thus making it possible to work with fixed rollers, and making the motion quite independent of springs. This gives quite a positive motion. The cams are arranged on vertical shafts working in a completely inclosed box, which, by reference to the cuts, will be seen to stand midway between the cylinders. This box is filled with oil, consequently the whole of the valve-gear works absolutely immersed in oil. This is thought to have a very important bearing on the satisfactory working of the cam gears, and further, it leaves no part of the valve-gear to be oiled by the engine attendant. The connection between the cam and the valve is a direct one, thus there are no joints to wear, and the external valve-gear is extremely simple. The cam shafts are driven by means of cut gearing from the crankshaft, and each wheel is arranged to run in an inclosed casing containing oil, eliminating in this way any question of perfect lubrication. The governor can be either arranged to vary the cut-off automatically, or to act on the throttle valve, in which latter case the cut-off can be made either adjustable by hand or fixed.

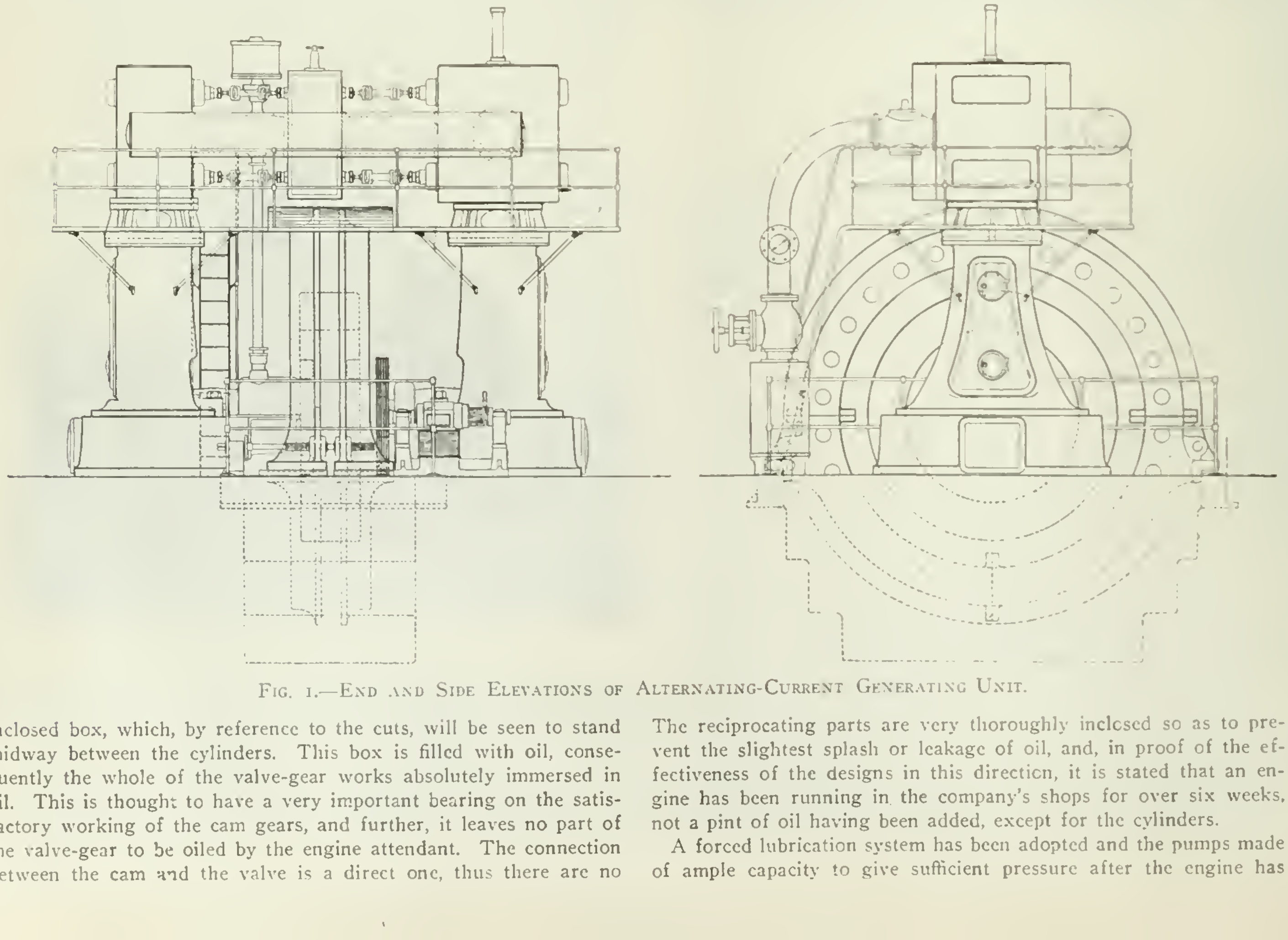


Fig. 1.—End and Side Elevations of Alternating-Current Generating Unit.

Turning to the main parts of the engine, it may be said that these are, on the whole, of ordinary construction, similar to those usually adopted in marine practice, except that the crank-pin bearing is of the spherical type, so as to insure equality of pressure along the pin. The main bearing steps rest in spherical seats with the same object.

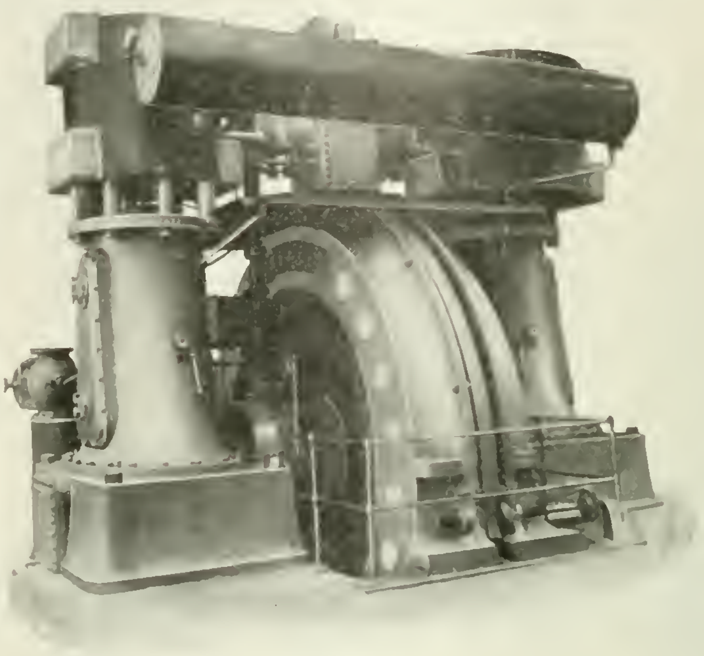


Fig. 2.—Alternating-Current Generating Unit.

The reciprocating parts are very thoroughly inclosed so as to prevent the slightest splash or leakage of oil, and, in proof of the effectiveness of the designs in this direction, it is stated that an engine has been running in the company's shops for over six weeks, not a pint of oil having been added, except for the cylinders.

A forced lubrication system has been adopted and the pumps made of ample capacity to give sufficient pressure after the engine has run a considerable time, and, in consequence, worn the bearings rather slack. This removes the necessity for frequent adjustment of bearings, which is experienced if the oil pump is small. The oil is forced from the pump through a very effective filter, which is arranged in the engine bed-plate; the door of this filter will be seen in the engravings. From the filter the oil passes to the various bearings, from which it falls into the bed-plate through a strainer at the bottom of the bed-plate into a tank below. Thence it is again pumped through the filter to the bearings. To prevent the oil creeping along the crankshaft, oil throwers are arranged in series, it being believed that the only effective way to prevent creeping of the oil is to see that the last thrower has only to deal with such small quantities of oil as may have escaped past the preceding ones. In connection with electrical work the matter of keeping oil away from the dynamo is of the utmost importance, quite apart from the point of view of cleanliness and avoidance of waste. It is further to be remembered that oil damages concrete foundations.

Switchboard Connections for Standardizing Ammeters.

By THEODORE W. FRECT, JR.

In years gone by the accuracy of switchboard instruments was given little if any attention, owing probably to the fact that the instruments of the past were unreliable at the best. As the development of electrical measuring apparatus has gradually been brought to its present stage, so the requirements of the station management have become more rigid. At present the user who was formerly satisfied to regulate the e. m. f. of his plant with a worn-out incandescent lamp and the distribution of current on his several dynamos according to the apparent load on engines, spends a great deal of time wondering whether the accuracy of his voltmeters and ammeters are strictly within the guarantee of the manufacturer, and in many instances unjustly condemns his instrument through some little irregularity which he thinks he has discovered. And yet with these requirements which are so essential in determining the efficiency of the plant and maintaining it, the switchboard designers do not seem to have taken any steps to provide for the convenience of occasionally checking the ammeters.

This could easily be done by providing a break in the circuit of each machine which, under ordinary conditions, could be closed with a suitable movable connection. When a check is desired, this connecting bar could be replaced with a shunt similar to the one used with the dynamo ammeter. If the dynamos were of different capacity, as is often the case, the station superintendent could have a number of shunts to correspond with the different ranges of his ammeters. All of these shunts could readily be adjusted to one instrument, and would prove sufficiently portable to be sent to a standardizing laboratory occasionally for correction. This arrangement would not only prove very satisfactory for determining the condition of the switchboard ammeters, but would be of inestimable value for temporarily replacing an instrument which it is found necessary to send away for repairs. Of course, a standard voltmeter would also be essential, but it would not be necessary to make provision for placing it in circuit.

While it is possible to insert a standard shunt by fitting it with terminals to engage the blades of the dynamo switch or making connection at the dynamo itself, it is usually very inconvenient and subject to error on account of the lack of knowledge or experience on the part of the person making the test. With compound-wound machines it is necessary to place the standard shunt in the leg of the circuit occupied by the dynamo shunt, and if connections are made at the machine it will often be found that the standard will indicate the output of the machine plus the field current, while the dynamo instrument indicates the output only. These difficulties would be overcome if the switchboard designer would provide the necessary connections for each ammeter, preferably on the front of the board, for if properly made they would not mar its appearance and would be most accessible. The labor involved in these additional connections would not materially increase the cost of the board and would accomplish much to allay or confirm suspicion directed toward the ammeters, often saving a great deal in the way of charges for checking and transportation on instruments which were really in good condition, not to mention the trouble incident to removing them from the switchboard.

American Street Railway Association.

The executive committee of the American Street Railway Association met at the Murray Hill Hotel, New York, on Feb. 28, to make arrangements for the twentieth annual meeting of the Association, which will be held in New York City. The following named members were present: President Walton H. Holmes, Kansas City, Mo.; H. H. Vreeland, New York; N. H. Heft, Meriden, Conn.; John B. McClary, Birmingham, Ala.; G. W. Baumhoff, St. Louis; Frank L. Fuller, Philadelphia; John R. Graham, Boston, and T. C. Penington, Chicago. It was decided to hold the meeting on Wednesday, Thursday and Friday, Oct. 9, 10 and 11. There will be two sessions of the convention on each of the first two days, and the last day will be set aside for the inspection of exhibits. The banquet will be held in the evening of the last day, when the newly elected officers will be installed. Madison Square Garden has been leased from Oct. 6 to 13, and it is expected that the exhibit of street railway appliances will be on a very large scale. The meetings of the association will be held in the same building. Provision has also been made for the meetings at the same time of the Street Railway Accountants' Association of America. The usual charge of 10 cents per square foot for space in the exhibit hall will be made.

A new departure has been decided upon in the matter of the papers presented to the meeting. They are to be printed and advance copies sent to the members. They will be read at the meeting by title only. The president was authorized to select a speaker to open the discussion on each paper, and 30 minutes will be given to the consideration of each paper.

The following topics were selected, upon which papers are to be presented:

Street Railway; a Review of the Past and a Forecast of the Future.

The Adoption of Electric Signals on Suburban and Interurban Railways, Single or Double Track, and Their Economy of Operation.

The Value of Storage Batteries as Auxiliaries to Power Plants.

The Public, the Operator and the Company.

The Best Manner and Mode of Conducting the Return Circuit to the Power House.

The American Street Railway Association: The Purposes of Its Organization and the Benefits Accruing to Investors in and Operators of Street Railway Properties by Memebership Therein.

The Economies Resulting from the Use of Four Motors Instead of Two on Double-Motor Equipments.

The Best Form of Car for City Service; A Consideration of the Various Types of Car as to Size of Car and Arrangements of Seats, Including the Best Types of Brakes and Wheels.

Practical Results Obtained from Three-Phase Transmission and Rotary Transformers or Motor Generators in Transmitting Power on Railway Lines.

Relations of Interurban and City Railways.

The Modern Power House, Including the Use of Cooling Towers for Condensing Purposes.

The admission fee will be waived in the case of any company becoming a member of the association prior to Oct. 1 next, provided the annual dues to October next be paid at the time the application for membership is made.

The president appointed the following named gentlemen as a committee of five on Standardizing of Street Railway Equipment: J. R. Graham, Boston; N. H. Heft, Meriden; F. G. Jones, Memphis; W. J. Hield, Minneapolis, and C. F. Holmes, Kansas City. The committee is authorized to incur an expenditure not to exceed $1000. The president also appointed the following named gentlemen as a committee of three to report at the next convention on the subject of Transporting the Mails and Mail Carriers on Street Railway Cars: C. S. Sergeant, Boston; C. L. Rossiter, Brooklyn; J. B. Parsons, Philadelphia. It is confidently expected that the forthcoming meeting will be the most largely attended and of greater value from a practical standpoint than any that have been held. The executive committee was most pleasantly entertained by President Vreeland, of the Metropolitan Street Railway Company, during the stay of the members in the city. Mr. Vreeland counts confidently upon having all the important new work upon the Metropolitan system completed by the time of the October convention, so that then visitors will be able to see in full swing the largest street railway system in the world.

Three Important Electric Railway Patents Declared Invalid.

The United States Circuit Court of Appeals for the Second District in New York handed down decisions on Feb. 27 declaring invalid the Knight patent on the controller interlocking device, and on two Thomson electric blow-out patents. The Knight patent (No. 428,169), issued May 20, 1890, relates to electric railway controllers having a reverser and regulator manipulated by separate handles, in combination with a stop or lock so constructed and arranged as to leave both the reverser and the regulator free to be operated independently of each other. In order to reverse, however, the motorman is required not only to operate the reversing arm, but is compelled to bring the regulator back to its "off" position before the other can be moved, and conversely he cannot operate his regulating lever until his reversing lever has been removed from the "off" position to the one side or the other. The point involved in the litigation was whether Knight invented the locking arrangement whereby one device locks the other.

The Court held that the patent is in no sense a pioneer one. It did, however, add a new or locking feature to preceding devices in which the regulator and reverser were operated by different methods. The Court considers while this locking device was undoubtedly an improvement, it was not an invention of such novelty and importance in motor apparatus as to make a distinct step in the progress of the art as contrasted with mere improvement or perfection of what had gone before. Several interlocking devices of prior date and for other uses are described which, the Court stated, like those of the patent in suit, consist of two parallel shafts provided with handles and mounted side by side in a common frame and manually operated, and capable, except for the locking apparatus, of being simultaneously manipulated by the operator.

In view of the limitations imposed upon the claims of the patent in suit by the prior state of the art as thus illustrated, the Court considered that they ought not to receive a construction which will enable them to include a combination in which the several devices are not substantially described in the patent. It will not do to say that because the patentee was the first to introduce locking devices into a motor in which a regulator and reverser were operated by different levers, he is entitled to a monopoly of all locking devices in such a motor that will so co-ordinate the movements of two levers that neither will move except when the other is at a predetermined position. The patentee is entitled to the merit of being the first to conceive of the utility of interlocking two levers of a motor controller of a type in which the said levers are employed, but his right to the patent must rest on the novelty of the means he has devised to carry his idea into practical application.

The first four claims of the patent cover in the broadest terms the combination of any locking device with any parts of a two-lever controlling apparatus which will effect function or result in the claims, and the great scope of these broad claims were held not to be warranted by the scope of the real invention of Knight. Concerning the contention of the defendants in the suit that the device described in the fifth claim of the Knight patent is inoperative, the Court states that as it is not asserted by the complainant that infringement of the fifth claim has been established, it is unnecessary to advert to the difference between the devices employed by the defendant, and the patented devices. The Court declared that the first four claims of the patent are invalid, and in absence of any proof of infringement whatever of the fifth claim, the decree of the lower Court in favor of the complainant, is reversed.

Of the two Thomson patents, one (No. 233,167) was issued Aug. 14, 1883, and covered the magnetic blowout principle as applied to street railway controllers. The second patent (No. 401,085) was issued April 9, 1889, and related to the application of a shield of insulating material between the opposed surfaces of the arc-rupturing device and the electrodes between which the arc to be ruptured is formed, threby preventing an arc from forming at any other portion of the electrodes than is directly subjected to the arc rupturing force, and permitting a conducting material to be applied, without danger of defect of action, very closely to the electrodes.

Concerning the first patent the Court, referring to the early experiments of Davy and others, stated that the old scientists demonstrated that the magnetic field pulls the arc away from the electrodes and extinguishes it. Experts for the patentee admitting this, claimed that "it pulls so rapidly and scatters the arcs so widely that the contact surfaces are kept smooth and are not fused." The Court considered, however, that this new discovery of the preservative action upon the contact points is so much a part of the known result of the old law as not to deserve the name of a new discovery. The theory of the divisibility of the Davy discovery of the effect of a magnetic field upon a voltaic arc which burns, from the alleged discovery of Thomson of the effect of the magnetic field upon the ends of the conductor between which the arc is burning, is held not to be strong enough to bear the weight that the experts placed upon it. The Court concluded that if the patent was to be sustained it would rather rest in its support upon the declaration that Thomson applied the law which the scientists observed in laboratory experiments upon magnets and electric wires, to a switch of commercial use and efficiency and made the experiments of practical utility.

As to the second patent, the Court considers there is no doubt that the improvement caused by the insulation described has novelty in, and that it nad not been used before the date of the invention upon arc-rupturing devices of the character mentioned in the patent; it was also useful in connection with other inventions of the same patentee, and by resulting in an automatic circuit breaker, it has been of great value. As to patentability, however, there was nothing new in the conception of the idea that the way to prevent lateral discharges between conductors was by the interposition of insulation. The fact that the insulation of the poles of the magnet allows very close approach to the electrodes and thereby enhances the intensity of the field, is a result which was incidental to the main object of the invention, for after insulation had stopped the danger of lateral discharges from electrodes, the magnet could then be pushed more closely to them. The Court concluded that it cannot perceive that the effect of the insulation in an arc-rupturing device was anything more than the old effect which had always accompanied insulation, and which was accomplished by the old mechanical means, although it was used to prevent lateral discharges in connection with an arc-rupturing device.

Electrical Developments in the British West Indies.

A cablegram has just been received from the British Colonial Government of the Island of Trinidad by Mr. W. B. Chapman, of Montreal, representing the Trinidad Electrical Company, which is composed of Montreal capitalists, stating that the Colonial Office has consented to the granting of a charter to the company for the construction of an electric tramway line and an electric lighting plant in the city of Port of Spain, the capital of the island. The Trinidad Electric Company some months ago obtained control of the existing tramway lines and lighting plant in Port of Spain, and made application for a charter to convert the tramway lines into electric trolley lines, covering the entire city. The charter also asked for power to extend the lighting plant to all parts of the city, and its adjacent suburbs. This application was dealt with by the Colonial Government of the island, and referred to the Imperial Government for ratification. This has been given, and the company now has a charter under which it proposes to expend some $940,000 in acquiring existing tramway and lighting plants and converting them into a system covering the whole of the city of Port of Spain and three adjacent suburbs. The new company, which will shortly meet for organization purposes and election of officers, will be capitalized at over $1,000,000, and the work of construction will be commenced in the course of a few months. Already Messrs. Bruce and McConnell, engineers in the employ of the new company, have gone over the ground and prepared plans and specifications of the work the company proposes to undertake. The existing plants, which the company will take over, include a good electric plant with a mile and a half of poor tram-line, and a small lighting system. There are also about 8 miles of good mule-car line in and outside the city. The Island of Trinidad is the most prosperous of all the British West Indies. There is reason to believe that resort will be had to the American market for much of the material required.

After an English Franchise.

A dispatch from London, Feb. 27, states that Mr. Tom L. Johnson, the American electric railway promoter, is seeking Parliamentary sanction for an electric railway from London to Brighton. This has been talked of before.

Views in the Telephone Industry as to the Berliner Decision.

The effect of the decision of Judge Brown in Boston last week declaring the Berliner microphone patent invalid, has naturally been the subject of much discussion in electrical circles and in the public press during the past week. As a general thing, officials of the Bell companies are reticent on the subject, and the counsel have given it to be understood that the decision will, of course, be appealed. Those who have spoken out, like President Tyler, of the Southern New England (Bell) Telephone Company, have said that they either did not consider the decision of any great importance, or that patents did not now play a leading part in the industry—it was a question of good service at fair rates. The patent, if sustained, would have run until 1908, but for the past few years all the independents, except a few under agreement to stay out of the business, have been busy installing systems all over the country, so that it is claimed there are now nearly 6000 exchanges, offices and small groups, with 1,500,000 subscribers, while the Bell interests claimed less than 700,000 stations in the last annual report. Judge J. M. Thomas, the president of the National Independent Telephone Association, when interviewed last week, as noted in these columns, expressed the belief that a great incubus had been lifted from the art, and that millions of new capital would now be poured into the independent exchanges for their development. He stated also that the Berliner suit was only one of a long series that had been won by the independents against the Bell Company, the total of such victories being put by him at 60. While this decision was expected, he said, a good deal of capital had been holding back until the Berliner patent was out of the way.

As might be expected, independents are very frank in the expression of their views on the situation, and we are able to give below interviews and authoritative statements from a large number of them.

The Farr Telephone & Construction Supply Company, of Chicago, C. W. Farr, president, says: "The last decision given by Judge Brown in the Berliner transmitter case will not cut much figure with the capital now invested in the independent telephone business throughout the United States. The capital now invested had already decided that the case would never be decided against it, and for that reason the men interested have pushed the independent telephone business in all parts of the country. More timid capitalists have been slow to invest their money with the independent telephone people of the country, fearing that the decision might be in favor of the Berliner patent, and in some localities it has been quite hard to raise money on independent telephone stock for this reason. We think the late decision will surely make a big boom for the independent companies throughout the United States, and that all classes of capital will now feel at liberty to invest their money in the enterprise. The Bell Company will probably keep up the bluff and have their agents inform all interested that they will carry the suit to a higher court, although we do not fear any bad results any more by this kind of talk from the Bell people. We are looking forward to a very heavy business in the telephone line the coming spring and summer."

The Lambert Schmidt Telephone Manufacturing Company, of New York, through its president, Mr. Schmidt, offers the following considerations: "The recent decision before Judge Brown in the United States Circuit Court declaring the Berliner microphone patent invalid is unquestionably of paramount value to the independent telephone business. It is a direct slap at the unreasonable claims of the Bell Company, and will be the means of a large increase in the development of independent exchanges. The independent manufacturers have always held that the Berliner claim was a false one, and that no right-minded judge could render a decision in favor of the Bell Company. The fact that a patent is considered lawful until declared otherwise in the United States Courts has been the only obstacle. This decision will furnish the independent manufacturers as well as the exchanges a new source of energy in raising competition against a monopoly that is without comparison anywhere. It is indeed hard to foretell the enormous advantage that will accrue from this decision, but it is certain that it will be a large one and will result very quickly in the favor of the independent industry. It also demonstrates that a so-called monopoly cannot operate independently in this country except on a fair and justifiable basis. This decision has been received by our company with considerable pleasure, and we feel that there is a bright future before us."

Mr. Elisha B. Seeley, manager of Couch & Seeley Company, leading telephone manufacturers in Boston, where the decision was given out, says: "There has never been any question in our minds as to the ultimate outcome of the Berliner case; nevertheless, we are cognizant of the fact that people having money to invest will more readily recognize the opportunity and desirability offered by this course of investment now that this old bugbear, which the Bell Company has never ceased to flaunt in our faces, is dead beyond the possibility of resuscitation, and to this extent telephone industry will be benefited by this decision."

Mr. J. A. Williams, president of the Williams Electric Company, of Cleveland, does not see much immediate effect: "I do not consider that the decision in the Berliner case, recently handed down, will make much difference in the status of the independent telephone business, as the vast majority of all the parties interested in exchange promotion construction or operation have been practically certain, for the last two or three years, that the decision would be rendered just as it is. The only thing which it has done will be to remove the doubt which may have existed, in the minds of a few who contemplated engaging in the independent telephone business, and to this extent only will it affect future prosperity of the industry. Had this decision occurred three or four years sooner, the independent telephone business would no doubt to-day be much greater in extent than it now is. It, however, places independent telephone interests beyond the peradventure of a doubt, upon an absolutely safe commercial footing, and we may look for within the next four or five years unparalleled advancement and prosperity in the independent telephone interests. To the early investors in independent telephone exchanges a great deal of credit is due. They really were the pioneers in the field and performed their work and risked their means under what certainly must have seemed to them at that time risky conditions."

President G. A. Briggs, of the Chicago Telephone Supply Company, takes the following view of the situation: "In our opinion the decision of Judge Brown invalidating the Berliner patent will have a beneficial effect on the telephone trade. The Berliner microphone patent has been used by the Bell Company for years to intimidate users of independent apparatus everywhere. There is no question but what the threats of the octopus had great effect in deterring large numbers of people from becoming interested in independent telephony. The decision of Judge Brown is decisive on every point involved. It completely demolishes the claims of the Bell Company and confirms the contention of the independent interests that the Berliner patent was the last hope of organized greed to retain its hold on the pockets of the people. The most timid of purchasers will no longer have cause for apprehension and independent telephony will spread until there will not be a farmhouse, however isolated, which will not be provided with that modern necessity—telephone service."

Mr. E. B. Overshiner, president of the Swedish-American Telephone Company, of Chicago, makes the following remarks: "Once more the right and justice predominated and the decision rendered reveals the absurdity of the Berliner claims. The honor of the victory belongs to the many independent exchange owners, as Judge Brown no doubt took into consideration that if the Berliner claims were valid, then so many good business men would not have invested their money. This decision simply explodes another bugaboo claim held over the independents and the threats implied in same. The decision rendered was a surprise to no one except to those not posted. The Bell Company knew that they were fighting against a lost cause and were simply fighting for time, realizing that as long as the decision hung fire they had a certain amount of capital intimidated. That capital will now come forward and set a pace for the would-be monopoly that will compel it to adopt the independent method of doing business—'Live and let live.'"

The Holtzer-Cabot Electric Company, of Brookline, Mass., says in regard to the decision: "We believe that it will instill new confidence in those who are investing in independent telephone securities, and will doubtless assist greatly the undertaking of large telephone enterprises independent of the Bell Company. We believe, however, that there was very little fear of this particular patent; in fact, it seemed a forgone conclusion that it would be declared invalid, and it was rare indeed that the question of infringing this patent was ever considered when any telephone enterprise was on the tapis. If the decision had been in favor of the Bell Company it would have paralyzed the independent companies temporarily at least, but we do not believe it would have ultimately affected the development of that field. Of course, there is the possibility of the case being brought to a higher court with the risk of a different opinion being handed down, but the decision of Judge Brown was so complete in refuting any claims of Berliner that no person is likely to fear any further action that might be taken."

The Central Telephone & Electric Company, of St. Louis, Mo., say: "We believe that the Berliner decision has been discounted by the independent telephone companies to a very great extent. Still the subject has been used for bluffing purposes by the Bell Telephone Company for quite awhile, and in many instances it has prevented capital from being invested in the independent telephone business. We do not look for any immediate increase from the effects of this decision, but believe that it will certainly add to the already large demand for independent telephone goods."

One of the largest independent telephone exchanges is that at Atlanta, Ga., employing the Clement-Gharky system. Mr. Edward E. Clement, the president and general manager of the Sun Electric Company, of Philadelphia, contributes the following interesting discussion of the decision and its effects: "In the matter of the Berliner patent, we beg to say that the protracted character of the proceedings has resulted in a rather general discount of the decision. That is to say, that the bugaboo has been in sight so long, its first effect has pretty well worn off. There has been, however, a lurking sense of uneasiness in the minds of all those who understood the action that would probably be taken by the Bell Company if the patent was sustained, and to them the decision comes as a relief. As regards investors in the independent field, they will doubtless be impressed by this clearing of the atmosphere, and this will help in the immediate growth of enterprises that would otherwise progress more slowly. Capital is more or less timid, and despite the statements of Bell leaders, that their company has relied for years upon purely commercial methods in competition, nevertheless the Berliner patent has been flaunted in a manner to obtain all the benefit possible from its flourishing. Speaking generally, the effect of this decision will doubtless be to strengthen and stimulate the independent movement all along the line, but to my mind the most important effect it has, and will have, is not confined to the telephone industry by any means. I refer to restoration of confidence to our patent laws, as administered by the courts, which must ever be beyond coercion or control by any individual or corporation, no matter how powerful. This patent was an iniquitous grant. It has depended for its existence purely and simply upon an artificial interpretation of a law, which is so important to the well-being of this country, that its administration should never be hampered by unnecessary adherence to mere technicalities. The very foundation of our whole patent system is the friendly agreement between the people through their governing officials, and the inventor, that he shall be ensured the exclusive right to the product of his brain and skill for a term of years, if at the expiration of that time it shall be free for all. There is here a fair concession on both sides. The public relinquishes the right to invent the same thing, as well as the right to make it or use it, without the inventor's permission, and the inventor limits himself to the stated period of 17 years in which to gather compensation for his labors. In the case of the telephone, the Bell Company long ago received all benefits in full that it was entitled to, as the assignee of its inventor, Mr. Bell, and its other inventors, Mr. Blake, Mr. Edison, et. al. Having established a questionable right in the beginning, the public acquiesced in that establishment, and waited patiently the expiration of the controlling patents. During this time specific patents on the microphone had had come and gone, lending their strength to the Bell Company, while they lasted. Then came the Berliner patent, having absolutely no moral reason for its existence, but purely and simply a technical reason, and through its agency this corporation, which had not only derived millions from the people, but had limited the use of the telephone by an iron rule to such territory as it could itself supply, and in future possibly control, essayed once more to put up the bars against public entrance to a field, where it had already maintained exclusive pasturage longer than the spirit of the law contemplated. Looked at in this light the decision cannot fail to have a wholesome effect in restoring confidence. Capital needs protection, but so do the people, and perfect laws are not so important as a perfect administration."

Mr. I. J. Kusel, of the Eureka Electric Company, of Chicago, makers of telephone instruments and switchboards, writes us as follows: "The fact that Judge Brown, in reviewing the decision in the case lays bare all of the weaknesses of the claims only proves conclusively that the opinion and strength of this patent was as maintained by knowing independent telephone men simply what it has always been claimed—great in notoriety only! There is no question that the Bell Company had hoped against the worst. Had they won, it would have only meant continued litigation in the higher courts. The decision is so sweeping and so clear that there can be no hope that we can see for the monopoly in the upper courts in the event that they should take an appeal. While the independent field has grown beyond the fondest hopes of its earliest promoters, we can only believe in the realization of the wildest imagination of success in store for the independent field, and the future movements of the monopoly along other lines will be watched with interest, for amusement's sake if for nothing else. That the independent field is in a most healthy condition, and that future prospects are certainly flattering is evidenced by the fact that all factories manufacturing high-grade apparatus have all that they can handle. The faith that independent manufacturers have maintained all along that the claims of this patent were worthless is further evidenced by the extent to which each and every plant has been extended from time to time, until now the telephone manufacturing industry may be classed along with any of the electrical branches."

We are indebted to Mr. W. E. Doolittle, general manager of the Sterling Electric Company, of Lafayette, Ind., for the subjoined expression of opinion: "The decision handed down by the United States Court in the Berliner patent case is the most important happening since the inauguration of the independent telephone field. The Berliner patent has always been held as a club, a bugbear and a menace over independent telephone manufacturers, operatives and prospective investors. With this decision against the patent, confidence will be established, manufacturers and operators will take hold with renewed vigor, but the most important effect will be the giving to independent properties a stability and firmness that will attract the attention of capital and will bring large amounts of new capital into the field for new enterprises. The independent telephone field since this favorable decision will show a growth and improvement with the year 1901 that will exceed the expectations of the most sanguine."

The Kokomo, Ind., Telephone & Electric Manufacturing Company says, under date of March 2: "We were not surprised at the decision: in fact, we expected it. We feel it will have a wholesome effect on the industry as it will remove a scarecrow that has hung over the business for several years past. New capital will take hold, and the independent telephone industry will grow as never before."

Our regular Cincinnati correspondent writes: "The recent decision of the United States Circuit Court at Boston in the matter of the Berliner transmitter patent, has aroused considerable comment among the independent telephone people of Ohio, which is said to be the largest field of the country, with Cincinnati as its principal point. Says one of the managers of one of the largest Ohio concerns: 'The decision will have little effect on the independent companies, as they are already using the transmitter. As to what will be done, it is said the sub-companies may refuse to pay royalty and buy out the transmitters. The principal obstacle to this scheme would be the fact that the Bell Company has possession of 51 per cent of the stock.' There is some curiosity as to whether the Bell Company will go into the retail sale of apparatus or deal with the public only through its 39 licensee companies as regular subscribers."

Mr. W. J. Barr, telephone apparatus manufacturer of Cleveland, says: "The Boston decision on the Berliner patent will no doubt increase investments in the independent telephone field and make the industry more substantial. However, it is hoped that any increase of business will not have the effect of decreasing or abandoning the experiments upon new principles and new construction."

Mr. J. D. Leatherbee, of the National Telephone Company, of Boston, who has been one of the most conspicuous figures in the litigation, is very reticent as to his part in it, and thinks that compliments are due rather to the lawyers who fought for the defense and secured a verdict. There has been a great deal of interest as to Mr. Leatherbee's plans for his company in the near future, now that an injunction no longer hangs over him, but he has so far refused to state what he proposes to do.

Mr. Philip S. Dorlon, of Troy, N. Y., who, it is said, is now likely to be active again in the field, remarks: "I believe that the Boston decision invalidating the Berliner microphone patent is an incident from which tremendous benefits will result to the whole country during the coming years. It is an auspicious event in the unfolding of the new century."

Mr. W. E. Russell, president of the Russell-Tomlinson Electric Company, Milford, Conn., writes us: "The recent decision against the Berliner patent we consider to be of the greatest value to the telephone industry, both to the independent field and to the Bell interests. While we have been very busy in the past, we now expect to be more so, and have, therefore, provided for a much larger increase in our output than would otherwise have been the case."

In an interview in the Washington *Star*, Hon. C. H. Duell, Commissioner of the United States Patent Office, is quoted as saying: "There will be no limit in long-distance telephony. And how cheap telephones will be! Washington merchants will have no cause to complain. Quadruplex machines will come and telephones at 10 cents a month will be about what to expect. It will be as easy to send four or five messages over a single wire by the telephone as it is with the telegraph now. Everybody will have a telephone. People will live longer, be happier and enjoy greater blessings."

Judge R. S. Taylor, of Fort Wayne, Ind., who conducted the defense for the independent companies, says: "The decision made in Boston is in two suits brought by the Bell Telephone Company against independent manufacturers of telephones upon a patent granted to Emile Berliner Nov. 17, 1891. The patent covers in the broadest terms what is known as the microphone, a form of telephone transmitter in universal use. It differs from the form of the transmitter invented by Bell and described in his patent of 1876, and in an improved form in his patent of 1877. The microphone was introduced into use as the invention of Thomas A. Edison in 1878. During that year an interference in the patent office, to which there were a great number of parties, disclosed the fact that Emile Berliner had in the office an application filed in June, 1877, in which could be perceived by the Bell Company's experts some suggestions which by suitable alteration and expansion could be made to cover the idea of the microphone. The Bell Company bought the application, changed it so as to make it describe the microphone, then kept it in the patent office until 1891, when it took out the present patent. I am advised by my associates that the opinion of the Court sustains the first, second, third, fourth and fifth defenses completely. Such a decision destroys the patent, root and branch."

Mr. C. A. Brown, the well-known patent lawyer of Chicago, formerly in the Western Electric Company, in an interview, said: "The decision of Judge Brown, following the decision of Judge Carpenter of the Circuit Court, will have the effect of relieving the apprehension of manufacturers and investors who are interested or likely to be interested in independent telephone enterprises on the score of any fundamental patent controlled by the American Bell Telephone Company at the present time, and will give a decided impetus to new telephone enterprises, so that it may be looked upon with certainty that there will be more development of the telephone industry in the immediate future than there has been even in the past."

Mr. J. A. Haines, president of the Haines & Noyes Company, of Chicago, writes us: "We might say that we believe that independent telephone manufacturers in the past have succeeded in inventing and manufacturing transmitters which were just as satisfactory as the Berliner transmitter, and did not encroach upon that patent. As the independent telephone field is growing rapidly, we see no reason why the fact that the Berliner patent has been declared invalid will in any way increase the telephone business. It is true that some manufacturers may make radical changes in their transmitters, but others, like ourselves, who manufacture transmitters without the use of felt or other moisture-absorbing material, will still continue making the same without regard to the invalid patents. The independent telephone manufacturers have succeeded in putting on the market apparatus equally as efficient as the Bell, and in many cases superior to it."

The Phœnix Electric Telephone Company, of New York City, say through President G. W. Sutton: "We believe the principal effect to be looked for from this decision is that the investing public and bankers generally will look with more favor upon the securities of independent telephone companies. Those conversant with the facts of the case have not lost much sleep on account of the Berliner patent, but investors generally are over-averse to putting money into a possible lawsuit, which has, to a considerable extent, hampered the independent company in receiving money to fight the monopoly. It is our opinion that prices to be derived from well-equipped independent telephone exchanges will now attract the investing public, and that honest enterprises of this character will no longer have difficulties in floating their securities."

Relative Efficiency of the Steam and Gas Engine.

In a paper read at the February meeting of the American Institute of Electrical Engineers, Mr. W. J. Hammer quoted the following from a letter written by Prof. R. H. Thurston in reply to a request for an opinion as to the relative efficiency of steam and gas engines:

The best work, to date, is practically the same for both engines. Each has delivered the net horse-power with a consumption equivalent to about 1 lb. of good coal. The consumption of such fuel for efficiency unity would be about one-fifth of a pound per horse-power, and these engines have thus both attained an efficiency, between the coal pile and the point of delivery, of about 20 per cent.

The steam engine has attained so nearly its limit that further progress under commercial conditions would seem to be likely to be hereafter very slow and to be dependent mainly upon the possibility of increasing the thermodynamic efficiency by extending the thermodynamic range of working temperatures. In the steam engine, this range may be increased either by still further increasing the working pressure at the boiler or by superheating the steam or by both expedients combined. Higher pressures are coming to be available, with progress in the construction of high pressure, presumably water-tube boilers, and we have, in Sibley College work, employed over a thousand pounds without special difficulty, and I have no doubt that we can quite as well, as did Perkins two generations ago, use pressures of 2000 lbs. and probably more. We are now beginning to find practical methods of construction and use of superheaters for ordinary pressures, and I have little doubt that we will be able to superheat steam of those higher pressures in course of time. These improvements should permit the increase of efficiencies by something like 50 per cent and bring the consumption of fuel down to three-fourths of a pound of good fuel per horse-power hour, and perhaps within the next generation, if not within 10 years.

I am not prepared to say what should be hoped for with the gas engine; but the indications at the moment would seem to be that, as we have a very much larger opportunity to reduce wastes that now characterize the gas engine than to extinguish those affecting the steam engine, more should be expected from the coming years with the former than with the latter. The gas engine has only now come to be a formidable rival of the steam engine and is gaining upon it rapidly. The deduction seems fair, therefore, that the next few years should see the gas engine so much improved as to permit it, for many places and purposes, to become a successful rival. In some directions, as at sea; in the locomotive, and perhaps in some other departments, it is possible that steam may continue to hold its place unchallenged, but this is by no means certain.

It is unquestionably the fact that to-day the gas engine is steadily overhauling the steam engine and as steadily displacing it in many directions. I think it extremely possible that it may ultimately displace it very largely, but I think that the steam engine is likely to hold a place among economically available prime movers for a long time to come, and no one can say what may be anticipated to follow its further improvement by effectively combining a maximum range of pressure and a maximum range of coincident temperature, the one giving maximum mechanical efficiency and the other maximum thermodynamic, the combination yielding what is the main object of selection in practically all cases—production of power with minimum costs on all accounts, production of power with least reduction of dividend-paying capacity.

A New District Messenger System.

Just what may be disclosed later as to telephone work grafted onto the district messenger system is not now clear, but it is interesting to note that the Postal District Messenger Company, with a capital of $10,000, has filed articles of incorporation in the office of the County Clerk of Hudson County, N. J. The articles provide that the business of the concern may be conducted in every State, Territory and colony of the United States. The company is incorporated to include the business of a common carrier and construct telegraph and telephone lines. The capital stock is fixed at $10,000, and the local agent of the company is Aaron C. Ackerman, of 99 Montgomery Street, Jersey City. The incorporators are W. H. Baker, Charles P. Bruch and John O. Stevens, all of the Postal Telegraph & Cable Company, and well-known telegraph men of long standing.

Mr. Baker is a vice-president and Mr. Stevens secretary of the Postal Telegraph & Cable Company. Mr. George G. Ward, vice-president of the Postal, said that the organization of the new concern was simply a matter of legal expediency, and that it would be to the Postal what the American District Messenger Company is to the Western Union. The work it will do is not just the same as has been done hitherto by the telegraph company itself, and it will make no difference at all in the service.

Illumination at Washington During the Inauguration.

The electric lighting decorative displays at the National Capital for the second inauguration of President McKinley were remarkably fine. From the Peace Monument to the Treasury, and from there on to Seventeenth Street, incandescent lamps by thousands shed their glow over building fronts lining both sides of this historic thoroughfare. Other prominent streets and cross streets along the blocks entering Pennsylvania Avenue were also handsomely illuminated. The variety of the electrical decorations was striking. At one place one would see long streamers of white lights hanging from the top to the bottom of large buildings, at another every door and window was outlined by rows of lamps, and street awnings, with successive arches, studded with lamps strung across them. At other places the entire fronts of buildings were festooned with strings of lamps of various colors, with here and there large five-pointed electric stars, shields and flags. In several instances the current to the lamps in the flags was interrupted to give the effect of waving.

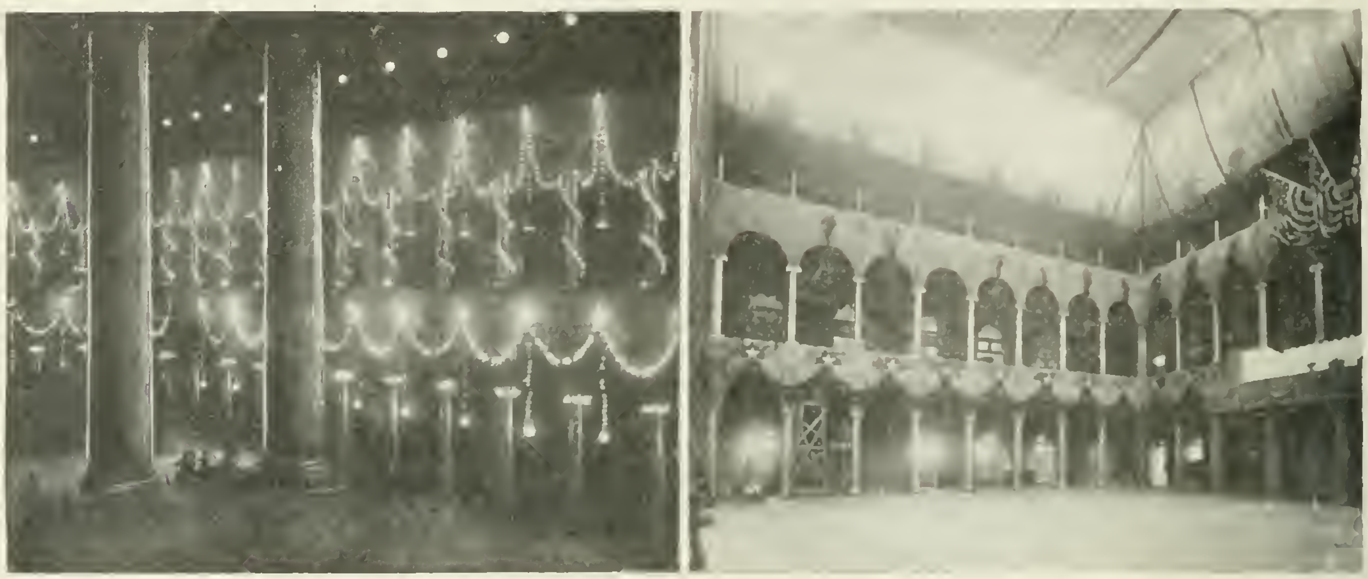


Fig. 1.—Night and Day Views, Decorations, Pension Building.

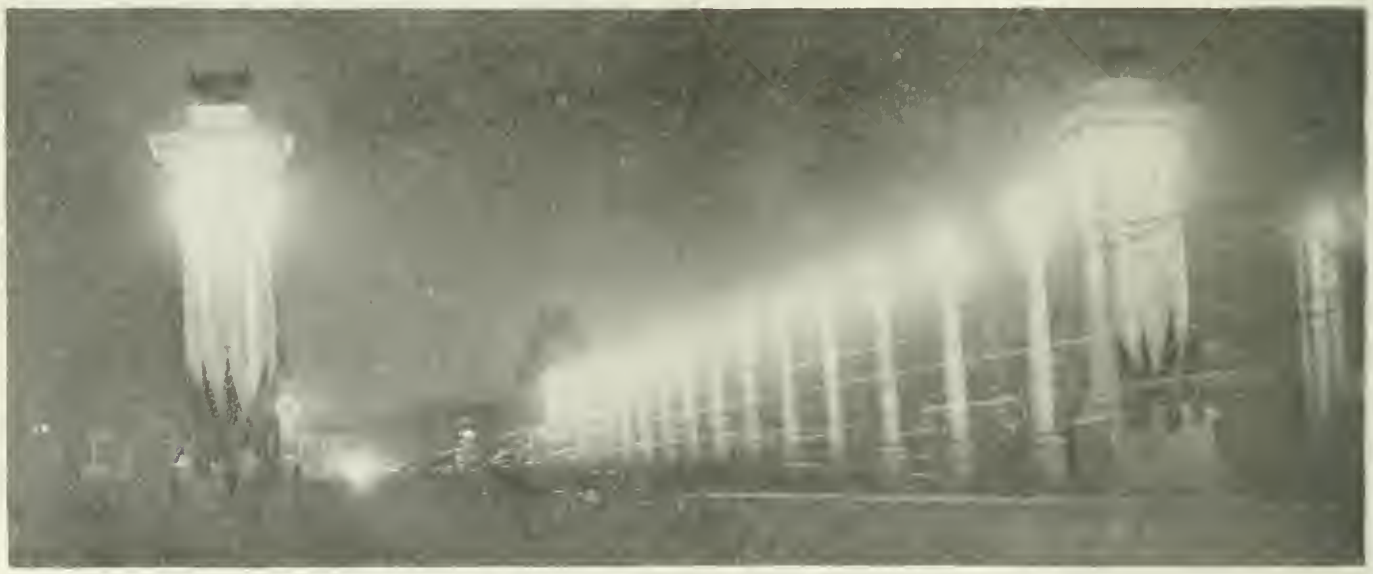


Fig. 2.—Incandescent Lighting Effect, Court of Honor, Washington.

The use of electrically illuminated signs for advertising purposes has been steadily growing in Washington, but at this time new signs in great number seemed to spring up as if by magic, and the lamps in these signs were so numerous at many points that newspaper reading was of easy accomplishment in the centre of the street. Public buildings, office buildings and stores along the avenue operating isolated electric plants were all aglow. It was along this dazzling line of light the multitude slowly threaded its way to the Court of Honor, the name given that portion of the avenue from Fifteenth Street to Seventeenth Street, overlooked by the White House, the Treasury and the State, War and Navy Building.

There were four great white columns on each side of the court, surmounted by bronzed urns. Facing the White House were 14 round white columns, about 30 feet high, each topped by a globe studded with about 60 incandescent lamps, and the top of each column was encircled with lamps. Inside the White House grounds 18 similar columns were placed at equal intervals on each side along the carriage drive. At the ends of the Court of Honor were erected two ornamental roofed stands, finished in white. Under the eaves of these stands were rows of electric lamps. The night view of this court with the lamps aglow and the urns burning colored lights was one of great beauty.

After driving along the magnificent court and avenue taking the oath of the highest office in the world, reviewing thousands of troops and veterans, the President returned to the White House to prepare for the inaugural ball at the United States Pension Building. This building, as is generally known, has been used on several occasions for inaugural balls. About a week before the date of the ball the clerks, with the exception of those in the mailing division, were given official leave of absence, and the building was turned over to a small army of decorators and electricians.

Two No. 8 copper wires carried all the current used for light and power, prior to Feb. 27. Since then cables aggregating 1,500,000 cir. mil., with a capacity of 2500 amperes, were run into the building to a temporary switchboard, and the current distributed through the five main circuits to the lamps. The three-wire system was used, the wooden switchboard, covered with three layers of asbestos paper, had mounted on it a three-pole, single-throw feeder switch, capacity 2500 amperes, two 1500-ampere shunts to two Weston 1500-ampere shunt ammeters, one Weston 150-volt voltmeter, five current meters, four 500-ampere and one 300-ampere single-throw switches. From the switchboard the feeder mains are led to various parts of the building. Some idea of the amount of wiring done can be gathered from the fact that over 10 miles of wire were used.

A few words about the building and its decorations may not be out of place here. The inside dimensions of the ballroom are 316 ft. length by 116 width. Two balconies, supported by 76 gilded columns, overlook the ballroom. The ceiling was made of "old gold" colored bunting, supported on heavy wires, and draped on the sides and ends in graceful curves to hide the top balcony. The walls and balconies, with the exception of the columns, were completely covered with yellow cheesecloth. The short columns of the second balcony were decorated with needle pine, and on top of each was mounted a 32-cp incandescent lamp within a 12-inch ground glass globe. From a central point between these columns two strings of 20 electric lamps were hung and secured in graceful loops to the top of the columns of the balcony. From the same point there hung a string of 25 1-cp lamps, with 3 16-cp lamps in yellow flower-shaped paper shades at the lower end. Twined around each of the columns of the first balcony was a string of 35 lamps. Over the center of each arch of the supporting columns of the first balcony was a silvered five-pointed star filled with 11 lamps. Festooned from star to star was a string of 28 16-cp lamps. Around the top of each column was a circle of 12 lamps. From the center of the lower arches hung a string of 25 1-cp lamps, ending with a 16-cp enclosed in a 12-inch ground glass globe. In the center of this immense hall there was a magnificent floral display arranged in and around the basin of a large fountain. The palms and other foliage plants were lighted by many hundreds of 1-cp lamps. The floral decorators followed the electrical wiremen and skillfully concealed every inch of the wiring with Southern smilax. Six hundred potted pink azaleas in groups of four were suspended above the capitals of the columns. The rooms of the President and the Vice-President were hung with many streamers of lamps, as was also the large banquet hall, built adjourning the Pension Building. The covered passages leading from the streets to the doors of the building were lighted by clusters of electric lamps. On March 3 the current was thrown on for the first time, in an instant transforming the Stygian darkness of the ballroom to the brilliancy of sunlight, flashing into view a scene of dazzling splendor, with "colors blending in one perfect harmony" under the glow of 16,000 lamps.

FIG. 3.—A GLIMPSE OF PENNSYLVANIA AVENUE, INAUGURATION NIGHT.

Without the aid of electricity the Court of Honor would have been cold and commonplace; the ballroom a vast gas-lit cavern. The tremendous task of installing the wiring and electric lights of the ballroom on time was entrusted to the Electric Motor & Equipment Company, of Newark, N. J. The work was done expeditiously by a large force of skilled men under the direct supervision of Mr. George E. Davis.

CURRENT NEWS AND NOTES.

STANDARDIZATION BUREAU.—The bill to establish a National Bureau of Standards passed both Houses of Congress at the last moment—the House on the afternoon of March 2 and the Senate the following evening. Several amendments were made to the original bill reducing items of appropriation, but none of these will materially affect the establishment or work of the bureau.

IOWA TELEPHONE ASSOCIATION.—The fifth annual meeting of the Iowa Telephone Association will be held at Des Moines, Iowa, on March 12 and 13. One of the questions to be discussed at the meeting is the matter of checking reports and making settlements between companies for their inter-line toll business. Another subject for discussion will be farmers' lines, their construction, equipment and rates of charge thereon.

PREPAYMENT WATT-HOUR METERS.—We have received from the Patent Office a belated budget of patents—11 in number—on prepayment electric meters, the date of issue being Jan. 29. All of the patents are assigned to the General Electric Company. Six were issued to Frank P. Cox, two to Eustace Oxley, two to Charles E. Holmes and one to Edmund Allo. The dates of application of the Cox patents are Sept. 13, 1897 (three), April 14, Oct. 8 and Oct. 12, 1898, the titles being prepayment electric meter (three), coin box for prepayment mechanisms (two), and prepayment mechanism. The applications for the Holmes patents were filed March 26, 1898, and Jan. 18, 1900, the titles being respectively, coin-controlled meter and coin-controlled mechanism. The applications for the Oxley patents were filed Oct. 28, 1899, and March 14, 1900, both titles being prepayment meters. The application for the Allo patent was filed April 20, 1898, the title being prepayment meter.

ELECTRIC RAILWAY CONTROLLER.—A patent was granted May 26 to Francis H. Shepard on a motor-grouping switch, and in the specific form of a series-multiple switch, which is operated through instrumentalities controlled by the current or counter e. m. f. conditions, or these combined, of the motors to be grouped. The illustrations accompanying the specifications show the invention applied to the controller of two motors by a master controller operating independent rheostatic and series-multiple switches through relays. With the exception of the series multiple arrangement the system is similar to that described in a patent granted to F. J. Sprague, dated Oct. 16, 1900. The claims are a combination in a system of control of a series-parallel switch, a rheostatic switch, a motor circuit, a governing circuit, means for operating the series-parallel switch controlled by the motor circuit and the governing circuit, means for locking the series-parallel switch controlled by the motor circuit, and means for unlocking the series-parallel switch controlled by the governing circuit. Another claim is the same as the above with "motor-grouping switch" substituted for "series-parallel switch."

THEATER DIMMERS.—Mr. Charles Wirt read a paper Feb. 25 before the Chicago Electrical Association on "Theater Dimmers," in which the subject was developed from its first beginnings in the earliest days of incandescent lighting. The paper states that Chicago is entitled to the credit of having had the first electrically lighted theater in the United States, and most probably in the world the Halsted Street Academy of Music having been equipped electrically in 1882. The first form of fireproof rheostat was designed by Mr. John Van Vleck and Mr. Albert B. Herrick, and comprised a cast pipe frame, cast heads, porcelain insulators and galvanized steel wire coils connected to each other and to the copper division wires by brazing. In the earlier iron-clad rheostats plaster of paris was used as a filler, which later gave way to Portland cement. The latest and best practice for this form of rheostat is to use ground glass sand. The Auditorium Theater of Chicago has a total of 5000 lights; there are 50 32-cp lamps in the footlights and 6 ranges of border lights, numbering from 150 to 165 lights each, 32-cp lamps being used; there are 6 bunch lights and 18 strip lights, for which 32-cp lamps are also used. The footlights are provided in three colors. An efficient theater dimmer is made with 50 or 100 steps, according to size, and the cross-section of the conductor is graduated from the first step to the last in the ratio of 3 to 1. Even this large number of steps and the graduation of the conductor fails to give that smoothness of shading which is so much desired, making it necesary to decrease the resistance of the first steps more than the regular decreases caused by the taper of the conductor.

SPLIT-PHASE PATENT DECISIONS.—In the notices which appeared in recent issues of the decisions in the cases involving the Tesla split-phase patents, it should have been stated that the Westinghouse Electric & Manufacturing Company vs. the Dayton Fan & Motor Company were the parties to the suit.

DEVELOPMENT OF THE NERNST PRINCIPLE.—The article with this title, which appeared in our issue of Feb. 16, should have been accompanied by a foot-note (dropped out by the printer), stating that it was based on a thesis submitted by the author to the faculty of the Worcester Polytechnic Institute, Jan. 1, 1900.

BRITISH CABLE OPERATORS.—A cable dispatch from Halifax, N. S., says: "It is reported from the French island of Miquelon that the French administration has given the English cable operators, whom it has imported to operate the submarine lines ending at Miquelon, their choice of taking the oath of allegiance to France or resigning their jobs. Most of the men have done as was demanded rather than quit." "But their hearts are true to Poll."

LACHINE RAPIDS COMPANY.—The annual report of the Lachine Hydraulic & Land Company, of Montreal, shows a gross revenue for the past year of $269,401. The general operating expenses amounted to $79,607, and for betterment and repairs, $11,604, leaving a profit of $130,977 for the year. Two dividends, equal to 10 per cent for the year, were paid; $10,587 were added to the contingent account, and a balance of $4015 was carried forward to profit and loss. The company has been remarkably successful in the past, but it is likely to yield even better results in the future. It came out during the discussion on the annual report that the machinery now in use was working nearly up to its full load, and that the directors would shortly consider the advisability of installing the rest of the plant for which room had been provided in the power house. The plant now in use constitutes about two-thirds of the capacity of the power house.

THIRD-RAIL ELECTRIC RAILWAY.—Three patents were issued Feb. 26 to George H. Davis on details relating to the third-rail system of electric railway. The object of the patents is to provide an electric railway of the third-rail type possessing the advantage of other systems as far as concerns economy of construction, solidity and durability in operation, and ease of repair, while at the same time concealing the working conductor to practically the same extent as in those systems employing slotted contacts. Further objects are to provide an improved support for the current-collecting shoe which will permit the latter to co-operate with the working conductor with the greatest possible degree of efficiency; and to improve the construction and mounting of the working conductor. A series of brackets parallel to the third rail carries a continuous housing arranged so as to enclose the working conductor, there being an opening or slot in one side for the contact device. In one patent the rail is shown mounted in the usual way for contact on the upper face; in another patent the rail is mounted for side contact, and in the third patent is overhung and contact made with the lower face. The details of the mounting of the contact arm and of the contact shoe are covered by claims.

NEW YORK TO BOSTON.—A very intelligent correspondent writes to the New York *Sun* about the slow, bad train service from this city to Boston, and remarks very forcibly: "The New Haven road may some day find out that it has made a serious mistake in not cultivating the good will of its passengers by faster trains and more commodious equipment. There is every chance that the bill to make a high-speed electric railway between Liverpool and Manchester will be passed at the present session of the British Parliament. This is no mere promoter's scheme on paper, but a thoroughly well-designed plan for which the capital has been subscribed to run trains between Liverpool and Manchester, 35 miles in 20 minutes, or at the rate of 105 miles per hour. If the Liverpool and Manchester electric line proves a success from a financial point of view—its engineering difficulties are already considered solved by Sir William Preece and other eminent electricians—no two cities in this country would offer the same temptation for a similar line as New York and Boston. With a line 200 miles across country, five trains a day each way doing the journey in two hours, an average of 100 passengers to each train, and service 300 days a year, such a line might demand $10 for passage one way. This would give an annual revenue of $3,000,000. With operating expenses at 50 per cent of the gross receipts, there would remain $1,500,000 for interest and dividends, $1,000,000 of which would pay 4 per cent interest on $25,000,000 bonds, or enough to allow $125,000 a mile for construction and equipment. This is about the amount that the far dearer Liverpool and Manchester road is to cost. Before a serious proposition to build a road of this sort, the New Haven's opposition would be paralyzed. The lesson of which is that even a great railroad corporation with apparently all the avenues of transportation between two large cities in its grasp may repeat the saying attributed to the late W. H. Vanderbilt once too often."

STREET LIGHTING IN CITIES.—Mr. H. H. Humphrey, in a paper with this title read before the November meeting of the Engineers' Club of St. Louis, described the plant of the Imperial Electric Light, Heat & Power Company, which plant also furnished the subject of a paper read by Mr. George A. Damon in 1898 before the American Institute of Electrical Engineers. Several paragraphs of the paper give an account of trouble with the underground distribution from static discharges. It was believed that drawing both cables through a single iron duct leading to the base of the iron arc lamp poles used, would provide a sufficient connection between the two so that the lead sheaths would be practically connected together throughout the entire circuit. At the plant all of the six cables of the three circuits installed were also drawn into a single duct of the conduit with the same object in view. It was ascertained, however, soon after starting the plant, that these contacts were not sufficient. A static effect from the cables manifested itself in the short-circuiting of arc lamps through the insulation at the top of the enclosing globe where the full difference of the potential of the lamp is maintained. The lead sheaths of all the cables were then securely soldered together in the manholes where they enter the duct which goes to the lamp poles, and they are also connected together at the station just behind the switchboard. This, however, had little if any beneficial effect upon the portion of the circuit. A special static discharger was then installed, consisting of an ordinary Leyden jar condenser connected to the copper of each circuit at the rear of the station switchboard. Each condenser is provided with a revolving contact arm driven by a small motor, which alternately connects the condenser to positive wire, to ground, to negative wire and to ground, thus receiving a charge from the line and discharging it to ground about 30 times per minute. After this apparatus was installed the static effect of the cables was unappreciable in the operation of the plant. A test of the motor-driven arc-lighting units of the Imperial plant showed that the average efficiency of a unit was 80.5 per cent, reaching in one case as high as 82.5 per cent and another 82.4 per cent; the guaranteed efficiency was 78.25 per cent. At present the Imperial station has a maximum load of about 13,000 amperes, and an average load of 6345 amperes. During the past year the load factor of the plant has increased from 39.27 to 47.7 per cent. A switch is described whereby a number of incandescent street lighting circuits are switched in and out by means of current from the arc-lighting circuits. When the arc current is turned on it operates a solenoid which closes a switch controlling the incandescent street-lighting circuits. In the morning, when the arc circuit is shut down, the plunger of the solenoid is released, thereby opening a switch and cutting the incandescent lights out of circuit.

LETTER TO THE EDITORS.

Profitable Use of Inventors' Profits.

To the Editors of Electrical World and Engineer:

Sirs:—In the valuable issue of March 2, 1901, you quote from the *Iron Age* to the effect that pecuniary success would probably more often spoil than benefit an inventor. Some people will believe phrenological or clairvoyant statements of this kind, and therefore I would like to call to mind, by way of refutation, the well-known fact that as soon as an inventor profits financially, he uses his time and money for experimenting and making other inventions, or continues to be useful in some direction. The list of examples would take too much of your precious space. The Edison laboratory is a gigantic illustration. Permit me to start the names with the list of the 25 greatest scientists in your first issue of 1901. Practically all great scientists are discoverers and inventors. Were the following men spoiled by success? Edison, Bell, Westinghouse, Thomson, Brush, Sprague, Weston, Howe, Gatling, Mergenthaler—but the reader can go on with the list, as these are taken at random from memory, as a start.

Some ill-informed writers are continually harping upon the crank or unsuccessful inventor, but never before have I known of any one who considered it commendable that an inventor should remain as poor as he started. The would-be inventors, amateurs and cranks are not true inventors, and a person is not properly an inventor until his invention is in public use. Then the more money he makes the more inventions he will make, or try to make, and therefore, the more will the public be benefited. The amateur should be encouraged, for he is an embryo of a famous and wealthy man. In addition to the long array of inventors of world-wide reputation, there are hosts of minor lights in all the factories in the world—not, perhaps, wealthy—but receiving handsome royalties, dividends from stock or salaries.

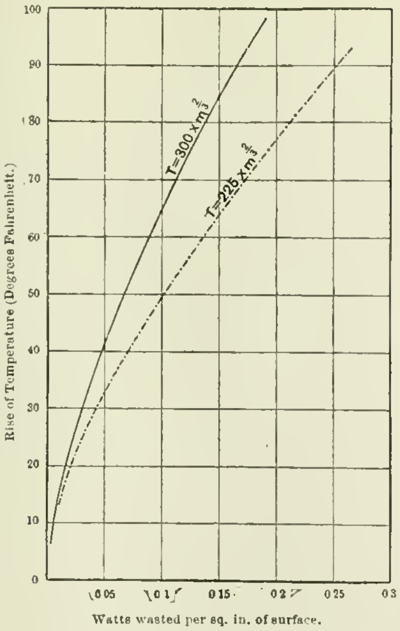
Edward P. Thompson.

New York City.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

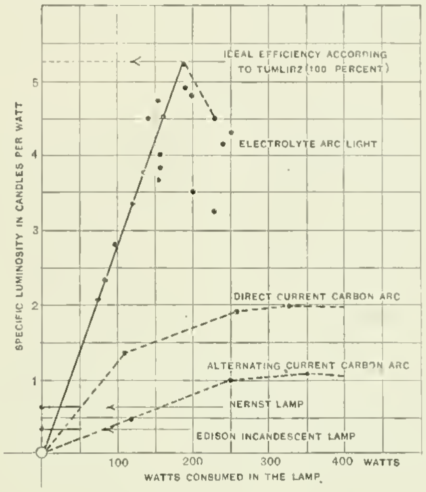
Transformers.—Woodhouse.—The first part of a paper on "The design of transformers." After some general remarks on transformer design and a brief summary of the relative advantages of core transformers and shell transformers, he gives examples of suitable dimensions for both types. With the aid of diagrams he explains the terms no-load current, magnetizing current and hysteresis current, and shows how to calculate the same, and also the efficiency. He then discusses the temperature rise of a transformer. Heating depends upon the watts wasted per square inch of radiating surface, and upon the conditions of cooling, whether the transformer is cored or not, whether oil or air cooling is used, etc. If two similar transformers are considered in which the linear dimensions of the one are n times that of the other, then if the value of the maximum flux density in lines per square inch be kept the same and the same proportion of space be occupied by the winding, in each case, the cooling surface will only increase as $n^2 : 1$, while the output increases as $n^3 : 1$; great care must therefore be taken in large transformers to keep the temperature rise small. Oil cooling is much to be recommended as it tends to equalize the temperature of the whole transformer. The following rules are said to hold good where the value m of the total watts wasted in a transformer per square inch of cooling surface is not greater than 0.4: for an air-cooled transformer with natural draft the final rise of temperature in degrees Fahrenheit is $300 \times m^{2/3}$, while for an oil-cooled transformer the same rise is $225 \times m^{2/3}$. Curves corresponding to these rules are given in the adjoining diagram.—Lond. *Elec.*, Feb. 15.



TRANSFORMER CURVES.

LIGHTS AND LIGHTING.

New Electric Arc Light.—Rasch.—An illustrated article in which he gives the principles of a new electric arc light, which, in its production and action, is somewhat similar to the Nernst light, as the electrodes of the arc are made of very refractory solid electrolytes, as magnesia, oxide of thorium, oxide of zirconium, oxide of calcium, etc. In order to obtain an arc between such electrodes, the same must be heated before, just like the incandescent rod of the Nernst lamp. He claims that the technical difficulties are here much smaller than in the Nernst lamp. The energy density at the ends of the electrodes is very great, 30 to 40 watts per square millimeter or more; the temperature is therefore also very high. The arc between magnesia electrodes or between electrodes of oxide of zirconium is white like sunlight. The light is produced not only at the ends of the electrodes, but the gases also participate in the light production. By a special choice of suitable material for electrodes a light may be produced, the color of which suits special purposes; for instance, electrodes made of magnesia, calcium fluoride, oxide of chromium, and oxide of nickel, give a yellow light. Electrodes of 0.1 or of 0.2-inch diameter yielding 600 to 1000 candles, give 3 to 4 candles per watt; or consume only 0.25 to 0.3 watt per candle. When the length of the arc is kept constant, the ratio giving candles per watt increases with increasing watts. In his experiments the candles were found to be proportional to the square of the watts to a certain extent. He calls attention to the fact that the specific luminosity in candles per watt, with constant arc length, increases up to 5.21 candles per watt, and then decreases. This maximum was obtained in his experiments at 200 volts. The electrodes then became liquid. This is of theoretical interest because Tumlitz in his investigation of the mechanical equivalent of light has shown that an ideal efficiency of 100 per cent corresponds to 0.192-watt per candle, or 5.21 candles per watt. For practical purposes he recommends burning the arc with 3 to 4 candles per watt. He claims that this new arc light is considerably cheaper than the Welsbach incandescent gas light. In the adjoining diagram a comparison of the specific luminosity in candles per watt is given for different electric lamps. The ordinates give the watts consumed in the lamp. It is evident that the electrolyte arc light is by far the most economical.—*Elek. Zeit.*, Feb. 4.



NEW ARC LIGHT.

Arc Lighting from Constant-Pressure Mains.—Adams.—An article on "The economic radius of arc-lamp service from constant-pressure dynamos." He remarks that great extensions in the service of arc lamps directly from constant pressure supply mains is constantly going on under two distinct conditions: First, the supply of arc lamps in multiple from the same mains that deliver energy to incandescent lamps; second, the case in which series of two or more arcs are operated at constant pressure, because all of the lamps in each series are wanted when any are necessary, as in some large buildings and in street lighting. The greatest impediment to this development is the cost of copper of the line. As incandescent lamps are operated at 110 or 220 volts, series arc lines at 2000 to 3000 volts, it is obvious that the economic radius of distribution for arc lamps at those low voltages must be much less than that with ordinary arc dynamos. He gives several numerical examples and finds that more than one or two arc lamps may often be supplied by an extension of a constant-current circuit to distances of one-half mile or one mile from given points on it. Unless more than 8 arcs can be connected over the distance of one mile, or more than 4 arcs cover the distance of one-half mile, from any point, where constant current and constant pressure circuits coincide, the constant-current circuit offers no saving of copper for the line efficiency. Where the mains and feeders of three-wire systems at 220 to 250 volts are extended to distances of as much as one mile from the central station, branches for those three-wire mains may be economically extended in any direction to a distance of one mile for arc lamps, so that if the station is in the center of the district served, arc lamps may be supplied over an area four miles square where 220 or 250-volt incandescent lamps are distributed on the two wire-system, the advantages for arc-lamp distribution remain the same as for the three-wire system using 110-volt lamps.—*Elec. Rev.*, Feb. 23.

Power

Cost of Power.—Brown.—A paper read before the Eng'ing Ass'n of the South at Nashville, Tenn. From reports of a number of large power stations, between 4000 and 600-hp capacity, he gives the cost of one indicated horse-power per year as follows: On the average, it is $41.21, while in the most expensive and in the most economical plant, it is $71.10 and $30.96, respectively. For a small plant of, say, 10-hp capacity, he gives the total cost of one indicated horse-power per year at $54.48 for good practice, $68.94 for average practice, and $84.15 for poor practice; also the cost of one effective horse-power year in these three cases at $72.64, $106.06 and $210.40, respectively, under the assumption of 75, 69 and 40 per cent mechanical efficiency, respectively. Data are also given on the working of locomotives and of gas engines.—*West. Elec.*, Feb. 23.

Gas Power for Central Stations.—A communication, by Humphrey, in which he says that while the cost of generation and transmission must be considered together, there is no apparent and obvious reason why a cheap gas, like the Mond gas, with the more expensive transmission should not be much better in the end than more expensive rich gas. On the other hand, the editors express in a note, the opinion, that a richer gas, even though costing more to manufacture, is better for long-distance transmission. Producer gas consists largely of nitrogen, and, to some extent, of other inert gases, and although it can be produced very cheaply, yet it does not pay to pipe-line it over long distances, because of the much greater capital outlay on larger pipes and gas holders, and because of the extra cost of forcing large volumes of useless gas through the mains.—Lond. *Elec.*, Feb. 15.

Electric-Driving of Hoists.—An anonymous article giving some practical notes on the driving of hoists by electric motors. He has made experiments with direct-coupled electric hoists with the motor coupled onto a worm shaft, and arranged to rotate in either direction, controlled by means of a resistance and reversing switch. With this type of hoist driving, he found the greatest trouble when the hoist was traveling repeatedly from one floor to the next only, the motor requiring much more attention and the starting switch constant renewal of contacts, thus the labor item became prohibitive. He recommends working an ordinary type of mechanically-driven hoist, suitably loaded, by means of an electric motor. Such a hoist, which has given great satisfaction, is illustrated. There are precautionary measures for the prevention of accidents. The reversal of the hoist by the counterweight is prevented by the use of a finely pitched worm and worm wheel, thus ensuring safety in case of failure of the belts. Automatic stopping and lock motion for each floor; self-opening and closing doors. In a table he gives the power absorbed in driving motor and working hoist with different loads.—Lond. *Elec. Rev.*, Feb. 15.

Traction.

Electric Tramway Statistics of Germany.—The very full annual statistical tables, filling 16 full pages, and giving a large amount of information on the electric tramways and railways in Germany on Sept. 1, 1900. As a special accomplishment of the last year, the introduction of electric traction on the Wannsee R'y between Berlin and Fehlendorf is mentioned. Although this is only a small trial on a main line of 7 miles, the success of this experiment is said to have been so great that electric traction will come into more extended use in the near future on short sections of main lines with a great passenger traffic. The Berlin-Fossen Railway, which has a length of 18 miles and probably will be opened this summer, will also be used for important experiments with electric high-speed service on main lines. The number of centers of electric tramway systems was 42 in 1896, 68 in 1898, 99 in 1900. The length of lines 350, 858, 1731 miles, respectively. The length of track 512, 1163, 2553 miles. The number of motor cars 1571, 3190, 5991. The number of trailers 989, 2128, 3962. The capacity of the electric machinery 18,560, 33,333, 75,608 kw. The capacity of storage batteries in tramway stations 0, 5,118, 16,890 kw. The trolley system is used almost entirely. Besides this, in some cities a mixed trolley and accumulator system is used, the accumulators on the cars being charged on those parts of the roads where the trolley is used. This system has not been successful in Berlin, and will be replaced by the trolley system, with the exception of some brief sections where a conduit system will be used. The conduit system is in use at present only on three short roads in Berlin, Dresden and Dusseldorf, of together two miles in length. The pure accumulator system is also used only in three cases. This system is, however, in use on two lines of 30 and 36 miles length of main railways in Bavaria for special trains. A new system in Germany is the third rail, used on the Wannsee R'y.—*Elek. Zeit.*, Feb. 7.

Conduit System in London.—An article giving some information on the conduit system it is proposed for use on three routes of the London County Council tramways. An illustration gives a general view of the conduit. The slot rails are of steel, the slot being ¾-inch wide. The conductors carrying the electric current will be soft-steels tees, carried within a concrete conduit. Some particulars are given concerning the mechanical construction of the conduit. The conductor tees will be divided by section insulators into sections not exceeding half a mile in length. Each section of the conductor tees will consist of a positive and negative length in each conduit. Normally, each of the two conduits will be electrically separate from the other, and will be supplied from feeders having a branch for each section. Automatic cutouts and cross-over switches will be provided for each section, and are so arranged that in the event of a fault occurring and persisting on the positive of any section the polarity of the two conductors in that section can be reversed so as to throw the fault on the negative where it can remain until the stoppage of traffic at night allows it to be located and rectified. The voltage will be 500.—Lond. *Elec. Eng.*, Feb. 15.

Central London Railway.—An editorial in which the accounts for the first five months of working of the "Two-penny Tube" (underground electric railway), are analyzed. There is a uniform charge of 4 cents for any distance traveled. The total capital created includes $14,250,000 in shares and $4,380,000 loan, or a total of $18,630,000. Of this, $17,560,060 have been expended on works and rolling stock. During the first five months 14,916,932 passengers were carried, about 3,000,000 per month. The actual service train-mileage was 486,004. The revenue derived was nearly $600,000, and the workin expenses $352,000, so that the ratio of expenditure to revenue was nearly 59 per cent. A considerable reduction of this ratio is expected in future. A dividend is recommended on the share capital at the rate of 2½ per cent per year. This financial result is regarded as a satisfactory one, but far better results are expected in the near future.—Lond. *Elec.*, Feb. 15.

Guard Wires.—An illustrated article referring to the serious accident which recently occurred in Liverpool, when telephone wires came into contact with the trolley wire. Guard wires are not used at Liverpool, the guard in use being what is known as the wooden strip guard. This is illustrated. It is pointed out that the use of the wooden strip must be discontinued in favor of guard wires. A good system of guard wires is described and illustrated. There is also required a device for arresting the passage of any high-voltage current that may enter a telegraph wire. This is accomplished by a fine platinum fuse, fixed generally on each side of the point at which the telegraph and trolley lines cross each other.—Lond. *Elec. Rev.*, Feb. 15.

High-Speed Electric Railway.—A note on plans of the German company which has been formed for the purpose of studying the problem of high-speed electric railways, the leading electrical firms and industrial banks of Germany participating in this investigation.

as noticed before in the Digest. No actual experimental line has yet been constructed, but it is proposed to build, as a trial a military line intended for a speed of from 125 miles to 150 miles per hour from Berlin to Fossen.—Lond. *Elec.*, Feb. 15.

Electric Traction on Main Lines.—Wiechel.—An article referring to a remark in the recent paper of Langdon. He shows that it is of commercial value also for merchandise traffic to let shorter trains be runs at more frequent intervals.—*Elek. Zeit.*, Jan. 31.

Automobile.—An illustrated description of the Holson automobile, which consists of a seat and carriage frame suspended between two very large wheels, each containing a motor in its hub. The motor is placed cross-wise of the axle, with a pinion on each end of the motor shaft. The pinions operate on oposite sides of a two-faced bevel annular gear. The motor is entirely encased. The motors are multipolar and series wound, each giving 1 hp. He claims a large advantage of having two 1-inch pinions on the same shaft, gearing into a 12-inch gear wheel. With a 1-hp motor each pinion will deliver ½ hp to the wheel. With each revolution of the wheel each pinion will revolve 12 times on its own axis, while a single 2-inch pinion that would be necessary with a 1-hp motor and a third gear to give the same power would only revolve 6 times on its axis. The diameter of the entire hub casing is 13 inches, while that of the wheels is 6 ft. 3 in. The storage battery weighs 1200 lbs., and being suspended below the axle and at the lowest part of the frame, serves to keep the seat right side up. It consists of 40 cells and has a capacity of 30 amperes at a three-hour discharge rate.—*West. Elec.*, Feb. 23.

REFERENCES.

Polyphase Railways.—Perkins.—The first article of an illustrated serial on polyphase electric railways in Europe. He deals with the road from Zermatt up to the Gornergrat.—*El'ty*, Feb. 20.

Electric Locomotives.—An illustrated description of modern electric locomotives of foreign and American make.—*Elec. Rev.*, Feb. 23.

Installations, Systems and Appliances.

Fulham.—A long, well illustrated description of this new British municipal lighting plant in combination with a refuse destructor. The destructor house contains 12 destructor cells, capable of destroying efficiently 120 tons of refuse in 24 hours. The destructor gases alone will be able to furnish sufficient steam to maintain the boiler pressure at 160 lbs. per square inch up to a certain load, but it is not anticipated that they will suffice at large loads. There will be considerable consumption of coal in the boiler furnaces, and a coal-handling plant is being put down. It is estimated that the amount of refuse passed through the destructor per year will be approximately 40,000 tons, and its calorific value is placed at one-twentieth that of good steam coal. It is, therefore, expected to save the cost of 2000 tons of coal per year. There are three steam-driven two-phase alternators of the flywheel type, each giving a normal output of 300 kw, each of the two sets of coils being capable of giving 150 kw at all e. m. f.'s from 2800 to 3000 volts at the terminals of the machines. There are also three 60-kw direct-current dynamos for exciting and light and power supply in and about the works. Three Ferranti rectifiers are used for supplying the public lighting circuits. The two-phase 3000-volt current is led by means of pairs of concentric lead-covered cables to five sub-stations, each containing two 50-kw transformers, one for each phase, for transforming each phase down to 200 volts and distributing at that pressure to the consumers. In the low-pressure cables the phases are also kept apart, and one is used on each side of the street. If a motor is required, a service line is run across the street and both phases are brought in. The charge for lighting is 10 cents per unit, and for motive power 5 cents during the hours of daylight.—Lond. *Elec. Elec. Rev.*, Feb. 15.

REFERENCES.

Austria.—Perkins.—An illustrated article on alternating-current development in Austria. Some information is given on the single-phase and two-phase systems of Vienna, the three-phase system of Trieste, and the Bozen-Meran high-tension, polyphase power transmission.—*West. Elec.*, Feb. 23.

Charging for Energy.—Wilkens.—An article illustrated by diagrams, in which he develops the principles of the maximum demand system of charging, and gives some numerical examples from German practice.—*Elek. Zeit.*, Feb. 7.

Wires, Wiring and Conduits.

Fire Due to Short Circuits.—Schinke.—A communication on experiments made during several years on a tramway line with insufficient rolling stock, where there were often accidents. He claims that scarcely a fire was due to a short circuit. Fires which occurred could be proven to be due to other causes. A continuous passage of a small current is more dangerous than a sudden direct short circuit. —*Elek. Zeit.*, Feb. 7.

Electro-Physics and Magnetism.

Anti-Coherers.—Marx.—An illustrated account of an investigation of the action of Schaefer's "anti-coherer," which consists in dry slits scratched in a silver film deposited on glass and covered by a thin layer of celluloid. When electric waves fall upon such a device the resistance falls at once, while in Branly's coherer the resistance increases. For this reason Schaefer's plate is called an anti-coherer. When the electric waves stop the anti-coherer at once assumes the original resistance again. He has examined the conditions which govern the sensitiveness of Schaefer's plate. He finds that the celluloid film does not penetrate into the interior of the gap, being unable to overcome the capillary repulsion. The chief effect of the celluloid is to prevent the dissipation of the minute particles of silver which partly fill up the gap, and whose motion under the influence of electric waves is probably one of the causes of the temporary increase of resistance, although it does not fully account for it. These anti-coherers are just as sensitive as Branly's coherers, but require no tapping, and are much freer from accidental disturbances.—*Phys. Zeit.*, Jan. 26; abstracted in Lond. *Elec.*, Feb. 15.

The Electric Analogue to the Zeeman Effect.—Voigt.—A theoretical investigation of the electric analogue to the inverse Zeemah effect. The effect to be expected would be the following: "A body with fine and sufficiently separated absorption lines, shows for ordinary light traversing it parallel to the electric lines of force (without double refraction), a displacement of these lines without separation, while for light traversing it normally to the lines of force (with double refraction), it shows a displacement with accompanying separation." He arrived at an estimate of the magnitude of the phenomenon looked for. The effect would be very minute, as even in the case of the greatest known electric double refraction, with a potential gradient of 300 volts per centimeter, which is not easy to produce in a vapor, the effect to be observed would not exceed the 20,000th part of the distance between the two *D* lines.—*Ann. der Physik.*, No. 1; abstracted in Lond. *Elec.*, Feb. 15.

Velocity of Ions Drawn from a Flame.—Child.—An account of an experimental investigation, with a method for determining the velocity of ions in a gas, suggested by J. J. Thomson. He found that the velocity of the positive ions drawn from a Bunsen burner is approximately 2.2 cm per second for a potential gradient of one volt per cm., and that for negative ions 2.6 cm. In the case of an unlimited supply of ions, if the discharge takes place between two regular surfaces, the velocity may be determined by simply measuring the current per unit area and the difference of potential between these surfaces, and if the surfaces are not at all regular the relative velocities of the positive and negative ions may be determined by comparing the positive and negative currents. He promises an account of an application of this method to the comparison of the velocities of the positive and negative ions drawn out from an electric arc.—*Phys. Rev.*, Feb.

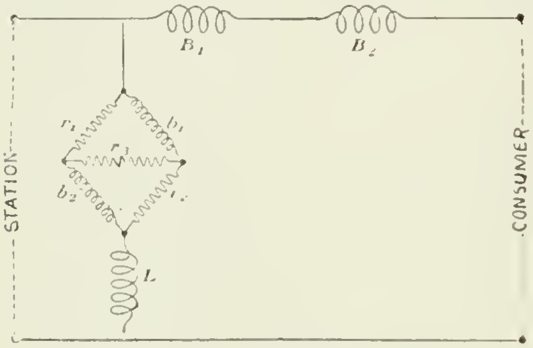
Conductivity of Positive Light.—Stark.—An account of measurements of the conductivity of unstratified positive light columns of considerable length. As in that portion of the discharge the transverse conductivity and the gradient are constant for relatively large distances, the gas can be assumed to be there in a uniform condition and to possess no internal e. m. f.'s. The conductivity depends upon the current density. For great densities the conductivity increases more rapidly than the current density.—*Ann. der Physik.*, No. 1; abstracted in Lond. *Elec.*, Feb. 15.

Induction-Coil Phenomenon.—Johnson.—An account of an investigation of the phenomenon that when a voltmeter is inserted in the secondary circuit of an induction coil, hydrogen and oxygen gases are developed at both electrodes. He found that the electrolytic decomposition of the water is due only to the oscillations of the opening current, and that no visible electrolysis is produced by the closing current.—*Ann. der Physik*, 1900, v. 3, p. 744; abstracted in *Elek. Zeit.*, Jan. 31.

Remanent Magnetism.—Holitscher.—An abstract of a paper giving an account of an experimental investigation of the remanent magnetism of iron. Among other things he studied the influence of the duration of magnetization upon the remanent magnetic momentum. With increasing duration of magnetization the remanent momentum increases first, but after a certain value, "the duration of saturation," the momentum remains constant. This duration of saturation increases with the magnetizing force. Remanent magnetism is found also with exceedingly small magnetization.—*Elek. Zeit.*, Jan. 31.

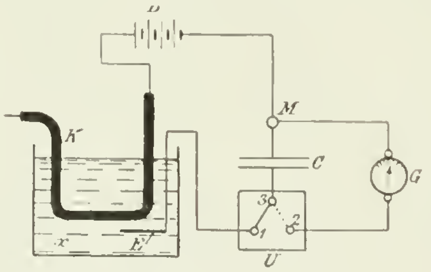
UNITS, MEASUREMENTS AND INSTRUMENTS.

Adjustment of Induction Meters.—A short illustrated note showing the method used by Siemens & Halske to overcome a certain difficulty in the adjustment of alternating-current induction meters. Such meters, in which a revolving field is produced, are subject to two adjustments. The first, that of the shunt winding, is for producing a field which is exactly in quadrature with the difference of potential; the second adjustment modifies the intensity of the field so as to enable the reading to be made directly, thus avoiding the use of a coefficient. Each one of these adjustments generally affects the other, so that the ultimate results often require numerous trials before both are correct. To avoid this, the apparatus is connected as shown in the adjoining figure, in which B_1 and B_2 represent the chief coils, b_1 and b_2 the shunt coils, which produce the field in quadrature. The adjustment of the phase shifting is effected by varying the known inductive resistance, r_3, and the adjustment of the intensity of the field is effected by simultaneously varying the two resistances, r_1 and r_2. Those five resistances thus form a Wheatstone bridge connected in shunt with the lamps, and in series with a high self-induction coil, L.—*L'Ind. Elec.*, Jan. 25.



ADJUSTMENT OF INDUCTION METERS.

Measuring Insulation Resistance.—RABINOWICZ.—An illustrated description of a simple method of testing the insulation resistance of conductors. It is illustrated in the adjoining figure where G is a galvanometer, U a switch for connecting 3 either with 1 or 2, x an insulated basin of water, K the cable to be tested, E a copper plate placed in the water, B a battery of 20 volts, C a condenser of about 1 microfarad. The electricity passing through the insulation of the cable is used to charge the condenser, C, while 3 is connected with 1 in the switch, U; after a certain time this connection is broken and 3 is connected with 2, so that the condenser is discharged through the galvanometer. To compare the insulation resistance of different cables, the condenser is charged for the same time and the deviations of the galvanometer in the different cases are compared. That cable for which, with equal time of charging the deviation of the galvanometer is the smallest, is the best. He has found that in general impregnated paper insulation is to be preferred to insulation with impregnated cotton.—*Elek. Zeit*, Jan. 31.



MEASURING INSULATION RESISTANCE.

Mixed Currents.—An anonymous article on the "Sifting of mixed currents," i. e., currents obtained by the superposition of an alternating current upon a direct current in the same conductor. An instrument for direct current only, such as a galvanometer of the coil and magnet type, of which either the coil or the magnet is movable, measures the direct current only; for measuring the alternating part, a dynamometer is required. He gives the formulas, relating to such measurements. A very convenient form of voltmeter applicable in cases of mixed currents, consists of a galvanometer of coil and magnet type, and a hot-wire instrument connected in series. The hot-wire instrument gives the square of the direct-current voltage plus half the square of the alternating-current voltage. The galvanometer gives the direct-current voltage alone. He makes an application to an experiment of Duddell, in which an oscillation is produced in an otherwise direct current by means of a condenser and an arc light.—Lond. *Elec.*, Feb. 15.

Bolometer.—KURLBAUM.—A description of a remarkable improvement of the sensitiveness of the bolometer. This is accomplished by placing it in a vacuum. In this way the rise of temperature due to absorption of heat, and hence also the efficiency is considerably increased. Moreover, the air currents produced by the heated bolometer, which produce the well-known disturbances of the galvanometer needle, are also done away with. The vacuum bolometer is peculiarly fitted for the measurement of Röntgen ray intensities, since polished platinum is used for that purpose and the loss by radiation is then very small. The sensitiveness of the bolometer can be thus increased 40 or 50 times.—*Phys. Zeit.*, Jan. 26; abstracted in Lond. *Elec.*, Feb. 15.

REFERENCES.

Measurements in Alternating-Current Circuits.—A communication by Sumpner pointing out some inherent sources of error in Campbell's "Phase-turning device," which was mentioned before in the Digest. Also a reply by Campbell to Duddell's criticisms. He also describes a modification of the three-voltmeter method which might be used with advantage when the power factor is low.—Lond. *Elec.*, Feb. 15.

Recording Alternating Current Waves.—LAWS.—An illustrated description of an apparatus for recording alternating-current waves. It is a modification of the "Contact method," by which the record is rendered continuous and traced photographically.—*West. Elec.*, Feb. 23.

Testing Alternating Current Meters.—ORLICH.—An illustrated article on the methods and apparatus used in the German Reichsanstalt for testing alternating-current meters. The tests of motor meters, pendulum meters and three phase meters are separately discussed.—*Elek. Zeit.*, Jan. 31.

Magnetic Tests of Iron.—CAPITO.—A communication criticizing a special point in Kamp's article on the errors in magnetic measurements, due to the surface film of iron sheets. (Digest, March 2.)—*Elek. Zeit.*, Feb. 7; also a brief communication by Roehr on the same subject.—*Elek. Zeit.*, Feb. 14.

Testing Cells.—An illustrated description of the cells and batteries used in the British Navy for testing purposes or for performing some kind of work. The methods of testing are also described.—Lond. *Elec. Rev.*, Feb. 15.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Arc Telephony.—SIMON.—Independently of Duddell's recent improvements in the "speaking arc," he has made a number of advances in the construction of his arc "radiophone," which promises to place wireless telephony with the aid of light upon a basis of practical success. He has confirmed the supposition, advanced by Brown, that the intensity of sound is in direct proportion to the intensity of the current upon which the microphone currents are superimposed. This is no doubt due to the fact that the Joulean heat is directly proportional to the square of the current, and that the sounds emanating from the flame are produced by variations of its temperature. He uses a projection-arc lamp with differential gear, and a current of 16 to 20 amperes. To increase the distinctness of transfer, the change of resistance of the microphone must be small. As a receiver he uses by preference a selenium cell, placed in the focus of a searchlight mirror. Experiments were successful with distances of 65 ft., but the author expects that Bell's radiophone limit of 800 ft. will soon be very considerably exceeded.—*Phys. Zeit.*, Jan. 26; abstracted in Lond. *Elec.*, Feb. 15.

Wireless Telegraphy.—GUARINI.—A communication referring to some experiments which he has made between Malines and Brussels.

He found that a large receiving surface is advantageous for the receiving air wire. He tries a theoretical explanation of the advantage of using one wire or cylindrical wires for the transmitting air wire, instead of a stranded or even lightly twisted cable. He concludes that "the maximum action between a transmitting and receiving air wire is obtained by using as air wire two metallic right cylinders of a certain height (length), and a certain diameter, disposed parallel to one another in the two stations, and of such a height that they are in sight of one another. Assuming that the two cylinders are of equal length, each must be included entirely between the two planes passing through the base of the other."—Lond. *Elec.*, Feb. 15.

Multiplex Telegraphy.—Giltay.—An article, illustrated by diagrams, in which he suggests a system of multiplex telegraphy, Morse signals being transmitted by alternating currents of different periods. Each station gives an alternating current of an exactly fixed period, each other station one of another period. When the line is used at the same time for different telegrams, the waves of different periods must be separated at the receiving stations. This is done with the aid of tuned organ pipes and resonators.—*Elek. Zeit.*, Jan. 31.

MISCELLANEOUS.

REFERENCES.

Lightning Rods.—Findeisen.—A long reply to some criticisms of his views on the best construction of lightning rods, which had been expressed in a discussion of the subject in the Electrotechnical Society of Berlin.—*Elek. Zeit.*, Feb. 7.

Obituary.—A long account, by Fontaine, of the life and work of Zenobe Gramme, with his picture.—*L'Ind. Elec.*, Feb. 10.

Paris Exposition.—Girault.—The conclusion of his well illustrated article on alternating-current machinery exhibited by Schneider & Co. This part deals with three-phase and single-phase transformers.—*L'Ind. Elec.*, Jan. 25.

Haussegger.—The first part of a well illustrated article on alternating-current dynamos and transformers exhibited by Ganz & Co.—*L'Ind. Elec.*, Feb. 10.

Kordu.—An illustrated description of a 1600-hp Farcot two-phase alternator, with Leblanc's "amortisseurs."—*Elek. Zeit.*, Feb. 7.

New Book.

Theory and Calculation of Alternating Current Phenomena. By Charles Proteus Steinmetz, with the assistance of Ernst J. Berg. Third edition, revised and enlarged. New York: Electrical World and Engineer. 525 pages, 210 illustrations. Price, $4.00.

The third edition of the work before us contains such a wealth of information that the reviewer is embarrassed in making a choice of parts for particular comment. A work of Mr. Steinmetz requires no praise, for what but meritorious could come from so gifted and talented a man?

It need hardly be said that the book is not for the tyro who intends to tackle alternating currents and learn all about them in the span of a few weeks or months. The book itself is a good illustration of the largeness of the realm of alternating currents. It is no introduction to alternating currents, but it is a wonderful book for the profound and earnest student, taxing his mathematical and reasoning powers to the utmost, and, in general, rewarding him for his pains.

There is, right at the outset, a chapter perhaps the most charming and original of the whole work. We allude to the sixth chapter, entitled "Topographic Method." The diagrams for a transmission line with distributed capacity, inductance, resistance and leakage are conspicuous by solving with the greatest ease in the most elegant manner a problem at first sight appearing most abstruse and complex. These diagrams go to show that their author is as familiar with graphic methods as he is with the algebra of complex imaginary numbers.

Another most admirable chapter is the eleventh, on "Foucault or Eddy Currents." Clear, simple and concise, it is a perfect example of how mathematics should be applied to the solution of physical or engineering problems. No waste of thought occurs in this chapter—the results are reached by the shorter road. A paragraph is devoted to the unequal current distribution in conductors through eddy currents, or the phenomena usually termed "skin-effect."

Chapter XIII deals from the mathematical point of view with the problem of distributed capacity already treated in the sixth chapter by the topographic method, as throughout the volume, the authors treat and solve this problem with the help of complex imaginary numbers.

Chapters XIV, XV and XVI treat of the theory of the alternating current transformer and of the induction motor, with an elaborate and most instructive theory of the concatenation of these motors. The authors start by developing the vector-diagram of the transformer and then go on to express all quantities in the symbolic method, a procedure highly to be recommended.

The name "frequency converter" is made use of for the general alternating current transformer with revolving secondary or primary, as illustrated by the induction motor. Though the treatment is almost everywhere clear and comprehensible, and though diagrammatic representation is often made use of for elucidation, yet it cannot be denied that the formulas are rather appalling, though this is more in seeming than in reality. Might not a graphic treatment of the involved phenomena in transformers and motors after all prove more perspicuous and lucid? It would hardly be considered justifiable, as it was once done, to express the motion of a slide-valve in mathematical raiment, owing to the fact that the slide-valve diagram is simpler and fully answers the purpose. It is not the complexity of the solution, it is the fact that there is a simpler solution possible, that makes us, to say the least, regret the absence of a detailed graphic treatment of the questions involved.

Steinmetz's great work suggests another important question, viz., whether we are justified in giving in a book, written obviously for engineers and not for mathematicians, purely theoretical and mathematical deductions without giving experimental illustrations, as long as there are methods available which, without abating an iota of accuracy, would lay the results before the student in a more tangible and palpable form?

Most interesting and suggestive is also the chapter on the synchronous motor. Graphic methods are constantly made use of in this chapter, but we must own that Prof. Blondel's development of the V-curves represented in Figs. 154 and 155 is briefer and more elegant. In this place we cannot forbear from remarking that it is surprising that in a scientific work of this kind no references are made to the works of other workers in the same field. There is hardly a problem in the wide field of alternating currents on which the best theorists have not tried their strength. Far from disputing the originality of the work of a man of such natural mathematical genius as Steinmetz, it has to be borne in mind that most of the problems in alternating currents with which this book deals were not first solved by the author, though the author is doubtless in America the foremost representative of the laborers in alternating current theory.

The most prominent features of the book are so well known as to require little comment. A new, but rather brief, chapter on the transformation of polyphase systems has been added and the two appendices on the "Algebra of Complex Imaginary Quantities" and on "Oscillating Currents" conclude the book, as in the first and second editions.

The use of complex imaginary quantities cannot highly enough be recommended. The student of mathematical physics knows that since the time of Sir William Rowan Hamilton's great work on quaternions, vector-algebra has developed into a most powerful calculus. All men of great mathematical genius seem to have recognized the power of the symbolic method. What admirable use was made of this method, students may see from the works of that most powerful mathematician, William Kingdon Clifford, whose name we may not write without the expression of deepest regret that such a noble mind was lost to the world in the early prime of its powers without being able to finish a great work. We cannot think of a more useful introduction to Steinmetz's book than Clifford's "Common Sense in the Exact Sciences," edited by Prof. Karl Pearson, and Clifford's "Dynamic," edited by Prof. Tucker. Euler's formulas and De Moivre's theorem, so puzzling to the beginner, are here shown to be merely symbolic expressions of common sense facts, and diagrams are used to illustrate graphically the meaning of the complex imaginary number. Considering that this work of Clifford's was done almost a quarter of a century ago, it appears most wonderful how few of the crumbs from the table of this rich genius have been appropriated by the scientific world at large. The human mind is apt to unconsciously ignore the work of its predecessors and to consider everything as new when it is first thrust upon its perception.

We said at the outset that the author's work requires no word of praise, and we only wish to say in conclusion that the work before us is one deserving of most careful study, a mine of valuable information, one of those mines, it may be said, that will yield treasures to all who dig in them.

Directory of Electrical Societies, Etc.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

New Westinghouse Transformers.

The Manhattan Elevated Railroad Company has recently ordered a large number of Westinghouse transformers, known as type "O. D.," which are to be used for lighting the elevated railway passenger stations throughout the city of New York. These transformers are to be of 3.2-kw and 6.4-kw size.

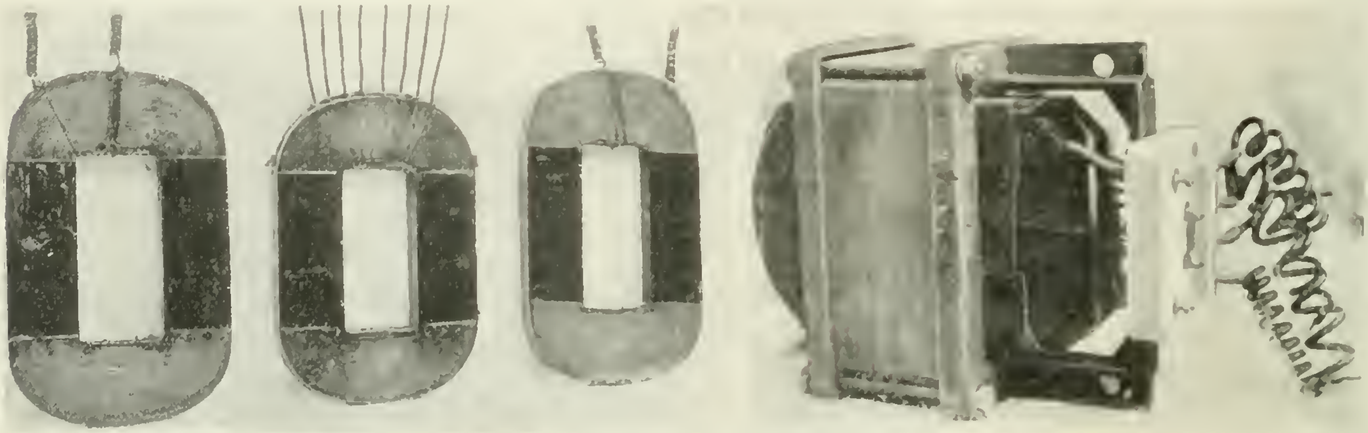


FIG. 1—WESTINGHOUSE TRANSFORMER.

Although this type of transformer is of relatively new design, they partake of all the distinctive characteristics which have marked the Westinghouse transformers for many years. A number of new details, however, are incorporated. A feature is the use of a surrounding body of oil, enclosed in a metal outer case. This oil is valuable both as a cooling medium and because it increases both the life of the insulation and the lightning resisting power of the transformer.

The coils are individually insulated and are spread apart at the ends in such a way as to secure the greatest possible heat radiating surface without in any way lowering the efficiency of the apparatus. The transformer has been given a considerable range of e. m. f. by winding it for two primary and three secondary voltages. Individual sections of the windings are supplied with terminal contacts which, by a simple change of connections, give a range of voltage covering all practical requirements. The secondary coils are wound with copper of square cross-section, which gives about 30 per cent more available cross-section than similar coils wound with round copper, thus reducing the loss due to the resistance of the windings.

Before this type of transformer was placed upon the market it was subjected to a series of the most thorough tests in order to remedy any possible defects in design or construction. The complete line of transformers was operated for nearly a year at twice their normal e. m. f. The insulation was subjected to tests in which the e. m. f. was raised to eight times the normal figure, and careful measurements were made of the iron losses, which showed that throughout this long period of experimental overloading the iron had undergone no deterioration, the method of treating the iron being thus proven to be entirely satisfactory.

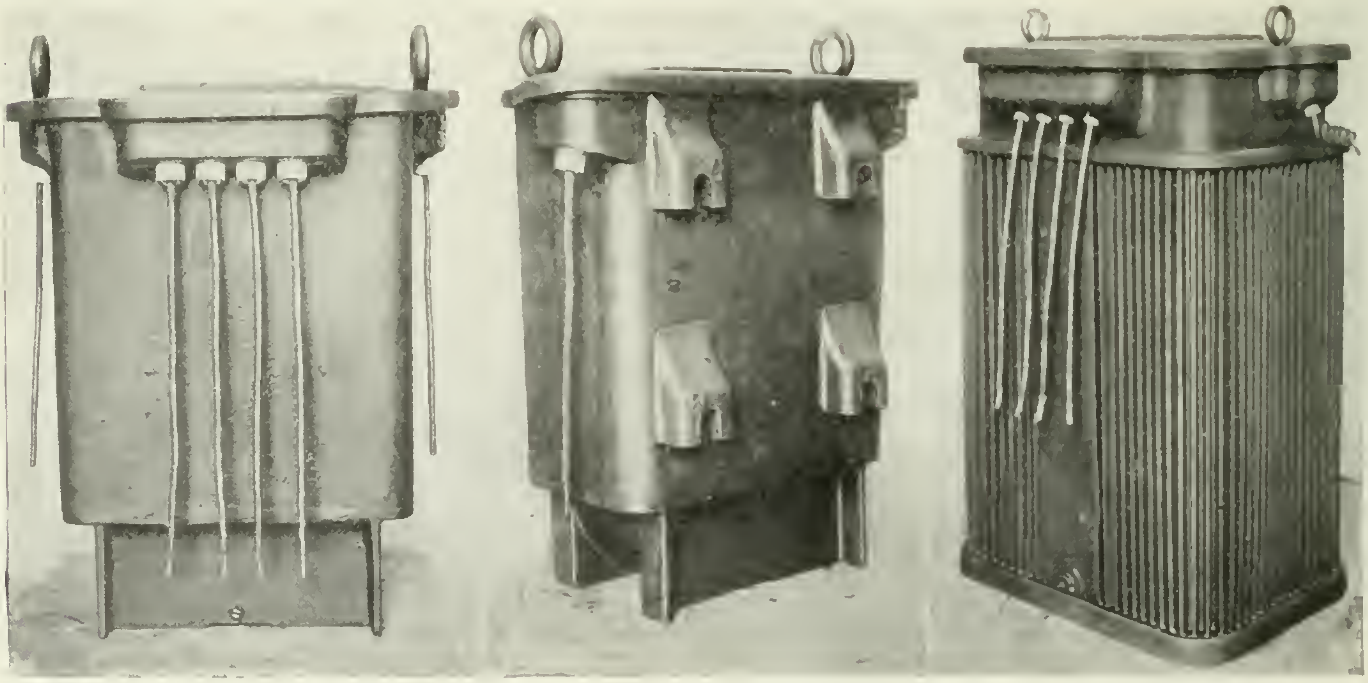
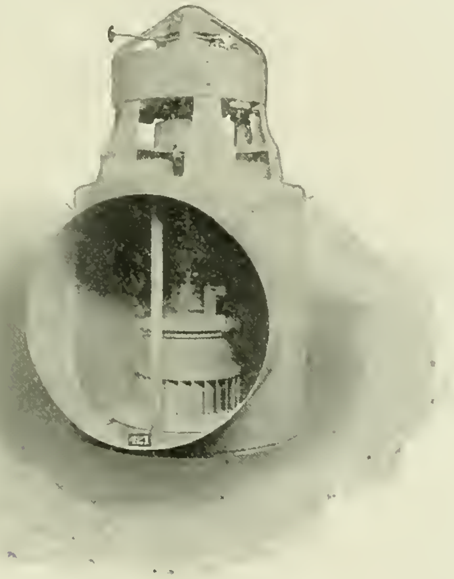


FIG. 2—WESTINGHOUSE TRANSFORMER.

Every individual transformer before leaving the factory is run at overload with the normal potential at three times the normal voltage without load, and insulation tests are made at voltages ranging from four to eight thousand. Subsequently the coils are immersed in oil, which greatly increases their insulation resistance. These transformers may be wound for any e. m. f. up to 6600. They may be arranged for the Scott system of three-phase, two-phase transmission, and may be adapted to almost any special class of work. For capacities greater than 50 kw the Westinghouse Company manufactures a line of transformers known as the oil insulated self-cooling type. These self-cooling transformers are now being made in sizes up to 500 kw. The oil-insulated water-cooled transformers are being made in sizes up to 2250 kw, and the air-blast transformers in sizes up to 2750 kw.

Massachusetts Chemical Company's Water Power Plant.

The accompanying engraving shows a 33-inch cylinder gate Victor turbine, which was recently furnished to the Massachusetts Chemical Company, of Walpole, Mass. While there is nothing novel in the setting of the waterwheel, yet the combination of the waterwheel and the generator is something new in this country. The wheel operates under about 14-ft. head, developing about 115 hp, and running at about 150 r. p. m. The wheel is set in a steel flume with cast-iron heads, the water being conveyed to the flume by means of a steel feeder pipe. The flume stands on I beams across the pit, with the customary draft-tube leading from the wheel to the tail water. Floor space in this particular case, however, was valuable, and for that reason the generator was mounted directly on top of the waterwheel shaft, the shaft through the armature being an extension of the waterwheel shaft. The generator is a Thresher direct-current machine.



CYLINDER GATE TURBINE.

The weight of the armature is carried by means of a thrust bearing, which is a combination of rings and pressure running in oil. This bearing is mounted on top of the flume cover immediately underneath the armature of the generator. The whole makes a very complete outfit, and the plan could be used to advantage in many places where light powers are to be developed. The designers and manufacturers were the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio.

Drilling Machine with Turret.

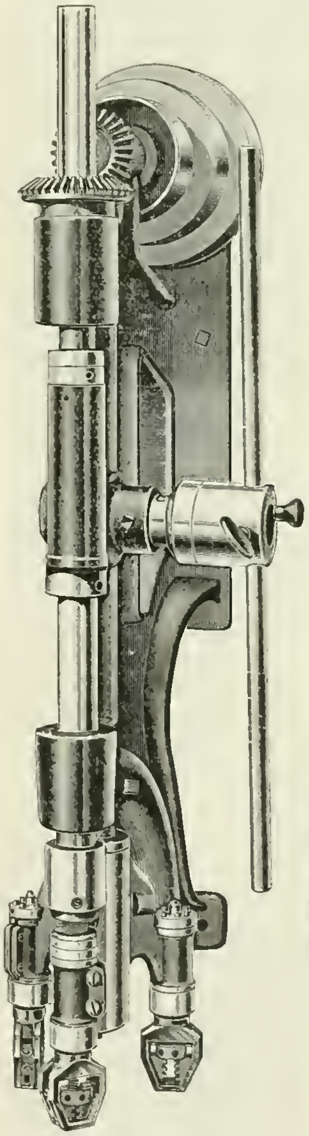
The machine illustrated herewith is designed for drilling marble switchboards, and is made for overhead suspension in order to allow placing any size switchboard under it. The heads are held up in their usual position by a pin and spring. When the drill spindle is brought down it connects with the head under the drill spindle, and as the spindle goes down it unlocks the head from the cylinder and at the same time locks the head to the driver in the drill spindle, and remains locked until the spindle is carried back to its usual position, when it unlocks of itself and locks into the cylinder. The cylinder is turned by a slight touch and the next head stops exactly under the drill. When one of the heads is locked to the drill spindle it practically becomes a part thereof, and very little, if any, strain comes on the slides of the cylinder. It is not necessary to stop the machine in order to change drills. When the lever is raised it releases at once, and a slight touch brings into place another drill or countersink. Turrets of two to six heads or more can be fitted to this drill. The hole that is to be drilled and countersunk can be finished without moving the work. All the different sized holes can be drilled in the order in which they come, thus saving much time. Another advantage is that all the spindles in the turret can be fitted with drills of the same size, and when one becomes dull the next head is used, and so on until all are dulled, then one trip to the grindstone will do for all. For the largest work the turret can be taken off and a drill spindle used as a single spindle drill.

The turret heads illustrated have a run of 4 inches each, and swing in a 7-inch circle to the center of the spindle in the head, or 9 inches over all. The ends of the spindles can be fitted to a universal chuck, or bored out for straight or taper shank drills. This machine is manufactured by the George Burnham Company, Frank Reed, proprietor, Worcester, Mass.

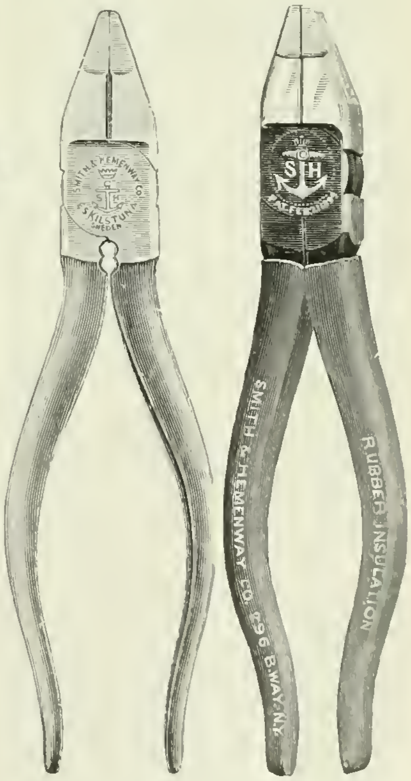
Side Cutting and Splicing, and Insulated Pliers.

The Smith & Hemenway Company, 296 Broadway, New York, has placed on the market its No. 125 side cutting and splicing plier, shown in Fig. 1. This plier is made from Swedish electric boracic steel, and is especially adapted for linemen. One of its advantages is that it has a splicing clamp in the handle, which takes the place of a connector. It has round edges and polished head and jaws.

Fig. 2 shows the No. 118 insulated plier handled by the same company. The handles are rubber covered, thereby insulating them thoroughly and protecting the user from electric shock. Its round edge feature, it is stated, has met with much praise from electricians who have used the tool. It is convenient in size and can be carried in the pocket without injuring the clothes.



DRILLING MACHINE.



SMITH & HEMENWAY CO. ESKILSTUNA SWEDEN
S H
SMITH & HEMENWAY CO. 296 B'WAY N.Y.
RUBBER INSULATION

FIGS. 1 AND 2.—PLIERS.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The money market was quiet and easy; considerable Western money has been placed in the New York market. Time money is quoted at 3½ per cent for 60 to 90 days, and 3¼@4 for longer periods. Call money is quoted at 1¾ to 2½ per cent, 2 per cent being the prevailing rate. Commercial paper was dull, business being done on the basis of 3¾@4½ per cent for prime double names. In the stock market the predominating influence was the proposed combination of the Carnegie Company and other prominent steel manufacturing concerns. The preliminary incorporation of the United States Steel Corporation diverted speculative activity and attention to the industries, and heavy trading ensued in the stocks of the companies included in the deal. The dealings in railroad shares were not on a large scale, and outside participation was sensibly diminished. In tractions Brooklyn Rapid Transit was under pressure at one time, but rallied on the short interest. It is stated that the attack was based on rumors of friction between the company and its employees as a result of a report that the employees would be required to wear new khaki uniforms. The sales amounted to 80,507 shares, the closing price, 74¾, being 2 points lower than last week's closing. There was increased selling activity in Metropolitan Street Railway, but the price tended downward and closed at 161, a net loss of 1⅞ points. In the electrics General Electric was weak, closing at 210; a net loss of 3 points is recorded against this stock. The dealings in Western Union are dropping down to the normal, the total number of shares sold during the week being 8,550, closing at 86⅞, a net gain of ⅛. There was an unusual amount of activity in American District Telegraph, the number of shares changing hands having been 1300. The closing price was 37, which was a gain of 2 points over the close of the previous week. In the outside market the new steel stocks absorbed most of the attention. The appearance of these securities caused the most active market in the history of the curb. In the other stocks there was practically no change. A hopeful tone pervaded the market at the close of the week, and a general feeling prevailed that there would be a general advance in quotations during the coming week. The following are the closing quotations at the four cities named:

NEW YORK.

	Feb. 23.	Mar. 2.		Feb. 23.	Mar. 2.
General Electric	213	210	Elec. Veh.	14½	15
Bklyn Rap. Tran.	76¾	74¾	Elec. Veh., pfd.	30	30
Met. St. Ry.	162⅞	161	Gen. Car	2¼	2¼
Am. Tel. & C.	—	94	Ill. Elec. Veh. Tran.	¾	⅞
West. Un. Tel.	86¾	86⅞	Hud. Riv. Tel.	117	120
Am. Dist. Tel.	35	37	N. E. Elec. Veh. Tran.		2¾
Com. Cable	—	160	N. Y. Elec. Veh. Tran.	4½	3¾
Elec. Boat	24	27	Tel. & Tel. Co. of Am.	4	4
Elec. Boat, pfd.	52	52	N. Y. & N. J. Tel.	175	180

BOSTON.

	Feb. 23.	Mar. 2.		Feb 23.	Mar. 2.
New Eng. Tel.	—	135	Erie Tel.	57	50
Mex. Tel.	2⅝	2⅞	Gen. Elec., pfd.	175	—
Westing. Elec.	60	—	Am. Tel. & Tel.	161	158⅞
Westing. Elec., pfd.		—	Boston Elec. Light	212	—

PHILADELPHIA.

	Feb. 23.	Mar. 2.		Feb. 23.	Mar. 2.
Elec. Stor. Bat.	68	75½	Phil. Elec.	6¼	6¼
Elec. Stor. Bat., pfd.	68	75½	Pa. Elec. Veh.		1½
Elec. Co. of Am.	—	8¾	Pa. Elec. Veh., pfd.	—	1
Gen. Elec. Auto.	—	—	Am. Rys.	—	33½

CHICAGO.

	Feb. 23.	Mar. 2.		Feb. 23	Mar. 2.
Chicago Edison	150	150	Chicago Telep Co.	260	260
Chic. City Ry.	255	255	Union Traction	13¾	14
Nat'l Carbon	17	16	Union Traction, pfd.	53	56
Nat'l Carbon, pfd.	83	82	Northwest. Elev. Com.	34	36

THE COMMERCIAL CABLE COMPANY reports that the revenue from submarine cables and land lines increased $339,946 over the previous year. A sum of $350,000 was set aside as an addition to the reserve fund, $150,000 to the fund for insurance of stations, etc., and $400,000 to the reserve for renewal of land lines. After providing for operating expenses and reserve, the balance of said revenue, including amount brought forward from the previous year, amounts to $2,007,730, out of which have been paid interest on bonds and debenture stock and dividends of 8 per cent on the capital stock, leaving a balance of $221,066 to be carried forward to the present year. The share capital of the company has been increased from $10,000,000 to $15,000,000, and of the increase $3,333,300 was issued to shareholders at par to provide for extensions. The board of directors has been re-elected.

NEW YORK & NEW JERSEY TELEPHONE.—The annual report of the New York & New Jersey Telephone Company for the year ended Dec. 31, 1900, shows:

	1900.	1899.	Changes.
Gross	$2,827,481	$2,381,368	Inc. $446,112
Op. exp.	2,018,603	1,618,191	Inc. 400,411
Net	$808,877	$763,177	Inc. $45,700
Int., tax. and divs.	665,381	540,406	Inc. 124,974
Surplus	$143,496	$222,770	Dec. $79,273
Prev. sur.	1,933,112	1,710,342	Inc. 222,770
Total surplus	$2,076,609	$1,933,112	Inc $143,497

At a special meeting of the stockholders of the company held last week it was voted to increase the capital stock of the corporation from the present amount, $8,000,000, to $15,000,000. The increase of capital will be devoted to the enlargement and improvement of the plant of the company. The new stock, it was stated, would be offered to the present shareholders from time to time in such amounts as may be needed in construction requirements.

AMERICAN STEEL & WIRE.—The officers elected at the annual directors' meeting of the American Steel & Wire Company were as follows: J. W. Gates, chairman; William P. Palmer, president; William Edenborn, first vice-president; J. S Keefe, second vice-president; P. W. Moen, third vice-president; S. H. Chisholm, fourth vice-president; F. L. Watson, treasurer; T. P. Alder, assistant treasurer, New York; A. F. Allen, assistant treasurer, Chicago; C. S. Roberts, secretary; F. E. Patterson, assistant secretary, New York; A. F Allen, assistant secretary, Chicago; C. A. Honecker, auditor, C. A Vogt, assistant auditor; Max Pam, general counsel.

WESTERN UNION.—An operator interested in Western Union says: "Arrangements were made some little time ago with the idea of putting Western Union to the neighborhood of par. The stock was carried above 90. The market began to be unfavorable and it was decided to suspend operations. Recently an operator identified with the bull move has been absent from the Street and this has led to selling and a lower price. The general plan, however, is unchanged, and when the market is again right, there will be at least an effort to bull Western Union."

NEW JERSEY. The Traction & Light Company, authorized capital of $4,000,000, has been incorporated to manufacture light, heat and fuel; to do a transportation business in New Jersey, not requiring condemnation of property, and to construct and operate railroads outside of the State The stock is divided into $1,000,000 first and $1,000,000 second preferred, each with 4 per cent non-cumulative dividends. The rest of the stock is common The incorporators are Samuel Thomas and Samuel B. Lawrence, New York; James C. Young, Jersey City.

THE STEEL CONSOLIDATION, or the United States Steel Corporation (as the new concern is called), is to have a capital of $1,100,000,000, made up of $300,000,000 5 per cent bonds, $400,000,000 7 per cent cumulative preferred stock, and $400,000,000 common stock, and it would seem that there are besides outstanding $26,500,000 of what may be called underlying bonds. It includes American Steel & Wire and National Tube, but the American Bridge Company is not a part of it.

GENERAL ELECTRIC directors will presumably meet for dividend early this month. It is expected that they will declare something better than 2 per cent for the quarter. The last dividend was 3 per cent in December, "making 8 per cent for the year." The company is earning well over 25 per cent on the stock at present, and its business is the largest in its history.

TELEGRAPH, TELEPHONE & CABLE.—The acceptance by Randal Morgan, of the Widener-Elkins-Dolan syndicate of a place in the Telephone, Telegraph & Cable Company's board, is interesting as apparently showing that the syndicate will now have representation in the management of the Latta Company.

COLUMBUS EDISON.—The stockholders of the Columbus Edison Company are offered the right to subscribe for 6¼ per cent of additional preferred stock at par. The proceeds of the sale, $47,000, are to be used in enlarging the company's stations.

DIVIDENDS.—The Alley Elevated, Chicago, has declared the regular dividend of ¾ of 1 per cent, payable March 31. Books close March 20 and reopen April 1.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports of trade conditions received by the mercantile agencies last week indicate general improvement and activity, and the future outlook is regarded as hopeful. Some "soft spots" are found, of course, *Bradstreet's* says, notably in the manufacturing branches of the cotton and wool trade, but advices from other kindred lines are encouraging. As to distribution, the best reports come from the West and Southwest. Trade on the Pacific Coast continues good, although rains have interfered with it somewhat in California, while at the same time helping the already good crop prospects. In the Northwest cold weather has somewhat retarded spring trade preparations, but the conditions are, on the whole, as satisfactory as those of a year ago. The iron and steel market exhibited quite a boom and steady advances are noted. It is thought that the broad and strong consumptive demand, and not the operation of pools or cliques, is responsible for the advances. Practically all the markets report iron and steel higher. The situation in textile manufacturing is unchanged, and the same applies to cereals. The gross earnings of 60 railroads for the third week of February show a gain of 8 per cent over a year ago. The business failures of last week, as reported by *Bradstreet's*, number 177, as against 221 the week previous, 173 the same week last year, 170 in 1899, 232 in 1898 and 262 in 1897. Copper during the week was dull and prices remain unchanged. The aggregate amount of business for home consumption was rather meagre. Quotations are 17c. for Lake Superior ingot and 16⅝c. for electrolytic and casting stock. There is very little demand for export, business in Europe being extremely dull, particularly in Germany. In the machinery market satisfactory conditions prevailed, and while there were few orders of magnitude, the balance shows very favorably, since small orders were numerous. On the whole the market is very satisfactory.

THE SPRAGUE ELECTRIC COMPANY reports an increase of sales over the corresponding month last year. The outlook for this year is exceedingly bright. Among recent orders are: One 75-hp and 4 30-hp motors for the Cooke Locomotive & Machine Company, Paterson, N. J.; 35 motors for the Central Lard Company, New York, who placed the order through their electrical engineers, Messrs. Floy & Carpenter; one 400-kw generator, one 125-kw generator, one 100-hp motor and six 80-hp motors in addition to a number of small motors for the Wellston Portland Cement Company; an order placed by Mr. George Hill, of New York, for the Dunmore Iron & Steel Company, Dunmore, Pa., consisting of one 62½-kw generator, one 100-kw generator and 25 motors of assorted sizes; one 75-kw generator, one 25-hp and one 30-hp motor for the National Distilling Company, Milwaukee; one 125-kw generator for the Big Muddy Coal & Iron Company, Murphysboro, Ill.; one 100-kw generator for the Keystone Leather Company, Camden, N. J.; 17 motors for the Norfolk Navy Yard; one 50-kw and one 75-kw engine type generator for the new Windsor Arcade Building, New York; two 75-kw engine type generators for the new city prison, Blackwell's Island; two 100-kw engine type generators for the Manhattan State Hospital, Central Islip, and two 300-kw, 500-volt street railway generators for the Central States Construction Company, Chicago.

KEYSTONE STATE TELEPHONE & TELEGRAPH COMPANY has been incorporated under the laws of the State of New Jersey, with a capital of $2,000,000, and has made an arrangement with the Keystone Telephone Company to handle all of its toll line and long-distance business. The officers of the Keystone State Telephone & Telegraph Company are as follows: C. E. Wilson, president; W. W. Wharton, secretary and treasurer. The directors are: W. H. Clark, C. E. Wilson, Edward Foerderer, George Kessler, Norman Grey. The present offices of the company are in suite No. 750, Drexel Building, Philadelphia. They will probably remove to the Keystone Telephone Company's building at Second and Sansom Streets early in May. The Keystone Telephone Company is progressing very rapidly with the work on its new exchanges. It has secured properties for the two main exchanges, purchased the ducts formerly owned by the Standard Telephone Company, has purchased conduit and will let contracts for switchboard during the present week. The contracts for constructing the subway work will be let within 10 days. The management reports that it is much gratified with the way contracts for service are coming in.

WESTERN TELEPHONE CONSTRUCTION COMPANY.—Owing to the large increase of subscribers the new Corsicana, Tex., Telephone Company has ordered additional telephones and another section of multiple central switchboard from the Western Telephone Construction Company, of Chicago. In addition to the central battery equipments recently furnished Pottsville and Williamsport, Pa., and Corsicana, the same type of multiple equipment is being made by the Western for exchanges at Greensboro, N. C., and Binghampton, N. Y. Western "Express" switchboards of 100 lines capacity have been furnished the Shamokin Valley Telephone Company (increase), Northumberland, Pa.; Sebree (Ky.) Telephone Company (including large shipments of telephones), Jameson (Md.) Telephone Company, John Bringman, Taylorsville, Ind.; Washington (Iowa) Telephone Company; J. W. Sparks, Giddings, Texas (including telephones), and numerous smaller orders for other points.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., has recently closed a contract with the United Electric Light & Power Company of Baltimore, Md., for the installation of a battery of chloride accumulators consisting of 132 elements, having a capacity of 1200 ampere-hours, and with tanks allowing an ultimate increase by additional plates to a capacity of 2100 ampere-hours. The battery is located 5000 ft. from the power house and is to be operated in connection with two boosters having a capacity of 500 amperes at 35 volts. This battery is for the purpose of furnishing light and power to the Continental Trust Building and the Merchant Bank Building. The current is furnished from the power house at 220 volts and as it is intended to use 110-volt lamps and 220-volt elevator motors, a third wire will be taken from the centre of the battery to form the neutral of the 220-volt three-wire system. The two constant current boosters will be used on the outside wires for regulating the elevator load.

SALES OF BULLOCK APPARATUS.—The following sales are reported by the Bullock Electric Manufacturing Company: Glasgow *Evening News*, Glasgow, Scotland, three motor generators; London *Daily Express*, London, Eng., three motor generators; Montreal Water & Power Company, Montreal, Can., one 400-hp three-phase motor; Aberdeen *Journal*, Scotland, one 30-hp teaser equipment and one motor generator; Carnegie Steel Co., Pittsburg, Pa., one 25-hp type H motor; Greuner & Co., Johnstown, Pa., one 30-kw type I generator; Brown & Sharp, Providence, R. I., four type N motors for direct connection to machine tools; Wier Frog Company, Cincinnati, Ohio, three 10-hp type N motors; Pullman Company, Pullman, Ill., two 150-kw type H generators; Mosler Safe Company, Hamilton, Ohio, one 50-hp type H motor; Susquehanna Valley Electric Company, Sidney, N. Y., one 65-kw single-phase generator; Central Lard Company, New York City, N. Y., one 65-kw engine type generator; Buffalo *Evening News*, Buffalo, N. Y., one 70-hp type H motor.

THE CLARK AUTOMATIC SWITCHBOARD COMPANY, 938 Banigan Building, Providence, R. I., through its engineer, Mr. J. L. Putnam, has just installed at the establishment of the Walther-Robertson Drug Company, Pittsburg, Pa., a 12-point station automatically connecting several floors of its building with the main office. In addition to this other systems have been installed at the Union Wadding Company's works, at Pawtucket, R. I., comprising an 18-point plant, and another of 8 points has been placed in the office of L. C. Page & Co., publishers, in Boston. The last two as well as the first represent some of the most recent work of the Clark Company, which is having much success in having its automatic telephone system installed in a number of places.

THE MAXWELL M. MAYER ELECTRIC COMPANY, of New York City, reports the following sales for the month: One 2-hp motor, Standard Dairy Company, city; one 30-light dynamo, Appomattox Iron Works, Petersburg, Va.; one 1-hp motor, Bonner Sons, city; one 1-hp motor, Morton & Hover, city; three 50-light dynamos, Pernambuco, Brazil; one 5-volt, 500-ampere testing dynamo, Cutler-Hammer Manufacturing Company, Westfield, N. J., factory; one 10-hp motor, Birmingham, England.

DODGE MANUFACTURING COMPANY, of Mishawaka, Ind., has let plans for machine shop extension 185 ft. long by 120 ft. wide, and foundry extension 185 by 127 ft. In each building a 25-ton, 4-motor electric traveling crane, with 5-ton auxiliary hoist, will be installed. A 28 by 48 Corliss engine for the main power plant will be purchased. This company will also buy one or two generators. All these orders are now being placed.

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., has recently installed two direct-connected self-oiling engines, one of 150 hp and one of 100 hp, in the Pittsburg Bank for Savings building, Pittsburg. The St. Vincent's Arch Abbey, Beatty Station, Pa., has recently installed an electric plant. The engines were built by the Ball Company, and are two 125-hp direct connected.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., has recently installed in the Newburg plant of the American Steel & Wire Company, Cleveland, a special double trolley, 3-motor, 5-ton electric traveling crane, 51-ft. span.

TRAIN LIGHTING.—The New York Central, which has been experimenting with the axle-light system for lighting cars, will shortly equip 14 more cars with this system.

MAGNETIC SEPARATORS.—We have an inquiry from France for magnetic separators for a South American mine, and shall be glad to receive catalogues and price lists to be forwarded.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Feb. 13: Antwerp—2 packages electrical material, $143. Argentine Republic—36 packages electrical material, $3,351; 3 cases electrical machinery, $332. British Australia—167 packages electrical material, $8,673; 48 packages electric car material, $9,917; 12 packages electrical machinery, $1,770. Bremen—4 packages electrical material, $401. Barcelona—8 cases electrical material, $566. British Possessions in Africa—1 package electrical machinery, $23; 1002 packages electrical material, $35,090. British East Indies—19 packages electrical material, $500. Bilbao—1 case electrical material, $30. British West Indies—57 cases electrical material, $2,403; 2 coils cable, $968; 6 cases electric motors, $227. China—12 bundles electrical material, $505. Cork—20 packages motor trucks, $1,300. Central America—212 cases electrical material, $501. Cuba—88 cases electrical material, $2,339; 6 packages electrical machinery, $550. Ecuador—1 case electrical material, $23. Florence—5 cases electrical machinery, $366. Glasgow—49 packages electrical material, $475; 8 cases electrical machinery, $1,600. Genoa—120 packages electrical material, $12,658. Gibraltar—5 cases electrical material, $115. Hamburg—35 packages electrical material, $5,657. Havre—39 packages electrical machinery, $1,936; 2 packages electrical machinery, $36. Japan—174 cases electrical material, $35,143; 24 cases electrical machinery, $6,665; 44 cases motors and parts, $3,528. Korea—45 packages electrical machinery, $4,735; 102 packages electrical material, $14,153. London—73 packages electrical machinery, $7,051; 374 packages electrical material, $38,942; 28 packages motor vehicles and parts, $14,075. Liverpool—69 packages electrical machinery, $3,689; 63 packages electrical material, $21,267. Mexico—96 packages electrical material, $2,153. Manchester—13 cases electrical material, $2,680. Madrid—2 packages electrical material, $67. Milan—33 packages electrical material, $2,400. Marseilles—2 cases electrical material, $225; 44 bales electrical machinery, $385. Naples—1 case electrical material, $719. Philippines—12 cases electrical material, $1,388. Reval—30 cases electric fans, $403. Southampton—11 cases electrical material, $800. Siam—3 cases electrical material, $329. St. Petersburg—22 cases electrical material, $251. San Domingo—8 packages electrical material, $891. Tasmania—4 packages electrical material, $94. United States of Colombia—4 cases electrical goods, $59.

THE GERMAN WESTINGHOUSE COMPANY.—The Westinghouse Electric & Manufacturing Company, through the Westinghouse Electric Company, Ltd., of London, has recently caused a company to be organized in Germany, known as the Westinghouse Electricitäts Aktiengesellschaft, with a capital of 1,000,000 marks, for the purpose of selling the apparatus of the Westinghouse Electric & Manufacturing Company. Felix Singer has been appointed a member of the vorstand, or managing board, the officers being as follows: President, Lemuel Bannister; vice-president, W. E. Smith; managing directors, Felix Singer and F. Hessenberg; supervising board, Lemuel Bannister, Ph. Ferd. Kobbé, W. E. Smith, Otto Müller, Arthur Führ. The company's main office is at 19 Jägerstrasse, Berlin, and it will represent the Westinghouse interests in Germany, Austria, Hungary, the Balkan States, Turkey in Europe, Turkey in Asia, and Greece. It is understood that it was organized as the most convenient way for exploiting in Germany and the other countries named the business of the Westinghouse Electric & Manufacturing Company, which already promises to be of magnitude in those countries.

THE OTIS ELEVATOR COMPANY, of New York City, reports a steadily increasing foreign demand for electric elevators, which are being shipped to various parts of the globe. Recent contracts call for the installation of elevator equipments in the Government railway offices in Wellington, New Zealand; the palace and presidential offices of President Diaz of Mexico, and the residence of the Viceroy of India at Calcutta. Among the foreign hotels about to be equipped with electric passenger elevators are the Hotel de Orange, at Spa, and the Hotel Royal de Belge, at Ostend, Belgium. Japan is also a customer, a large equipment having been ordered through Takata & Company, of 10 Wall Street, for the offices of the Nippon Insurance Company, of Kobe, Japan, while the Japanese banking offices of Mitsui & Company will also be furnished with American electric elevators. Other orders lately obtained include equipments for the Bazaar Wertheim, one of the large department stores in Berlin; a hospital in Calcutta, India, and a large office building in Madrid, Spain, while shipments have been made during the last 10 days to Rostoff-on-Don, Russia; Cape Town, South Africa; Colombo, Ceylon; Shanghai, China, and Perth, Western Australia.

THE ST. LOUIS CAR COMPANY has opened New York offices in the Taylor Building, 39-41 Cortlandt Street, under the management of Edward D. Floyd & Co., which concern will handle all business secured in New York, New Jersey, Delaware and the eastern portions of Connecticut and Pennsylvania. The company is making a serious bid for the export trade and is shipping several cars abroad, principally to Great Britain and Germany. The cars intended for England are forwarded "knocked down." A. K. Baylor, of St. Swithin's Lane, London, E. C., whose New York offices are located in the Bowling Green Building, has formed a company for the purpose of erecting a plant on the other side, where the cars will be assembled.

TROLLEYS FOR NEW ZEALAND.—Consul Dillingham writes from Auckland, Jan. 2, 1901: "For more than three years Auckland has discussed the advisability of introducing an electric tramway system. Several contracts have been granted to local firms and to London syndicates, but the change has not been made. A New York company has now arranged to build the road. Rails, cars and other material will be brought from America, as well as a force of men to equip and put it into operation. The cost of the line will be about $1,000,000.

TROLLEY CAR BUILDING.—A special dispatch from Newburyport, Mass., of March 2 says: "Representatives of New York capitalists have been making a canvass of the electric railway car manufacturing plants in New England with a view of securing control and consolidating the industry. With the proposed building of a large number of electric roads in New England the coming summer, the promoters look upon the great demand for cars as a prospect of big profits in this industry It is said that a number of the companies have given options on their plants."

ENLARGEMENT OF PLANT.—Work is now progressing on the new addition, 60 by 220 ft., of the James Leffel & Co.'s plant, Springfield, Ohio, to be built of brick and steel, and equipped with electrical cranes and a number of new machines to enable them to supply the increased growing demand for their Samson wheels These works will now give work for 300 men. This company has just received an order for a large pair of horizontal wheels from Minneapolis to develop 3000 hp, and another contract for 10 68-inch Samson wheels from Michigan for driving electrical machinery.

THE NATIONAL CONDUIT AND CABLE COMPANY'S new wire plant at Hastings-on-Hudson will begin working operations within the next 10 days. The plant, which entailed an expenditure of over $400,000, will have an annual capacity of 100,000,000 lbs. It is said to be the largest strictly copper wire plant in the world. The National Company's recent foreign business includes contracts for the supply of conduit to be utilized on the Newcastle-on-Tyne and Island of Thanet electric railroads, England.

THE MOUNT LAKE RAILWAY COMPANY, of Gloversville, N. Y., is at present purchasing some of its equipment, etc. It has closed a contract through Edward D Floyd & Co., of New York City, for the furnishing of seven trolley cars and trucks, which will be built by the St. Louis Car Company, of St. Louis, Mo. The order for the electric equipment is not yet placed. The Washington Company, New York City, of which John G. Wright is secretary, has obtained the contract for the power house and its equipment

THE KRAWJEWSKI-PESANT COMPANY, of 32 Broadway, New York City, is placing important orders for long-distance telephone equipments requisitioned for by the United States Government for shipment to Cuba. The Western Electric Company is said to be receiving fair-sized orders for telephones, insulators, brackets, etc., while the American Steel & Wire Company is securing a number of orders for telephone wire.

FIRE.—The Thresher Electric Company, of Dayton, Ohio, was burned out last week. The Thresher Company sustained a loss of about $25,000; the insurance is $22,450 The company was at the time at work on a large contract for electrical equipment for the Government.

THE PITTSBURG BOILER SCALE RESOLVENT COMPANY, Park Building, Pittsburg, Pa., has received an order from the Government for a quantity of its boiler scale resolvent, to be used in the boilers of the United States ice machine plant, Iloilo, Philippine Islands.

WESTINGHOUSE GENERATOR.—The Cleveland office of the Westinghouse Electric & Manufacturing Company has closed a contract to furnish the Cleveland Hardware Company with a 75-kw two-phase 720 r. p. m. generator for a new power house now building The hardware company will operate its plant by electricity

MR. JOAQUIN MAIZ, a large owner of lead and copper mines at Monterey, Mexico, is visiting New York City and staying for a time at the Waldorf. He is very much interested in the question of electric power and the transportation of his ore, and would, if possible, like to apply electrolytic or electric smelting methods.

PHILIP LESERMAN, whose New York offices are in the Havemeyer Building, is about to place some substantial contracts for electrical machinery required by various South African water power plants.

THE BRIDGETOWN CRYSTAL ICE COMPANY, of Bridgetown, Barbados, is about to install an electric light equipment in its ice-making plant.

Special Correspondence.

ENGLISH NOTES.

London Office of Electrical World and Engineer,
Feb. 23, 1901.

THE BIOGRAPH AND THE QUEEN'S FUNERAL.—From a spot apparently close to St. George's Hospital an excellent biograph picture of the funeral procession was obtained, and this, giving a vivid impression of the scene, will be appreciated by many thousands who were unable to obtain a view of the mournful pageant itself. The picture was shown, for the first time, at the Royal Aquarium, and it made a profound impression on the large number of spectators, who stood, bareheaded, to see it, while the orchestra played the "Dead March in Saul."

THE QUEEN'S DEATH AND CABLING RECORDS.—The important news which culminated in the Queen's death caused a rush of work to the cable companies. Of course, the great American newspapers made the greatest demand for news. The Commercial Cable alone carried 25,000 words in description of the funeral to American newspapers. Its best previous record was 13,000, made during the Jubilee. The French Cable carried close to 20,000 words, while the Western Union Telegraph Company transmitted 15,000. The New York *Journal* alone received 16,000 words from London. Each word cost the newspaper receiving it 5d.

THE X-RAYS AT LADYSMITH.—At a meeting of the Roentgen Society held recently at 20 Hanover Square, a paper by Lieut. F. Bruce, R. A. M. C., on "Experiences of X-Ray Work during the Siege of Ladysmith" was read. He pointed out that Ladysmith afforded the first instance in which such work had been carried out under shell fire. There was little trouble about the apparatus itself, but the supply of electricity was not so easy a matter, since the town was not installed with the electric light. He had no faith in the system of driving a dynamo by a man on a bicycle, for the process of charging six cells in that way was like climbing a very steep hill; still he took a dynamo with him. In addition to the storage cells which formed part of his equipment, he applied for some of the large cells which he noticed were used for lighting the train by which he traveled. In Ladysmith two small rooms in the town hall were set aside for X-ray work, and one of them was fitted up as a photographic dark room. The battle of Elandslaagte furnished the first cases; in these, while there was much bone-splitting, there were few cases of embedded bullets, though in those that did occur they were successfully localized. When the Boers cut off the main water supply there was a scarcity of water for washing the plates, and what there was available was exceedingly dirty. Later fighting yielded many cases, and as the supply of electricity was giving out it became necessary to do something to get the batteries recharged. This was managed at a flour mill near the town hall, the dynamo brought by Lieut. Bruce being attached to the mill shafting. The arrangement worked well, the current obtained supplying electric light to the operating room by night, besides charging the cells. On Nov. 5 they had to move across the Klip, owing to attentions from Boer shells. The wagon stuck in the middle of the river, and when they did arrive at Intombi, their destination, there were no tents available for them, and their apparatus had to lie on the bare ground for two days until the tent came. Later, they were ordered back to Ladysmith, in case the relieving columns arrived. The battle of Jan. 6 showed some interesting cases, apparently due to the use of explosive bullets by the Boers. The X-rays were employed in all in some 200 cases, nearly half being photographed, and the apparatus proved itself of great advantage. As to improvements suggested by his experience, Lieut. Bruce thought a properly constructed operating table was required, in which, if desirable, the photograph could be taken from below. But the generation of electricity was the chief point, and he was of the opinion that for field use an outfit could not be considered as complete unless it had its own machinery for the production of electricity. He suggested that an oil motor, like those used on motor tricycles, might be provided to drive the dynamo.

General News.

THE TELEPHONE.

NORTH BEND, NEB.—The Farmers' Telephone Company has been incorporated here with a capital stock of $20,000.

ALEXANDRIA, IND.—The City Council has granted a franchise for a new telephone system to a company headed by L. C. Nieason.

MARION, IND.—The Central Union Telephone Company will put in a rural telephone system. The farmers propose helping to build the lines.

NEW HOPE, KY.—The New Hope Telephone Company is equipped with Farr apparatus and has 53 subscribers. Mr. F. W. Hagan is secretary.

BIRMINGHAM, ALA.—The magnificent system of telephones installed here by the People's Telephone Company is being put in operation and will soon be doing business.

JEFFERSON CITY, MO.—The bill providing for the taxation of telephone companies in the same manner as telegraph companies are now taxed has been favorably reported.

FAIRFAX, MO.—The Fairfax Telephone Exchange Company has in contemplation the erection of some toll lines. It is enjoying a good business and is using Stoddard apparatus. It has a switchboard capacity of 100 drops and has 40 subscribers.

LOUISVILLE, KY.—The Cumberland Telephone & Telegraph Company and the Cincinnati Telephone Company have agreed to build connecting lines between Cincinnati and other Southern cities. The Cincinnati company is to build 300 miles at once.

DAYTON, OHIO.—The franchise application brought by the Home Telephone Company before the Probate Court has been dismissed on the motion of the company itself. It is believed the city is now willing to come to satisfactory terms with the company.

LE SUEUR, MINN.—The Le Sueur Telephone Company is operating a switchboard of 100-drop capacity. The apparatus used is that of the American Electric Telephone Company. The company now has 60 subscribers and is expecting an addition of 20 more.

INDIANAPOLIS, IND.—The New Telephone Company will construct new lines from this city to Logansport, Shelbyville and Greensburg; Greencastle and Terre Haute and Greencastle and Rockville. The company has placed an order for $37,000 worth of copper wire.

KOKOMO, IND.—W. N. Turner and C. A. Jay, of the Independent Telephone Company of this city, have made application to the City Council of Logansport and the commissioners of Cass County for franchises for a long-distance telephone connecting Logansport and Kokomo.

CHARLOTTE, N. C.—It is stated on what is claimed to be good authority that the Southern Bell Telephone Company contemplates extensive improvements during the present year, for the purpose of heading off competition which already exists to a large extent in several of the Southern States.

PINCKNEYVILLE, ILL.—A meeting of the Independent Telephone Association of Southern Illinois was held March 5. Both the Bell and Kinloch long-distance companies have submitted propositions to the association for securing long-distance connections for the various companies forming the association.

TERRE HAUTE, IND.—The Citizens' Telephone Company, of this city, which recently began extending its system throughout the city and country, is meeting competition from the Central Union Company. The latter is planning to extend its service, and the liveliest competition in all quarters is anticipated.

SAN FRANCISCO, CALIF.—The Postal Telegraph Company has just completed a new line from Albuquerque, N. M., to Bakersfield, Calif. The Pacific States Telephone & Telegraph Company is also running a loop on the same pole line. The Postal Company has just laid a new cable from Goat Island in San Francisco Bay to Oakland, Calif.

SPARTANBURG, S. C.—The Spartanburg Telephone Exchange has a switchboard capacity of 600 drops and 450 subscribers. It is a rapidly growing concern, the plant and its capacity having been greatly enlarged recently. A direct connection with Asheville is projected. The company is using the apparatus of the Telephone Manufacturing Company.

KENTLAND, IND.—Mr. Wm. K. McCray is the owner of the Home Telephone Exchange in this place. The exchange has a switchboard capacity of 200 drops, 160 of which are installed. There are 175 subscribers, of which 25 are new-comers. The exchange is operating a toll line to Fowler. The apparatus used is that of the Sterling Electric Company.

SYDNEY, IA.—The City Telephone Company has stations at Sydney, Tabor, Randolph, Henderson, Malvern, Anderson, Silver City and Hastings. It has 300 subscribers and is using American Electric and Victor apparatus. The company expects to increase the number of subscribers during the present year between 200 and 300 and to install 200 instruments during March.

AUSTIN, TEX.—A bill has been introduced in the House of the Texas legislature providing that all telegraph and telephone companies shall in the future be placed under the authority of the Railroad Commission of Texas. This is done with a view to having rates established by the commission forcing these companies to keep general offices in the State and to submit their books to the commissioners for inspection.

SCALP LEVEL, PA.—The Salix Telephone Company, during the past year, placed 100 telephones in Windber and Scalp Level. It is operating two 100-drop boards and one 50-drop board and has 200 subscribers, the switchboards being made by the Western Telephone Construction Company and the Keystone Company. The company contemplates extensions to Center City, Loydell, Lovet, Rummel, and to 39 Eureka mines. Mr. C. S. Ickes is the manager.

ST. CHARLES, MO.—The telephone war between the Kinloch and Bell companies is becoming very interesting. At last week's Council meeting the Kinloch people were granted permission to erect poles in various parts of the city wherever they were asked for, and it is claimed that company will reconstruct the entire local system, thus giving equal service at much lower rates than the Bell. In retaliation the latter company is putting in residence telephones free the first year.

YORK, PA.—Representatives of the independent telephone companies of Pennsylvania, Maryland, Virginia and West Virginia have effected an agreement whereby a consolidation of all the companies will be made, with a capitalization of $2,000,000. The headquarters will be in this city. It is stated that they have made arrangements whereby they will begin a long-distance service to Philadelphia and New York through the Keystone Company of Philadelphia. They hope ultimately to unite with the independent telephone companies of the Western States.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Home Telephone Company, New Philadelphia, Ohio, has exchanges at this place, Canal Dover, Uhrichsville, Dennison, New Comerstown and Mineral City, under separate organizations, which, however, will be merged into one company during the next 60 days. There are 464 subscribers in New Philadelphia, the total in all of the towns named being 1400. Mr. Geo. I. Hoffman, president, states that by Dec. 31 next he expects to have not less than 2000 subscribers. The company is using American Electric telephone apparatus.

LEBANON, IND.—The Lebanon Telephone Company has offered all Boone County patrons of the Farmers' Co-operative Telephone Company free service with any of its subscribers, and free service to their homes when in the city. The Co-operative Company demands that this offer be extended to all members of the co-operative system, irrespective of county lines, and that patrons of the Lebanon Company be granted free communication with the co-operative members. Unless this concession is made the co-operative company will put in a system in Lebanon if a franchise is granted.

INDIANAPOLIS, IND.—According to dispatches reaching this city, plans have matured for the formation of a combination of independent telephone interests. The dispatches say that two companies have been formed to effect a consolidation of all the short and independent lines in Indiana, Ohio, Michigan and Eastern Illinois. It is also said that an extension in Indiana will be constructed south from Mishawaka to connect with the Indianapolis independent lines, and that another extension will be built to Butler, Ind., connecting there with a line running into Cleveland, Ohio. By a wire to Chestertown, it is said a Chicago service can be had. The complete plans embrace connections between Cleveland, Indianapolis, Toledo, Detroit, Chicago and hundreds of smaller cities and towns in the four States concerned.

CINCINNATI, OHIO.—At the annual election of the City & Suburban Telegraph Association the following directors were elected: Henry Hanna, C. H. Kilgour, George Bullock, John Kilgour, C. Jay French and Capt. George N. Stone. Capt. Stone was re-elected president, C. W. Kilgour vice-president, John Kilgour treasurer, W. A. Blanchard secretary. Capt. Stone's annual report showed that during the year the company handled 231,071 messages, an average of 637 a day. There were 59,943 ft. of aerial cable strung during the year, equal to 718 miles. This makes a total of 4863 miles of metallic circuits on 520 miles of poles. In the underground system there are 345,475 ft. of cables, containing 6543 miles of conductors.

BUFFALO, N. Y.—The Queen City Telephone Company was incorporated last week with a capital stock of $500,000. It is to operate an independent telephone system in the city of Buffalo, connecting with the following other cities: Easterly to Rochester, Syracuse, Utica, Albany, Poughkeepsie and New York City; northeasterly to Tonawanda, Niagara Falls, Lockport, Oswego, Watertown and Ogdensburg; westerly to Dunkirk, Erie, Cleveland, Detroit, Toledo and Chicago, and southerly to Jamestown, Hornellsville, Binghamton, Corning, Elmira, Scranton, Wilkesbarre, Philadelphia, Jersey City and Washington. The directors are Hardin H. Littell, Robert R. Hefford, Frank H. Goodyear, Charles W. Goodyear, Robert F. Schelling and Eugene A. Georges of Buffalo, and Samuel E. Wayland of Scranton, Penn. As in Cleveland, some of the capital represented comes from the street railway field.

GLOUCESTER C. H., VA.—The Tidewater Telephone Company is now operating 226 miles of line and has a half interest in 19 miles of toll line and about 568 miles of wire, 2 exchanges and 137 stations, besides the public telephones used at the exchanges. The company is changing its system to full metallic circuits. Last year a very large growth was recorded. A metallic trunk line was built from Gloucester C. H. to Newport News, a distance of 32 miles, and various extensions were made in Gloucester. A half-mile of 4-conductor cable was laid between Gloucester Point and Yorktown. Several other improvements were made to the system, and there are many new applications for service. Nearly all of the lines are party lines, carrying from 2 to 12 stations. It is proposed to open an exchange at Matthews C. H. The company also proposes to build a metallic trunk line from Gloucester C. H. to Richmond, a distance of about 75 miles. For these improvements the company will issue $10,000 of stock. The standard Bell long-distance apparatus is used. Mr. L. C. Catlett is superintendent.

ELECTRIC LIGHT AND POWER.

DENTON, IND.—Application has been made to the Town Commissioners for an electric light franchise.

SHEBOYGAN, WIS.—The C. Reiss Coal Company is figuring on installing a complete electrical power and lighting plant.

HALIFAX, N. S.—The City Council has decided to at once install a municipal electric light plant at an estimated cost of $100,000.

ALBANY, GA.—The Albany electric light plant suffered loss by fire amounting to several hundred dollars on the night of Feb. 24.

THOMASTON, GA.—This town has voted $10,000 electric light bonds. It is stated that an electric light plant will be established at an early date.

BOLIVAR, MO.—In a special election here the proposition to increase the debt of the city $4,000 for a municipal electric light plant was carried.

THOMPSONVILLE, MICH.—The dam at the village electric plant has been destroyed by a flood, and the village will be in darkness for some time.

ST. JOHN, N. B.—The Manchester, Robertson & Allison Company has been incorporated here with a capital of $800,000 to supply electric light and power.

ST. LOUIS, MO.—The County Court has granted a franchise to the city of Kirkwood to erect poles and string wires for electric lighting certain territory surrounding that city.

CHILLICOTHE, MO.—The city of Chillicothe has sent a committee to visit Macon, Mo., to examine the municipal electric light plant there, with a view to establishing one here.

SACKVILLE, N. B.—It has been decided to enlarge the electric light plant of the town of Sackville, N. B. A brick power house will be erected and a new boiler and engine installed.

YORK, PA.—Application has been made to the City Council for a perpetual franchise by the Merchant's Electric Light, Heat & Power Company; capital, $100,000. C. H. Baer, president, York, Pa.

VAN BUREN, ARK.—The Van Buren electric light plant, owned by Johnson Brothers & Faulk, the railroad contractors of St. Elmo, Ill., was sold by them Feb. 27 to J. E. Powers of Van Buren.

WARRENTON, MO.—The Electric Company of Warrenton has been incorporated with a capital stock of $6,000. The incorporators are F. E. Schowengert, George Hillemeyer, R. H. Kemper and others.

SAN FRANCISCO, CALIF.—The San Francisco Electrical Works recently closed a contract for a switchboard and wiring of buildings at the Naval Training Station on Yerba Buena Island, in San Francisco Bay.

SAN FRANCISCO, CALIF.—The Truckee River General Electric Company recently paid its second monthly dividend at the rate of 10 cents per share on the capital stock. The company's plant is in Floriston, Calif.

VINCENNES, IND.—Mr. E. J. Julian has been appointed receiver of the City Electric Lighting Company of Vincennes. A recent reference to this appointment might lead to the erroneous impression that he was appointed receiver of the Vincennes Electric Light Company.

GRANTSBURG, WIS.—Eastern capital has been interested by business men in a plant to utilize the water power of the Kettle River Rapids, six miles from the village, and transmit the power to this and surrounding towns electrically. These rapids are 6 miles long and have a fall of 70 ft.

THE INDIANA ENGINEERS' ASSOCIATION held its annual meeting in Indianapolis recently. A paper was read by J. B. Nelson on "Municipal Control of Electric Light and Water Works Plants." Discussions were had on electric engineering and the comparative advantages of American and European electric railways were explained.

SAN FRANCISCO, CALIF.—The work of installing electric hoists in the mining shafts on the Comstock Lode in Nevada is steadily progressing. The work in the Belcher mine shaft is about done, and that in the C. & C. and the Union shafts about half completed. The Risdon Iron Works recently shipped the greater part of the hoisting machinery for the Yellow Jacket mine.

SPOKANE, WASH.—The Big Bend Light & Power Company has filed articles of incorporation and intends to furnish electric light and power to towns on the Central Washington branch of the Northern Pacific. Responsible capitalists are interested. The Spokane Electric Power people are also trying to get into the field with power furnished by Spokane Falls. There is a race for the prior establishment of systems.

DETROIT, MICH.—The St. Joseph & Elkhart Power Company has been incorporated with a capital stock of $100,[illegible]00. The following officers have been elected: M. V. Beiger of Mishawaka, Ind., president; C. H. Tenney, New York, secretary; C. F. Hewitt, Elkhart, Ind., treasurer and general manager. The company will build a new power house and dam on the St. Joseph River, near here, and furnish electric power to adjoining towns.

PORTLAND, ORE.—The Portland General Electric Company is about to erect an auxiliary steam power generating station on the site of the old Union power station in the northern part of this city. Contracts have been closed with the General Electric Company for a 750-kw three-phase generator and a 325-kw 500-volt street railway generator. The plant will be used in case of trouble from high water at the company's transmission plant in Oregon City.

PINE BLUFF, ARK.—The Board of Public Affairs Feb. 27 let to the Pine Bluff Traction Company a contract to do the city lighting for 15 years. The contract carries with it an agreement to build an electric street car line. The Pine Bluff Light & Water Company put in a lower bid, but would not build the car line. It will contest in the courts the awarding of the contract to its rival, which was organized by home people for the purpose of building the car line.

CHARLESTOWN, VA.—A movement is on foot in this place to organize an electric light company. The promoters of the enterprise are represented by Messrs. Chew and Norris, of this place. It is expected to have the plant in operation shortly, and electric light and power will be supplied to mills and factories in this and neighboring towns. The generating plant will be located on the Shenandoh River, where, it is stated, there is ample power for all the needs of the company. The company will need electrical and hydraulic apparatus.

COBURG, ONT.—At a recent meeting of the town council a by-law was passed granting a franchise for pole rights to the Central Ontario Power Company, of Peterboro, Ont., for the purpose of transmitting electric current from Burleigh Falls for lighting and power purposes. The Port Hope, Ont., town council has passed a similar by-law for the same purpose, as also all the intervening townships that lie between Port Hope and Burleigh Falls. The Crossen Car Manufacturing Company and the Dick Ridout woolen mills will be supplied with 500 electric horse-power and the town of Port Hope has arranged with two new manufacturing corporations to establish works in the town, the town furnishing the buildings. Mr J. Alexander Culverwell, of Peterboro, is the managing director of the power company.

THE ELECTRIC RAILWAY.

BRESE, ILL.—An electric light plant will be established here.

INDIANAPOLIS, IND.—The Union Traction Company is establishing an express system over its interurban lines.

SANDUSKY, OHIO.—J. C. Parker, of Sand Hill, is promoting a new road to be known as the Sandusky, Clyde & Tiffin Electric Railway.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company has filed a franchise ordinance for various extensions and some new work.

FRANKFORT, KY.—The Shelby County Electric Power & Railway Company has been incorporated with $10,000 capital stock, with the privilege of increasing to $200,000.

NEWCASTLE, IND.—A. D. Ogborn and others have secured a franchise through Newcastle and Spiceland for an electric railway from Newcastle to Knightstown.

INDIANAPOLIS, IND.—The Indianapolis & Lebanon Traction Company has filed articles of incorporation. Capital stock, $400,000. William Helfenberg heads the board of directors.

TERRE HAUTE, IND.—As the result of a religious revival a man has sent 20 cents to the local company as conscience money, having ridden four times on the line without meeting the conductor.

CINCINNATI, OHIO.—The Cincinnati street railway system, with its franchises, rolling stock and all other rights and equipment, passed into the hands of the Widener-Elkins syndicate on Feb. 21.

PAINESVILLE, OHIO.—Messrs. Tuttle, Goodrich and Stanley, of Geneva, promoters of a line from Geneva to Meadville, Pa., have secured a franchise from Geneva to Painesville by way of Fairport.

TOLEDO, OHIO.—Joseph L. Yost and F. V. H. Collins, representing local capitalists, have applied to the Lucas County Commissioners for a franchise for a road to Holland and Swanton. The franchise will be granted.

NEWBURYPORT, MASS.—Fire destroyed the car sheds of the Georgetown, Rowley & Ipswich Street Railway. Twenty-one cars, three snow plows and many trucks and other equipments were also destroyed. The loss is $75,000.

CRESTLINE, OHIO.—The Cleveland, Elyria & Western interests and the Ohio Central Traction Company are rivals for a road from Galion to Crestline. The local council and the commissioners have advertised for propositions.

COLUMBUS, OHIO.—The Richmond, Marysville & Columbus Electric Railroad Company has been incorporated by F. V. Fullington, William King, R. L. Woodburn, John Hendrixon and N. E. Niggett. Temporary capital stock, $10,000.

INDIANOLA, IA.—The City Council has granted a franchise to the Des Moines & Indianola Railway to build a road from Des Moines to the army post and thence to Indianola. The ordinance will be voted on at an election on March 25.

AKRON, OHIO.—D. Davis, representing the local promoters of the Aurora, Wheatland & Chicago Railway, is placing contracts for the equipment of the road. A contract has been closed for 2000 horse-power of Edgemore boilers. S. Morse, of this city, is engineer for the road.

LAFAYETTE, IND.—The Lafayette, Purdue & Northern Railway Company has been incorporated. Detroit, Indiana and New York capital is said to be behind the scheme. The company has an option on the local railway system and will pay $500,000 for it and take possession April 1.

MANSFIELD, OHIO.—T. Y. McCray and J. F. Boles, promoters of the Mansfield, Mt. Gilead & Columbus Railroad, and the Mansfield, Savannah & Wellington Railroad, have announced that all rights of way have been secured and that grading will be started at once at several points.

LEXINGTON, KY.—The Blue Grass Rapid Transit Company, with a capital stock of $30,000, with privilege of increasing to $1,000,000, has filed papers of incorporation. Electric car lines will be built to Richmond, 26 miles; Winchester, 18; Paris, 18; Georgetown, 12; Versailles, 13; Midway, 12.

NORFOLK, VA.—An ordinance has been referred to the Councils, which, if passed, will require the Norfolk Railway & Light Company and the Norfolk & Atlantic Terminal Company to adopt a double-wire system instead of its single-wire trolley system, in order to prevent damage to water mains.

CAPE MAY, N. J.—Vice-Chancellor Reed has signed a decree ordering the sale of the Cape May, Delaware Bay & Sewell's Point Railroad Company, the trolley line along Cape May's beach front. This sale is made to satisfy the claims of the holders of the $300,000 of bonds of the company, on which interest has not been paid for some time.

CLEVELAND, OHIO.—The belief is expressed in Cleveland railway circles that Henry A. Everett is making an effort to secure control of the Cleveland City Railway Company, of which M. A. Hanna is president. If control of this company is secured, the much-talked-of consolidation of Cleveland interurban companies will probably be effected.

DETROIT, MICH.—The Wyandotte & Detroit River Electric Railway, running from Detroit to Trenton, was purchased from J. C. Hutchins of Detroit, A. B. Dupont of St. Louis and other owners, by the Detroit United Railway. President Everett says the new purchase will be consolidated with the United Railway Company and operated in the same way as the city lines.

THE NORTHWEST RAILWAY CLUB.—At the regular monthly meeting of the Northwest Railway Club, held at the West Hotel, Minneapolis, Minn., Feb. 13, a paper on "Electric Traction for Heavy Railway Service," read by Mr. E. P. Burch at the previous meeting, was discussed. Prof. Shepardson of the University of Minnesota gave a lecture on "The Principles of the Dynamo."

COLUMBUS, OHIO.—The Franklin County Commissioners have granted a 25-year franchise to the Columbus & Southern Railway Company. The Scioto Valley Traction Company, a rival road, has abandoned its efforts to secure a franchise in the county and has purchased a private right of way. The latter company has placed contracts for rails and will commence construction work at once.

ALBANY, N. Y.—The Monticello, Fallsburg & White Lake Railroad has been organized to build a new 16-mile trolley road through Sullivan County, N. Y., to carry passengers, freight and dairy and farm products between Monticello, Fallsburg and White Lake. The first section of the road is to be in operation by July 1, and is to be run in connection with the New York, Ontario & Western Railroad.

CLEVELAND, OHIO.—Mayor John Farley has presented to the City Council a second franchise extension ordinance in favor of the Cleveland City Railway Company. It shows several changes from the ordinance submitted to the Chamber of Commerce some weeks ago, although they are comparatively unimportant. It is not generally believed in Cleveland that the ordinance will pass, as the citizens are against it.

PHILADELPHIA, PA.—The stockholders of the Carbon County Electric Railway Company have voted to increase the present capital stock of $60,000 to $300,000. The increased capital will be used to improve the present line and to make extensions through Lehighton to Millport, and from Lehighton to Stroudsburg and the Delaware Water Gap. A new power house is also to be erected between Mauch Chunk and Lehighton.

CHICAGO, ILL.—The Chicago & Des Plaines Valley Electric Railway Company and the Des Plaines Valley Electric Railway Company have been consolidated under the name of the Chicago & Des Plaines Valley Electric Railway Company. The capital stock of the consolidated company is fixed at $1,000,000. The parties to the consolidation contemplate the construction of an electric line from Joliet into Chicago via the Des Plaines Valley. The first board of directors of the consolidated company are Clayton E. Crafts, Samuel G. Decoursey, Henry J. Crowley, Philip H. Gray, George Simpson Eddy and C. L. S. Tingley.

COLUMBUS, OHIO.—A deal has been practically closed for the purchase of the property of the Columbus, Buckeye Lake & Newark Traction Company by Gen. A. H. Warner of Marietta, Pomerene Brothers of Coshocton, Michael Spellacy, A. E. Appleyard and others of Columbus. The company has a capital stock of $1,000,000 and was organized about five years ago. It has changed hands several times and about 20 miles of road have been built. The new promoters are closely identified with the Columbus, London & Springfield and the Dayton, Springfield & Urbana roads, and it is said to be the intention to consolidate the three roads into one trunk line about 100 miles in length. There is talk also of connecting Newark with Zanesville, giving an additional 35 miles.

AKRON, OHIO.—The annual meeting of the stockholders of the Northern Ohio Traction Company was held Feb. 17. The former officers and directors were re-elected, with the exception of H. A. Everett, the former president, who retired in favor of E. W. Moore, of Cleveland. L. E. Beilstein will continue as general manager and will not go to Detroit, as has been reported. The annual report showed the gross earnings for the year as $425,880. The operating expenses were 61 per cent, and the interest charges $125,000. The dividend on preferred stock amounted to $25,000, leaving a balance of $30,000 in the treasury, to be applied to common stock. The stockholders voted favorably on the question of buying the property of the Akron & Cuyahoga Falls Rapid Transit Company; decided to increase the common stock of the company to $2,500,000, and voted to amend the articles of incorporation to authorize the construction of lines to Canton and Kent. The common stock of the company is at present $2,000,000 and the preferred $1,000,000. The entire stock, by the issue of $500,000 of new common stock, will amount to $3,500,000.

THE AUTOMOBILE.

THE AUTOMOBILE CLUB OF CALIFORNIA has arranged for quarters in the Parrott Building, San Francisco.

IN THE PHILIPPINES.—The first automobile in the Philippines is an electric machine, imported for the use of the Signal Corps.

AUTOMOBILE MAIL WAGON IN WINNIPEG.—Winnipeg, Manitoba, is to have an electrical automobile mail carrier for the conveyance of mail to and from stations and street box collections.

NEW YORK STATE.—In the State Senate, Mr. Hennesy has introduced a bill exempting from the application of Section 155 of the Highway Law regarding the posting of an advance guard to warn people of the approach of a steam traction engine, any carriage or motor vehicle propelled by steam developing less than 25 horse-power.

CHICAGO, ILL.—A strike occurred last week in the Illinois Electric Vehicle Transportation Company. The drivers, who organized a few months ago under the jurisdiction of the United Brotherhood of Electrical Workers, went out because of a system introduced by the company to change the wages paid from $2 a day of 12 hours to 20 per cent of the gross earnings. The men presented an agreement to Superintendent Jenkins calling for a wage scale of 16⅔ cents an hour, with a 12-hour day.

BOSTON, MASS.—The Automobile Club of New England has opened its new quarters on Newton Street, Brookline, the property being that formerly occupied by the Suburban Club, directly opposite the Country Club. The clubhouse has undergone such changes as to adapt it to its new uses that the former members of the old social club would hardly recognize it as the same building in which they once entertained and were entertained. Where handsome carriages and noble horses were once sheltered are now to be found the finest specimens of motor vehicles that the country affords. There were electric, gasoline and steam vehicles, making altogether as fine a collection as could be shown by any American automobile club.

NEW INDUSTRIAL COMPANIES.

THE W. G. NAGLE ELECTRIC COMPANY has been incorporated at Toledo, Ohio, with a capital stock of $50,000.

THE AMERICAN ELECTRICAL NOVELTY & MANUFACTURING COMPANY, of New York City, has been incorporated in Illinois with a capital stock of $25,000. The Illinois capital stock is $2,500.

THE MOTOR MANUFACTURING COMPANY has been incorporated in Eureka, Calif. Directors: A. L. R. Hendricks, D. C. McDoneld, F. W. Pease, F. E. Cook and G. T. Rolley. Capital stock, $25,000; subscribed, $930.

THE FRESNO MOTOR COMPANY has been incorporated, with Fresno, Calif., as the place of business. Directors: F. G. Berry, W. H. McKenzie, G. S. Calyuhoun, O. B. Olufs and J. W. Cate of Fresno. Capital stock, $100,000; subscribed, $9,500.

THE ELECTRIC INSULATION COMPANY, with a capital of $400,000, has been incorporated at Newark, N. J., to manufacture electric supplies. Incorporators: Elijah Woodward, Newark, N. J.; C. H. S. Woodward, Louis A. Ziegler, attorney, Newark, N. J.

THE AMERICAN WAVE MOTOR COMPANY was recently incorporated with Los Angeles, Calif., as the principal place of business. Directors: A. L. Stevens, V. G. Gifford, A. Villinger, D. S. Gillespie, W. A. Colwell, H. G. Watkins and W. C. Petchner. Capital stock, $300,000; subscribed, $150,000.

LEGAL.

ILLEGAL USE OF MAIL SIGNS.—Papers have been filed with United States District Attorney Evans by the postal authorities at St. Paul, Minn., looking to the prosecution of the Twin City Rapid Transit Company for an illegal use of the "U. S. Mail" sign upon its cars. The company carries the mail between St. Paul and Minneapolis, but has for a long time had the "U. S. Mail" sign painted upon the sides of numerous cars not engaged in this traffic. The statute imposes a penalty of from $100 to $500 fine per car. It is understood that labor organizations throughout the country have urged the Government to take steps to have such signs removed from street cars, it being alleged that they were used for the purpose of intimidating labor unions in case of strikes.

OBITUARY.

MR. T. H. McLEAN.—Thomas H. McLean, manager of the Toledo Traction Company, died of pneumonia at Toledo, O., on March 1. He was formerly manager of the Twenty-Third Street Railway of New York, the Citizens' Street Railway of Indianapolis, and the electric lines in the City of Mexico. He went to Toledo in 1898. He was a man of agreeable personality and marked ability, and stood high in the American Street Railway Association, of which he was an active member.

MR. JOHN P. MADDEN, deputy commissioner of highways of Long Island City, died last week in Texas of consumption. He was only 38 years old. At one time he ran for mayor of the Gleason bailiwick, and then began the publication of *Electrical Doings*, a paper of some merit. He dropped the enterprise after a couple of years and got into politics.

PERSONAL.

MR. T. F. RYAN has been elected a director of the Union Elevated Road of Chicago.

DENSMORE & LE CLEAR, the engineers, of Boston, are removing their offices from Exchange Place, in that city, to the Whittier Building, on Exchange Street.

IRA FRANCIS, city electrician of Los Angeles, Calif., has left that office to become the Southern California representative of the John A. Roebling's Sons Company.

MR. W. W. DONALDSON, of Baltimore, Md., an engineer of long experience in accumulator work, has become associated with the New York interests of the Gould Storage Battery Company.

MR. J. GILMOUR no longer represents the interests of the Whiting Foundry Equipment Company of Harvey, Ill., in New York and vicinity. He has been succeeded by Mr. Edward J. Etting.

MR. AXEL HULTMAN, of Stockholm, a Swedish governmental telephone engineer, is visiting this country on a tour of inspection, and has gone West after a study of the Bell system in New York.

MR. CHARLES T. YERKES, although he has sold out his street railway interests, will continue to reside in Chicago. He will devote himself to his London underground road and his newspaper the Chicago *Inter-Ocean*.

MR. F. H. NALDER, of the well-known English firm of Nalder Brothers & Thompson, electrical instrument manufacturers, is to sail on March 13 for the United States, where he has a great many friends and acquaintances.

MR. T. A. EDISON is reported from the South to have been enjoying the sights of Jacksonville, Fla., with Mrs. Edison and family, en route for his plantation near Punta Gorda, where he proposes to spend the month of March.

MR. CALVERT TOWNLEY, heretofore manager of the Boston office of the Westinghouse Electric & Manufacturing Company, has been promoted to the position of general agent, with headquarters at 120 Broadway, New York City.

MR. C. G. ROEBLING, a leading member of the house of John A. Roebling's Sons Company, is, we regret to say, undergoing an operation this week for appendicitis at Roosevelt Hospital. A speedy recovery is earnestly hoped by hosts of friends.

MR. W. P. HALL, of the Hall signal works at Garwood, N. J., and the well-known inventor of the electrical system bearing his name, is, it is stated, to conduct the revival meeting at Plainfield, N. J., under the direction of the Ministers' Association.

DR. M. I. PUPIN has been selected by Columbia University to be its representative at the ninth jubilee of Glasgow University, to be held in June. He has also been promoted to a full professorship with the title of Professor of Electro-Mechanics.

MR. W. W. MARKS.—It is understood that this well-known veteran cable manufacturer has connected himself with an important rubber insulating company as expert and superintendent of the works, news that will give much pleasure to many old friends.

MR. CLARENCE BUCKINGHAM has been elected president of the Northwestern Elevated of Chicago. Mr. Clarence A. Knight has been elected temporary president of the Lake Street Elevated, and Mr. J. B. Dennis of New York president of the Union Loop.

MR. R. L. WARNER, who has been in charge of the engineering and commercial work for the Westinghouse Electric & Manufacturing Company in Southern New England, has been promoted to the position of manager of the Boston office, to succeed Mr. Calvert Townley.

MR. J. AMBOR, an importer of electrical supplies and mechanical rubber goods, of Hamburg, Germany, is now in this country for a short time and will be glad to learn of any specialties and novelties he can represent. He may be addressed in care of the ELECTRICAL WORLD AND ENGINEER.

JUDGE J. M. THOMAS, the energetic president of the National Independent Telephone Exchange Association, whose headquarters are in Cleveland, is spending a good deal of time just now at the Holland House, New York, in order to keep in touch with the important developments now going on.

CAPT. G. O. SQUIER, U. S. N. Signal Corps, now laying Government cables in the Philippines, contributes a very interesting article on "The Influence of Submarine Cables upon Military and Naval Supremacy" to the last quarterly issue of the Proceedings of the United States Naval Institute.

MR. BENJAMIN HAYLLAR, JR., who for some time past has been connected with the Walker & Kepler electrical supply house, Philadelphia, has just become associated with the Mayer & Englund Company, 10 South Tenth Street, in that city. Mr. Hayllar's many friends wish him success in his new position.

MR. WM. J. BARRETT, of Los Angeles, Calif., who has heretofore ably looked after the interests of the John A. Roebling's Sons Company in Southern California, has resigned that position and will have charge of the Westinghouse Electric & Manufacturing Company's business hereafter in that territory.

MR. HENDERSON W. KNOTT, chief engineer of the Imperial Electrical Supplies, Ltd., is visiting this country and making arrangements for his company, which has a large connection all over the world. Mr. Knott has had engineering experience in this country and "knows the ropes." He will be here for a few weeks.

MR. CHAS. J. GLIDDEN, president of the subsidiary companies of the Erie Telephone System, is at Galveston, Tex., on a tour of inspection of the Erie Company's property. He will visit the principal cities of Texas, Arkansas, Minnesota, Wisconsin, Michigan and Ohio, returning to Boston the latter part of March.

MR. EDWARD WESTON and wife, while staying at the Waldorf-Astoria this week, had the exciting experience of finding a Brazilian in a closet in their room after retiring. The noise he made betrayed him, and the distinguished electrician was then, as usual, fully equal to the occasion. The intruder was soon locked up by the police.

MR. S. H. ROSENBLATT.—Zimmermann & Forshay announce that Mr. Sig H. Rosenblatt has been admitted to partnership in their firm and that the businesses become consolidated under the present firm name of Zimmermann & Forshay. The constant increase of their stock clientele renders an increased representation in the Stock Exchange necessary and is attained by the advent of Mr. Rosenblatt, who, with Mr. L. Zimmermann and Mr. L. Schafer, will compose their membership in the board. Mr. Rosenblatt has a wide circle of acquaintances and friends in the electrical field.

COL. W. S. ROGERS, a prominent man in the old Brush electric lighting industry, is promoting an enterprise to cure consumption by electricity. His headquarters are in Cleveland. He says: "The company will be launched shortly. At this time I cannot say just whom you will find in the directorate or in the official capacities, but they will be representative financiers of Cleveland, and there are also a few from the East. The company is financing a new invention. An absolute cure for consumption has been found. Electricity will play a prominent part in the cure we are advancing, and we anticipate that the ends we aim at will be attained. Medicine plays no part whatever."

MR. J. P. ORD has resigned the second vice-presidency of the General Electric Company. It was reported that Mr. Ord had resigned to become head financial man of the United States Steel Corporation. Mr. Ord, however, denies positively that there is any truth in the report. He would say nothing regarding his future plans. As comptroller of the company and of the old Edison General Electric Company, Mr. Ord has long enjoyed a well-deserved reputation for financial ability of a high order. His annual reports have stood high for their clearness and fullness and have won general commendation from the financial and lay press. Of late his services have been called in for some of the larger consolidations and reorganizations.

MR. T. C. WOOD, president of the Ball & Wood Engine Company, has just done a very graceful thing. A special dispatch from Annapolis, Md., of March 2, says: "At the Naval Academy this morning a new stand of colors, the gift of a graduate of the academy, Thomas C. Wood, of New York, an ex-lieutenant in the Navy, was presented by his daughter, Miss Jessie C. Wood, to the battalion of naval cadets. In presenting the colors Miss Wood said: 'It is to me a delightful duty to present to you these colors, the gift of my father, once a member of this battalion, and who in the Spanish-American war renewed his allegiance to the service he loved and still loves so well. In his name I present them. They are the colors of your country, and I am sure they will be safe in your hands.'" Mr. Wood, as an officer on the "Mayflower," had a very warm half hour in the ever-memorable destruction of Cervera's fleet at Santiago.

Trade Notes.

CINCINNATI, OHIO.—The Jones Bros.' Electric Company has increased its capital stock from $136,000 to $400,000.

THE SANBORN MARSH ELECTRIC COMPANY has succeeded the Advance Electric Company, Indianapolis, Ind.

THE AMERICAN BRIDGE COMPANY is furnishing to Wm. Young & Company, Mexico City, Mex., eight bridges to be erected over the Sacramento Canal at Torreon, Mex.

OIL FILTERS.—The Badger Brass Manufacturing Company, Kenosha Wis., has just installed a No. 1 special Cross oil filter, purchased from the Burt Manufacturing Company of Akron, Ohio.

THE ELECTRIC APPLIANCE COMPANY, Chicago, owns the factory in which "Crystal Lake" cross arms, pins and brackets are made. It claims, therefore, to be in an excellent position to make prompt and satisfactory shipments.

TRANSFORMERS.—Core type transformers for three-wire secondary service form the subject of a pamphlet of recent issue by the General Electric Company. This type of transformer is well described and illustrated by general and sectional views.

ELECTRIC WINCHES FOR WHITE STAR STEAMERS.—It is stated that the White Star Line will replace its steam winches by electric winches on its steamers for the purpose of handling the cargo, gang planks, etc. The contract for the installation of the electrical plant, it is stated, has been signed.

THE ELECTRIC SUPPLY & CONSTRUCTION COMPANY, of Alliance, Ohio, has commenced business at 17 South Liberty Street, that city. It will carry a large line of electrical supplies and apparatus and will do electrical construction work of all kinds. Mr. S. Franklin Jones is at the head of the company.

FIRE ALARM CONTRACT.—Pasadena, Calif., has just closed a contract with the Gamewell Fire Alarm Telegraph Company for a four-circuit storage battery switchboard and 100 chloride accumulators for the city's 24-box fire alarm system. Additional apparatus for a new engine house is also included in the contract.

STEAM GENERATORS.—The Wickes vertical water tube safety steam boiler, manufactured by Wickes Brothers, Saginaw, Mich., is very completely described in a pamphlet issued by the company. Various illustrations scattered throughout the pages show the process of manufacture, and sectional views of the boiler; also views of several boiler plants.

NEW STREET CAR PLANT.—Mr. G. C. Kuhlman, of Cleveland, manufacturer of street cars, is preparing to incorporate a stock company with large capital to take over his business. Plans are being considered for the erection of a large plant which will be located in the vicinity of Cleveland. It is stated that the new plant will have four times the capacity of the present factory in Cleveland.

NEW BOSTON OFFICE.—The Standard Underground Cable Company has removed the headquarters of its Northeastern sales department to the Tremont Building, Tremont and Beacon Streets, Boston, Mass. Mr. A. B. Saurman is manager of this department and will be glad at any time to meet the company's customers and friends. Mr. Saurman has exhibit samples of the company's wires, cables and accessories.

NEW TYPE DIRECT-CURRENT MOTOR.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is placing upon the market a new type of direct-current motor. This machine is described and illustrated in Bulletin No. 3028, just issued by the company. These machines are made in sizes from ¼ to ½ actual horse-power. The company intends to make larger sizes as soon as the designs can be completed.

MECHANICAL DRAFT.—A third edition of Walter B. Snow's lecture on "The Influence of Mechanical Draft upon the Ultimate Efficiency of Steam Boilers" has just been issued by the B. F. Sturtevant Company of Boston, Mass. It treats of the different methods of application of fans for producing boiler draft, of the relative cost as compared with a chimney, of the possible economy in first cost of boilers, running expense for fuel, etc. Copies may be obtained upon application.

THE STERLING ELECTRIC MOTOR COMPANY, of Dayton, Ohio, is sending out its new price list and schedule of ratings of Sterling electric motors, which will be mailed upon application to any one interested. It is claimed that the company's success in supplying motors for active service is due to its devoting its entire time and attention to the manufacture of small motors of one horse-power and under, and that this concentrated effort has made the Sterling motor all that the name implies.

THE STANDARD PNEUMATIC TOOL COMPANY, of Chicago, manufacturer of the "Little Giant" air tools and appliances, has moved its New York offices from 619 Washington Life Building to more commodious quarters at 611-612-613 of the same building, this being necessitated on account of the great increase in its business in Eastern and foreign territory. All shipments for Eastern and foreign customers will be made from New York instead of Chicago, thus expediting the delivery of machines.

THE CREST MANUFACTURING COMPANY, of Cambridgeport, Mass., has sent out with its motors a number of the Loomis carburetters, made by the Loomis Automobile Company, of Westfield, Mass. The results have been so excellent that it has given an order for 250 carburetters, which is shortly to be followed by another large order. It was the combination of the Crest motor with the Loomis carburetter that did the extraordinary hill climbing at the Cycle and Automobile Show in Madison Square Garden in January.

A HANDY ATLAS.—The Bullock Electric Manufacturing Company is distributing a small atlas of the world. It points out on the cover that its machines are in operation in nearly every country shown in the atlas. This little work will be very handy and serviceable to those fortunate enough to secure a copy. It is of convenient size for desk use and is always at hand for reference. There are about 90 pages of maps, besides a list of the principal cities of the United States, giving their population at the last and preceding censuses. A few of the leading types of Bullock machines are also illustrated.

MESSRS. CHARLES H. BESLY & COMPANY, 10 and 12 North Canal Street, Chicago, Ill., are now in a position to handle their increasing business promptly and carefully. Numerous orders for their Helmet oil, Perfection and Bonanza oil cups are being received. They are very busy in their tap and die department at their factory in Beloit, and are receiving many orders for the Gardner disk grinders. Among others, recent shipments have been made to Ohio, Massachusetts and New York, and also to the Rock Island Arsenal at Rock Island, Ill. Their new 300-page catalogue is now ready for distribution and will be mailed free to any address upon application .

POWER TRANSMISSION MACHINERY.—The Hyatt flexible roller bearing as an anti-friction appliance is stated to be a saver of power. It is said that this bearing will save from 25 to 60 per cent of the frictional load, according to the class of machinery, the load, size of bearing, etc. This bearing, which has been illustrated in these columns, is described and illustrated in a new pamphlet just issued by the company. Many styles of roller bearings are shown. During the last few months the Hyatt Roller Bearing Company, Harrison, N. J., has largely increased its facilities and is now keeping constantly on hand a large stock of standard goods, from which shipments can be made promptly.

ELECTRIC TRAVELING CRANES.—The line of electric traveling cranes manufactured by Pawling-Harnischfeger, Milwaukee, Wis., is described and illustrated in a very artistic manner in a catalogue of 132 pages. Many very excellent half-tones show various establishments throughout the country using this firm's cranes, and others illustrate the different types of cranes turned out by the concern. Besides the large line of standard cranes, the firm also designs and erects many of special character for handling material in situations where a crane of the usual type would be inadaptable. The motors used in these cranes are of the firm's own make, and designed especially for this service. They are of the four-pole steel-clad type, and have, it is stated, very large starting torque and slow speeds. Each motor has its own reversible controller and rheostat.

ELMER G. WILLYOUNG, the instrument expert and manufacturer, has been compelled, owing to the increasing demand for his instruments, to seek larger quarters, and has removed his office, drafting room, show room and experimental laboratory to 10 Frankfort Street, New York (just opposite the *World* building). Here he has 1500 square feet of space. His laboratory is being very thoroughly equipped for all high grade standardizing work, and such work will now be vigorously solicited in addition to the regular trade. As a part of the equipment may be mentioned a complete set of Reichsaustalt standards of resistance from 10 ohms down to 0.0001 ohm, and carrying current from 1 to 10,000 amperes. A very complete photometer, with rotator, improved Lummer-Brodhun screen, etc., will also be set up. Mr. Willyoung publishes a very complete line of catalogues and circulars, which are free to interested parties.

THE VICTOR TURBINE.—Some valuable improvements have been made in the details of construction of the Victor turbine, manufactured by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio. These, it is stated, have greatly strengthened the wheel, rendering it more durable under the severe shocks and strains incident to modern practice in the use of water power. The company has just issued a catalogue of 184 pages, describing and illustrating many of the wheels manufactured by it. The wide range of work done by this company is very clearly indicated in this catalogue. The company builds numerous special designs of wheels not illustrated. It makes a specialty of complete water power plants for all purposes and is prepared to send competent engineers to examine water powers and make plans for their improvement. The catalogue includes illustrations and descriptions of the Victor high-pressure turbine, which is stated to be giving excellent satisfaction under high loads.

THE PARKER STEAM GENERATOR, built by the Parker Engine Company of California, is a steam boiler constructed on practically new lines. The principal claims made for it are that it is highly efficient, economical and safe. In developing this boiler the aim of the manufacturer was to combine the economizer and boiler in one compact and simple machine, requiring less space and reducing the first cost; to maintain a positive flow of water and steam within the tubes always in one direction, ensuring the tubes permanently against fire and securing absolute safety; to provide full release for the steam, and to eliminate the effects of bad water and hard firing, varying pressures, etc.; to provide accessibility to every square inch of surface, both inside and outside; to make leaks impossible, and, finally, to secure perfect reliability in operation under the roughest usage. A description of the complete construction of the boiler is given in a pamphlet of recent issue. The subject matter is also illustrated with general and sectional views of the apparatus. The home office of the company is at 123 Crocker Building, San Francisco, Calif., and the general offices and sales department in the Drexel Building, Philadelphia.

FOR INSTANTANEOUS FIRE ALARMS.—A revolution in the method of giving fire alarms was undoubtedly started last Wednesday when the New York Board of Fire Underwriters passed a resolution unanimously which approved the fire detecting wire now universally known as the Montauk Multiphase cable. The words of the resolution were as follows: "Resolved, That this board approves of the fire detecting wire hereafter described, as a fire alarm device for use in dwelling houses and other buildings in which it can be substituted for bell wires, and also by judicious distribution and arrangement in elevator and dumbwaiter shafts, coal and wood cellars, closets, store rooms and other unoccupied rooms, so as to give timely warning of fire and thus contribute to the greater safety of human life. (This fire detecting wire consists of two conductors. The central wire or core, which forms one side of the circuit, has a thick coating or wall of fusible metal; over this is an insulated coating. A number of fine wires are wound over this coating to form a second conductor. The whole is then covered with suitable insulation. When flame or a dangerous degree of heat comes into contact with this wire it will establish electrical connection between the two conductors and give a signal on the premises equipped.)" The description of the wire attached to this resolution conveys some idea of its manifold usefulness. It is manufactured to fuse at any desired temperature, from 150 degs. F. to 370 degs. F. The adoption of this twentieth century device by the New York Board of Fire Underwriters is adequate proof that they are on the alert.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 26, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

668,622. SECONDARY BATTERY; W. R. Bowker, Waltham, Mass. App. filed Feb. 16, 1900. A storage battery electrode, comprising a porous receptacle filled with the active material, and a conducting plate or sheet having flanges extending beyond the active material and inclosing the edges of the porous receptacle to prevent the escape of the active material, and form vertical and horizontal conducting surfaces.

668,630. ELECTRIC LAMP PROTECTOR; E. Eckl, Milwaukee, Wis. App. filed March 31, 1900. The lamp socket is set into the face of a signboard and a protecting shield surrounds the opening into which the neck of the lamp passes.

668,650. DOOR LOCK; C. J. Letzing, Boston, Mass. App. filed Sept. 20, 1899. Details.

668,653. TELEPHONE SIGNALING DEVICE; W. O. Meissner, Chicago, Ill. App. filed July 5, 1898. The movement of the hook switch is used to open and close the induction coil circuit a number of times to send in the calling current, thereby dispensing with the magneto.

668,661. ELECTRIC BATHING APPARATUS; O. Schneider, New York, N. Y. App. filed July 12, 1900. A bath tub provided with an arrangement of electrodes for passing a current through various parts of the body.

668,662. MOLD BOX OR FORM FOR CONDUIT JOINTS; J. O. Therien and A. E. Gregory, Minneapolis, Minn. App. filed Oct. 11, 1900. A form placed around the joint to receive cement.

668,662. ELECTRIC SWITCH; J. H. Spangler, Pittsburg, Pa. App. filed Feb. 21, 1900. The switch is moved by a solenoid thrown into circuit by the motorman operating through his controller. The movement of the switch is cushioned by an air cylinder.

668,664. STORAGE BATTERY SYSTEM FOR SIGNALING CIRCUITS; N. H. Suren, Needham, Mass. App. filed June 19, 1899. A switch for throwing the battery into and out of the circuit without causing a tap of the bell.

668,666. JUNCTION BOX FOR ELECTRIC LIGHTING SYSTEMS; M. Waddell, New York, N. Y. App. filed Jan. 31, 1900. A box containing a switch whereby the battery can be connected in series for charging and in parallel for discharging.

668,667. CHARGING SYSTEM FOR SECONDARY BATTERIES; M. Waddell, New York, N. Y. App. filed Feb. 15, 1900. Circuit breakers are automatically operated when the engine is reversed, the engine being used normally for propelling forward, but occasionally for backing.

668,689. ELECTRIC ATTACHMENT FOR RAILWAY SCALES; M. H. Reed, Pittsburg, Pa. App. filed March 30, 1900. An electric signal used in connection with railway trains to indicate whether or not all conditions are secured for properly weighing the car.

668,690. ELECTRIC ACCUMULATOR; P. F. Ribbe, Charlottenburg, Germany. App. filed April 30, 1900. A folded plate having slots with strips threaded through the slots to hold the folds of the plate apart.

668,702. TELEPHONE TRANSMITTER; D. H. Wilson, Chicago, Ill. App. filed April 29, 1899. Granulated carbon is placed in a holder in such shape as to make the body of the carbon thicker through the centre than at the edges, and being mounted so that the middle portion only comes in contact with the centre of the diaphragm.

668,708. ELECTRIC CAR LIGHTER; C. A. Bernhardt, Detroit, Mich. App. filed Jan 15, 1900. Details.

668,710, 668,711 and 668,712. ELECTRIC RAILWAY; G. H. Davis, New York, N. Y. App. filed Sept. 15, 1900. (See Current News and Notes.)

668,761. APPARATUS FOR CONNECTING STORAGE BATTERIES WITH CHARGING LINES; N. H. Suren, Needham, Mass. App. filed June 29, 1899. An arrangement of switches whereby the batteries can be connected with the charging circuits in different ways, in order to match the electromotive force of the batteries to that of the charging current.

668,779. APPARATUS FOR CONTROLLING CONNECTIONS OF STORAGE BATTERIES WITH CHARGING CIRCUITS; N. H. Suren, Needham, Mass. App. filed June 29, 1899. Relates to the preceding patent.

668,781. ELECTRIC TRACTION SYSTEM; S. P. Thompson and M. Walker, London, Eng. App. filed Oct. 22, 1897. A switch for connecting studs in the roadway with the feeder, consisting of a magnetizing coil placed around a plunger which occupies that part of the magnetic field in which the resulting magnetic pull, whatever current may be passing in the coil, is less than the resultant of all the forces which tend to keep the switch open.

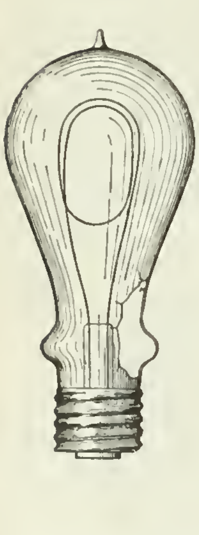
668,819. RAILWAY SIGNALING APPARATUS; W. Hume, New Broad Street, County of London, Eng. App. filed Oct. 6, 1898. A contact carried by a train is constructed with a certain relation to certain contacts in the track, so that each train will, in signaling ahead, indicate what particular train it is.

668,838. VOLTAIC BATTERY; H. D. F. De Lavison, Paris, France. App. filed July 19, 1899. Heated air is conducted to the interior of a cell in close proximity to the copper electrodes, so as to absorb the disengaged hydrogen.

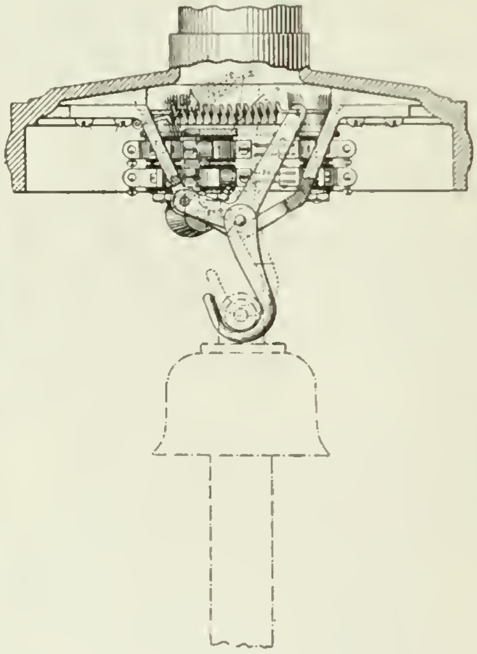
668,868. ALTERNATING CURRENT SERIES ARC LAMP; M. H. Baker, New York, N. Y. App. filed Sept. 5, 1899. Relates particularly to the cut-out, the same being included in a shunt across the arc, independent of the usual shunt magnet circuit.

668,869. RELAY; Sidney George Brown, Bournemouth, England. App. filed Nov. 14, 1899. A dynamo has such a field structure that normally no current is induced in the armature. When arrival currents are led through auxiliary conductors on the field, the magnetic balance is destroyed and the armature furnishes current.

668,886. ELECTRIC ARC LAMP; P. H. F. Spies, Mount Vernon, N. Y. App. filed June 5, 1900. Improvements in the clutch and in various details of the lamp.



668,904.—Incandescent Electric Lamp.



668,905.—Automatic Circuit Closer for Arc Lamp Circuits.

668,887. ELECTRIC SWITCH; P. H. F. Spies, Mount Vernon, N. Y. App. filed Aug. 2, 1900. A separable switch adapted for raising and lowering chandeliers.

668,889. TELAUTOGRAPH; G. S. Tiffany, Evanston, Ill. App. filed Oct. 19, 1900. Relates to the means whereby the transmitting tracer effects the movement of the receiving pen into and out of contact with the paper; also means for maintaining certain controlling parts in a state of vibration to reduce the friction of such moving parts.

668,890. TELAUTOGRAPH; G. S. Tiffany, Evanston, Ill. App. filed Oct. 19, 1900. Relates to the preceding patent.

668,891. TELAUTOGRAPH; G. S. Tiffany, Brooklyn, N. Y. App. filed Nov. 20, 1900. An improved inking device.

668,892. TELAUTOGRAPH; G. S. Tiffany, Brooklyn, N. Y. App. filed Dec. 20, 1900. Relates to the three preceding patents.

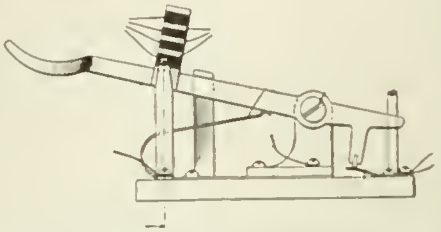
668,893. TELAUTOGRAPH; G. S. Tiffany, Brooklyn, N. Y. App. filed Dec. 20, 1900. Belongs to the system described in the preceding patents to the same inventor.

668,894. TELAUTOGRAPH; G. S. Tiffany, Brooklyn, N. Y. App. filed Dec. 20, 1900. Ditto.

668,895. METHOD OF TELAUTOGRAPHIC TRANSMISSION; G. S. Tiffany, Brooklyn, N. Y. App. filed Dec. 21, 1900. Ditto.

668,903. ELECTRIC BOND FOR RAILWAY RAILS; H. P. Brown, Montclair, N. J. App. filed April 7, 1900. The bond is a strip inserted between the web of the rail and the fishplate and having associated with it a spring or springs for holding its body portion in contact with the rail.

668,904. INCANDESCENT ELECTRIC LAMP; C. H. Chase, Chicago, Ill. App. filed Dec. 8, 1900. The neck of the lamp, just above the base, is formed with a bulging annulus, from which the moisture drips before it can reach the metallic portions.



668,653.—Telephone Signaling Device.

668,905. AUTOMATIC CIRCUIT CLOSER FOR ARC LAMP CIRCUITS; G. R. Davison, Newark, N. J. App. filed July 24, 1900. The weight of the lamp on its supporting hook acts in opposition to a spring to control the local circuit to the lamp.

668,909. ELECTRIC SWITCH; C. J. Doran, J. C. App. filed Sept. 11, 1900. Details.

668,931. TROLLEY CATCHER; F. W. Powers and M. L. Snyder, West Lafayette, Ind. App. filed Jan. 8, 1900. The rapid movement of the trolley pole when the wheel leaves the wire is utilized to throw a retaining device into operation to automatically lower the pole.

668,940. ELECTROMAGNETIC SEPARATOR; G. H. Waring, Tyrone, Pa. App. filed Jan. 30, 1900. A drum having annular polar surfaces of varying width and corresponding grooves between them of varying width, so that each particle of ore shall pass equally with every other particle through one or more zones of equally intense magnetic attraction.

668,941. METHOD OF MAGNETICALLY SEPARATING ORES; G. H. Waring, Tyrone, Pa. App. filed April 21, 1900. Method patent accompanying the preceding patent.

668,962. MOTOR GROUPING SYSTEM; F. H. Shepard, New York, N. Y. App. filed Jan. 21, 1901. (See Current News and Notes.)

668,967. SELECTIVE SIGNALING APPARATUS; John A. Barrett, Summit, N. J. App. filed Sept. 20, 1900. Provides a system of telephone station bells adapted for selective signaling on a four sub-station line, the bells have their selectivity determined by differences in arrangement of their magnet windings and in the connection thereof to the main circuit, and in the mode of transmitting the ringing circuit through the main circuit.

668,978. CONTROLLING DEVICE FOR ELECTRIC MOTORS; A. G. Carlson, Chicago, Ill. App. filed May 19, 1899. A coil conductor and a core therefor made up of pieces of magnetic and non-magnetic material; means for separately energizing different portions of the coil causing them to cooperate with the magnetic pieces of the core to produce a movement of the core.

668,979. CONTROLLING DEVICE FOR ELECTRIC MOTORS; A. G. Carlson, Chicago, Ill. App. filed May 19, 1899. Relates to the preceding patent.

668,987. ELECTRIC ATTACHMENT FOR ELEVATORS; D. B. Fleck, Portland, Ore. App. filed Feb. 2, 1900. Details of a signaling system.

669,007. PROCESS OF MANUFACTURING ZINC AMALGAM PLATES; G. T. Eyanson and A. J. Shinn, Philadelphia, Pa. App. filed June 11, 1900. A zinc plate is placed between two layers of zinc amalgam in a mold, and the same are united by pressure and heat.

669,015. ELECTRIC ARC LAMP; G. Rasmus, New York, N. Y. App. filed Nov. 30, 1900. Details.

669,051. DEMAGNETIZER; O. S. Walker, Worcester, Mass. App. filed July 31, 1899. Two magnetic bodies are arranged to be magnetically united by the article to be demagnetized, and a rotating electromagnet is arranged to bring its poles into proximity with said bodies to change their polarity.

669,052. ATTACHMENT FOR STATIC ELECTRICAL MACHINES; G. Werber, Washington, D. C. App. filed April 24, 1900. A section of insulating material is interposed in the discharge rod of either the positive or negative pole of the machine.

669,055. ELECTRIC ARC LAMP; M. H. Baker, New York, N. Y. App. filed Sept. 5, 1899. An adjustable counter-balance is applied to the carbon carrier and tube.

669,056. INCLOSED ARC LAMP; M. H. Baker, New York, N. Y. App. filed March 12, 1900. The shunt magnet causes a movement of the lower carbon and also operates the upper carbon clutch.

669,057. ELECTRIC ARC LAMP; M. H. Baker, New York, N. Y. App. filed March 12, 1900. A modification of the preceding patent.

669,058. ELECTRIC AMALGAMATOR; L. H. Barricks, San Francisco, Cal. App. filed Aug. 6, 1900. Consists of electrolytic boxes having vertical porous partitions, pivotal sectional sluices and supports adapted to an incline whereby the boxes, riffles and sluices may be arranged in series.

669,064. SECONDARY BATTERY; L. W. Collins, Chicago, Ill. App. filed July 7, 1899. Horizontal troughs are set into notches in the frame and welded or fused in place.

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Automobiles in Chicago.

The news that the company running ply-for-hire electric automobiles in Chicago has decided to suspend operations comes as a discouragement rather than a surprise to those who have been watching the situation. Threatened with a serious strike, but unable to increase wages above what was regarded as a fair figure, owing to the heavy cost of operation, the company has decided to abandon its work. This does not mean that electric automobiles will not flourish in Chicago, for aside from a re-organization of the old company, there appear to be others willing to occupy the field, which sooner or later should be one of the best and most profitable in the country.

We had rather hoped that Chicago might show good results, but at the same time had entertained doubts as to the possibility of doing a profitable business at the schedule of prices. So far as we can learn, the cost of maintenance has been extremely high in Chicago, the rubber tires suffering severely from the condition of the streets. The only way to offset heavy operation expenses is to get a large income, but this was denied both by the low tariff and by the lack of liberal patronage. It appears that the use in New York and Boston is proportionately much greater than in the Western center, where the population is overwhelmingly industrial, and where the street car and elevated system is most comprehensive.

We certainly expect to see another attempt made under more encouraging circumstances. Like those of New York, the streets of Chicago are bound to improve, and unlike those of New York, they are already normally level, presenting in that respect ideal conditions for storage battery work. It will be remembered that the question of the battery versus the horse has been most thoroughly thrashed out in these pages by Mr. Fliess and others, with the demonstration on a downright, conservative basis that the battery can compete on more than equal terms. This we still believe to be the truth, and even if it were not, we should still be firm in our conviction that the horse has to go. It has no proper place in city life, and the electric automobile remains one of the best means of replacing it.

The Berliner Decision.

As might be expected, the Berliner microphone decision continues to be a theme of lively discussion in electrical circles. The opinions we quoted last week from a number of well-known concerns and individuals are supplemented by an equally interesting batch this week. It will be noted that in general the independents take hopeful and roseate views, and expect greater activity than ever. As pointed out in an article on another page, from Ohio, it is believed that one immediate effect will be the improvement of apparatus, many old and cheap independent equipments being swept aside and replaced in the march of progress.

One of the elements in the situation is the effect on the telegraph. It is evident that among telephonists at least further encroachments on the earlier art are proposed. But, on the other hand, the Berliner decision may prove to be the salvation of the telegraph service by compelling attention to the desirability of adopting improved "machine," rapid systems. We note elsewhere what is already promised in this direction, and can see no adequate reason why machine telegraphy in the near future may not vastly enlarge the domain now occupied by the sounder and the key. There are various ways in which this result may be effected, and if the telegraph companies should not take up machine work, it seems by no means impossible that the telephone companies may do so, with the object of utilizing their copper circuits after those hours of the day when they are needed wholly for telephone work. The old central station wanted a day load. The modern telephone exchange needs a night load, after the same fashion.

LONG DISTANCE TELEPHONY.

In this issue we print the first of three articles on the several methods which have been proposed in order to attain a sufficient practical approach to the distortionless conductor of Heaviside for long-distance telephone and telegraph work. As pointed out by Dr. Roeber, Heaviside—whose shoulders so worthily bear the mantle of Maxwell—laid down the principles upon which a solution of the problem depends, namely, that the remedy lies in an increase of the inductance of the line, whereby both the distortion and attenuation of the currents may be diminished. Dr. Roeber in his articles will consider three methods that have been offered as practical applications of the Heaviside principle. The first taken up is that of Dr. Pupin, which, though the latest proposed, is the first method to enter the commercial stage. In this case the inventor himself thoroughly developed the mathematical theory involved, and the object of the articles is to perform the same office for the systems of Thompson and Reed, the writer following an analytical method analogous to that used by Dr. Pupin.

THE NATIONAL STANDARDIZATION BUREAU.

We print elsewhere the full text of the bill passed in the closing hours of Congress establishing a National Standardization Bureau. The electrical industry is to be particularly congratulated upon the passage of this valuable measure—first, because of its great importance to that industry, and, second, because its success at the present juncture is gladly acknowledged by those in charge of the measure to be due to the influential support it received from the electrical interests. The American Institute of Electrical Engineers was a potent factor in influencing Congressional opinion through the work of its committee appointed to further the measure, and the appearance of Presidents Kennelly and Hering and other members, before the House and Senate committees in the initiatory stages of the bill.

The selection of Prof. S. W. Stratton as director of the Bureau assures that the objects for which it was established will be thoroughly achieved during his incumbency. As the assistant for a number of years of Prof. Michelson, in whose laboratory some of the most refined physical experiments of the age have been carried on, Prof. Stratton is remarkably well qualified to undertake the task of establishing the standards upon which the work of the Bureau will depend for its value. But scientific attainments alone would not be sufficient where success also depends upon the continued support of Congress and the favor of the industrial interests, to whose needs the Bureau is intended largely to cater. When Secretary Gage selected Prof. Stratton to organize the movement in favor of the Bureau, he doubtless had in view the second qualification above implied, and the wisdom of his choice is certified by the result. We feel confident that in his attitude toward the industrial interests concerned in the work of the Bureau, Director Stratton will also be found an administrator fully equal to the demands upon him.

It will, of course, require some months to organize the Bureau, and perhaps a year or more will elapse before it is quartered in the building for which Congress provided in the act. We most sincerely hope, however, that one of the first objects to be provided for will be the testing and supply of secondary incandescent lamp standards, upon application of lamp manufacturers and central stations. This object more, perhaps, than all others combined, rallied the electrical industry in support of the Bureau, and its rapid attainment will serve to keep this interest unflagged—indeed, will still further enhance it. As the appropriation becomes available July 1, we hope it may be possible to inaugurate this branch of the service in the present quarters of the office of Standards, Weights and Measures, which department is now merged into the Standardization Bureau.

THE OSMIUM INCANDESCENT LAMP.

We publish this week some notes on the new incandescent lamp devised by Dr. Auer von Welsbach, possessed of a filament formed of the rare metal osmium. One regards with instinctive respect the work of this distinguished investigator, yet in this instance we are disposed to the opinion that—to drop into the vernacular—he has "barked up the wrong tree." On general principles there is no reason to suppose that the efficiency claimed of 1.5 watts per candle or better for some hundreds of hours is either a misstatement or an exaggeration. On the contrary, aside from the evident mechanical difficulties of producing a filament from a substance of such crystalline tendencies as osmium, inherent probability is in favor of the properties claimed. Osmium is nearly or quite infusible, and at the highest attainable temperatures evaporates somewhat after the manner of arsenic. But it appears to be entirely stable at or about the melting point of platinum and certainly will stand a far higher temperature than carbon filaments at their best. As efficiency in the production of light by incandescence is merely a matter of high temperature, osmium should give, as it apparently does, very remarkable results.

The difficulties to be encountered by the new lamp are of a grimly practical character. Foremost among them is the fact that osmium is too good a conductor, compelling the use of a very long and thin filament to produce a lamp of ordinary voltage and moderate candlepower. As osmium is really on the border line between the metals and the metalloids, it lacks the mechanical properties that permit the construction of a tenacious filament of small diameter, and there would seem to be no reasonable expectation of dodging this difficulty. Twenty-five to fifty volts is stated as the voltage for which osmium lamps can be successfully made. This means a very great limitation of practical usefulness, even supposing there were no other difficulties. The tendency of working voltages is upward, not downward, and limitation to a 50-volt lamp, with the accompanying necessity of burning lamps in series to obtain a reasonable voltage for distribution, is a very serious objection to overcome. For some special purposes such lamps might be usefully employed, but for general or even considerable employment, the low voltage is a handicap not to be overcome by an efficiency of 1.5 watts per candle.

But a far greater and, in our judgment, insuperable difficulty is the rarity and cost of the material. Osmium is found at present only as a trivial component of platinum ore which is itself painfully rare. Crude platinum contains among other rare metals a small amount of osmiridium, which is an alloy of osmium with iridium, containing, say, 25 to 40 per cent of the former metal. Some crude platinum from Australia has shown on analysis as high as 26 per cent of osmiridium or a little over 8 per cent of osmium. But unhappily the platinum of the Urals which forms the bulk of the commercial metal is very lean in osmiridium, containing usually less than 1 per cent, of which barely a quarter is osmium. It would be well within bounds to say that that osmium is more than a hundred times as scarce as platinum, itself the rarest of the commercial metals. Osmium is at present used in minute quantities as osmiridium and as osmic acid, and is costly in spite of the small demand. If one remembers the tremendous increase in the price of platinum due to its use for the leading-in wires of incandescent lamps, the construction of an osmium filament becomes a commercial absurdity. Unless new sources of supply should render osmium as common as gold at least, it would be hopeless as a material for filaments of incandescent lamps.

There is, moreover, a general objection to continuing the struggle after more and more refractory filaments. And this is the apparent hopelessness of getting any really great increase of efficiency through merely raising the temperature of an incandescent solid. So long as the energy spectrum of the radiant substance is continuous, extending far into the infra-red and the ultra-violet, there will be a considerable amount of radiation which is visually ineffective. Indeal efficiency is to be sought rather in non-production of these ineffective rays than in desperate efforts to intensify the luminous energy in a continuous spectrum. The work of Nernst, Welsbach and others may result in very material improvements, but the revolutionary seems to us to lie along another road—a path beset with obstacles, it is true, but worth the following. The glow-worm's secret may never be disclosed to human intelligence, but it is quite certain that it cannot be penetrated by reasearches at transcendental temperatures.

Gasoline as a Domestic Illuminant.

We wonder how long before our friends the underwriters, who have displayed such unflagging activity and richness of imagination in dealing with electric lighting as a fire risk, can spare time enough from their investigations to cast an eye on the exploiters of private crematories. We refer to the philanthropic gentlemen who for the past year or two have been engaged in introducing the gasoline torch as a domestic illuminant. Now, the gasoline torch, properly applied, is the valued ally of the electric wireman and the right bower of the lordly plumber, but it is not a proper member of the happy family circle even when crowned with a Welsbach mantle and adorned with a crepe paper shade. For the past two or three years there has been nothing short of a swarming of gasoline Welsbachs under various alluring titles, usually derived from the patronymic of the putative inventor. Like the gold brick and the green goods games, these devices have been most earnestly exploited in the country districts and in the smaller towns, where the underwriters have feeble jurisdiction, and there are only volunteer fire companies in great need of exercise. In such places a mantle burner seems a sun-like marvel of brilliancy, and its fine greenish glare a thing of beauty. More than all, it is cheap, like other green goods, and the prospect of getting something for nothing is just as alluring in the rural districts as in Wall Street.

So the gasoline burner has come with a blare of trumpets at regular advertising rates, and has settled down to steady business in increasing the death and insurance rates. The gasoline gas machine has been known for many years and has taken its place as a useful means of lighting on a small scale where other and better illuminants are not available. It has been worked out in a careful and scientific manner, and when carefully installed has proved to be most excellent and convenient for the lighting of country residences and similar work. And if any one wants to work that system with mantle burners, there is no reason why he should not, if he can stand the color of the light. As the historic book review has it: "This is a very good kind of book for them as likes this kind of a book." But setting up a gasoline tank on your parlor table or in the attic of your store is not a commendably prudent proceeding. The solemn fact is that gasoline is a highly dangerous explosive, far more dangerous to have around the house than dynamite, even supposing the character of both to be known. For if accidentally ignited, a dynamite cartridge will usually burn up without detonation, while the gasoline is sure fire every time and scarcely less destructive. Gasoline, to speak accurately, is a volatile mixture of hydrocarbons of the paraffin series, of density about 0.65, which gives off explosive vapor at all ordinary temperatures and ignites on the slightest provocation. It is by far the most dangerous of the ordinary petroleum products, those more volatile and inflammable being produced in small quantities and not widely used. As a well-known expert recently put it: "The smell of gasoline is explosive." While the substance can be safely used with proper care it is about the last thing which should be turned loose without elaborate warnings as to its nature. And let it not be supposed for a moment that the exploiters of the Jabez Houlihan Light, Limited, explain to their customers that they are dealing with a dangerous substance only to be used with extreme caution. Far from it, for every system of this sort is loudly heralded as entirely safe and so simple that a child can manage it. The most innocent of these "systems" are those devoted to the sale of stock only, paying fictitious dividends from the sale of State rights, for these take only the money of the gullible, without imperilling their personal safety.

But others, less considerate, have sold their infernal machines in large numbers, and the hapless user has done the rest. Already in at least one State the results have been so disastrous in loss of life and property that legal steps have been taken to check the sale of such appliances or to prohibit it altogether. If unchecked, the underwriters will soon find themselves face to face with destruction so serious that they will forget even their favorite "deadly wires" in the presence of the new peril. They have been active enough in harrying the users of acetylene, which is a far safer illuminant, and one which must be seriously reckoned with ere long in spite of their protests; but the self-contained gasoline lamp and all its kind has not yet received from them the attention it merits. Its danger is none the less by reason of the fact that there is good reason to believe that gasoline as sold to-day may mean almost anything. The gasoline as customarily defined in the past, has only been about 3 per cent of the entire petroleum product, but its use has greatly increased under the stimulus of the growing use of explosion engines for launches and automobiles, and one of two things must inevitably happen. Either the gasoline will become so expensive that inventors will be compelled to devise suitable means for utilizing the less volatile and safer petroleum products, or to meet the growing demand the obliging purveyors will class as gasoline such mixtures of the more volatile products as they see fit. In such case look out for components even more inflammable, admirably suited to serve as a priming to explode the rest. In all seriousness, the rapidly extending use of the gasoline torch or its equivalent for illumination is a menace to the safety of country communities that cannot be overlooked. We are not discussing the question in view of possible competition with electric lights, for the gasoline lamps will work their own destruction if left to themselves; but it is a duty that we owe to the community to sound a note of warning in face of an imminent danger.

The Telephone War in England.

At the twenty-seventh annual meeting of the National Telephone Company, of England, the chairman, Mr. J. Staats Forbes, made the announcement that the company intends to fight on in face of the post office competition. Having stated that the profit for the half-year amounted to $1,275,000, he declared that they had come to the parting of the ways, and the great question to be determined was whether they should go on. It seemed to him that they would have to fight for their own hand, and so they would go on using every effort to increase their subscribers and make the very best of their property. As to Government opposition, he could only say, with the greatest respect, that the Government had a great deal to learn, and if it persisted in its object and competed with the company at very low rates it would have a mournful story to tell the House of Commons in 1904.

Mr. Forbes said that the board had exhausted argument, conciliation, offers to deal on the square with the Government, to act with them in friendly competition, and make this company auxiliary to them, so that they might not rush into the folly of spending millions on duplicating the company's expenditure, but without avail. The directors believed that this company would be able to beat the Post Office. They were more adaptable. As a commercial company they were not tied down with restrictions and red tape.

Several shareholders spoke in indignant terms of the Government, and after some further discussion the resolution was carried, as well as one providing for the raising of an extra $5,000,000 by the change of unissued ordinary stock into preferred and deferred

Independent Long Distance Telephony in Ohio.

The growth of the independent long-distance telephone movement in Ohio and surrounding States is effecting a marked improvement in the systems and exchanges of the independent companies through that State and section. According to the statement of a prominent official of the United States Telephone Company, of Cleveland, which is building long-distance toll lines throughout the State, fully three-fourths of the independent home exchanges have rebuilt or are overhauling their equipments in order to secure satisfactory long-distance service through connection with the lines of the United States Company. In a number of cases it has been necessary to do this before any kind of long-distance service could be secured, while in others the managers of the local companies found they must improve their local service or the long-distance service would be of little practical value to their subscribers. In many cases the improvements have amounted to a thorough rebuilding of the exchanges. Unfortunately, many of the exchanges throughout this State as well as in other portions of the country, were built by farmers or small capitalists with whom a saving of expense was the main consideration, and who were satisfied with indifferent service. For local service this was frequently all that was required, but now that long distance service has been introduced, some radical improvements have been necessary, and this high state of efficiency must be maintained if the long-distance service is to give satisfactory results. The vast majority of the small home exchanges have never been in the hands of competent electricians. In too many cases the manager or superintendent has been a young fellow possessed of enough experience to connect up a telephone satisfactorily, but with whom switchboard troubles were intricacies too deep for experiment; and were allowed to remain until skilled attention was imperative.

The United States Company official referred to a case of a large country exchange which had just been connected with the long-distance lines, and which failed to give satisfactory service. The local expert thought the trouble was in the local switchboard, but said he had never been able to find it. Rather than have the service a failure the United States Company sent an expert who located the trouble and made the repair with a few hours' work. For more than a year the local service had been of an inferior quality for want of this day's work by an expert.

It is stated that a member of the local companies in various portions of this State have now become convinced as to the necessity and economy of first-class service, and have made arrangements with practical electricians to overhaul their exchanges at certain periods. The expense of maintaining a first-class expert at all times is too great for many of the small exchanges, and some of them have formed alliances with other exchanges in their district, each company paying a portion of the salary of a skilled man to act as consulting expert. In this direction it might be added this plan forms an excellent opening for young telephone experts to form a clientage among small exchanges, agreeing for a specified sum to inspect their systems at certain periods.

It is stated also that there is a growing tendency towards a standard equipment, and this more than anything else will improve the long-distance service. The official referred to suggested that manufacturers are able and willing to furnish equipments which would give uniform results, but in many cases they are backward about venturing suggestions and furnish the buyer what he asks for regardless of the requirements of the situation.

Improvements in Machine Telegraphy.

Anent the subject of impending changes inevitable in the telegraph and telephone situation, we are able to announce that very recent improvements in machine telegraphy by a well-known inventor who has given this branch of electrics close study for several years greatly advances the probability of cheap and voluminous telegraphy in the near future. The chief objection raised by telegraph managers against automatic working has been the special training required for operating the machines used for perforating messages on tapes. This difficulty has been entirely overcome, it is said, and messages may now be perforated by simple mechanism controlled entirely by the ordinary Morse key, so that every Morse operator in the country is at once available as a machine operator, his work being exactly as in operating a circuit in the ordinary way. Moreover, the perforating machine can be worked hundreds of miles away from the sending key, so that branch or outlying offices can perforate their messages at the distant central or relaying station with the same facility as though the key and punching machine were side by side. This will enable the accumulation by ordinary Morse transmission, of business from all branch lines at central points of distribution ready for forwarding over trunk lines by the rapid-machine system.

Another important improvement comprised in this new development consists in recording the messages in regular Morse dots and dashes without the slightest "tailing" or running together of the signals, owing to static capacity of the line.

The Question of Bell Telephone Sub-company Royalties.

The recent upsetting of the Berliner patent raises the question of whether this may not be to the advantage of Bell sub-companies. The policy of the Bell Company has been for several years past that of a steady reduction in telephone royalties and a steady increase in sub-company dividends. It is estimated that at present the American Telephone & Telegraph Company collects royalties of about $2,000,000 per annum. A large stockholder in one of the American Telephone & Telegraph Company's Western subsidiary companies and a resident of Illinois states, according to the Boston News Bureau, that at the time his company arranged for a perpetual contract with the American Bell Telephone Company, it was understood that when the patent on the Bell receiver expired the royalties on telephones would be discontinued.

"The Bell has met this question only in a partial way; that is, the royalties have been reduced, but we are still paying a royalty equal to 2½ per cent upon our capital stock, and this, taken with the portion the American Bell receives from its holding of so-called franchise stock, brings the total equal to about 4 per cent on all our issued capital. I believe our courts would grant a permanent injunction to prevent our company paying this royalty and that we have a good basis for a suit in equity to recover past royalties paid since the patent expired. If all the minority interests of the Bell subsidiary companies would join together this royalty could be terminated. It is quite an item to pay perpetually on articles that can be bought outright for a small sum, while to the Bell Company the dividends on free stock they have would make up loss of royalties. It is difficult for our company to meet competition for three reasons: First, we pay this large royalty on telephones; second we are obliged to pay dividends on free stock issued to the Bell; third, we pay 50 per cent to 100 per cent more for manufactured articles than we would have to pay if bought in the open market."

The Ganz Three-Phase Railway System.

ONE of the sections of the paper read by Mr. W. J. Hammer before the February meeting of the American Institute of Electrical Engineers on "Important European Electrical and Engineering Developments at the Close of the Nineteenth Centur," was devoted to the three-phase railway system of Ganz & Co., of Buda Pest.

Through the courtesy of Director Otto F. Bathy, of the Ganz Company, Mr. Hammer was enabled to examine into this system, which is now being installed upon the Lecco, Colico, Sondrio & Chiavenna line in Northern Italy, and which was at the time of his visit installed experimentally upon a circular track a mile in length at Alte-Ofen Island, near Buda Pest, Hungary. The length of the Italian electric road, which up to the present has been operated by steam, is 66 miles, and the maximum grade 22 per cent. The motive power now being arranged for respresents about 7400 hp, with facilities for increasing when necessary. The power will be derived from a waterfall near Morbegno, 9½ miles from Colico and 15½ miles from Sondrio. Four 2000-hp Shuckert three-phase dynamos, generating 20,000 volts at 15 cycles, are direct-connected to four turbines, which are supplied from a raceway between two and three miles long, delivering 35 cubic meters of water per second, and having a fall of 97 ft. The three-phase currents of 20,000 volts will be supplied direct to the line, and 12 sub-stations will transform to 3000 volts and supply 12 independent sections of the railway line. Two overhead trolley wires 3-16 inch in diameter represent two of the phases and the track the third. The line insulators are of porcelain, having five petticoats decreasing in size from top to bottom. The line wire, which is of copper, is ¼ inch in diameter.

The sections of road are operated upon an ingenious block system; when the stop signal is set the line circuit is opened and simultaneously the powerful brakes on the train are set. Passenger and freight traffic are operated independently. The freight locomotives will be of 700 hp, employing four motors, and capable of hauling 250 tons at a speed of 19 miles an hour up a 10 per cent grade. The passenger locomotives are also equipped with four motors, representing 300 hp. The schedule speed is about 37½ miles an hour on the level, and about half that on grades. The 3000-volt current is taken from the trolley lines by two aluminum rollers having a diameter of 3 inches; a collecting-brush running on a graphite collar takes the current from the two rollers and is then led by highly-insulated wires, protected by "grounded" metallic tubing, to the motors. Each car is mounted on two four-wheel trucks, and is equipped with two "primary" and two "secondary" induction motors, or four in all, each of 150 hp.

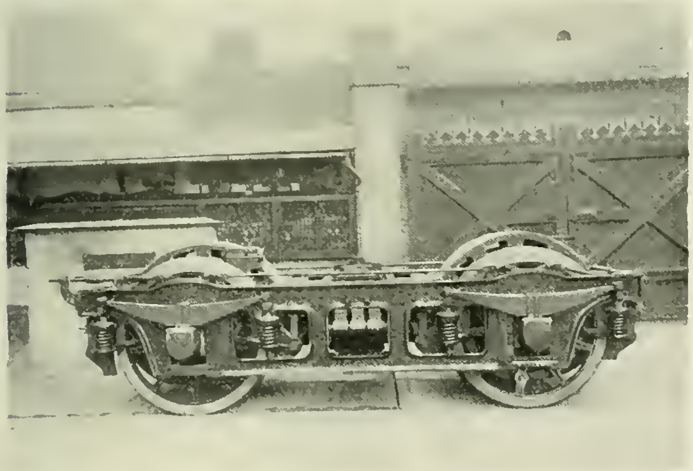


FIG. 1.—SIDE VIEW OF TRUCK.

The 3000-volt currents pass directly to the stationary windings of the "primary" motors. In starting up the train or in climbing a grade the motors are connected in "cascade"—that is the windings of the "primary" rotors, which are designed for 300 volts, are connected to the stationary windings of the "secondary" motors, while their rotors are connected to the fluid resistances; this gives a speed of about 18½ miles per hour. When speed is attained the controller is thrown to its second point, which throws the stationary fields of the "primary" motors on the line and their rotors on the fluid resistances which are slowly cut out of circuit, the secondary motors meantime being thrown out of circuit. This arrangement gives a speed of 37½ miles per hour.

The wires in both field and rotor windings pass longitudinally through insulated tubes in the iron, and at the ends of the windings are insulated by mica and protected by plates or caps bolted on. The controllers at each end of the car are connected mechanically and the high-tension switches are connected electrically. A small transformer on the locomotive connected to the line delivers current at 100 volts to a three-phase motor for compressing air for use on the air-brakes operating the high-tension switch, raising and lowering the fluid in the resistance boxes (which is simpler than raising the plates), and for raising and lowering the trolley. The same transformer supplies current for lighting the train. Cruto "three-phase" incandescent lamps are employed; the periodicity being but 15 per second, the fluctuations were too noticeable in the ordinary lamps, so the Cruto three-filament lamp was employed and showed no fluctuation.

The motors are direct-connected to the axle; that is, there is no gearing; the rotor axle is hollow, permitting the car axle to pass through it. The rotor shaft and the car wheels are flexibly connected, and thus jarring and vibration are prevented.

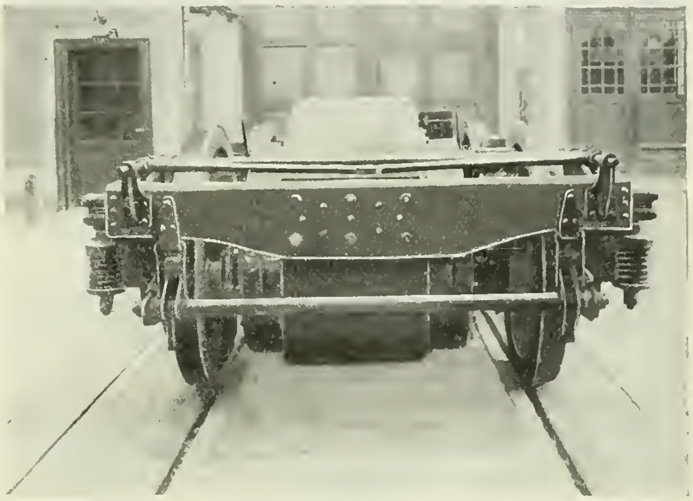


FIG. 2.—END VIEW OF TRUCK.

Our correspondent in Buda Pest enables us to add the following information concerning the Ganz system as applied in Northern Italy. At present 10 cars are under construction, of which five will carry passengers. Two electrical freight locomotives are under construction, each of which will weigh 40 tons. On down grades the motors will deliver energy to the line. The line will be divided into blocks and a train will cut off the current of the section which it has left and turn the current on again when it has passed over the following section. The next train, therefore, cannot overtake the first one, since the latter has always behind a section which is without current. The accompanying illustrations give two views of a truck, each equipped with two 150-hp two-phase motors. Fig. 3 shows a section of the experimental road at Alte-Ofen, Buda Pest.

In the London *Engineer*, of Feb. 15, is a lengthy article on the North Italy road, a considerable portion of which, however, is devoted to a comparison between the commercial advantages of the Ganz three-phase and the ordinary direct-current system of traction, which merely presents ordinary considerations. As to other points covered in the article, we abstract the following:

Accidents from breakdown of the trolley wires, or their cross suspenders, are provided against in the following way when the line passes through tunnels: Each cross suspender carrying a feeding conductor is passed through a copper ring of, say, 3-inch diameter, supported upon a light insulating bracket, at about 8 inches or 9 inches from the attachment at the side of the tunnel. This ring is the terminal of a stout short-circuiting copper wire. If a trolley wire, or a cross suspender, breaks from any reason, there is, in the first place, a flash across the broken conductor section; but this takes place at the instant of breaking, when necessarily all the wires are still approximately in their orginal high-level positions. Immediately after breakage the whole suspensory system sags heavily and suddenly throughout a long length of the line, and this almost instantaneously brings the feed conductor of the section into contact with the short-circuiting copper ring. Thus a short circuit through an inaccessible route is established several seconds before any of the wires can have fallen on the rails or other earthed conductors. The short-circuited current melts out safety fuses, which at once cut off the whole section. At the same time the trolley wires behind the accident become incapable of supplying power to any following train, which therefore cannot be driven into the neighborhood of the breakdown. In a tunnel there is no question of other wires breaking and falling on top of the trolley wires. In an open-country railway, all telegraph and telephone wires are crossed, buried underneath the railway and well insulated. In and immediately beyond stations everything except the trolley wires is well covered with insulation, and a complete network of guard wires prevent any accidents with the trolley lines.

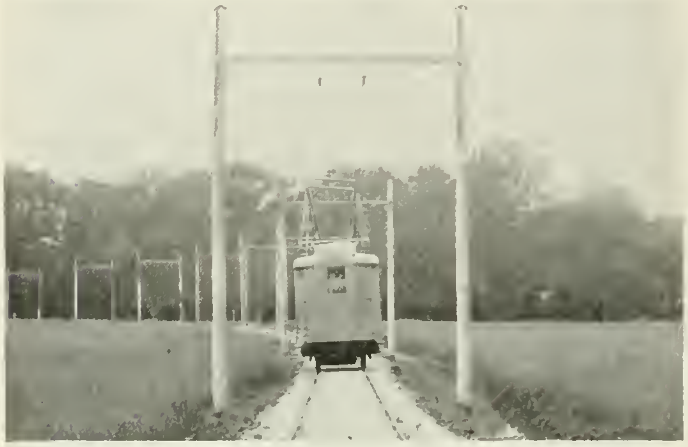


FIG. 3.—VIEW OF EXPERIMENTAL ROAD

Another element of safety in this system is that no train can obtain from the wires power to drive it unless the Westinghouse brake apparatus be in working order, at least, in so far as such good working order depends upon the proper and sufficient supply of air pressure, because, as has been explained, if this pressure fail the trolleys cannot be lifted into contact. The system also lends itself with special ease to the establishment of a complete and particularly efficient block system, the driver of any train being deprived altogether of power to run onto any section which is signaled against him, and of power to leave any section which the signals do not give him permission to leave. The signals switch on the current to the trolley wires of each section only when it is intended that driving power should be taken by a train on this section. Thus also, as regards safety in stations, it is necessary that the trolley wires in the station should be alive only at the time when a train is starting out of the station; they may, after it has cleared out, be left dead until the time for starting the next following train.

For the line in North Italy the motor cars are 18.1 m. long in the carriage body, and 19 m. equals 62¼ ft. over the buffers. The car rests on two bogie trucks placed 11½ m. between bogie pins, each truck having a wheel base of 2½ m. Without passengers they weigh 50 tons, including the motors. The wheels have 1.17 m. diameter, while those of the electric locomotives supplied to the same line have 1.4 m. diameter. The locomotive motor weighs 3.8 tons, its rotor weighing about 1½ tons. The motor car motors, with the smaller size of wheel, weigh 3½ tons approximately. Each cascade pair of these latter develop a full-load horse-power of 150, while the high-tension motor by itself, when running at full speed with the low-tension motor cut out, gives about the same horse-power. Thus, 300 hp are developed in one truck carrying two pairs of motors or 600 hp equals 450 kw on one train with front and rear driving cars. The momentary overload which these motors are capable of dealing with without damage to themselves is at least four and a half times the normal full load.

The cylindrical face of the rotor is toothed, the core being of stamped mild iron sheet built up and insulated between the sheets in the usual way. The air space is very small, not more than 4 mm or 5 mm. The rotor runs on bearings of ample length and specially large diameter, which are continuously flooded with oil. Large leather ring caps keep the oil from running to waste and from reaching any of the insulation in either rotor or stator. The larger circumferential edge of each leather cap is fixed oil-tight to a flange on the stator frame, while its smaller circumferential edge is cupped inwards and bears upon the running surface of the hollow rotor shaft with a pressure regulated by a light internal steel band tightened up by a small screw union. The internal diameter of the hollow rotor is over 8 inches, and is lined with brass sheet. Outside this sheet the inside of the core is slotted longitudinally to make three recesses, in which lie the cables leading from the windings to the three collector rings. These rings and their carbon-block brushes are entirely encased in a close-fitting cast steel case, on which a small inspection cover is bolted.

The rings are situated at one end of the rotor, while at the other the end plate of the core, which is a flange on the cast steel tubular body, is splayed out on one side so as to give two substantial driving horns, marked R_1 R_2 in Fig. 4. This figure is merely diagrammatic, and is not intended to give the true proportions of the various parts of the mechanism. The weight of this driving extension of the flange on one side is carefully balanced by a counterweight cast on the opposite side, but not shown in the diagram. At R_1 R_2 are pinned to the flange two parallel links of equal lengths stretching to r_1 r_2, where they are pinned to two bell cranks of equal size and form. The centers or fulcra D_1 D_2 of the bell cranks are placed each to the left—as viewed in the diagram—of its link R r, so that the two cranks have dissymmetrical positions relatively to the driving shaft and wheel. Their lower arms are linked together by the coupling rod, L_1 L_2, while the fulcra D_1 D_2 are pins upon bosses in two specially stiff spokes of the wheel. The boss, or nave of the wheel, is keyed in the usual manner to the axle, which passes through the hollow rotor shaft; but the rotor and the wheel are connected only by the linkage just described and through the body frame and the bearing springs. The bore of the rotor shaft is more than 4 inches greater than the diameter of the axle passing through it. The axle runs in axle-boxes sliding vertically between ordinary horn-plates. It carries the weights of the body frame, and of the motor, including the rotor running on bearings fixed in the motor casting and therefore fixed in the body frame, and also of the whole car with its passenger load, through the axle boxes and bow leaf springs and shackles in the ordinary locomotive fashion. This linkage enables the rotor running in such fixed bearings, to drive the wheel while leaving the wheel and and axle free to rise and fall in the horn plates in obedience to the varying bearing spring pressure. Considering the wheel, and therefore the joints D_1 D_2, to be held fixed, and understanding that the link length L_1 L_2 is made equal to D_1 D_2, and also equal to R_1 R_2, it is clear that the bell cranks are constrained to turn on their pivots only through equal angles, that the link L_1 L_2 keeps always parallel to D_1 D_2, that the geometrical line r_1 r_2 also keeps always parallel and of equal length to D_1 D_2, and therefore also of equal length to R_1 R_2. Thus the geometrical figure R_1 R_2 r_1 r_2 remains always one in which opposite pairs of sides are equal and therefore parallel. In other words, the rotor flange swinging on the base r_1 r_2 by the equal links r_1 R_1 and r_2 R_2 keeps R_1 R_2 parallel, and therefore also parallel to D_1 D_2, the line joining the bosses on the wheel. Two lines, one R_1 R_2 fixed in the rotor flange, the other D_1 D_2 fixed in the driving wheel, are kept continuously parallel. This means that the wheel is rotated

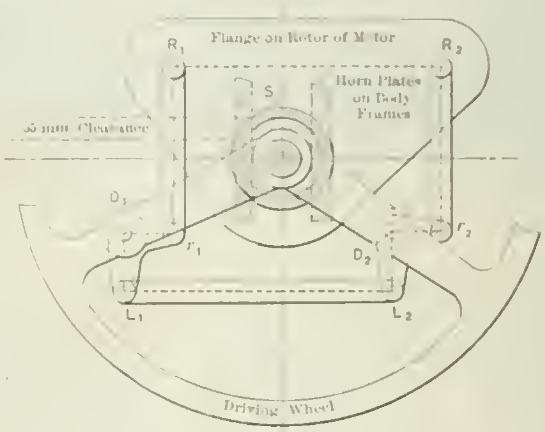


FIG. 4.—DETAILS OF MOTOR ARRANGEMENT.

continuously and exactly in correspondence with the rotor. But the swing of $R_1\ r_1$ and $R_2\ r_2$ permits translatory or non-rotative displacement of the wheel parallel to $R_1\ R_2$; while the swing of the equal and always parallel crank arms $D_1\ r_1$ and $D_2\ r_2$ permits translatory displacement perpendicular to $R_1\ R_2$.

The wheel thus driven drives the other wheel keyed on the other end of the axle through the axle. The rotor has a driving flange at one end only. At each instant one of the two links $R_1\ r_1$ and $R_2\ r_2$ acts by thrust and the other by tension. The two stresses in them are always of equal magnitude, so that the rotor always drives by a pure force couple. The wheel is acted on by a force couple of equal amount, the equal and opposite forces acting through the points $D_1\ D_2$. Each of these forces is directed along the line joining *D*, with the intersection of $R\ r$ with $L\ L$. This pair of forces is thus of varying magnitude and varying leverage, but their couple-moment remains always equal to that of the thrust and pull through the links $R_1\ r_1$ and $R_2\ r_2$.

This linkage illustrates prettily an interesting and important relation connecting the geometrical form and the dynamic action of mechanisms. The geometrical form produces only rotary constraint —it constrains the two parts to rotate together—but leaves them free to suffer translatory displacement. The dynamic result, or necessary concomitant, is that only a force-couple drive between them is possible; the one part cannot produce any resultant bearing pressure upon the other. The actual bearing pressures at the bearings of the rotor are wholly due to the weight of the rotor, and not at all due to the driving forces exerted. The bearings should therefore run very freely and smoothly—although it must be admitted that some variation of direction of bearing pressure is favorable to lubrication.

The induction motors, coupled as described to the driving axle, present decided advantages in respect of mechanical efficiency and minimization of cost of maintenance and repairs. There is no gearing except the simple linkage mentioned; there is no pressure on the bearings except that due to the 1½-ton weight of the rotor; there is no commutator. All high-tension connections are fixed; the connecting rings pass current only during the first half period of acceleration and during the first period of retardation, and during these periods, although the current passed may be considerable, the potential is very low.

The mechanical advantages of having all the bearings of the machine fixed in one rigid body frame will be appreciated by those engineers who have studied the losses of power and the costs of wear in machines in which this desirable fixity of relative positions of all the bearings is not attainable.

The engines used by Ganz & Co. to drive their alternators are made by an English firm, Messrs. Nicholson, in Buda Pest. These engines employ superheated steam, and their most noticeable characteristic is the use of a rolling valve-lever gear, similar in principle, although very different in construction, to that exhibited in Paris on the engines of Stork Brothers, of Hengelo, in Holland. Nicholson was one of the first, if not the very first, engine builder to embody this excellent principle in valve gears.

In continuous-current railway motors the large starting torque required is obtainable only by the passage of a heavy current through the armature, so that the copper section of the armature winding has to be greatly in excess of that needed for the normal working horse-power. Moreover, this large torque is useful only in proportion to the rail adhesion on the one pair of wheels driven by the motor, so that a load has to be heaped onto this one pair of wheels greatly in excess of what can be utilized in developing adhesion after the start. In Messrs. Ganz's cascade system during the start the load-producing rail adhesion is distributed over four wheels instead of two. Moreover, the starting torque is divided between two motors instead of being concentrated in one, whereby the windings are greatly relieved in respect of extra heavy current needed for starting as compared with that needed for normal or average running

When running synchronously, the motors make 300 r. p. m., the frequency of the current being 15. In the rotor of the same motor the periodicity of the induced currents varies according to the slip. During the start, when the high-tension is switched into "cascade" connection with the low-tension motor, after the speed has risen to "half-speed," or 150 r. p. m.—above which speed this cascade connection ceases—the periodicity of the currents in the rotor or secondary of the high-tension and in the stator or primary of the low-tension, is about 7½ per second. These figures refer to motor cars. The speed of the locomotive motors is 125 r. p. m. The Valtellina locomotive motors are not geared in cascade.

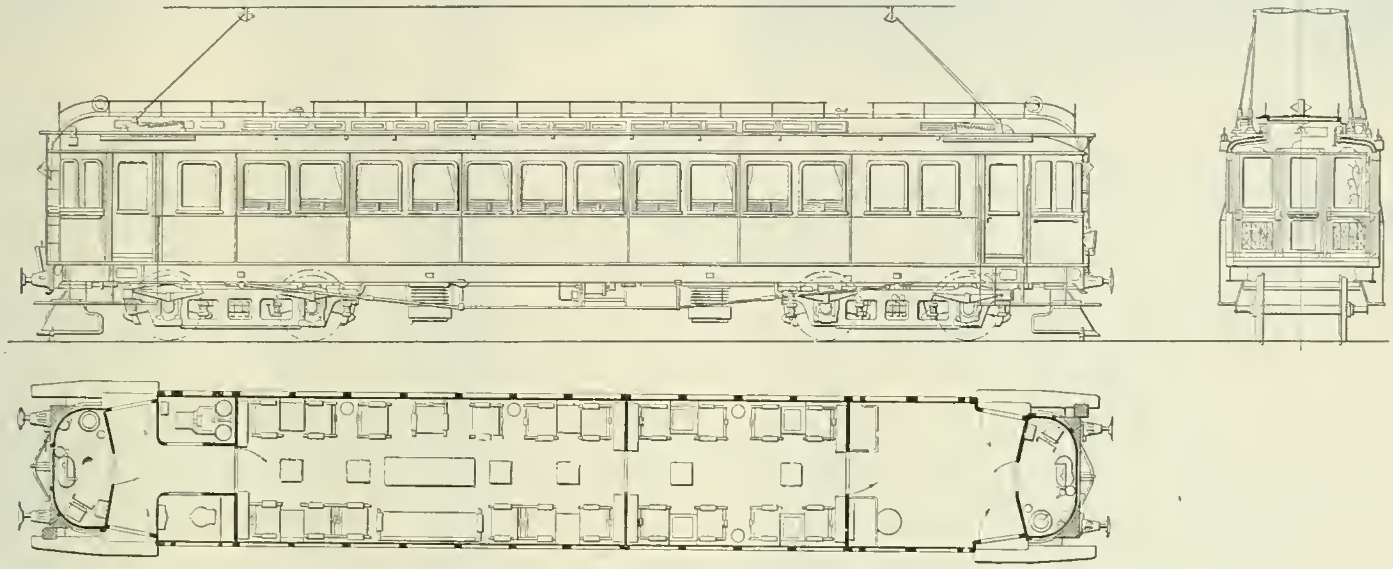


FIG. 5.—ELEVATIONS AND PLAN OF PASSENGER CAR.

Wireless Telegraphy, Past and Future.

The following is from the London *Electrical Review:* Discussing the past history and future development of wireless telegraphy in the ELECTRICAL WORLD AND ENGINEER, Mr. Arthur V. Abbott gives the credit for the initiative to Lord Kelvin's demonstration of the oscillatory nature of the discharge of the Leyden jar. It is rather surprising for an American to overlook the claims of his own countryman, Henry, who, at an earlier date, showed that the Leyden jar discharge was oscillatory, and actually sent wireless signals from the top to the bottom floors of his house. In giving Branly the credit for the invention of the powder coherer, he also overlooks the claims of Varley, who, many years before, had discovered the carbon coherer, and completely explained its action when subjected to electrical impulses. Dr. Chunder Bose's investigations are mentioned by the writer, but what does he mean by his curious deduction "that by a certain mixture of positive and negative substances, any degree of sensitiveness may be arranged"? Surely the aim must be to increase the sensitiveness of coherers, and any mixture of positive and negative substances must reduce it. Mr. Abbott has little faith in the application of syntony in wireless telegraphy, nothwithstanding the successful demonstrations of Marconi in England, and of Prof. Slaby in Berlin. There appears to be no prospect that wireless telegraphy will be used where wire telegraphy is possible, but there are many cases where that is not so. What is wanted is a portable Marconi apparatus that can be carried about the person, by which correspondents that are tuned to one another can talk to each other anywhere within 20 or 30 miles. Such an invention would be invaluable in military operations, but a system of wireless telegraphy which is thoroughly practical over *land* has yet to be devised.

Telephone Submarine Cable Work on the Milwaukee River.

A new departure, so far as telephone submarine work is concerned, has recently been engineered and completed across the Milwaukee River at Milwaukee, Wis. Heretofore the submarine cables for the Wisconsin Telephone Company were laid in the usual manner, viz., after dredging, armored cables were laid across the river. These were frequently interrupted by reason of additional dredging being done by the River & Harbor Improvement Company, and also by ice being jammed in the river.

The new work consisted, first, in excavating for a 48-inch iron pipe, to be laid as shown in Fig. 7A and in Fig. 7, whereon, in profile, is shown the original depth of the river and the position of the pipe after being laid, 24 ft. below the Government datum line. The pipe extends entirely across the river, a distance of 256 ft.

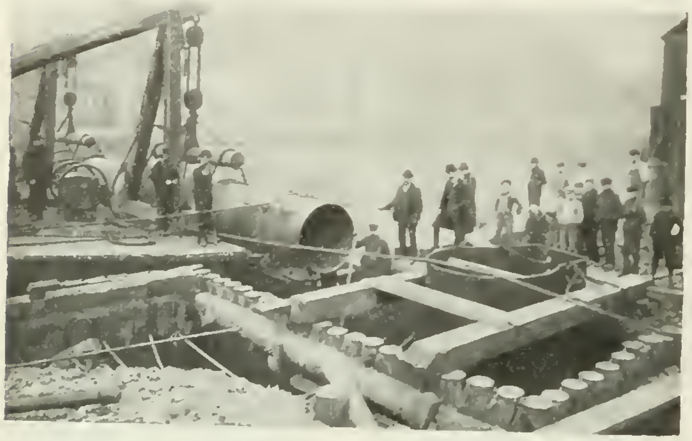
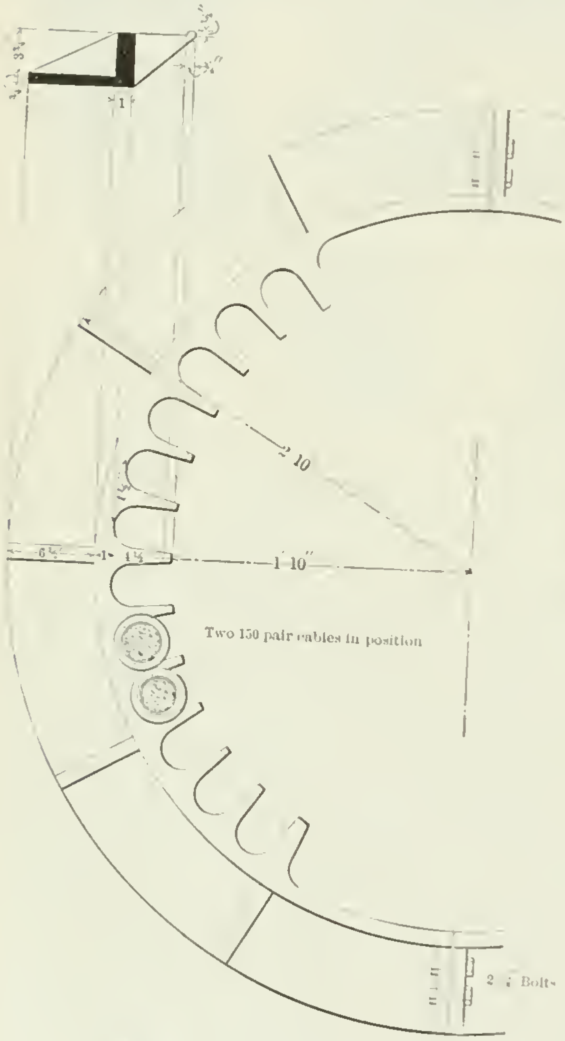
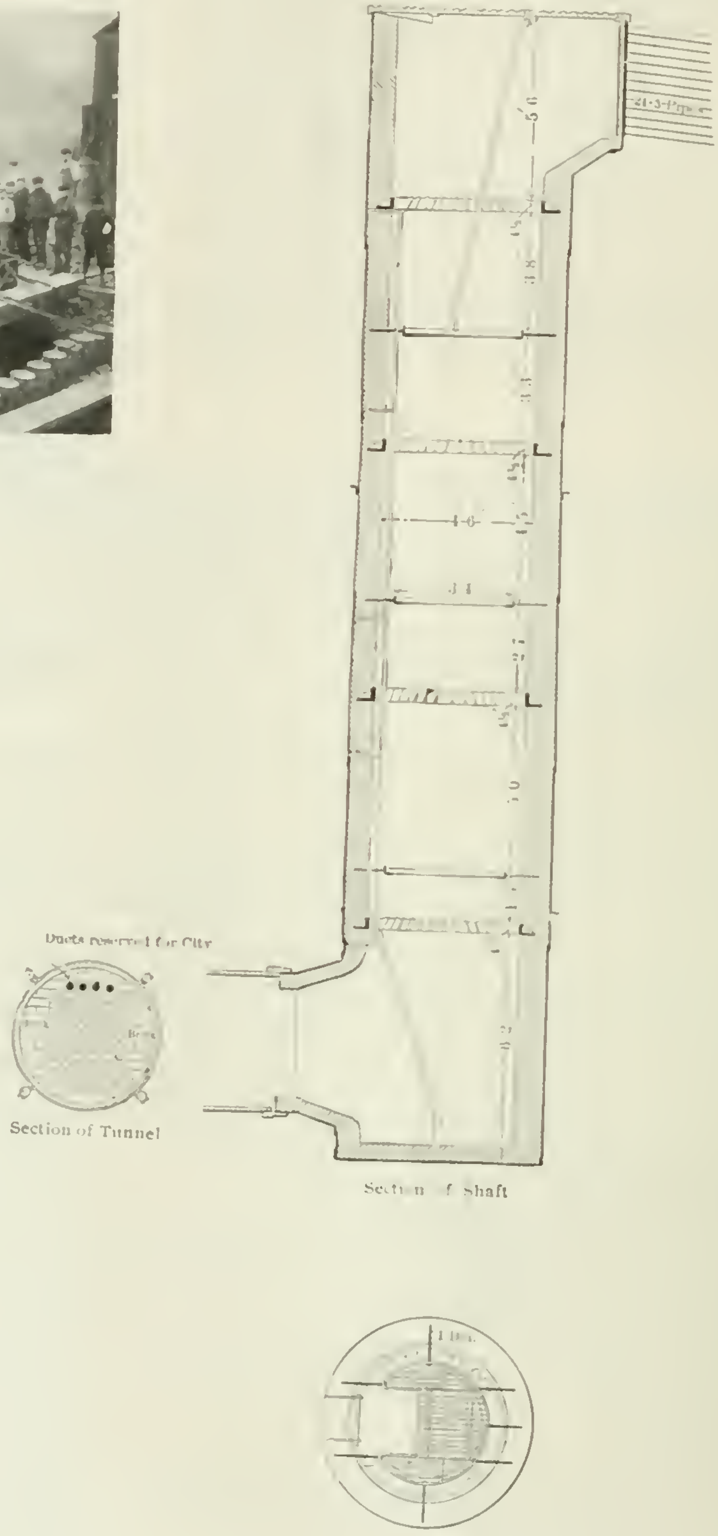


FIG. 1.—LAYING SECTION OF PIPE.



Cast Iron Ring for Support of Cables

FIG. 2.—DETAILS OF SHAFT AND TUNNEL.



Section of Tunnel

Section of Shaft

Plan of Shaft

FIG. 3.—DETAILS OF SHAFT AND TUNNEL.

On each side of the river a boiler iron shaft 6 ft. in diameter and 28 ft. in length is placed in a vertical position, connecting at its base to a 4-ft. iron pipe. (Figs. 2, 3, 5 and 6.)

After the excavating had been completed, the pipe was laid in sections of 60 ft. each (Figs. 1 and 4), connected to the vertical shafts on either side of the river, weighted down and the water pumped out. The pipe was found to be perfectly dry, after which 34 conduits were laid through the pipe and bricked in solid, and supports for the cable were placed in the brick wall, as shown.

In constructing a subway or tunnel of this character the Telephone Company are insured against any mechanical injury to cables or action of chemicals that may be dumped into the river from time to time. It also gives them a drawing-in system, so that cables may be added as necessity requires. The work of excavating and laying the shafts and pipe was done by the Starkey Dock & Dredge Company, of Milwaukee, Wis. The entire work was done under the

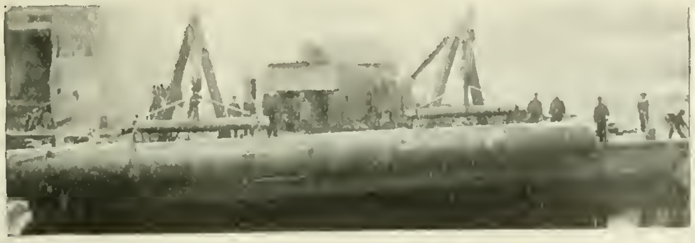


FIG. 4.—LAYING SECTIONS OF PIPE.

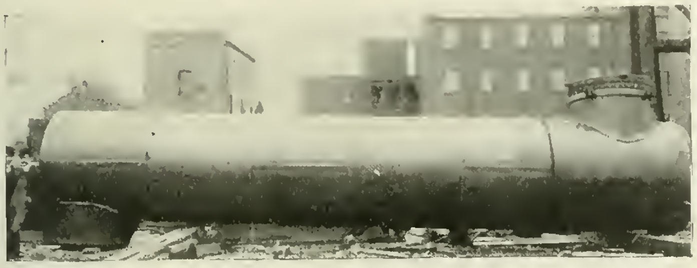


FIG. 5—ONE OF THE VERTICAL SHAFTS.

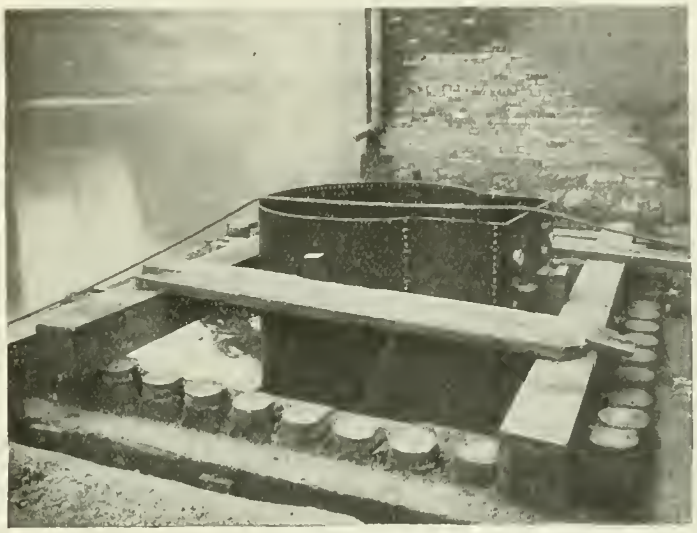


FIG. 6.—SHAFT IN POSITION.

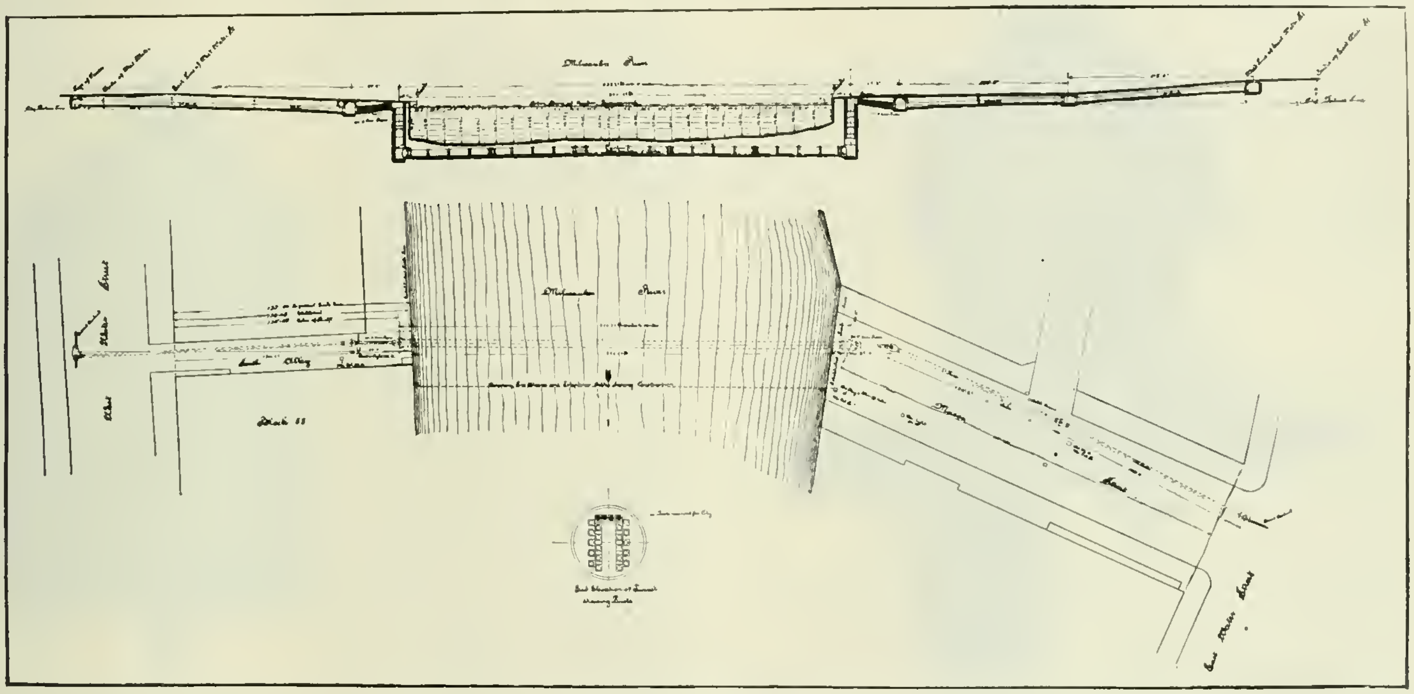


FIG. 7.—MAP AND PROFILE.

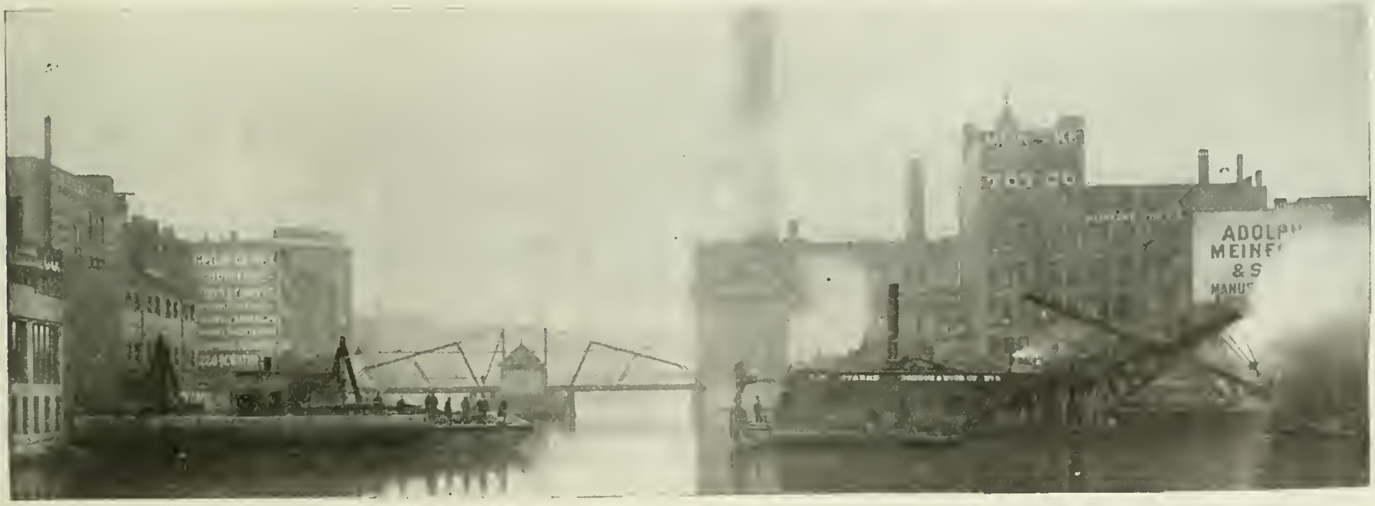


FIG. 7A.—DREDGING AND LAYING PIPE.

TELEPHONE CABLE SUBWAY TUNNEL UNDER THE MILWAUKEE RIVER.

supervision of Engineer John Harper and P. G. Reynolds, general superintendent of construction, the idea originating with the latter.

The Wisconsin Telephone Company have, at the present time, in the neighborhood of 15 cables crossing the river, lying on mud bottom, that will be transferred to the new subway that has been provided for them under and across the river.

The District Telegraph.

By Edward A. Calahan.

I NOTE some interesting references and suggestions recently as to the future of the district messenger system, either in conjunction with the telephone or subjected to a keener competition from that quarter. I am loathe to believe, nor do I entertain the conviction, that a service so useful and flexible is likely to be superseded. We shall rather see it developed and its utility even more strikingly brought out than in the past. Meantime, it may be fitting to add to my late articles on the pristine stock ticker and the telephone switch evolution, a few historical and gossipy notes on the early days of the "district telegraph." The call-box, if its vocabulary were not limited to the notches on its wheel, might tell many queer things and ask as many queer questions, among them being when, where and why it was created?

This article is intended to answer these few questions in the interest of somewhat ancient history, by stating causes and events which led up to it. The writer was no doubt inspired by personal interest in the gentleman who figured so prominently in the following event: The late Elisha W. Andrews, first president of the Gold & Stock Telegraph Company, resigned his office in 1870, in order to introduce the stock ticker in London. He lived in a fine residence in Englewood, N. J., where there were few other than fine residences. His trunk was packed in readiness for his trip to London. He had bidden his immediate friends good-by, and retired at a late hour. He had scarcely laid his head on the pillow when he saw directed on him the bullseye of the burglar's darklantern. He immediately raised himself in the bed and showed vigorous signs of protest, when the burglar, who had already secured his watch and chain, purse and trousers, and all that was contained therein, threw at him a jimmy, a sharp-pointed and exceedingly dangerous weapon. But for the number and folds of the blankets the jimmy would have fatally injured him. He immediately secured his pistol and fired at the fleeing burglar, but without effect. He next turned his attention toward the barn, where his coachman slept, but the latter did not respond. At daybreak he succeeded in getting some one to go to the residence of a prominent New York banker, who was a near neighbor, to secure a pair of suspenders, stating the reason for the rather strange request. The reply was a "regret" that burglars had entered his house that same night, and had taken nearly all his wardrobe, pocket-book, watch, etc., and that he was about to make a similar request of Mr. Andrews. A third and fourth party were appealed to with almost the same results.

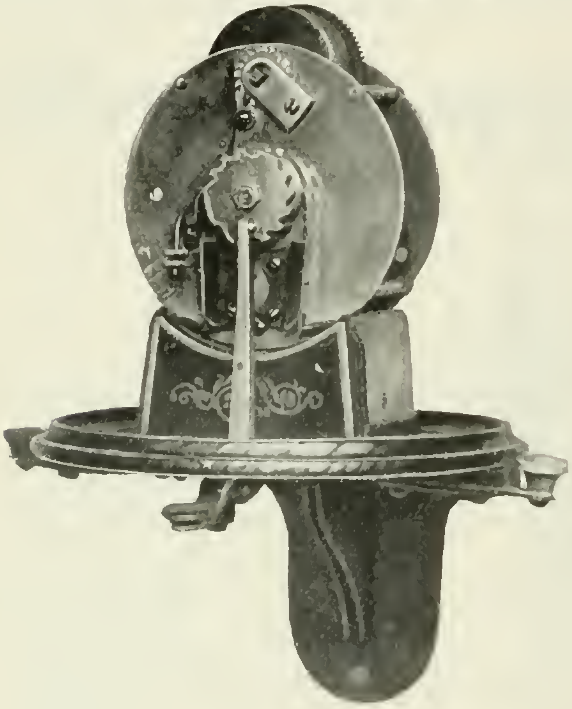


FIG. 1.—EARLY DISTRICT CALL BOX.

This evidence of over-confidence and want of protection where there were "none of the finest," not even a complacent tenderloin policeman, in a village where only the wealthy could reside, convinced me that a remedy or something approaching one should be applied. Mr. Andrews went to Europe a few days later. During his absence a system for such protection took form. I made personally the first instrument for this purpose. The plan was that each residence (there were at least 50) should be connected in one metallic circuit. A bell in each house, on the fire-alarm order, would wake up the whole village, and the signals would indicate whose house had been entered, or who was in distress. Under such circumstances, neighbors would come personally or send their coachmen or servants, and render whatever assistance might be necessary.

Events frequently change the best laid plans. A servant girl, who had been for many years in the service of a family in one of the best-known residences on Brooklyn Heights, suddenly became insane, and held the family, consisting of an aged lady and her daughter, as prisoners for 24 hours without food or water. That kindred painful incidents were of frequent occurrence, impressed me with the idea that Englewood and such exclusive villages could wait until Brooklyn Heights was protected. I at once devoted my efforts to inaugurate this system in this locality.

In this case I departed very materially from my Englewood proposition, viz., I connected every circuit which contained as many subscribers as we could possibly put in, to the main office, omitting the bell, thus giving no evidence to subscribers that the wire was in use. The instrument used was a round 8-day clock movement, mounted on a cast-iron base and covered with a glass shade, as shown in Fig. 1. On the front were two signal wheels, one containing odd and the other even numbers, as for instance, 13 and 14. Two spring contacts, insulated from each other and from the instrument, were connected one to each wheel, and to the stationary points of a switch. The odd numbered wheel when used called "Police!" or if repeated three times indicated "Fire!" The even number always called "Messenger." If the switch were thrown back or towards the wall it would throw the line on the spring connecting with the odd numbered wheel. This switch was usually kept forward, as the "messenger" call was much more frequent than the "police" or "fire" calls.

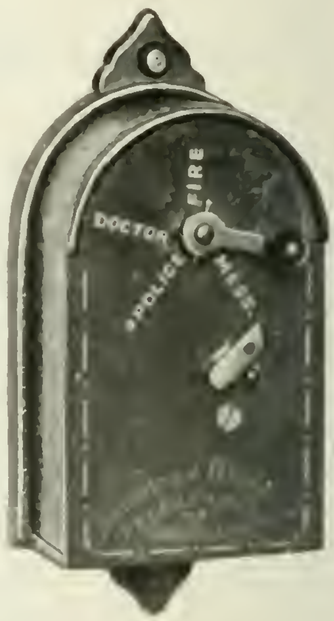


FIG. 2.—STANDARD DISTRICT CALL BOX.

The box-like pedestal or support for the clockwork movement contained a magnet and armature, or what might be better known as a miniature box sounder, the object of which was to enable one to know whether or not the line was in use before sending in a signal, thus preventing the mutilation of signals when two or more subscribers signaled at the same time. This was done by depressing the key which threw the magnet into the line circuit by opening the shunt formed by this key when in its normal position. It can now be understood that the call-box offered no resistance, excepting always imperfect contacts or connections. The relays on each circuit were adjusted with a liberal margin allowing for the resistance thrown in the line by some one depressing this shunt key; but when two or more did the same thing and at the same time, the relays would not respond to signals. A mathematical calculation developed the fact that in even 100,000 cases two signals would not come in at the same time. The magnets and shunts were therefore removed, resulting in a reduction in the cost of an instrument from $9 to $6. This instrument required winding about once a year.

The small box now in use and so familiar to the general public, requires no description or explanation beyond the fact that it was wound up by each person while in the act of sending in a signal.

The substitution was justifiable if for no other reason than the difference in cost, viz., from $6 to $1.05.

On Mr. Andrews' return from Europe the American District Telegraph Company was formed, with E. W. Andrews as president, and H. L. Hotchkiss as secretary and treasurer. We began work on Brooklyn Heights, and within a week we secured about 100 subscribers. Having constructed this plant, and demonstrating its practicability, I went to Europe to establish the stock ticker and later the district telegraph system. On my return I found the American District Telegraph in a very active and flourishing condition. At least a dozen branches were established and equipped in New York all of which were well patronized. An applicant for a position as messenger was of necessity well recommended, consequently boys of an unusually high grade were employed.

In many of the branch offices the managers, and in some cases the superintendents have been promoted from the grade of messengers. The stock brokers entrusted these boys with the delivery of stock certificates which were often equal in value to the capital stock of the district company. Every boy was uniformed and numbered, and many of them attracted the attention of prominent brokers and merchants. A record of each and every boy was kept at the main office. It was an almost every-day occurrence for some one desiring to take one of these boys into his service to have his record searched, and if found satisfactory to make application to the company for him. The request was invariably complied with. The result is that today in almost every bank, broker's office, law office and mercantile house, will be found among the best and most trustworthy clerks and employes, one or more who have graduated from a district telegraph office.

The first instrument placed in circuit and the one from which the first signal was received, is preserved in the main office of the American District Telegraph Company, of Brooklyn, and is highly prized by the officers of that company for that reason. That company has paid an annual dividend averaging 5 per cent since 1878, notwithstanding a lively competition in the field, and the naturally expected effect of the telephone which has stunted the growth of all things telegraphic, excepting quotation tickers which must make a record. It also still preserves in police patrol the first object of the invention.

The Glasgow Exhibition.

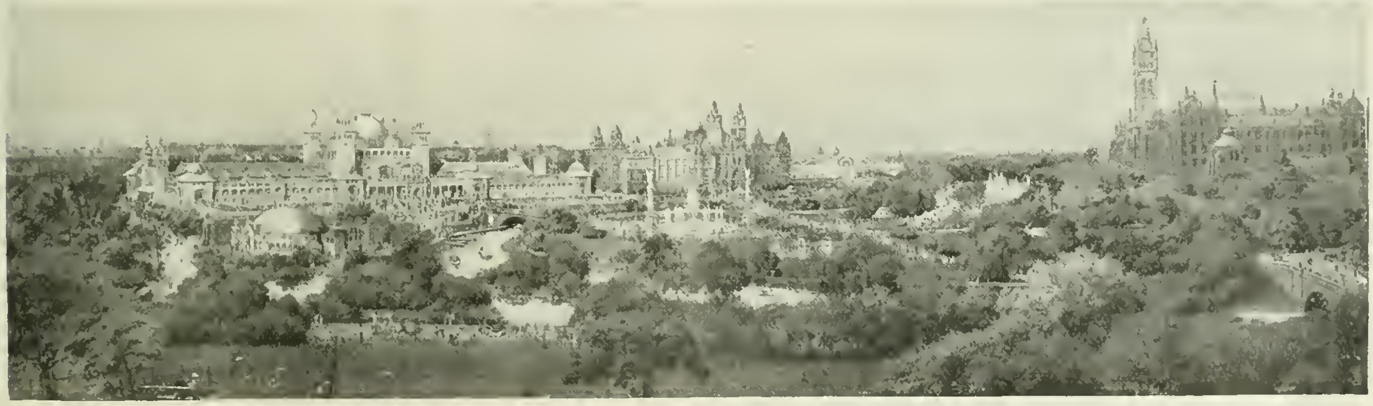


Fig. 1.—General View of Glasgow Exhibition Grounds.—University at the Right.

During the present year the University of Glasgow is to celebrate its 450th anniversary, and at the same time a fine exhibition which will open during the present month will be going on, while a number of engineering meetings and congresses will also be held at Glasgow during the summer months. The various events will be participated in by American electrical engineers, professors, etc, as in various ways electricity will play a conspicuous part. We present herewith a perspective view of the Exposition as now completed, and a map showing the disposition of the buildings and grounds. Those who are familiar with Glasgow will recognize the University in the fine structure on the hill to the right, while the stream flowing through the valley is that from which Lord Kelvin takes his title. The extent of the grounds is 76 acres, and a stretch of 1500 ft. of river is included for smaller marine exhibits. Some of the buildings will be permanent. The industrial group or section, as noted in the map, is 700 ft. long, 360 ft. wide, and covers some 6 acres. In addition, Machinery Hall is 500 ft. long and 320 ft. wide, with a dynamo room annex about 100 ft. square, and a boiler room 204 ft. long and 70 ft. wide. One of the largest exhibitors will be Russia, which country has spent $150,000 for buildings of striking character. America will have a large representation in various ways.

Altogether, 13 associations have officially intimated to the Corporation their intention of visiting Glasgow and holding their annual meetings there during the Exhibition. They comprise the following: The British Association for the Advancement of Science, Sept. 11; the International Association for the Advance of Science, Arts and Education, from July 15 to Sept. 14; the International Engineering Congress, from Sept. 3 to 5; the Royal Institute of British Architects, Oct. 4; the International Law Association, Aug. 20; Glasgow University Jubilee, June 12; Institution of Naval Architects, June 25; Institution of Chemical Industries, July; British Medical Association, end of August; Loyal Order of Ancient Shepherds (Ashton Unity), July; Institution of Mechanical Engineers, Society of Engineers and Shipbuilders, and the British International Association of Journalists. The exact dates in several cases have not, it will be observed, been definitely fixed.

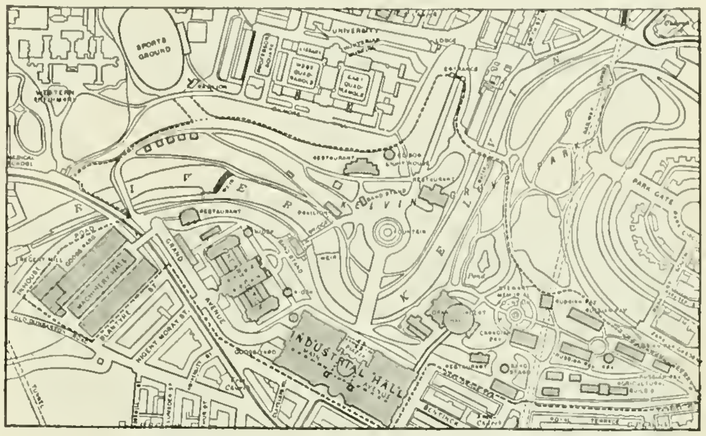


FIG. 2.—PLAN OF EXHIBITION GROUNDS.

The Institute Conversazione.

Plans for the conversazione of the American Institute of Electrical Engineers, to be held at Columbia University on April 12, are being developed very vigorously by the committee in charge, and a number of novel and interesting exhibits are promised, as well as some of the first importance. While the affair will be scientific in character, the lighter social side will not be neglected, as provision has already been made for music, collation, etc. The most encouraging feature next to the active interest shown by the members is the desire evinced by prominent inventors and the leading electrical companies to contribute items of intrinsic merit to the list of attractions, and it has been found necessary to impose a limit both as to space and as to time of entry. Lecture rooms, 301 and 302, in the Electrical Engineering Department, will be occupied, as well as 306 and 308 in the Mechanical Engineering Department. The elevators will be in service and cloak and dressing rooms provided on the upper floors. It has been decided by the Council and Committee to issue free to each member a ticket for himself and lady, on application. and a limited number of extra tickets at $1 each. Invitations will be extended to a select list of guests.

The Long Distance Telegraph and Telephone Systems of Pupin, Thompson, and Reed—I.

By E. F. Roeber, Ph.D.

THE principal purpose of this paper is to develop a mathematical theory of the Thompson system and the Reed system of line construction for long-distance telegraphy and telephony, as described in Section 2, by analogous analytical methods and to the same extent for "forced oscillations," as has been done by Dr. Pupin for his own system. It will be proven that for long distance-telegraphy and telephony, lines constructed according to the Thompson system or the Reed system, behave, to a certain extent, like a line constructed according to the Pupin system.

I. GENERAL INTRODUCTION.

It has been the endeavor of numerous inventors to improve the efficiency of long-distance telegraph and telephone lines. All these experiments and trials can be divided into two classes: First, devices employed at the ends of the line, especially in the transmitting and receiving apparatus; second, special constructions of the line between the transmitting and receiving stations. The following investigation is restricted to the line construction only, and the influence of special devices at the ends of the line or a special construction of transmitting and receiving apparatus will not be considered. The impedance of both these apparatus will be assumed to be zero in our formulas.[1]

Most of our theoretical knowledge of the wave propagation along wires is due to the splendid and persistent work of Mr Oliver Heaviside. To him is due the general answer to the question how a long-distance telegraph and telephone line should be properly constructed. It was he who pointed out that the dielectric should be the principal object of attention, the wires subsidiary. That the object to be attained in all improvements of line construction is twofold—to diminish "attenuation" and to diminish "distortion"—and that this twofold purpose may be accomplished by an increase of the inductance of the line. As this is of fundamental importance, it may be briefly explained.

How can attenuation and distortion be diminished by an increase of inductance? To diminish *attenuation* means to diminish the loss in the line. Now, which is the part that the inductance of the line plays in the transmission of power?

Let us consider a transmission line having resistance and inductance. We have in each instant, according to Ohm's law,

$$i\,R = E\,e^{pt} - L\,\frac{di}{dt}$$

where $E\,e^{pt}$ is the e. m. f. impressed at the instant, t; upon the line, i the simultaneous value of the current, and R and L the resistance and self-inductance of the line. Multiply this equation by $i\,dt$ and we get the equation of energy:

$$i^2\,R\,dt + \frac{d}{dt}\left(\frac{1}{2}\,L\,i^2\right)dt = i\,E\,e^{pt}\,dt.$$

The final term is the energy impressed at the instant t during the time element dt upon the line. The first term is the energy changed into Joulean heat, or the energy lost in the line; the second term is the magnetic energy stored up in the dielectric. To get an efficient transmission of energy, we must make the first term small, the second term large. It is the line itself in which the loss of power occurs, and it is the dielectric in which energy is stored up and propagated along the line. Now we see from the second term of the left side of our equation that for storing up a certain amount of magnetic energy in the dielectric, only one nth of the current is required, if the self-inductance is increased from L to $n^2\,L$; in this case, however, we see from the first term of the left side that the loss of energy, due to Joulean heat, is reduced to one n^2th of its value, the resistance remaining unchanged. In other words, the loss in the line—and therefore the "attenuation"—is just as effectively diminished by increasing the inductance as by diminishing the resistance.[2]

The second object to be accomplished is to diminish "distortion." Periodic signals impressed upon the line at the transmitting end can be resolved, according to Fourier's theorem, into a series of sine waves of different frequencies and phases. A distortionless circuit is one that reproduces the currents of all the frequencies at the distant end in proper proportion, attenuated as nearly as may be to the same degree. We know, however, that in general the attenuation increases with the frequency, as will be shown in Section 3. It will also be shown there that this is prevented by making the inductance high. In the extreme case in which the inductance per unit length of line is large in comparison with the resistance per unit length, the velocity of propagation and the attenuation become independent of the frequency. That is, all frequencies are transmitted with the same velocity of propagation and attenuated to the same degree.

The general result is, therefore, that a properly constructed long-distance telegraph or telephone line must have a high inductance

II. DISTRIBUTION OF SOURCES OF INDUCTANCE ALONG THE LINE.

This general result of Heaviside's theory is, however, not sufficient for practical application. The question arises, how must the sources of inductance be distributed? In any ordinary case of power transmission the capacity of the line can be overcome by the judicious use of reactance coils at the transmitting or the receiving end. But this will obviously not do in the use of wave propagation over long-distance lines. In this case it is evidently necessary to distribute the sources of inductance at equal distances along the line.

Mr. Heaviside's theory did not give any indication about the distances at which the sources of reactance are to be placed. It is this deficiency that has prevented his theory for such a long time from being introduced into practice.

The formation of the mathematical problem corresponding to this question, the development of the analytical methods for solving it, and its solution for the special case of inductance coils distributed at equal distances in series along the transmission line, are to be placed to the credit of Dr. M. I. Pupin.[3]

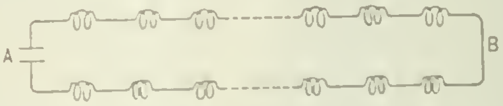


FIG. 1.—PUPIN SYSTEM.

This special system was first suggested, as far as I know, by Mr Oliver Heaviside in 1893.

The mathematical theory of this system has been given and a rule for the distances at which the coils are to be placed has been developed by Dr. Pupin in his 1900 paper. This system is diagrammatically shown in Fig. 1.

Besides this system, two other systems of distributing sources of inductance along the line have been suggested and patented at an earlier date.

One is the system advocated by Prof. S. P. Thompson in a paper read before the Electrical Congress at the Chicago World's Fair in 1893.[4] He has urged an experimental trial of this system again in his presidential address to the British Institution of Elec. Eng in 1899.[5] The characteristic feature of the system consists in inserting coils of proper resistance and inductance, shunted at equal distances across the line. This system is diagrammatically shown in Fig. 2.

The other system is that patented by Mr. C. J. Reed in 1893.[6] It consists in dividing the whole circuit into a series of circuits, connected together by transformers in such a way that the secondary of any transformer forms a closed circuit with the primary of the next transformer. This system is diagrammatically shown in Fig. 3. It will be shown in Section VII. that this system[7] is mathematically equivalent to a combination of the Pupin and Thompson systems.

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[1] It would be easy to make our formulas more general by introducing the values of the impedances of the transmitting and receiving apparatus; but I do not see that a clear insight into the influence of the transmitting and receiving apparatus can be obtained in this way. The influence of these apparatus should be considered separately, as it has nothing to do with the main purpose of this paper. In this connection I would like to call attention to an interesting paper by Dr. Breisig on the influence of the transmitting and receiving devices at the ends of a long cable upon the signals (*Elektrotechnische Zeitschrift*, 1900, Dec. 13). The A. I. E. E. paper by Dr. Crehore and Dr. Squier on "A practical transmitter using the sine wave for cable telegraphy; and measurements with alternating currents upon an Atlantic cable," (May, 1900) must also be noticed in this connection.

[2] This explanation is, of course, only intended to show in a special case the part that the induction plays, by storing up energy in the dielectric. The case of wave propagation along a long-distance line is much more general. There is capacity distributed along the line, and we have to consider the storage of both electric and magnetic energy, and the progressive transformation of the magnetic into the electric energy and vice versa. The principal point of the above explanation holds good also in this general case. It is the line in which the loss of energy occurs, and it is the dielectric in which the energy is propagated. And the process is regulated by the inductance.

[3] As his two A. I. E. E. papers on this subject will be repeatedly referred to in the following that on the "Propagation of Long Electrical Waves" (read March, 1899, and that on "Wave Transmission Over Non-Uniform Cables and Long-Distance Air-Lines" (read May, 1900), will be quoted briefly as his 1899 and his 1900 paper respectively.

[4] *Electrical World*, 1893, Sept. 2; *Electrical Engineer*, 1893, Aug. 30.

[5] *Lond. Electrician*, 1899, Nov.

[6] U. S. Patents Nos. 510,612 and 510,613, Dec. 12, 1893.

I am not aware that a theory of wave propagation over lines constructed according to the Thompson and the Reed systems has been published. In the conclusion of his 1900 paper, Dr. Pupin remarks briefly that the two cases, illustrated in Figs. 2 and 3, can be worked out by the methods used by him for the analysis of his own arrangement, illustrated in Fig. 1, but he does not give the analysis of those cases.

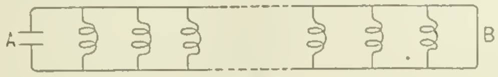

FIG. 2.—THOMPSON SYSTEM.

As I believe that, besides the Pupin system, the Thompson system and the Reed system of line construction may also play an important part in the future development of long-distance telegraphy and telephony, I have worked out the theory of the latter two systems. The analytical methods, used in this investigation, are entirely analogous to those used by Dr. Pupin.

III. WAVE PROPAGATION OVER A UNIFORM LINE.

It will be advantageous to summarize here briefly the theory of wave propagation over a uniform line, as illustrated in Fig. 4. For a complete theory of this case the reader is referred to Dr. Pupin's 1899 paper, Section 1, and to his 1900 paper, Part II., Section 1.

The line is a loop of wire, *AB*. At *A* there is the transmitting apparatus which impresses upon the line an e. m. f. of the type $E\,e^{ipt}$. At *B* there is the receiving apparatus. The impedance of both transmitting and receiving apparatus is assumed to be zero.

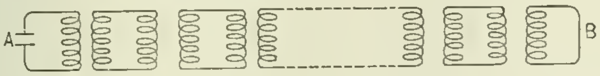

FIG. 3.—REED SYSTEM.

Let *R, L, C,* be the resistance, inductance and capacity, respectively, per unit length of line. *R* is measured in ohms per mile, *L* in henrys per mile, *C* in farads per mile. Let *y* be the current in amperes at any distance *s*, — measured from the transmitter *A* in miles, and let $\xi = l - s$, then the differential equation for *y* is

$$L\frac{d^2 y}{d t^2} + R\frac{dy}{dt} = \frac{1}{C}\frac{\delta^2 y}{\delta s^2} \qquad \ldots\ldots\ldots\ldots(1)$$

this equation is satisfied by the integral given by Dr. Pupin

$$y = K_1 \cos M\xi + K_2 \sin M\xi \qquad \ldots\ldots\ldots\ldots\ldots(2)$$

for all values of K_1 and K_2 proportional to $E\,e^{ipt}$,

$$\text{if } -M^2 = C(-p^2 L + i p R) \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

If $M = \alpha + i\beta$, we have

$$\alpha = \sqrt{\frac{1}{2}\,p\,C\left[\sqrt{p^2 L^2 + R^2} + p\,L\right]}$$

$$\beta = \sqrt{\frac{1}{2}\,p\,C\left[\sqrt{p^2 L^2 + R^2} - p\,L\right]} \qquad (4)$$

K_1 and K_2 are to be determined from the boundary equations at *A* and *B*; this gives

$$y = -\frac{i\,p\,C\,E\,e^{ipt}\cos M\xi}{2M\sin M l} \qquad (5)$$

If the e. m. f. impressed at *A* upon the line, is the real part of $E\,e^{ipt}$,

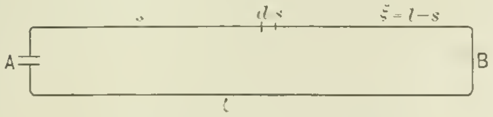

FIG. 4.—UNIFORM SYSTEM.

the current is the real part of *y* in (5). The wave length λ is $\lambda = \frac{2\pi}{\alpha}$ the attenuation factor is $e^{-\beta\xi}$, where α and β are the values from (4).

It will be seen that, as $p = 2\pi N$ where *N* is the frequency, the constant β, which determines the attenuation, is the greater, the greater the frequency, i. e., greater frequencies are attenuated more than smaller ones. But it will also be seen that the constant β diminishes as *L* increases. In the extreme case, in which $p\,L$ is large in comparison to *R*, the velocity of propagation becomes

$$v = \frac{p}{\alpha} = \frac{1}{\sqrt{L\,C}}$$

and the constant β becomes

$$\beta = \frac{R}{2}\sqrt{\frac{C}{L}}$$

i. e., both are independent of *p*, and all frequencies are transmitted with the same velocity of propagation and attenuated to the same degree, as mentioned in the general discussion of Heaviside's theory in Section 1.

IV. EQUIVALENCE OF NON-UNIFORM CONDUCTORS TO THEIR CORRESPONDING UNIFORM CONDUCTORS.

If the transmission line is not a uniform wire, but contains sources of inductance, uniformly distributed along the line, as in the systems of Pupin, Thompson and Reed, the question arises: How must these sources of inductance be distributed in order to have a beneficial effects? If they are not properly distributed, there will be detrimental effects due to reflections, and the transmission will be worse than on a uniform line.

In his 1900 paper Dr. Pupin has formulated this mathematical problem in the following way: *Under what conditions are non-uniform conductors equivalent to their corresponding uniform conductors?* This question is of great importance and must therefore be clearly understood. "Under what conditions," means: For what distances between the sources of inductance and for what wave lengths (or frequencies)? To be "equivalent" means to have approximately the same wave length and the same constant β, which determines the attenuation. The "corresponding uniform conductor" is a conductor with uniformly distributed resistance, inductance and capacity, the *total* resistance, inductance and capacity being equal to that of the non-uniform conductor which is considered.

For his system of inductance coils in series Dr. Pupin has developed the following very simple rule, which can be best expressed by introducing the term "angular distance" between the inductance coils, defined by the equation

$$\phi = 2\pi\frac{l}{\lambda}$$

where *l* is the distance (in miles) between two consecutive inductance coils and λ the wave-length (in miles). Then Pupin's rule, proven for his type of non-uniform conductor is: The non-uniform conductor is as nearly equivalent to its corresponding uniform conductor as $\sin\frac{\phi}{2}$ to $\frac{\phi}{2}$.

In the next article I shall develop the mathematical theory of the arrangements of Professor Thompson and Mr. Reed.

A National Electrical Contractors' Association.

A movement is on foot to found a national association of electrical contractors, and an important circular on the subject inviting support has just been issued from Utica, N. Y., by Mr. W. H. Morton, secretary of the New York State body, who will be glad to hear from all interested. In the course of his letter Mr. Morton says:

"In August, 1899, a number of electrical contractors of New York State, held a meeting in Buffalo, and an organization known as the United Electrical Contractors' Association of New York State was formed, the purpose of this organization being for the protection of the mutual interest of the members and promoting a more cordial feeling in the contracting trade. This association takes in the larger contractors in all the cities of the State, and has proved itself a great benefit to all the members.

"In view of the success of this organization it was decided at our annual meeting held in January of this year, to issue a call for a meeting at the Builders' Exchange Building in Buffalo, N. Y., on Wednesday, July 17, 1901, at 10 a. m., for the purpose of forming a National Electrical Contractors' Association. We feel very strongly that such an association will be a great benefit to the electrical contracting trade in many ways, and that the cost to each member for maintaining such an organization would be very small. We have called this meeting in Buffalo, thinking that many of the contractors will arrange to attend the Pan-American Exposition, and consequently will be able to attend this meeting without additional expense."

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[7] I am aware that this system of transformers distributed along the line has also been suggested by Prof. S. P. Thompson in his 1893 paper in Chicago.

The Osmium Lamp.

A lecture was delivered Jan. 23 by Engineer Scholz at the annual meeting of the Deutsche Gasgluhlicht Gesellschaft on the new osmium lamp invented by Dr. Auer von Welsbach. The lecturer at the outset emphasized the fact that the efficiency of an artificial source of light is greater the higher the temperature of the light-emitting surfaces. This has led to the substitution of the platinum filament by one of carbon, but even this material disintegrates in time due to the high temperature. Osmium, however, having the highest melting point of all known metals, resists such action for a very long time, but its employment in the form of a filament is of very recent origin. This has been due to the fact that up to the time that Dr. von Welsbach made his experiments, resulting in the manufacture of osmium filaments, the metal could only be procured in the form of a crystalline powder, a spongy mass, or after being molten in the electric furnace, in the form of a brittle, hard metal which could not be mechanically worked.

An osmium filament is a conductor and a lamp containing the same may be placed in an electric circuit like an ordinary incandescent lamp, no preheating devices being required. The advantages of an osmium lamp is its small current consumption for a high-candle power, which in turn means that the carbon filament is worn out long before the osmium filament shows any signs of wear. Lamps requiring 1.5 watts per candle-power possess a very long life, often as high as 700 hours, and frequently as high as 1200 hours and more. A lamp which had been burning 1500 hours was found to be in splendid condition, and had only lost 12 per cent of its original candle-power. The consumption of the lamp at the beginning was 1.45 watts per candle-power, and after 1500 hours it was 1.7 watts.

Should the filament become discolored it can easily be brought back to its original state without renewing it or the bulb. On account of its greater conductivity the osmium filament requires less voltage than the carbon filament, and lamps have been constructed requiring only from 20 to 50 volts.

As most central stations, however, furnish 110 and 220 volts, it would be necessary to burn a number of the lamps in series or to transform the voltage. In the case of alternating and three-phase distribution the problem becomes simpler, as the transformers may be built to reduce the pressure to the amount required by the osmium lamps. They will probably find ample employment on accumulator circuits, as they will reduce the weight of the accumulators on account of their small energy consumption. Among such might be mentioned the lighting of automobiles and railway trains.

During the lecture the speaker connected four 25-volt osmium lamps in series and in parallel therewith four ordinary 110-volt incandescent lamps of the same candle-power. The osmium lamps took .96 ampere, while the others required 2.4 amperes, a saving in favor of the former of 60 per cent. The heat generated is also less in the osmium lamps, and they can be made in candle-powers from 2 to 200.

We are able to supplement the above information abstracted from Engineer Scholz's paper (of which a notice appeared March 2 in the Digest), by the following account of the lamp which formed a part of the recent A. I. E. E. paper by Mr. W. J. Hammer.

During his stay last October in Vienna Mr. Hammer, through the courtesy of Dr. Gallia, of the Auer Company, was permitted to see several of the osmium lamps burning, and while unable to secure full particulars, he learned that the lamps were operated at an e. m. f. of 25 volts, and showed an economy of from .9 to 1 watt per candle. The three lamps which Mr. Hammer saw in use were all connected in parallel and operated with key sockets, and differed but little in general appearance from an ordinary carbon filament lamp. The globe was somewhat longer than an ordinary 16-cp lamp, and the filament, which was of the hairpin shape, was much longer. Mr. Hammer was told that these lamps had shown a life under test of 700 to 800 hours, and he adds that it will be interesting to learn to what extent the low voltage of the lamp and the rarity of the material used in its manufacture will affect its commercial application. It had been intended to show the osmium lamp at Paris before the close of the exhibition, but there was not sufficient time. Osmium, which was discovered by Tennant in 1803, is a blue-white metallic element, and is almost infusible. Mr. Hammer was informed in Paris, where he first heard of this lamp, that the successful method of handling this material, which has always been most difficult to work with, was due to a large extent to Mr. Waldron Shapleigh, of the American Welsbach Company, which concern controls the patent rights for the United States.

National Standardization Bureau.

As stated in our issue of last week, the bill establishing a National Standardization Bureau passed both Houses of Congress in the closing hours of the session. The late introduction of the bill was a serious handicap, and that it secured the preference leading to action is to be ascribed to the great merits of the measure and to the indefatigable manner in which those in charge of its interests labored to impress these merits on the attention of Congressmen. The bill as passed is printed below. The changes introduced in the original bill consisted in lowering the salary of the director from $6,000 to $5,000 per year, reducing the staff slightly and reducing the items for building and equipment. These curtailments will not affect the usefulness of the Bureau at the commencement, and can be made the subjct of future legislation.

1. That the office of Standard Weights and Measures shall hereafter be known as the National Standardizing Bureau.

2. That the functions of the bureau shall consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the Government; the construction, when necessary, of standards, their multiples and sub-divisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

3. That the bureau shall exercise its functions for the Government of the United States; for any State or municipal government within the United States; or for any scientific society, educational institution, firm, corporation, or individual within the United States engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments. All requests for the services of the bureau shall be made in accordance with the rules and regulations herein established.

4. That the officers and employees of the bureau shall consist of a director, at an annual salary of $5,000; one physicist at an annual salary of $3,500; one chemist, at an annual salary of $3,500; two assistant physicists or chemists, each at an annual salary of $2,200; one laboratory assistant, at an annual salary of $1,400; one laboratory assistant, at an annual salary of $1,200; one secretary, at an annual salary of $2,000; one clerk, at an annual salary of $1,200; one messenger, at an annual salary of $720; one engineer, at an annual salary of $1,500; one mechanician, at an annual salary of $1,400; one watchman, at an annual salary of $720; and one laborer, at an annual salary of $600.

5. That the director shall be appointed by the President, by and with the advice and consent of the Senate. He shall have the general supervision of the bureau, its equipment, and the exercise of its functions. He shall make an annual report to the Secretary of the Treasury, including an abstract of the work done during the year and a financial statement. He may issue, when necessary, bulletins for public distribution, containing such information as may be of value to the public or facilitate the bureau in the exercise of its functions.

6. That the officers and employees provided for by this act, except the director, shall be appointed by the Secretary of the Treasury, at such time as their respective services may become necessary

7. That the following sums of money are hereby appropriated: For the payment of salaries provided for by this act, the sum of $27,140, or so much thereof as may be necessary; for the erection of a suitable laboratory, of fireproof construction, for the use and occupation of said bureau, including all permanent fixtures, such as plumbing, piping, wiring, heating, lighting and ventilation the sum of $100,000; for equipment of said laboratory, the sum of $10,000; for a site for said laboratory, to be approved by the visiting committee hereinafter provided for and purchased by the Secretary of the Treasury, the sum of $25,000, or so much thereof as may be necessary; for the payment of the general expenses of said bureau, including books and priodicals, furniture, office expenses, stationery and printing, heating and lighting, expenses of the visiting committee, and contingencies of all kinds, the sum of $5,000, or so much thereof as may be necessary, to be expended under the supervision of the Secretary of the Treasury.

8. That for all comparisons, calibrations, tests or investigations, except those performed for the Government of the United States or State governments within the United States, a reasonable fee shall

be charged, according to a schedule submitted by the director and approved by the Secretary of the Treasury.

9. That the Secretary of the Treasury shall, from time to time, make regulations regarding the payment of fees, the limits of tolerance to be attained in standards submitted for verification, the sealing of standards, the disbursement and receipt of moneys, and such other matters as he may deem necessary for carrying this act into effect.

10. That there shall be a visiting committee of five members, to be appointed by the Secretary of the Treasury, to consist of men prominent in the various interests involved, and not in the employ of the Government. This committee shall visit the bureau at least once a year, and report to the Secretary of the Treasury upon the efficiency of its scientific work and the condition of its equipment. The members of this committee shall serve without compensation, but shall be paid the actual expenses incurred in attending its meetings. The period of service of the members of the original committee shall be so arranged that one member shall retire each year, and the appointments thereafter to be for a period of five years. Appointments made to fill vacancies occurring other than in the regular manner are to be made for the remainder of the period in which the vacancy exists.

Taxation of Telephone Companies.

An article was published in these pages recently as to the basis of telephone taxation in Michigan. The work in other States may be followed with advantage. The report of the Tennessee Railroad Commission, issued in December, 1900, shows that in arriving at the valuation of the property assessed the Commission had in view and looked to the capital stock, corporate property, gross receipts, market value of the shares of stock and bonded debt and the franchises of each company assessed for the years 1899 and 1900. In fixing the value of the telegraph and telephone property they assessed only the lines of wire, poles, instruments, batteries, etc. The real estate and personal property was not assessed.

The total wire mileage of the lines of telephone companies operated in the State is 10,320, which shows an increase since the assessment of 1897 of 3198 miles. A number of local telephone companies chartered and operated in the State were assessed, but after deducting the exemption of $1,000 allowed under the statute, had no value upon which a tax could be levied. They were as follows:

Pittsburg Telephone Company, valued at	$425.00
Selmer & Tennessee River Telephone Company	930.00
Fraley Telephone Company	520.00
Whitleyville Telephone Company	760.00
Gravel Hill Telephone Company	112.50
Meigs County Telephone Company	522.25

The telephone companies assessed after having deducted from their value the sum of $1,000, and the remaining assessed valuation, are:

	Miles.	Per Mile.	Total.
Bristol Telephone Company	41	$48.78	$2,000.00
Carroll County Telephone Company	43	16.74	720.00
Citizens' Telephone Company	420	20.76	8,719.20
Cumberland T. & T. Company	5,208	85.00	442,680.00
Dixie Telephone Company	134	30.00	4,020.00
East Tennessee Telephone Company	3,395	40.00	135,800.00
Gainsboro Telephone Company	194	25.00	4,850.00
Harriman Telephone Company	24	34.00	816.00
McMinnville Telephone Company	50	30.00	1,500.00
Nash. & K. Telephone Company	80	15.00	1,200.00
Newport Telephone Company	49	50.00	2,437.50
Nolachucky Telephone Company	112	30.00	3,360.00
People's T. & T. Company	619	32.50	20,117.50
Totals	10,369		$628,220.20

The Cumberland Telephone & Telegraph Company and the East Tennessee Telephone Company are Bell licensee companies, which probably accounts for the high asssessed valuation per mile, the property of the former being assessed at $85 per mile, or nearly three times the average assessed valuation of the 11 independent companies. And 92 per cent of the total assessed valuation is on Bell lines; that is, the total assessed valuation of the independent lines is $49,740.20, while the Bell lines are assessed at $578,480. Of the 10,369 miles assessed, 8603 miles, or 82 per cent, belong to the Bell companies, and 1766, or 18 per cent, to the independents.

This method of taxing the number of miles of line is followed in other States than Tennessee, though in certain commonwealths the distinction is carefully drawn between the number of miles of pole line and the number of miles of wire. Connecticut, for instance, taxes each mile of wire used by the telegraph companies at 25 cents per mile, the Western Union paying a tax of $3,783 on its 15,132 miles of wire within the borders of that Commonwealth.

This method is also followed in taking the 8552 miles of wire used by the American Telephone & Telegraph Company (the Bell long-distance lines). But Connecticut secures its taxes from the local telephone companies by taxing the transmitters at 70 cents each, which is a more equitable method in many respects. And in the case of long distance companies the transmitters are also taxed.

Thus the annual report of the Treasurer of the State of Connecticut for the year 1900 shows that six telephone companies were taxed on this basis, four of the six being independent companies and two Bell licensees, namely:

	Transmitters.	Value.
Ansonia Telephone Company	223	$156.10
Cornwall Telephone Company	5	3.50
New Britain Telephone Company	119	83.30
Farmington Valley Telephone Company	4	2.80
South New England Telephone Company (Bell)	11,440	8,008.00
American Telephone & Telegraph Company (Bell)	34	23.80
Totals	11,825	$8,277.50

That is, the Bell interests pay $8,031.80 taxes on 11,474 transmitters, or 97 per cent of the total taxes on transmitters, for having 97 per cent of the telephones in the State.

In Maine a direct tax is placed on all telephone companies, and the companies reported for the year 1900, and the amount of tax each is expected to pay, is as follows, the report showing that the Bell licensee pays 89 per cent of the taxes:

Dirigo Telephone Company	$250.00
Eastern Telephone Company	250.00
Nash Telephone Company	65.82
Princeton Telephone & Telegraph Company	12.50
White Mountain Telephone Company	557.02
New England Telephone & Telegraph Company (Bell)	9,885.12
Total	$11,020.46

Alabama does not assess telephone companies doing only a local telephone business. But it does assess long-distance telephone companies, classifying such as telegraph companies. Thus the American Telephone & Telegraph Company (Bell dong distance) is assessed on a valuation of $2 per pole, making an average valuation per mile of pole line of $80, on a basis of 40 poles per mile. This rate is nearly three times higher than the average assessment per mile of telegraph pole line, the railway telegraph lines being assessed at from $10 to $25 per mile, and the Western Union lines at $36. Then the miles of wire on the long-distance poles is assessed at $20 per mile. The assessment report shows that this company has in Alabama 18,598 poles at $2, $37,196; 2,378.52 miles of wire at $20, $47,570.35; instruments, $1,877; total, $86,643.35.

In New Hampshire the telephone tax is paid to the State Treasurer, and is not divided with towns and counties, as is the case with the railroad tax, but is held by the State as part of its revenue. The report of the State Board of Equalization for the year 1900 shows the assessed valuation of the seven telephone companies to be $347,700, on which a State tax of $5,910.90 was levied.

Of this assessed valuation of $347,700, 89 per cent, or $310,000, is on Bell properties, and 11 per cent, or $37,700, is on independent telephone properties, as follows:

Citizens' Telephone Company, Laconia	$20,000
Northern Telephone Company	15,000
Ossipee Valley Telephone Company	1,500
Granite State Telephone Company	600
Colebrook, St. & C. L. Telephone Company	600
Plymouth & Campton Telephone Company (Bell)	10,000
New England Telephone & Telegraph Company (Bell)	300,000
Total	$347,700

In Maryland telephone companies pay a tax on the aggregate value of charges of stock, on the assessed value of real property, and a further tax of 2 per cent is levied on the gross receipts. The amount of the gross receipts reported for the year 1899, the latest printed report issued by the State Taxation Commissioner, is shown below:

The total gross receipts reported were $419,645.12; of this amount $396,691.15, or 94 per cent, was reported by the two Bell licensees, and $22,953.97, or 6 per cent, by the 11 active independent companies. Two of the independent telephone companies named entered a formal appeal from the assessment of the State Tax Commissioner. In one case the Controller and Treasurer reaffirmed the assessment; in the other, the Western Maryland Telephone Company, the "aggregate value of the shares of stock" was reduced from $6,225 to $2,075. Referring to appeals taken by corporations, the State Tax Commissioner suggested a change in the law that would enable the county or the city in which the appellant corporation is operating to appeal from the assessment of the State Tax Commissioner after his valuation is announced just as a corporation may appeal from the valuation if believed to be excessive.

The county or the city officials may possess information not likely to reach the State Tax Commissioner that would show that the assessment placed upon the capital stock of the corporation by the Tax Commissioner is too low, and therefore unjust to city or county.

Name—	Gross Receipts.
American Telegraph & Telephone Company (Bell)	$53,343.36
Chesapeake & Potomac Telephone Company (Bell)	343,347.79
Gross receipts of Bell licensees	$396,691.15
Baltimore & Bel Air Telephone Company	478.87
Baltimore, Annapolis & Drum Point Telephone Company	22.55
Boyd Telephone Company	......
Citizens' Telephone Company	......
Dorchester Telephone Company, Cambridge	1,958.03
Enterprise Telephone Company	1,424.87
Gordon Telephone Company	790.00
Gapland Telephone Company	......
Harford County Telephone Company, Bel Air	2,092.23
Interstate Telephone & Telegraph Company, Frederick	6,193.22
Montgomery County Telephone Company	1,138.50
Maryland Telephone Company, Baltimore	......
Princess Anne Telephone Company	425.00
Salisbury Telephone Company, Salisbury	2,200.00
Standard Telephone Company, Baltimore	......
Western Maryland Telephone Company	6,225.00
Gross receipts of independent companies	$22,953.97
Total gross receipts of telephone companies	$419,645.12

Electric Automobiles for Hire a Failure in Chicago.

Considerable disappointment has been felt in electrical circles at the announcement that the operation of "ply-for-hire" electric automobiles in Chicago is to be given up by the local company, owing to the small use made of the vehicles by the public and the heavy cost of maintenance due to the bad condition of the streets. As the matter is one of general interest to the electrical community, we give below the full text of the circular issued to the stockholders by President Insull:

The Illinois Electric Vehicle Transportation Company was organized on May 5, 1899, under the laws of New Jersey, with an authorized capital stock of $25,000,000 to be represented by 250,000 shares of $100 each. At a meeting of the stockholders held April 5, 1900, said authorized capital stock of the company was reduced from $25,000,000, divided into 250,000 shares of the par value of $100 each, to $2,500,000, divided into 250,000 shares of the par value of $10 each. Of the capital stock of the company there have been actually issued 158,620 shares of the par value of $10 each. One hundred and twenty of said shares, or a total of $1,200 par value, have been fully paid. Upon the remaining 158,500 shares of the par value of $10 each, this company has received $5 cash on each share. The total money received by this company on stock subscriptions has been $793,700. There has been paid to apply on the purchase price of the real estate, being the leasehold interest at 171-175 Michigan Avenue, Chicago, Ills., $50,000. There has been invested in the improvements of said premises $31,760.35. There is owing as part of the purchase price of said real estate $150,000 secured by mortgage on said property, which bears interest at the rate of 4¼ per cent per annum, and is due on or before Oct. 7, 1904. The interest accrues semi-annually on said mortgage and has been paid as it matured. The company began actual business on or about Sept. 13, 1899. There has been expended up to Feb. 1 for vehicles, machinery, apparatus, materials, supplies, utensils, fixtures, labor, etc., approximately $643,588.42. The gross income of the business to Feb. 1 has been $137,106.90; the total expenses of operating and conducting said business, including all administration costs, has been $265,885.37, thus showing a loss of $128,778.47, with additional loss in depreciation of vehicles and station equipments. There was cash on hand or in bank to the credit of the company on Feb. 1 $205,458.13, and the company now owns 109 vehicles.

Outside of the $150,000 mortgage debt, which is secured by trust deed on the leasehold interest and plant, the company has no debts other than current liabilities, which did not exceed on Feb. 1, $23,000. The company is the lessee of two sub-stations, one lease on Cottage Grove Avenue at an annual rental of $1,167, expiring April 30, 1905, and the other on North State Street, expiring on April 30, 1902, if notice of termination be given to the lessor before Jan. 1, 1902, the rental of which is $1,000 per year.

Your board is of the opinion that owing to the local conditions and the consequent high cost of maintenance, the vehicles now owned by the company cannot be operated in the city of Chicago on a profitable basis. Your board is, therefore, of opinion that it would be advantageous to this company and its stockholders if this company in manner provided by law, be dissolved as soon as possible and its assets converted promptly into cash, the same to be distributed ratably among its stockholders. Your board has procured the consent of the Electric Vehicle Company to a cancelation of the contract between that company and this company, together with the settlement of all existing claims as between the two companies, and an exchange of mutual releases, such cancellation of contract to be subject to approval of the stockholders of this company.

The terms of the agreement with the Electric Vehicle Company were that it should receive 20 per cent of the authorized capital stock issued and 2½ per cent of the gross income from vehicle operation.

A State Electrical Laboratory for New York.

Attention was called recently in these columns to the bill now before the New York Legislature founding a State electrical laboratory. The New York *Sun* has jumped on this bill and stamped it hard with both feet. President A. V. V. Raymond, of Union College, the proposed beneficiary, replies as follows to the attack:

Your clear statement of the provisions of the bill leaves nothing to be desired in that particular. It proposes to build and equip a State electrical laboratory at Union College and to provide for its maintenance and for the work of experimentation and instruction. The college is to deed to the State the land needed for the laboratory and to offer to students resident in the State 100 free scholarships in electrical engineering. The passage of such a bill would be justified by certain considerations which I wish to call to your attention.

Electrical science, still new and but partially developed, is already of commanding importance to the State, since it enters more largely than any other science into industrial, commercial and domestic life; and it is certain to become still more closely identified with public interests by its application to new uses. Every thought of the future puts an emphasis upon this science that is given to no other. We have but to realize that all the water power of the State is being rapidly utilized for the development of electrical energy to see at once how vital is the relation between electrical science and public interests. This alone is enough to justify the State in fostering directly a study of this science on the same principle that has led to the establishment by State endowment at Cornell University of a State school of forestry, a State veterinary college and a State biological laboratory.

A second consideration is the increased legislation that will be demanded as electrical science progresses. Property must be protected and life safeguarded. For the enactment of right and necessary laws the State should have an independent and authoritative source of information free from the rivalries of commercial interests.

A third and most important consideration is the need of an official standardizing laboratory for electrical measuring instruments. No such laboratory exists to-day, and the demand for it increases every year.

If it is admitted, for the above reasons, that the State should be justified in establishing an electrical laboratory the question of location is still open. Why should Union College be chosen? Because the works of the General Electric Company, the largest in existence, make Schenectady the most natural place in the State, if not in the country, for an experimental station and for investigation and instruction in electrical science. Union College has the oldest engineering school connected with any college in America. It has already a fully organized department of electrical engineering. It is by its charter absolutely undenominational and, therefore, free from the Constitutional provision against State aid to sectarian institutions.

Pres't Glidden on the Erie Telephone System.

President Glidden, on returning from his Southern tour of inspection, says: "The State of Texas is very prosperous. Money is plentiful and banks are unable to loan their funds. Farmers have largely reduced their indebtedness and many mortgages have been paid off. Galveston is rapidly recovering from the effects of the flood, and at that point the company is now operating 1000 telephones, or 50 per cent of the number in operation at the time of the flood. Extensions in the Southwest are practically completed. The principal work to do is the connecting of new subscribers that apply for service, and this can be done at a moderate outlay on account of a liberal excess of switchboard, underground and pole facilities already established at the principal points. We look forward to a very satisfactory and still larger increase of business in 1901.

"Cleveland is rapidly approaching a population of 450,000 people. Many new buildings are to be erected the coming spring. The success of steel and iron industries is the basis of Cleveland's continued prosperity. We are now operating 15,000 telephone subscribers in eight exchanges located in buildings, all owned and, with one exception, occupied exclusively by the company, all connected into the underground system. Our ninth exchange building will be completed by July 1, when we shall be able to take care of 25,000 subscribers."

More Views on the Berliner Microphone Decision.

In addition to the numerous opinions printed in these pages last week, as to the probable effects of the decision against the Berliner microphone patent, we now are able to publish the subjoined:

Mr. J. F. Hemenway, secretary and treasurer of the Ericsson Telephone Company, New York City, says: "Since before the incorporation of this company we noted with interest the advertisement in all the electrical papers by the American Bell Telephone Company of their patent, No. 463,569, which is the well known Berliner patent, issued Nov. 17, 1891, and covering all forms of microphone transmitters. The recent decision in the United States Circuit Court is of the greatest interest to all independent telephone people, meaning every one outside of the American Bell Telephone Company, for numerous reasons, one of which is that the persistent advertising by that company of the patent referred to has made capitalists and investors very cautious. While the independent telephone movement has gone forward by leaps and bounds, it would have increased much more rapidly and will hereafter. In our opinion, the effect will be to increase the confidence of those already interested in the independent telephone movement, whether the manufacturer, the jobber or the exchange owner. Through the success of those outside of the American Bell Company, many others will now become interested, with the result of stimulating the growth of the business. With the growth in the independent fields should come improvements and standardizing of apparatus with a coninued growth in favor of the best goods."

General Superintendent J. J. Nate, of the Standard Telephone & Electric Company, of Madison, Wis., writes us as follows: "We believe with the removal of this last bugaboo the telephone atmosphere has been considerably cleared up, and that its effect will be to bring into the work more capital and combinations for investment in exchange plants to be established in our larger cities. The Standard Telephone & Electric Company was the first in the field with a battery transmitter, the "Milde," an imported transmitter, manufactured in France, and before engaging in the business of manufacturing telephone apparatus, able counsel was secured, and the investigation of the Berliner patent, at that time the most important in question, was very vigorous and complete; in fact, costing many hundreds of dollars. The knowledge gained, however, enabled our company to guarantee its customers absolutely, and this has tended to strengthen our position in the independent field, coming as it did in the very first. Others who followed suit have found that with the growing work the general confidence of the public was secured and money invested quite fearlessly. About the most valuable feature of the Berliner patent to the Bell Company, in our opinion, is with regard to its bearing upon the receipts of the company in the matter of royalties from its licensees. Whether an appeal will be taken with a view to continuing the collections of these royalties remains to be seen. There has been, in our opinion, no more far-reaching, honest and consistent consideration of any patent in suit than that of the Berliner, in which Justice Brown has just rendered so decided an opinion."

The Indiana Mutual Telephone Association, consisting of representatives of the independent telephone companies throughout the State, held a meeting in Indianapolis on the 27th ult. The members anxiously awaited the decision in Boston. The regular meeting of the association is held during the summer, but it is customary for the members to get together during the winter, and the brief session was made the occasion of rejoicing. "There will be increased capital invested in telephones in Indiana now," said Vice-President Sherin. "Money will not be so timid, and it is only a matter of time until every nook and corner of the State will be connected, and 'talk will be cheap.'" About 100 members, representing 150 exchanges, were present. The officers are: President, John McGregor; vice-president, C. M. Zion; secretary, H. B. Gales.

We have the following from Mr. Warren Stoddard, on behalf of the Stoddard Telephone Construction Company, of Monroe, Mich.: "The recent decision in favor of the defendant in the well-known suit of the American Bell Telephone Company against the National Telephone Manufacturing Company, involves the interest of operators in the entire independent field. The extent of this interest will be better shown by pointing to the large and prosperous exchanges already established in St. Louis, Minneapolis, Cleveland, Columbus, Pittsburg and Rochester. The decision will, we think, tend to develop this industry to its fullest extent, and will relieve the apprehensions of capitalists so that it is only a question of time when all the cities, towns and villages will enjoy the luxuries of the telephone at the popular 'independent' rates."

Mr. T. M. Brush, secretary and treasurer of the Rawson Electric Company, telephone switchboard and apparatus manufacturers at Elyria, Ohio, writes us: "The great value of the decision from a public standpoint is the demonstration to the American people that no matter how large or supposedly powerful the influence, a case must have merit to win before our high and able courts. Commercially, the decision will, we suppose, have the effect of attracting timid capital to a most promising field, a field, in our judgment, destined soon to be in almost absolute control of well constructed, equipped and managed 'independent' telephone interests. Why? Because (and we say it with all feeling) Bell telephone interests never knew and do not now know how to run the telephone business. It is true, they have shown ability of a certain order in the handling of the legal questions and complications arising which enable them to make money in spite of other considerations. But all that is now past. A new era dawns in the telephone field, and a sorry one, in our judgment, for those who have wasted their opportunities. We are of those who believe that in a business like the telephone it is important to so conduct it as to have at least the good will of your own patrons as that also of the outside public where possible. Not having it, a business is indeed helpless when faced with active and intelligent competition. The old company has in its employ many bright, intelligent, hustling fellows, but what can they do in a town organized against them? They might as well be men of stone. This is the situation to-day. It is a situation that will continue to develop to the advantage of the independents until the finish."

Mr. W. F. Richardson, secretary of the National Telephone Equipment Company, of Detroit, Mich., says: "In my opinion, it is impossible to estimate the value of the Berliner decision to the independents. It means to the manufacturer that he will be unable to get equipment out fast enough to meet the demand. It means to the supply houses that they will be taxed to their utmost capacity. It means easy money for the promoter. It means success to the exchange owner. It means success and prosperity to all of us."

The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, write us: "As to the recent decision of Judge Brown declaring the Berliner patent invalid, we are strongly of the opinion that the independent situation will show the greatest development and progress within the coming year or so known in the history of the industry. The decision will have a tendency to add confidence in the business with financiers and the investing public, and a number of important independent enterprises which have been in a dormant condition for the past year or so will now be taken up and developed, financed and completed, and not only the small cities of the United States will have independent telephone exchanges, but all of the larger ones as well. While it is to be expected that the Bell Company will still endeavor to harass the manufacturers of independent apparatus as much as possible, their threats at the same time will cut comparatively little figure in the situation in the future. We firmly believe that by this decision a new era for the independent telephone industry has been established, and that the prospects for future business have never been as bright in its history."

German Telegraph Service.

A recent dispatch from Berlin states that a number of prominent men in that city, representing commerce and industry, had a conference with the Secretary of Posts and Telegraphs regarding the frequent interruptions to the telegraph service to England. They declared that they would prefer to send their dispatches to London by way of New York, as they would reach their destination that way sooner than if sent direct from Berlin.

The Drawbacks of "Party" Telephone Lines.

We print below a copy of a letter addressed recently to a large telephone company by one of its subscribers on the "party line" plan. It sums up in somewhat graphic fashion the evils of that method:

Undersigned, a subscriber who was lured into putting a telephone into his house by your clever advertisements in the street cars, which admonish us "Don't walk! Talk!" would prefer to do the walking hereafter instead of putting his monumental patience to the daily test on account of the innumerable troubles attending a hapless telephone subscriber.

I have repeatedly complained to your chief operator of my utter inability to make use of this telephone 75 per cent of the time on account of an infernal woman on our party line, who believes that speech is silver; also believes in the divine ratio of silver 16 to 1; that is, 16 of her talks to our one. I cannot remember that I have ever gone to the telephone, either at my residence to call some one up or from my store to call up my house, but that I had my eardrums cracked with your "busy" signals. Or, if Heaven in its goodness was giving the dear woman a rest, some exchange annoyance or impudence would make me remember that I was getting all this pleasure for 16 cents a day.

The chief operator has always listened courteously to my complaint, and, as I suppose, has courteously shelved it, as I have never received any relief, and, to cap the climax, I was obliged to call up to Toledo, Ohio, by long-distance telephone on a family matter of importance, and after I got the party to the long-distance exchange in Toledo he was obliged to leave, as he had waited nearly an hour to get connection with me, but could not, as the line was "busy." As a result, instead of settling the matter right there and then, we were obliged to spend a night of anxiety, as, after that, we could not reach the party again.

I respectfully request that you place me on another circuit, or take off that loquacious woman, who is the wife of a well-known rag-time music publisher, and who seems to have her 5 o'clock teas and evening receptions by telephone, with utter disregard of other parties on the line.

Or, if you prefer, you may remove the telephone, refunding the unexpired premium on it, and I shall have peace on earth again.

Seeing by Electricity.

Mr. F. E. Kinsman, a well-known electrical inventor, writes as follows to the New York *Times:* My attention has been called to a short reference to an experiment by Prof. Dubois regarding the action of electric currents upon the human eye, and it may be interesting to mention some experiments I was accidentally led to make in this direction in 1878 in Chicago, which led me to believe that the solution of the problem of seeing by electricity would ultimately be found in electrically exciting the retina or nerves of the eye, independently of the external or light process with which nature has endowed a majority of the race through the medium of the external eye, and I believe that through this medium the blind will be made to see and appreciate the beauties of nature as they are now enabled to judge of forms and texture by the sense of touch.

My experiments have enabled me to produce to my own vision (with my eyes closed) the colors of the spectrum. This was done by varying the location of the electrodes of a voltaic battery, as related to the facial nerves, but I have not yet secured an instrument of sufficient delicacy and adaptability of adjustment as to attune the electric pulsations to the extreme delicacy of these nerves to which the application is necessary.

This application must be made through the medium of a facial mask with a "loud adjustment," as is commonly used by telephone operators, and must be quite as delicate in its operation as that wonderful instrument. Since it is all-important to impress the optic nerve with the same number and kind of impressions as are now produced by light waves, the transmitter for such an apparatus must necessarily be capable of receiving light waves as the telephone now receives sound waves and transposes them into electric pulsations, in which service the selenium battery will receive its fullest development.

I am led to make this matter public by the appearance of Prof. Dubois' article, and if possible hasten the day "when we shall see as we are seen," and suggest a line of investigation for others which, in my opinion, will soonest lead to the success I had hoped to meet with and thus give to the public a boon which my experience with the telephone has convinced me it would be but little short of criminal to patent.

CURRENT NEWS AND NOTES.

NO SUBMARINE BOATS FOR GERMANY.—Admiral von Tirpitz, Naval Secretary, declared in the Reichstag last week that he still adhered to his unfavorable opinion regarding submarine boats, and that the Naval Department would not construct any.

WAR TAXES.—The National Senate and House has concurred in the report on the War Revenue Reduction bill, which repeals various taxes, including that on telegraphs, estimated at a yield of $800,000 per year, and that on telephone long-distance messages, estimated at $315,000.

CONSOLIDATIONS IN MASSACHUSETTS.—The Massachusetts House rejected the Gilpatrick order for an investigation of the Massachusetts Electric Companies and accepted the Luce order which calls for a general investigation with a view to a revision of the anti-stock watering laws.

GOVERNMENT TELEGRAPHS.—The United States Senate, on motion of Mr. Butler, has adopted an amendment directing the Postmaster-General to make an investigation of the question of a postal telegraph system and report his findings to Congress, together with the probable cost of establishing the system.

LOCATING FAULTS IN UNDERGROUND ELECTRIC CABLES.—Methods of locating faults in underground electric cables was the subject of a paper read by Mr. H. W. Fisher before the December meeting of the Engineers' Society of Western Pennsylvania. All the methods in common use are quite fully described, and with respect to their application rather than their theory. Among the methods treated are testing with the magneto bell, telephone, voltmeter and galvanometer, and the Murray and Varley loop methods. Practical methods are also given for locating faults when the ordinary apparatus are not at hand.

ELECTRIC COMBINATION IN MONTREAL.—The Montreal capitalists, who are at the head of the big scheme for the amalgamation of the lighting and power companies of Montreal, under the name of the Montreal Lighting & Power Company, expect to have everything in shape to complete the deal by July next. It is freely admitted by the promoters that the absorption of the Lachine Rapids Hydraulic & Land Company is the most difficult part of the work in effecting this combine. The Lachine people are still outstanding, but it is stated that the negotiations, now in progress, will accomplish the amalgamation by the time above mentioned.

REVIVALS BY TELEPHONE.—At New Florence, Mo., Mr. Martin, an evangelist, of the Methodist Episcopal Church South, who is conducting a revival, has adopted the plan of preaching a sermon by telephone. Arrangements were made with the telephone company to place a telephone in such a position that every citizen in the county who had a telephone might hear it, as well as the congregation before which it was delivered. The sermon held the auditors glued to the receivers because of its force and eloquence. After the sermon, one man telephoned that he had been converted. This was announced from the pulpit. There appears to have been some difficulty since in determining his identity.

ALUMINUM HOUSES.—At the Buffalo Pan-American Exposition visitors will have the opportunity of seeing a small building made of aluminum. Niagara Falls is the principal aluminum manufacturing place in the world, and the white metal is a product of two principal factories located there, current being taken from both of the great power companies. This Pan-American structure, to be made of aluminum, will be located in the Manufacturers and Liberal Arts Building. In shape it will be octagonal, and it will be as large as can be built in a space 15 ft. square. The height will be about 22 ft., and it will be made of No. 24 sheet. The architecture will resemble the Spanish Renaissance, practically the same style adopted for the buildings of the great Exposition. Its lines will be graceful and there will be a beauty about it that is expected to win new admiration for aluminum.

IN THE PHILIPPINES.—A cable dispatch from Manila states that a wagon train and a detachment of the Signal Corps, together with six Macabebe scouts, were attacked by the insurgents about midway between the towns of Silang and Das Marinas, in Cavite Province. Three American were killed and two of the scouts were wounded, while one man is missing. Four horses and one mule were killed. Capt. Mair, with detachments of infantry and cavalry from Silang, arrived at the scene of the surprise too late to intercept the enemy's retreat.

ELECTROLYTIC METHOD OF MANUFACTURING PHOSPHORIC ACID.—A patent was granted March 5 to F. P. Denbergh on a process for the manufacture of phosphoric acid from apatite or other materials containing phosphorus, by means of heat and electrolysis. The phosphorus-containing material is crushed and mixed with sand or other material that will serve as a flux, and the whole placed in an electric furnace. The materials are then fused by the heat of the electric current and form a molten bath, and an electric current passing through this bath liberates phosphorus in an atmosphere containing an excess of oxygen, thus producing phosphorus oxides which are led off and condensed. To insure the hydration of the phosphorus oxides, steam or vapor is introduced into the furnace chamber.

DOGS AS ELECTROTHERAPEUTS.—The following letter appears in the New York *Evening Post:* A black cocker spaniel of my acquaintance has hit upon a pleasure so novel in canine society that it deserves recording. A young lady of the family to which he belongs once tested him by scuffing about the rugs of her home until she could give an electric spark of considerable snap, and then discharging it upon the nose of her pet, the spaniel. Not long after this abuse the dog was observed to roll upon the rugs, entirely of his own accord, and then to run to the brass bedsteads and obtain a spark. This he continues to do, and his own observations seem to have taught him that he must approach metal in order to receive the spark. In one room he runs to the bedstead; in another to the register, and as he licks his nose after the pricking of the spark he never fails to wag the remains of his tail, and his face assumes a decided expression of pleasure." There is no need to throw physic to the dogs when they run after it.

A NEW INSULATION FOR CONDUCTORS.—A patent was granted March 5 to C. P. Steinmetz on a method of insulating fine wire of the kind used in electrical measuring instruments and the like, with a structureless coating of cellulose. The wire is first passed through a solution of cellulose made by dissolving cotton wool in an ammoniacal solution of cupric oxide; the latter re-agent is prepared by first precipitating with caustic soda a solution of sulphate of copper to which salammoniac has been added, preserving the precipitate under water, and when the re-agent is new adding the hydrated cupric oxide to ammonia so long as it dissolves. The solution produces a deep blue mucilaginous liquid. After the wire has been passed through the solution it is allowed to dry, and is then passed through diluted hydrochloric acid in the proportion of one part of acid by weight to five parts of water, and is afterwards freely washed in pure water and dried. The dilute acid dissolves out the cupric ammonia and leaves the cellulose upon the wire in the form of a horny, brownish gray structureless coating. For larger wires or thicker films of cellulose, the coating may be impregnated with linseed oil or some other similar substance, to increase its toughness and flexibility.

ACCIDENTS AS A LIVELIHOOD.—A lawyer of this city who recently had business with the courts in the Borough of Brooklyn that occupied his time for several days, is quoted by the New York *Times* as follows: "It seems to me as if pretty nearly the whole of the population of Brooklyn is engaged in bringing suits against the Brooklyn Rapid Transit Company. Such as are not bringing suits already have them pending in some one of the courts. These suits are a source of steady income to a lot of attorneys who make a specialty of this practice, and I expect some would be on the verge of starvation but for them. It appeared to me as if people who had nothing else to do stood about near the tracks of some one of the trolley lines awaiting opportunities to be knocked over by the cars, and so secure the basis for a suit at law. Such a knock-down seems to be considered by the juries as worth about $7,500, and a fellow who can get a couple of such accidents in three years manages to get a very good living out of the experience without much inconvenience or bodily distress. What the effect of the recent setting aside of verdicts as exorbitant may be I cannot say, but the business up to this has been a good sort of thing to those who do not mind the nervous strain. One of my friends tells me that the doctors over there have changed their office hours from 9 to 11 in the morning to 9 to 10, so as to be in the courts in time to testify in these damage suits. This is said to have become far more profitable to them than the ordinary office practice, and a source of a very satisfactory income to such physicians as have offices conveniently near places where accidents are most likely to happen."

TWO-LIQUID REGENERATING PRIMARY BATTERY.—A reissue was made March 5 of a patent dated May 15, 1900. on a process of operating two-liquid primary batteries and regenerating the elements thereof. The invention properly speaking is for the use of the same liquid in the one compartment and then in the other of a two-liquid primary battery. In a two-liquid primary battery the depolarizer is destroyed by local causes if it is in contact with the zinc, but if the liquid is first used as a polarizer and when exhausted as such is then used as an excitant in the zinc compartment, the same liquid may be used for both purposes. The chief advantage claimed for this method is that it very greatly facilitates the regenerating of the liquids by electrical means, and many difficulties are thereby overcome, such as those due to diffusion of the two liquids if they are different. By the method described in the patent the normal amount of diffusion through the porous cup does very little harm, and the process of regeneration and subsequent use becomes a complete cycle, since for each regeneration the liquids are exactly the same, no matter how much diffusion there has been. It is claimed that a battery of this kind may be employed for transporting energy from a central station to the place of consumption. by means of a liquid which is not expended but merely acts like the plates of an ordinary secondary battery in storing electrical energy in the form of chemical energy. An advantage over the storage battery is that only the liquid need be transported from the place of consumption to the source of energy. Moreover, the amount of energy of one discharge is limited not by the size of the battery but by the amount of liquid at hand. which may be any amount desired. The difficulties heretofore met with in the regenerating of primary batteries have been due largely to the fact that, unlike the present method, the process was not completely cyclic.

ELECTROLYTIC INTERRUPTER.—A patent granted March 5 to Elihu Thomson describes an automatic interrupter of electric currents, designed particularly for employment with alternating current. The invention is based on the discovery that the Wehnelt type of interrupter may be successfully used with alternating currents by suitably varying the inductance or exposed area of the anode, or both, to effect an interruption of the circuit during successive pulses of alternating current of like sign. The instant of interruption depends upon the value of inductance, the voltage of the circuit and the area of the exposure of the anode surface, or upon the variation of the current density at that point. In carrying out the invention an adjustable inductance is placed in circuit with the anode and cathode of the interrupting device, to which circuit a moderate potential is supplied, such, for example, as that commonly employed in operating incandescent lamps. In this circuit is included the primary of an induction coil, the secondary of which is wound for step-up transformation, in which the rapid interruptions created by the interrupter may be rendered useful for operating high-frequency, high-potential devices. The induction coil or transformer in which the step-up transformation is effected may be used as the auxiliary variable inductance in circuit, by providing it with a movable core or other means of varying the inductance of its primary circuit. By this means the impulses of the alternating current of such a sign as to pass through the liquid conductor from the anode to the cathode, are suddenly interrupted, producing sharp fluctuations of e. m. f. in the translating circuit, and the alternating impulses of opposite sign pass through the apparatus without interruption, and are practically eliminated so far as any material reaction on the step-up transformer is concerned. By means of this arrangement an alternating current may be employed with equal efficiency with direct current for all purposes for which the Wehnelt interrupter has been proposed.

RELIGIOUS SERVICES BY TELEPHONE.—Owing to the prevalence of smallpox in Mount Pleasant, Mich., several of the churches were closed on Sunday a couple of weeks ago. The ministers hit, however, upon a plan to conduct services by telephone. The telephone company made proper connections to the houses of some of the members and the Baptist and Presbyterian ministers delivered 15-minute sermons over the wires.

AUTOMOBILE ENDURANCE TEST.—The Long Island Automobile Club is to hold in the near future a 100-mile endurance test. Mr. L. R. Adams is chairman of the committee, which has already formulated its rules. The maximum speed is 15 miles an hour; the minimum 8, where local ordinances require. The time unit for basis of computation is 500 minutes. The course must be covered in 12½ hours. There will be several awards. The entrance fee is $10. Motive power will be divided into classes, and there will be three judges in each.

ELECTRIC HEATING.—A patent was granted March 5 to Adolf Vogt, of Westminster, England, on the manufacture of electric heating appliances of high electrical resistance, capable of sustaining very high temperatures during long-continued use. The resistance is mainly composed of a non-conducting substance and a metal conductor. A mixture of a finely divided metal, such as nickle and of a non-conducting material such as kaolin is subjected in an atmosphere of hydrogen to only such a temperature as to cause all the oxidized metal particles to be reduced to the metallic state. The compound is then heated to about the welding temperature of the metal, whereby the non-conducting particles thereof are caused to assume a more or less vitreous and dense condition. In the specifications it is stated that this material is particularly applicable for effecting the preliminary heating of electrolytic conductors, and also for lighting cigars, for heating branding dies and a variety of similar purposes.

SUBMARINE BOATS IN NORWAY.—Admiral Börresen, Chief of the General Staff of the Norwegian Navy, has demanded through the medium of a supplementary budget the sum of $175,000 for the construction of a submarine ship in accordance with the system invented by the builder of the Holland. The Admiral, in his request, declares that "these vessels will have a speed of nine knots on the surface and seven knots under water. They will, too, if the hopes of their constructors are justified, be able to sink 10 meters under water and to remain continuously submerged during the space of four hours." Admiral Börresen says that he fully believes that the hopes of the constructors will be realized. He also regards these boats as admirably adapted to the needs of a country like Norway. The unique nature of the Norwegian coast, with its many fjords, would give them particularly effective opportunities for operating. He further anticipates that with one of these submarine vessels, which require only four men apiece to work them, it will be possible to inflict more destruction on an enemy than with a line of battleship manned by a crew of 300.

LIGHTNING ARRESTER.—Ordinarily when a double-pole lightning arrester is used, or two single-pole arresters connected to opposite branches of a circuit, a shunt circuit is formed from line to line, and when the lightning discharge passes it establishes a vapor between the discharge terminals, which may cause the arc to persist under the potential of the generator. This is especially true when metallic pieces are placed close together so as to produce a discharge path for the lightning at relatively low potentials in order to insure the protection of the insulating devices on the circuit. In a patent granted March 5 to Herbert C. Wirt on an application filed April 30, 1897, a means for obviating this objection is described. Metallic cylinders are used of sufficient mass to cause the heat generated by the lightning discharge to be directed away from the surface adjacent to the air-gap, the dischargers thereby being kept cool. In series with the lightning charge circuit, a rod of graphite or other non-inductive resistance is introduced to limit the flow through the lightning arrester circuit, thereby keeping down the heating and preserving the terminals at such a temperature that the arc once extinguished does not start up again.

DEATH OF PROF. FITZGERALD.—Prof. George Francis Fitzgerald died Feb. 21 at Dublin, Ireland. Prof. Fitzgerald was born 50 years ago in Dublin, and was a son of Dr. Fitzgerald, Bishop of Cork. We quote the following tribute to the eminent mathematician and physicist from Dr. Oliver Lodge, and printed in the London *Electrician:* "A good man he was if ever there was one, devoting himself to public work, free from all petty ambition, caring nothing for himself, throwing out his ideas right and left with splendid prodigality, rejoiced if they were absorbed and utilized by others. How quick he was to seize a point, how keen to criticize, to expand, to illuminate, a subject. Put near his elbow an abstruse paper, he would take it up casually, as another might a newspaper, and soon he would be absorbed and begin pencilling out calculations indicative of luminous ideas. See him at a British Association meeting of Section A. He was the life and soul of debate, he was always ready with some semi-paradoxical but wholly suggestive and stimulating idea. See him at that memorable meeting at Bath, when he brought forward and made known to the world the brilliant experimental discoveries of Hertz, discoveries which verified Fitzgerald's own suggestions and surmises. Hear him at that same Ψ and J and the propagation of electrostatic potential in time, and meeting when he was discussing with Lord Kelvin and others about the other outstanding difficulties in Maxwell's splendid work."

CAPILLARY ELECTROMETER FOR RELAY PURPOSES.—As is well known, the Lippmann electrometer consists of a glass tube drawn down to a capillary size at its lower end and filled with mercury. If this tube is made part of an electric circuit, any variation in potential at the terminals of the tube causes the mercury meniscus to move up and down, the extent of the movement of the meniscus measuring the variation in the potential. In a patent issued March 5 to Prof. A. C. Crehore and Capt. George O. Squier, the principle of this electrometer is applied to several new purposes. The space above the mercury is filled with a liquid such as oil and in the oil is located a receptacle, one or both sides of which are formed of metallic diaphragms. These diaphragms are insulated from each other and form terminals of the local circuit, and between them a suitable variable resistance is placed, such as carbon granules. Any variation in the elevation of the mercury in the tube will cause the diaphragms of the receptacle to be pressed forward, thereby decreasing the resistance through the granular carbon, and vice versa; by placing in the local circuit any device responsive to this variable resistance, the variations in the main circuit may be shown. The meniscus of the electrometer is very sensitive and rapid in its movements, and, therefore, the apparatus is well adapted for use as a receiver for submarine cables. Moreover, it may also be used for other purposes, since it responds quickly to changes of current; a deflection of the meniscus is proportional to difference of potential; it takes no current; the arrangement is dead beat and responds to exceedingly small voltages.

LETTERS TO THE EDITORS.

Automobile Construction.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of March 2 there appears a letter from Mr. John C. Henry, of Denver, Colo., purporting to be a new departure in the construction of automobiles. While agreeing with Mr. Henry in his views respecting the construction of a vehicle on the lines indicated by the description and drawings given, the writer wishes to state that in point of novelty, Mr. Henry's construction is anticipated by a patent which was granted to Mr. F. A. La Roche, of this city, on June 28, 1900, record of which appeared in your "Record of Electrical Patents" in the following issue of your journal. The description of Mr. La Roche's combination motor vehicle or "multi-mobile," as he terms it, appeared in issue of the *Motor Age* of July 5, 1900, disclosing practically the same features which Mr. Henry describes.

New York City. Philip K. Stern.

The Electric Sign for Summoning Vehicles.

To the Editors of Electrical World and Engineer:

Sirs:—Upon reading your editorial remarks on illuminated electric signs in the March 9 issue, I was greatly pleased to note the encouraging future you predict for this twentieth-century advertising medium. Having acquainted myself of late with the various types of electric signs in the market, I fully appreciate your statement as to the shortcomings of the old stationary electric sign and the ease with which the sign can be made automatically changeable by means of electricity. This is beautifully and almost perfectly exemplified by the methods which were thoroughly described and illustrated in your issue of March 2.

You further point out in your editorial the employment of electric signs for the purpose of summoning vehicles to the doors of the theater. You suggest a keyboard consisting of 8 rows having 10 numbers each. This, however, naturally implies the use of fixed letters lighted and extinguished at the will of the operator. For this purpose the Mason changeable letter you described is splendidly adapted, as by the use of three boxes or monograms all numbers up to 1000 may be formed. A keyboard consisting of only 3 rows of 10 keys each and a cable consisting of 3 × 21 = 63 wires, only need be installed. This small installation reduces the cost of operating such a system to a minimum, and should make this electrical calling system a very popular one; in fact, the "monogram" sign seems to solve this problem entirely, as it is in every way a "talking" electric sign.

Max Loewenthal.

New York City.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

REFERENCE.

Rotary Transformers.—Colles.—The first part of an illustrated paper on "Rotary transformers, their history, theory and characteristics." It is a broad review of the subject. He first characterizes briefly the rectifier type, the inductorium type, the motor-generator type, the dynamometer type, and the rotary converter type, and gives illustrated descriptions of different devices and machines for continuous current only. The inductoriums of Boyle, Van Depoele, Waterhouse, Main, Edison and Jehl, the motor-generators of Van Depoele, Thomson, Henry, Rice, the dynamometers of Van Depoele, Walter and Thomson, the Thury method and the Scribner method of constant current to constant pressure transformation are described and illustrated.—*Jour. Frank. Inst.*, March.

Lights and Lighting.

The Welsbach Osmium Lamp and Electric Plants.—A long and detailed discussion of the results which may be expected from the introduction of the Welsbach osmium lamp for the profitable working of electric stations. Attention is first called to the well-known disadvantage that the present lighting station must be installed for maximum demand, while the lighting load is very irregular, and is a maximum only during a few evening hours. Storage batteries help to overcome this disadvantage somewhat. In alternating-current stations, however, it must be the aim of the managers to deliver during the daytime as much energy for power and traction purposes as possible. The smaller the ratio of the energy consumed for lighting to the energy consumed for traction and power purposes, the greater is the economy of working of the station. This ratio will evidently be diminished by the introduction of the osmium lamp, which consumes about 40 per cent of the power per candle of the ordinary incandescent lamp, so that from the introduction of the osmium lamp eventually a profit must result for the station. He considers the case of the Berlin Electric Works. The total capacity of the dynamos is 29,372 kw; the average load during the last year was 3291 kw, or 8.9 per cent of the total capacity, of which 1193 kw are the average lighting load. If, now, all the lamps were replaced by osmium lamps, and if as a result of this it is assumed that then only 50 per cent of the former electric energy is consumed for lighting, the total capacity of the works could be reduced to 19,825 kw and the average total load would be 13.6 per cent of the total capacity instead of 8.9 per cent, as above. In reality, the dynamos are available, and if we assume that the double number of lights would be connected on account of the higher economy, no more dynamos would be required and the works with the present capacity of 29,372 kw would be equivalent to a plant with a capacity of 48,467 kw supplying only Edison lamps. But this case is purely hypothetical. In practice, even with a very rapid introduction of the economical osmium lamp, the number of converted lights would not be doubled, but the following advantage would be obtained. Extensions of the plant which would become necessary for power and traction purposes, would be unnecessary. It is claimed that the power which would become available, as less power is required for lighting, would be utilized at once for power and traction purposes. In this case the whole capacity of the plant is again 29,372 kw, the average total load would be 12 per cent of the total capacity of the plant, against 8.9 per cent, as above. Finally, the case of a pure lighting plant is discussed. After the introduction of the osmium lamp the receipts would first decrease, but the connections of lamps would soon increase, just as has been the case with gas works after the introduction of the Welsbach gas lights. In smaller direct-current lighting plants, which are provided with storage batteries, the introduction of the osmium lamp would cause a saving of fuel, because the batteries have now virtually double the former size, as far as the lamp hours are concerned. It is finally pointed out that the introduction of the osmium lamp will probably also cause the introduction of storage batteries in the premises of the consumer. As the osmium lamp burns at 25 to 30 volts, only a third or fourth of the number of cells required for 110-volt lamps are necessary. The cells can then be charged at a low rate during the day, and the load factor of the electric station is improved. At the same time the important question is solved, how to produce the transformation of the voltage necessary for osmium lamps.—*Zeit. fuer Beleucht*, Feb. 20.

Power.

Electricity vs. Steam for Station Auxiliaries.—An article in which the author says that one of the novel features of the Manhattan Railway system is the use of electric motors for operating the pumps. He considers the economy of this method as compared with the use of steam pumps. The latter will take about 3⅓ times as much steam as the electrically-driven pumps, but this steam can afterwards be used in the feed-water heaters and about 75 per cent of its energy saved in this way. In the case of the Manhattan station, the feed water is heated by economizers. He concludes that the steam-driven pumps are the more economical.—*St. R'y Jour.*, March 2, and Int. Ed., March.

REFERENCES.

Electricity in Mines.—An illustrated description of the installation in the coal mines de l'Esperance et Bonne Fortune, in Montegnee-lez-Liege, in Belgium. The power house contains three 200-kw three-phase generators. The motors used in the mines for pumping, ventilating, etc., are all induction motors.—*Revue de l'Elec.*, Feb. 15.

Electric Power in Workshops.—Geipel.—The first part of a paper on electrical power in British works. He discusses the advantages of electric driving under the following headings: Reduction of loss in shafting, saving of loss in steam pipes, saving of loss in engines, saving of water and stoves, saving of labor, increased output, facilities of working, facilities of extending, reduction of cost of repairs. —Lond. *Elec. Rev.*, Feb. 22.

Electric Power in Workshops.—A reprint of a report on electric driving in engineering workshops, especially electric driving of machine tools, presented to the Am. R'y Master Mechanics' Ass'n at the last annual meeting, as noticed before in the Digest. There is also a series of illustrations of some of the latest forms of machine shop application of electric driving in this country and abroad.—*Cassier's Mag.*, March.

Electric Cranes.—Kolben.—A long and very well illustrated article on electric cranes. He deals especially with mechanical details. For the gearing with electric cranes either spar and pinion is used, or a worm gearing combined with spur and pinion. He recommends standardizing worm gearing, as this is preferable for the constructor. He describes several modern types of cranes made by Kolben & Co.—*Elek. Zeit.*, Feb.

Traction.

Lisbon.—A very well illustrated article on the street railway system of Lisbon, Portugal. The city is very hilly. Mule cars have been used before, exclusively, the principal company having about 70 km. of track and 330 cars. When the change to electric traction was decided upon one important subject discussed was the best method of preventing the competition of omnibuses which used to run on the tracks. It was decided to build a very narrow gauge for the electric cars (90 cm), as it would be almost impossible to build omnibuses to this narrow gauge. As the difference in temperature between night and day in Lisbon, especially in summer, is very large, considerable trouble has been experienced with expansion and contraction of the rails. They were originally laid with tight joints, but now a slight clearance is left between the ends of the rails, and they are clamped to the ties. The power station contains six engines of about 700 hp, three return boosters, one line booster, and one battery booster, all of which are driven by 500-volt motors. The car house has a capacity for 140 cars, and pit room for 107 cars. This pit construction was very expensive to build, and is a distinct departure from the usual American practice, where much less room is taken for car pits. The company is importing 195 new cars from America, all to be motor cars, the motors for these cars to be of a special type to fit the narrow gauge.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Boston Elevated Railway Company.—A very fully illustrated description of the new system. For some years Boston has been operating many of its trolley cars in a subway. The company is now building a system which is nearing completion, which includes an elevated structure about the city, and will be used in connection with the subway. The elevated trains will run into the subway by grades at each end, and both elevated and subway trains will transfer to the surface cars, the whole system being run under one management. There is a large, new power station near the center of the system, with two 2700-kw railway generators. There are at present 100 cars being equipped for this road. The cars are long, with double tracks, one truck only being used for the motors, which are two in number. The motor truck is slightly larger than the trailer truck. The third-rail system of collecting the current is to be employed, the shoes being suspended from cross beams between the two journal boxes by four links. The cars are to be run in trains by a system of multiple unit control, and no trailer cars are to be used. The power on each car approximates 300 hp, this large figure being necessitated by the rapid acceleration which it is intended to obtain in order to run on the high-speed schedule which has been mapped out. In order to provide safety for this speed a complete system of interlocking signals and switches is used and an extra high guard-rail placed at curves as well as safety stops, which set the brakes on a car passing them.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Portland.—An article giving some notes from Portland, Oregon. Owing to the distance of this company from the manufacturers in the East, much home-made material is used. The company builds its own cars, takes its own discarded motor fields, burns off the insulation and then insulates the wire anew, saving considerable money over new copper wire. The cars are dispatched by telephones. Sawdust is used as fuel in the power station.—*St. R'y Jour.*, March 2, and Int. Ed., March.

London.—A very fully illustrated description of the system of the United Tramway Company, which has been completely equipped, but has not yet been put in operation, owing to the opposition of the managers of the Kew Observatory. The power station contains three 750-hp engines, of which two are directly connected to direct-current generators, and one to a 500-kw three-phase generator. Many of the station auxiliaries are operated by electric motors. There are four sub-stations, each containing from two to three 250-kw rotary converters.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Germany.—An article giving notes from Germany. A description is given of the new power station at Leipzig, which contains three 420-hp condensing engines. The street railway company of Frankfort has installed some mail cars measuring 7.62 meters in length, and 1.8 meters in width. The cars are run between the main post office and the principal railway station. During January a convention of Prussian city authorities was held in Berlin, and arguments were made in favor of municipal control of tramways. The experience in Germany in this direction has been somewhat disastrous, especially in Dusseldorf. Some particulars of the results secured in that city are given. The city of Berlin has purchased two small electric lines about 16 km. in length for 10,000,000 marks, and will operate them.—*St. R'y Jour.*, Int. Ed., March.

Non-Paying Roads.—Cooper.—The fourth article on the question of how to make non-paying roads pay. He discusses income from transportation outside of the fare question, and speaks first of chartering cars. The charge for a car should amount to more than the regular fare for each individual of the party. This traffic seldom comes of itself, and must be created by a personal canvass. He also refers to advertising and paragraphs in the local newspapers. The carrying of freight can often be made remunerative, but this should be carried on a special car, and not on the regular cars, as it takes room, delays regular service, and interferes with the performance of the duties of the motorman and conductor. Freight cars can often be made out of old horse cars, when the freight is not too heavy. Milk is often a profitable item in a regular freight business. On long interurban cars the light freight can often be carried in a separate compartment at the end of the passenger car. The profit of carrying bicycles is a debatable question, but, as a rule, the writer does not recommend it. The leasing of some of the space in the cars for advertising can bring in an income, but usually takes considerable of the time of the manager.—*St. R'y Jour.*, March 2, and Int. Ed., March.

High-Speed Electric Railroading.—Hughes.—An article giving some particulars of a road which he commenced to build between Chicago and St. Louis, where a speed of 75 to 100 miles per hour was planned. To avoid curvatures, it was decided not to pass through the large local towns, but reach them by spur lines. The current was to be transmitted at 10,000 volts, and the line was divided into 5-mile sections. Each section was to be alive only while the car or train was thereon, and was to be followed by a dead section, to prevent rear-end collisions. The trolley line was to be strung parallel with the rail, and not in catenaries. The trolley pole was to have a sliding contact with the trolley wire by means of a renewable carbon fuse. The motor car was shaped so as to reduce the resistance. The wheel base of the trucks was to be very long. The writer estimates that the road could be operated more cheaply than parallel steam roads. The project was abandoned later.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Spokane Snowplows.—An illustrated description. Owing to the power required to raise and lower the plows and flange diggers on each side, the company has put in a compressed air equipment for doing this work. The snowplows when in service are always run on the multiple position of the motors instead of the series, as there is less tendency of one pair of wheels to slip.—*St. R'y Jour.*, March 2, and Int. Ed., March.

REFERENCES.

Street Car Hoods.—Partridge.—A long and well illustrated article. The hood used on most street cars at present is of plain "clam shell" form; it is inherited from horse-car days, when all parts of a car had to be made light, but is generally satisfactory for electric service. Another form of hood is copied rather closely from steam practice.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Heavy Electric Railroading in Germany.—A digest of lectures by Bork, of Berlin, and Von Kando, of Buda Pest. The former gave some particulars of tests on the Wannseebahn, which show an estimated cost of 420 marks for each 100-car km. for electric service as against 480 marks for steam service. Von Kando referred to some experiments in Italy by Hungarian manufacturers with high potential transmission.—*St. R'y Jour.*, Int. Ed., March.

Conduit System in London.—A well illustrated description, with some critical remarks, on the proposed electric conduit for the London County Council's Tramways, a briefer description of which was noticed in the Digest, March 9.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Feb. 22; *Lightning*, Feb. 21.

Polyphase Railways.—Perkins.—The second article of this illustrated serial on polyphase electric railways in Europe. He describes the Burgdorf-Thun railway.—*El'ty*, Feb. 27.

Railway Generators.—Ryan.—A well illustrated description in detail of the three-phase alternators of the Metropolitan St. R'y Company, of New York City.—*Sibley Jour.*, Feb.

Huddersfield.—A long and well illustrated description of the municipal railway system of Huddersfield. There are 15 miles of single track, being supplied from one station with direct current at 500 volts. There are two 375-kw generators.—Lond. *Elec. Eng.*, Feb. 15.

Current Supply to Long Railways.—Rasch.—A brief reply to the criticism of Sieber (Digest, Feb. 23). He remarks that his calculations refer to normal conditions only.—*Elek. Zeit.*, Feb. 7.

Motor Control.—Sieber.—A longer abstract of his German article, giving a comparison of different methods of motor control (Digest, Feb. 23).—*St. R'y Jour.*, Int. Ed., March.

Automobile Trials.—An abstract of the judge's report on the

Chislehurst motor-car trials, which were noticed before in the Digest.—Lond. *Elec.*, Feb. 22; *Lightning*, Feb. 21.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCES.

St. Petersburg.—BAKER.—The first part of an illustrated description of the high-tension alternating-current station of St. Petersburg, which has a capacity of 7000 hp. There are seven steam-driven alternators, generating single-phase alternating currents at 3000 volts, with a frequency of 50.—*Lightning*, Feb. 21.

Capacity in Alternating-Current Working.—An account of the very long-continued discussion of Mordey's paper, which was abstracted in the Digest. Sparks, Fleming, Swinburne, Mather and Threlfall participated. Mordey's tests were criticized and the correctness of their results was questioned. Mordey replied that he was right.—Lond. *Elec.*, *Elec. Eng.*, Feb. 22; abstracted in *Lightning*, Feb. 21. Lond. *Elec. Rev.*, Feb. 22; an article by Ayrton on the same subject in Lond. *Elec. Rev.*, Feb. 22.

Graphite Rheostat.—DIETZE.—An illustrated description of a starting rheostat used by Flohr for crane and elevator motors. The principal feature is the use of a powdered mixture of graphite and ordinary carbon. The variation of the resistance is gradual as in water rheostats, but there are no disadvantages due to evaporation or decomposition.—*Elek. Zeit.*, Feb. 14.

Cost Determinations in Isolated Electric Plants.—MOSES.—An article in which he urges the owners of isolated electric plants to keep detailed hourly records of the items of cost, and gives general suggestions how to make such a system of "log" records.—*Eng. Mag.*, March.

Switchboard.—WEEKS.—An illustrated article on the Niagara Falls Power Company's switchboards.—*Elec. Rev.*, March 2.

WIRES, WIRING AND CONDUITS.

Wiring Accessories.—An article in which is given a list of fittings, approved by the Manchester Corporations. It comprises switches for currents from 35 to 120 amperes, motor-starting switches, cut-outs, distribution boxes, ceiling roses, wall plugs, lamp-holder plugs, lamp holders and lamp-holder switches. The total number of fittings is 710, of which 289 are single-pole and 421 double-pole; 395 are for 100 volts, 300 for 200 volts and 15 for 400 volts.—Lond. *Elec. Rev.*, Feb. 15.

ELECTRO-PHYSICS AND MAGNETISM.

Stratification of Discharges.—STARK.—A paper in which he sketches the production of stratification as follows: As soon as the discharge has been started, the difference of velocity between the two kinds of ions produce a reduction of the ionization, and hence also of the force at the cathode. The negative particles acquire a great velocity and retain it for considerable distances owing to ionic shooting. The negative glow-light is a region of strong ionization, which reduces the velocity of the negative ions and produces an accumulation of them just beyond it. That accumulation acts as a secondary cathode, and produces similar phenomena.—*Phys. Zeit.*, Jan. 19; abstracted in Lond. *Elec.*, Feb. 1.

Thermoelectric Ores.—VAN AUBEL.—An account of an investigation of Abt's electromotive series of thermoelectric substances. In several instances this series was found to follow the law of thermoelectric force which applies approximately to the metals. But this approximation is by no means general, and a definite series cannot be made to include certain minerals.—*Ann. der Physik.*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.

Magnetic Expansion of Iron and Nickel.—SHAW and LAWS.—The first part of an illustrated account of an experimental investigation of this subject. While in every previous research on this subject an optical lever method has been used for measuring minute changes of length, they use a different method of greater delicacy and greater range. They employ Shaw's "electric micrometer," which has a screw and set of levers moved at will by an experimenter; any movement made by the screw head is reduced by the joint action of the levers (whose arms are unequal), say, 1,000 times. The lever farthest from the screw carries a contact head of iridio platinum, and is arranged near a plate of iridio-platinum fixed to the body the amount of whose movement is to be measured. The contact head and plate, if they touch, complete an electric circuit which includes a telephone used by the experimenters. Another novelty in their measurements was that the current used for producing the magnetic field was measurd by the Crompton potentiometer method.—Lond. *Elec.*, Feb. 22.

Testing of Magnets.—KLEMENCIC.—An account of an investigation in which he found that the magnets which show the greatest permanency when exposed to shock, do not at all necessarily possess the greatest resisting power to other demagnetizing influences, but rather the contrary. Magnets should be tested with the same patience as standard cells, and their examination should occupy a corresponding interval of time. Experiments extending over a whole year showed that a magnet which in the first 27 days was placed near the end of the series in the order of permanency, advanced to the first place in the course of subsequent tests. This was largely due to its dimensions, and it appears that generally those magnets have a better chance in which the ratio of length to cross-section is great. The decrease in the moment is great within the first few days after magnetization, after which it becomes much slower. This indicates two causes of diminution, one of them being the "magnetic after-effect," and the other the structural changes connected with the hardness of the metal. In magnets which are not exposed to rough usage. as, for instance, in magnetometers, specimens with much coercive force, are more advantageous. Even soft iron, when preserved from shock, maintains its remanent magnetism for an extraordinary length of time.—*Ann. der Physik*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.

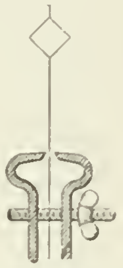
ELECTRO-CHEMISTRY AND BATTERIES.

Gas Polarization in Lead Accumulators.—C. J. REED.—A paper in which he severely critizes the article of Nernst and Dolezalek abstracted in the Digest, June 9, 1900. The problem proposed by these authors was: Why can a lead accumulator with an aqueous electrolyte and an e. m. f. exceeding two volts exist, since the electrolyte is decomposed rapidly between platinum plates when the e. m. f. reaches 1.7 volts? The theory proposed by them was that the liberation of hydrogen from a given combination and condition does not require the absorption of a fixed quantity of energy, but that besides the free formation energy there is a variable quantity required, the value of which depends upon the occluding or absorbing capacity of an adjacent body. They assume that greater energy is required to liberate hydrogen in contact with lead than when in contact with platinum, because the platinum has a greater occluding capacity for hydrogen than lead has. Against this theory Reed makes the following statements, which leave their entire theory "not only without facts to stand on, but without any object or anomaly to explain": Hydrogen gas is evolved electrolytically in unlimited quantities from dilute sulphuric acid with electrodes of pure metallic lead when the e. m. f. is less than 0.5 volt. To prove this, he uses as an anode lead in a state of very minute division, as in a charged accumulator plate or in an electrolytically deposited lead tree. As a cathode, he uses a clean strip of sheet lead. The e. m. f. required to maintain a steady current between electrodes of pure metallic lead is less than 0.01 volt. This occurs without the agency or presence of lead sulphate in the solution or on the cathode. The e. m. f. required to charge an accumulator is in no way dependent upon or related to the evolution of hydrogen or oxygen on a lead electrode, nor is it dependent upon the occluding capacity of lead. He shows that Nernst and Dolezalek, while working with lead sulphate electrodes instead of pure lead electrodes, have not considered that the conversion of the lead into lead sulphate has produced an entirely new apparatus. He discusses the different electro-chemical actions which can occur in this new condition, and calculates the corresponding e. m. f.'s. When the electrodes of an electro-chemical system constitute also the electro-chemical re-agents, as in the case with the lead sulphate, lead peroxide and metallic lead of an accumulator, the decomposition tension of the intervening electrolyte is not necessarily a factor in determining the e. m. f. between the electrodes. It will usually be a factor if the constituents of the electrolyte are actually set free, but it cannot be a factor if none of the constituents of the electrolyte is liberated by the electro-chemical action, because the decomposition cannot then cause the absorption or evolution of the formation energy.—*Jour. Phys. Chem.*, Jan.

Electro-Chemical Units.—A summary of the electro-chemical units, suggested by Le Blanc, representing the German Electrochem. Soc'y, before the recent Paris Congress. Conductivity is to be expressed in ohm-centimeters and designated by K. A body has unit conductivity when a cylinder of the body of a square centimeter cross-section and 1 cm high has a resistance of 1 ohm. (This is evidently what is generally called specific conductivity.) Molecular conductivity is the conductivity, as defined before, divided by the number of gram-molecules dissolved in a cubic centimeter. The quantity of electricity necessary for the separation of a gram equivalent (96,540 coulombs) is to be designated by *F*, after Faraday. Definition and units of the concentration equivalent, dilution equivalent, conductibility equivalent, electrolytic mobilities and velocities are also suggested.—*The Elec. Chem. and Met.*, Feb.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Measuring the Frequency.—WACHSMUTH.—A description of a very simple device for determining the frequency of an alternating current. It consists of a piece of watch spring clamped in a vice, and provided with a small square piece of white paper, stuck on by means of wax, as shown in the adjoining figure. When this is illuminated by a source fed by an alternating current and set vibrating, it will appear to stand still when the frequency of the current equals its own frequency of oscillation. The latter can be calculated easily from the thickness and the length, and in practice a graduation can easily be marked on the spring itself. A small correction must be added for the paper in the case of light springs. The method is very convenient, and can be used for frequencies up to 150 per second, beyond which the springs become too stiff.—*Ann. der Physik*, No. 2; abstracted in Lond. *Elec.*, Feb. 22.


FREQUENCY MEASURING.

Compensating for Voltmeters for the Voltage Drop in Long Feeders.—FIELD.—The first part of an illustrated paper read before the Glasgow section of the Brit. Inst. Elec. Eng. He describes a method whereby any voltmeter whatever may be compensated for the feeder drop of either a two, three or multiple wire system without necessitating constructional modifications of any kind, and, more than that, can be arranged to indicate the average voltage obtaining at any group of distant feeding points. The method depends on the insertion of a resistance at the staion end of the feeder whose resistance is some small fraction of the whole feeder resistance. "A high resistance is also placed between the bus-bars, and from a point on it some small fraction of the whole distance from, say, the positive bus-bars, connection is made to one voltmeter terminal, while the other is connected to the end of the feeder resistance rmote from the bus-bar." The ratio of this resistance to that of the feeder being properly chosen, the reading on the voltmeter will be a certain small fraction of the potential difference between the bus-bars, less the same fraction of the drop on the feeder. He discusses the following three cases: First, the measurement on the same instrument, not only of the actual voltage existing at various feeding points of a two-wire network, but also the average of the voltage at all the feeding points, or the average voltage at any desired group of feeding points of the network; second, the measurement of the individual feeding point voltages and the average voltage at any group of feeding points of a network on the three, five or other multiple-wire systems; third, the measurement by means of a low-tension electro-static multicellular voltmeter, of the voltage at the far end of a long single or polyphase power transmission line working at extra high-tension, and possibly possessing a comparatively large self-induction. In the present part the first case is discussed. The paper is illustrated by many diagrams.—Lond. *Elec.*, Feb. 22; the discussion which followed is given in *Lightning*, Feb. 21.

Measuring the Power of an Alternating-Current Circuit.—An illustrated description of a method of Langdon-Davies for measuring the true watts on an alternating-current circuit. Three ammeters and a voltmeter are required. One ammeter measures the current in the inductive circuit; the second measures the current in a non-inductive resistance, like a water rheostat, connected in parallel with the inductive circuit; the third measures the resultant current of the two branches together. The voltmeter is connected across the terminals. The power factor can be found by means of vector geometry, by a very simple geometrical construction, so that the power can easily be determined.—*Lightning*, Feb. 7. Some further notes on the method in *Lightning*, Feb. 14.

REFERENCES.

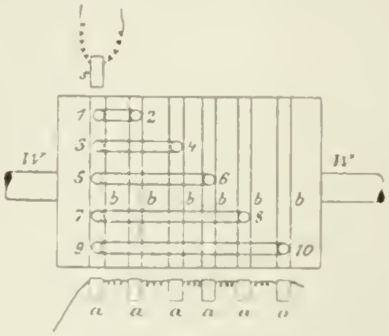
Thomson Bridge.—EDELMANN.—An illustrated description of three types of the Thomson bridge for small resistance.—*Elek. Zeit.*, Feb. 14.

Influence of Tramway Currents Upon Galvanometers.—CHEVALIER.—A brief paper read before the Internat. Soc'y of Electricians in Paris. He gives an account of the observations made in Bordeaux regarding the influence of neighboring electric tramways upon galvanometric measurements.—*Bull. de la Soc Int. des Elec.*, Nov.

Clark Cell.—CARHART.—A summary of the various determinations of the e. m. f. of the Clark cell. The mean of the absolute determinations is 1.4333 volt at 15 degs. C.—*The Elec. Chem. and Met.*, Feb.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Relay.—WEST.—An illustrated paper read before the Electrotechnical Soc'y of Berlin, on Poulsen's telephonograph, which has been mentioned repeatedly in the Digest. He gives the principles of the instrument, describes the wire used, the ribbon types, its use for a telephonic newspaper, and Pedersen's device of using it for duplex telephony by using two electromagnets instead of one. Hagemann has applied the telegraphone from a telephone relay in the following way. As seen in the adjoining figure, there is a drum *W W*, upon which a number of closed steel ribbons *b b* are wound. The drum is revolved by a motor at high speed. The small "writing electromagnet" *s* is connected to the transmission line, and writes, so to speak, the arriving sound waves magnetically on the steel ribbon. The ribbon then passes along another similar electromagnet 1, in the coils of which currents are induced which are supplied to the writing electromagnet 2, so that the sound waves are recorded on the second ribbon *b* also. In the same way they are recorded on the other ribbons *b* by means of the third, fourth, etc., electromagnets. All ribbons, therefore, receive the same record. The energy required for generating the currents in the electromagnets 1, 3, 5, etc., is supplied from the motor which drives the drum. When all the ribbons have received the record they pass along the electromagnets *a a* which are connected in series. The e. m. f. at the terminals of this series is greater than the e. m. f. at the terminals of *s*. The terminals of the series *a* are connected with the next section of the transmission line. The effect of the device is to increase the amplitude of the waves. The apparatus is, however, still in the first experimental stages. There is also an editorial on the commercial prospects of Poulsen's instrument.—*Elek. Zeit.*, Feb. 21.



TELEPHONE RELAY.

Propagation of Wireless Waves.—LAGRANGE.—An investigation of the part played by the earth in the propagation of the electric waves used in space telegraphy. He concludes that the earth behaves as a conductor and not as a dielectric. A coherer was buried in the ground 1 ft. deep, at a distance of some 100 yards from a 25-cm spark-gap provided with an air-wire 2-m long. Before the earth was covered over the coherer the latter responded well, and a relay actuated by it exploded a dynamite mine with the greatest ease. But when the wooden box containing the apparatus was covered with earth to the depth of 1 ft. all action upon the coherer and upon the mine ceased. He says nothing about the quality or the moisture of the soil. He believes the waves are partly absorbed and partly reflected by the coil, as they would be by a conductor, and points out that the explosion of underground mines cannot be carried out with the apparatus described.—*Comptes Rendus*, Jan. 28; abstracted in Lond. *Elec.*, Feb. 22.

Application of the Manometric Flame to the Telephone.—AUSTIN.—An illustrated description of a method of making visible the sound waves produced in a telephone, by using a manometric flame and photographing the records. The manometrical telephone is useful for lecture-room demonstrations of the telephone diaphragm, and of the undulations of an alternating current. In connection with a second manometric flame, actuated by a tuning fork of known period, it becomes a frequency teller. It may also be used in studying the distortions in sounds, produced by telephone transmission, and offers a convenient method of comparing small alternating electromotive forces.—*Phys. Rev.*, Feb.

Wireless Telegraphy.—Fleming.—An abstract of a paper on "The Marconi system of wireless telegraphy as applied to lightships and lighthouses." An improvement which Marconi has made, is that instead of connecting a sensitive tube with a long aerial wire, he introduced a type of tube, known as a "jigger," which enabled him to conduct his experiments over a greater distance and to get rid of disturbances due to atmospheric electricity. He has recently succeeded in establishing perfect communication between St. Catherine's and the Lizard, 200 miles apart; he can send two messages each way at the same time.—Lond. *Elec. Rev.*, Feb. 22.

MISCELLANEOUS.

Training of Electrical Engineers.—Nicolson.—A long abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. He first speaks on the importance of laboratory work in engineering schools; their purpose is to extend scientific knowledge by providing more experimental data, and to show the student the scope, value and limitation of the theories he has studied in the classroom. He recommends that the laboratory should contain machines and instruments of the newest types procurable, which may serve as object lessons on the general trend of electrical engineering design. He strongly advocates, that, after leaving school, the student who intends to become an electrical engineer, should first spend at least two years in the workshops of a mechanical engineer and then enter an engineering college to study there for not less than three years. The particulars of this study are discussed in detail. The paper is commented upon in some editorial notes.—Lond. *Elec. Rev. and Elec.*, Feb. 22.

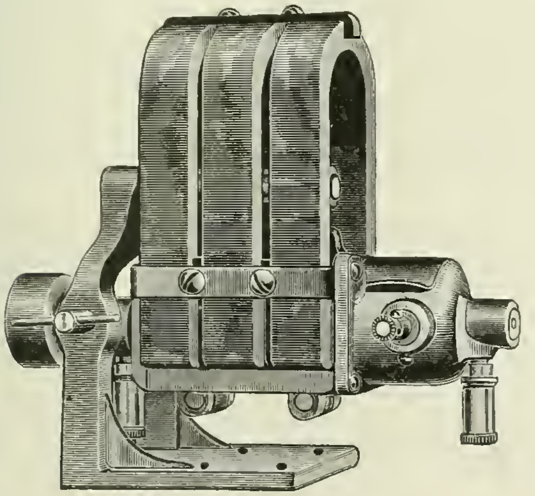
Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 9, 10 and 11, 1901.

National Electric Light Association. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

Gas Engine Igniter.

The igniter illustrated herewith is of the magneto type and manufactured by the Carlisle & Finch Company, Cincinnati, Ohio. It is said to differ from other machines of this class in that it has a toothed laminated armature, and does not require to be run at a high speed. It will produce a good spark when running at 1100 r. p. m.



GAS ENGINE IGNITER.

The magnets are made of special steel, and are said to be much stronger magnetically than it has been possible to make magnets heretofore. The special belt tightener obviates trouble due to loose belts; a turn or two of a thumbscrew rocks the magneto just enough to tighten the belt and a small lock clamp holds it from slacking off again. Among the good features of this machine to which attention is called by the company, are carbon brushes, copper commutators and self-oiling bearings.

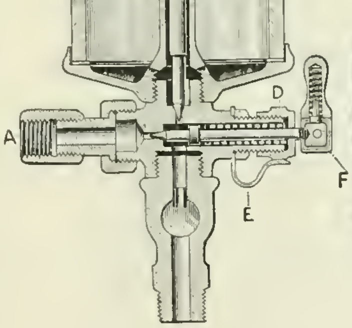
Pressure Oil Cup.

The pressure oil cup shown in the illustration given below possesses some improvements, to which the Lunkenheimer Company, Cincinnati, Ohio, calls attention. The glass reservoir is not under any pressure whatever, but instead the oil supply is piped through the union *A* in the base, the opening of which into the oil duct leading to the bearing is controlled by an oil-regulating valve, *F*. The auxiliary supply is regulated by the oil valve, *C*. With this cup it is said to be easy to regulate the supply of oil under pressure at all times. When it is desired to cut off the supply, the valve, *F*, is turned down and it will then act as an indicator, showing from a distance that the supply is shut off. The regulation of this valve is very easily and simply effected, and when once the valve is set it is not disturbed by the jarring of the machinery. The feed can be turned on or off by simply raising or lowering the cam lever, *F*. The auxiliary oiler, which is intended to be used in case the pressure supply should be discontinued or cut off, consists of the Company's "Sentinel" oil cup, the feeding of the oil being regulated by the cam lever, *C*, in the same manner as with the pressure supply. The auxiliary oiler has a large slide filler, *B*, which dispenses with the use of screw plugs. All the parts of the cup are made of cast brass.

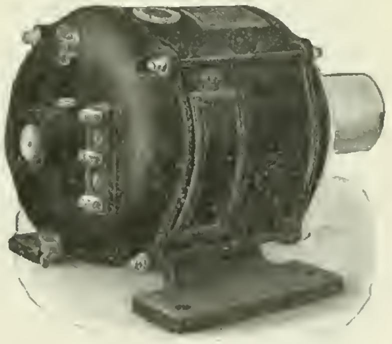
Direct-Current Power Motors.

The accompanying illustration shows a new direct-current power motor being put on the market by the Emerson Electric Manufacturing Company, St. Louis, Mo., which has several new features. It is made with six poles, the field iron being made of punched sheets or laminated in the same manner as in alternating-current motors. This field, it is said, gives all of the advantages derived from an ordinary multi-polar construction, one of the most important of these being the fact that all magnetic circuits and all-wire circuits are much shorter than in the bi-polar construction.

In both the mechanical and electrical design of these motors, the company is following the construction of large engine-type generators. The armature and commutator are mounted upon the same casting, thus allowing the shaft to be removed without disturbing the relative positions of the armature and commutator. The armature is laminated, no band wire being used, and a straight line type of brush holder, which is claimed to be both simple and reliable, has been adopted. The motors are entirely enclosed and are, therefore, suitable for operation in places where it would be undesirable to expose the commutator and brush.



PRESSURE OIL CUP.



DIRECT-CURRENT MOTOR.

The commutator end of the motor frame is provided with two small covers, which, upon being removed, give access to the brushes and brush holders. In order to permit of visual inspection without removing these covers, a peephole, covered with mica, is provided in the top of the motor, so that any excessive sparking can be detected without opening the cover of the machine. Every motor is tested before leaving the factory, each one being required to carry 50 per cent above its actual rated capacity.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2 per cent nominally. Time money during the week was in good demand at rates ranging from 3 to 3¼ per cent for 60 days to 4 months, and 3½ per cent for 5 and 6 months. Mercantile paper is quoted at 3½@4 per cent for 60 to 90 days' endorsements, 4@4½ per cent for choice 4 to 6 months' single names; 5 per cent for others. In the stock market the activity and strength in railroad and miscellaneous shares was somewhat checked by a firmer tendency in money. The so-called "steel deal" was the topic which received the greatest amount of attention in Wall Street. Various special shares also secured prominence, the most conspicuous movement of this kind being in Amalgamated Copper, which rose from 95 to 103⅜ on reports as to the copper mining and the legislative situation in Montana, where the company's chief interests are centred. The New York local gas stocks also had large advances on favorable intimations, and some bullish interest was displayed in traction securities. In the traction list Brooklyn Rapid Transit showed the greatest activity, closing with a net gain of 3⅞ points. The total number of shares sold was 108,685, which shows a close approach to the activity of the week ending Feb. 9. Metropolitan Street Railway Company was also actively dealt in, 45,000 shares having changed hands. The highest price reached was 166¾ and the lowest 161, the stock closing with a net gain of 4 points. In the electrical stocks General Electric was unusually lively, closing with a net gain of 5 points, the highest price being 216½, and the lowest 211½. The total number of shares sold was 13,925, which is about three times that of the preceding week. There was a revival of interest in Western Union during the week, which resulted in higher prices. The speculation, however, soon subsided and the stock closed at 87⅞, 1 point higher than the close of the previous week. The total number of shares sold was 30,970. American District Telegraph records a net loss of 1 point, and American Telegraph & Cable ¾. In the list of outside securities nothing of particular importance transpired, and the changes in quotations of electrics were generally fractional. Electric Boat, both common and preferred, closed with a net loss of 2 points each. Electrical Lead Reduction Company stock was dealt in on the "Curb" during the week for the first time. Following are the closing quotations at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Mar.-2.	Mar 9.		Mar. 2.	Mar. 9.
General Electric	210	215	Elec. Veh	—	14
Brooklyn Rap. Tran	74¼	78⅝	Elec. Veh., pfd	30	—
Met. St. Ry	161	165	Gen. Car	2¼	2¼
Am. Tel. & C	94	95	Ill. Elec. Veh. Tran	⅞	1
West. Un. Tel	86⅞	87⅞	Hud. Riv. Tel	120	120
Am. Dist. Tel	37	36	N. E. Elec. Veh. Tran	2¾	3
Com. Cable	160	—	N. Y. Elec. Veh. Tran	3¾	4
Elec. Boat	27	25	Tel. & Tel. Co. of Am	4	4¼
Elec. Boat, pfd	52	50	N. Y. & N. J. Tel	180	180

BOSTON.

	Mar.-2.	Mar 9.		Mar. 2.	Mar. 9.
New Eng. Tel	135	135	Erie Tel	50	51
Mex. Tel	2⅞	*2⅞	Gen. Elec., pfd	—	—
Westing. Elec	—	60	Am. Tel. & Tel	158⅞	160
Westing. Elec., pfd	—	—	Boston Elec. Light	—	—

PHILADELPHIA.

	Mar.-2.	Mar 9.		Mar. 2.	Mar. 9.
Elec. Stor. Bat	75½	74	Phil. Elec	6¼	6⅛
Elec. Stor. Bat., pfd	75½	76	Pa. Elec. Veh	1½	1½
Elec. Co. of Am	7¾	8½	Pa. Elec. Veh., pfd	1	1
Gen. Elec. Auto	—	—	Am. Rys	33½	34½

CHICAGO.

	Mar.-2.	Mar 9.		Mar. 2.	Mar. 9.
Chicago Edison	150	150	Chicago Telep. Co	260	260
Chic. City Ry	255	260	Union Traction	14	15½
Nat'l Carbon	16	16	Union Traction, pfd	56	56
Nat'l Carbon, pfd	82	83	Northwest. Elev. Com	36	35½

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*Asked.

ELECTRICAL LEAD.—The Electrical Lead Reduction Company has a new process of converting lead ore—galena—into various lead compounds by electrical reduction. It is stated that it has no competition in its line, being the first concern in the United States to make lead or lead compounds by electrical reduction. Its factory is at Niagara Falls, and the ore is procured at Joplin, Mo. The company also makes pure sulphuric acid as a by-product. Dividends on the preferred stock are cumulative at 7 per cent. Among the original subscribers and present stockholders are Robert H. Sayre, president of the Bethlehem Iron Works; Samuel R. Shipley, president of the Provident Life and Trust Company of Philadelphia; Alfred Skitt, second vice-president of the Manhattan Railway Company, and Henry G. Morris, of Morris, Tasker & Company. Reference to the system was made recently in these pages.

ELECTRIC STORAGE BATTERY.—The net earnings of $1,317,865 reported by the Electric Storage Battery Company for the year 1900 are 7½ per cent on nearly $17,000,000 capital stock outstanding, of which amount $5,000,000 is preferred. The $460,000 above the 5 per cent dividends on each class of stock, carried to the credit of surplus account, is being used as working capital in the business. While in 1899 the profits included profits from Electric Vehicle investments, the profits for 1900 are stated to represent entirely the regular receipts from the storage battery business, which is steadily expanding. The company has paid off its $400,000 mortgage and $300,000 in accumulated dividends in the last two years, and the way is now clear for continuing dividends and making increase in the earnings for the stock.

GENERAL ELECTRIC.—This stock was very active on Monday last, breaking sharply at one time from 216½ to 211, and later rallying to 214. The decline was on the announcement that the directors of the company had declared only the regular quarterly dividend of 2 per cent. In the preceding quarter an extra dividend of 1 per cent had been declared, and it was expected that something extra would be given the stockholders this quarter. The rally was on the announcement that in the suit of the company against the Lorain Steel Company a favorable court decision had been handed down as to the use of the overhead trolley.

UNION TRACTION.—The Union Traction Company, incorporated recently in New Jersey with an authorized capital of $1,000,000, has increased its capital to $15,000,000, of which one-half is preferred, with 5 per cent cumulative dividends. The papers were signed by Ashley W. Cole of New York, president, and L. B. Grant of Brooklyn, secretary. The purposes for which the company is incorporated are to construct bridges, buildings, machinery, engines, cars and other railway equipments, water works, gas works and electric light and power works. It is expected to buy into control of New York traction properties.

DIVIDENDS.—The Philadelphia Traction directors declared a regular semi-annual dividend of $2 per share, payable April 1. A dividend of 6 per cent on the preferred and 1 per cent on the common stock of the Hall Signal Company has been declared, payable April 1. The General Electric Company has declared a quarterly dividend of 2 per cent, payable April 15. The American Steel & Wire Company has declared a quarterly dividend of 1¾ per cent on the preferred stock and 1¼ per cent on the common stock, payable April 2.

DENVER TROLLEYS.—At the annual meeting of stockholders of Denver City Tramway, directors were re-lected. President Curtis' report showed gross receipts for the year of $1,302,289, the largest for any time since 1892. The entire floating debt of the company was paid off during the year, and the company has now no other indebtedness outstanding than its bonds. Improvements planned for the present year include a new central power house.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company, which operates Bell exchanges in Albany and the cities and villages of the Hudson River and Mohawk Valleys and of Northeastern and Southern New York and Northern Pennsylvania, has filed with the Secretary of State a certificate of increase of capital stock from $3,000,000 to $4,000,000.

MR. E. F. KIRKPATRICK, Western manager for McRoy Clay Works, Chicago, has just closed a contract with the Keystone Telephone Company, of Philadelphia, Pa., for 4,000,000 ft. of the McRoy conduit. This is the largest single order that has ever been placed in the United States for conduits, and Mr. McRoy has secured some pretty heavy ones already.

UNION SWITCH & SIGNAL.—The annual report of the Union Switch & Signal Company showed that the profits of the company were $390,000, equivalent to about 26 per cent on the entire capitalization. This is the best showing ever made by the company.

COMMERCIAL CABLE.—A regular quarterly dividend of 1¾ per cent will be paid April 1, 1901, to stockholders of record on March 20, 1901.

Commercial Intelligence.

THE WEEK IN TRADE.—The mercantile agencies report that trade as a whole continues quite cheerful. Most lines of distributive spring trade are active, and the leading industries are actively employed. Some "soft spots" are still in evidence in the textile industries, particularly in cotton goods, and raw cotton has again sagged heavily. The cereals, too, lack snap. In the iron and steel trade buoyancy existed. Finished products shared the strength of the general market, and plates are bringing $2 a ton above the schedule, while the rail, bar and structural mills are quite busy. Preliminary February returns of gross railway earnings point to an aggregate gain of 10 per cent over the same month last year. Business failures for the week, as reported by *Bradstreet's*, numbered 208, as against 177 the week previous, and 189 in the same week a year ago. While the failures last week were more numerous than they were a year ago, they were much less costly. There is no change in copper prices, the situation, however, remaining firm. Business was quiet and there was scarcely and inquiry for export. Lake is quoted at 17c. and electrolytic at 16⅝c.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week just ended, Feb. 28: Antwerp—5 packages motors, $700; 4 packages motor vehicles, $850; 51 packages electrical machinery, $5,554. British Australia—72 packages electrical material, $4,646; 22 packages electrical machinery, $1,575. British Possessions in Africa—110 packages electrical material, $5,056. Belfast—1 cable, $125. Bremen—2 packages electrical material, $146. Bilbao—1 package electrical machinery, $23. Brazil—8 packages electrical material, $597. British West Indies—66 packages electrical material, $563. Central America—25 packages electrical material, $667. Cuba—67 packages electrical material, $2,072. Ecuador—13 packages electrical machinery, $1,300; 1 package electrical material, $20. Glasgow—62 packages electrical material, $7,534; 19 packages electrical machinery, $1,500; 69 reels cable, $24,763; 2 cases auto vehicles, $2,500. Hull—45 packages electrical machinery, $8,462. Havre—20 packages electrical material, $2,754. Hamburg—4 packages electrical machinery, $851; 99 cases electrical material, $8,959. Liverpool—39 packages electrical machinery, $5.284; 36 packages electrical material, $8,069. London—7 packages electrical machinery, $1,505; 67 packages electrical material, $9.935. Munich—1 case electrical machinery, $500. Mexico—460 cases electrical material, $5,246; 11 cases electrical machinery, $5,228. Milan—36 packages electrical material, $3,119. Newcastle—8 cases electrical machinery, $829. Naples—1 case electrical material, $512. Nova Scotia—3 packages electrical material, $274. Newfoundland—7 packages electrical material, $683. Peru—61 packages electrical material, $5,335. Reval—3 cases electrical material, $780. Ramsgate—1 case electrical material, $100. Santo Domingo—23 packages electrical material, $389. U. S. Colombia—2 packages electrical material, $60. Venezuela—36 packages electrical material, $1,306.

RUSSIAN TRADE.—President Vintschger, of Markt & Co., Limited, exporters of hardware, machinery, etc., to Russia, contends that the general trade of America with the Czar's country has been greatly underestimated, because of the peculiar conditions under which a great part of American goods find their way to that country. A considerable volume of this trade is set down to the credit of Germany because the shipments are made to German ports and to German merchants, and by the latter resold and reshipped to the Russians, who ask generally from six months to a year. With Russia American trade is conducted through central European houses, who better understand conditions there. American exporters are quick and businesslike, and want quick returns on their capital. They sell on a cash basis to German and English houses, and these latter resell to Russians, on longer time payments. It is these indirect exports that Russian trade gets no credit for at all, and yet they amount to millions of dollars annually, making the actual loss of trade to the United States by the present situation far beyond any estimate that has yet been made.

THE YORKVILLE INDEPENDENT HYGEIA ICE COMPANY, which is building a huge ice-making plant in East Eighty-second Street, New York City, has closed a contract with the Frick Company for the supply of two ice-making machines having a combined daily capacity of 250 tons. Two large Corliss engines to drive the machinery will also be built at the Waynesboro (Pa.) works of the Frick Company. The boiler contract, which calls for three boilers of 400 horse-power each, has been secured by the Stirling Company, of Chicago. The value of the above-mentioned contracts is close on $150,000. The plant is to be lighted by electricity. A 25-kw generator, switchboard and other accessories will be furnished by the Milwaukee Electric Company, while the Frank M. Pierce Engineering Company, of New York City, is to supply an 8x10 Erie Ball engine.

BULLOCK ORDERS.—The advance department of the Bullock Electrical Manufacturing Company, of Cincinnati, Ohio, reports the continuance of an unusual demand for medium-size machines, particularly for power. Among the orders of the past week were: One 20-hy motor for the Baltimore *Star* (the fourth order); one 100-kw engine type generator for the Lexington & Boston Railway Company, Lexington, Mass.; one 22½-kw generator for the Cedartown Cotton Mills, Cedartown, Ga.; one 50-kw engine type generator for the "Schuyler" apartment house in New York City; one 750-kw, 180 r. p. m., two-phase alternator for M. T. Davis, Sheik's Island, Canada; one 50-kw engine type generator for the Parkersburg Iron & Steel Company, Parkersburg, W. Va.; and for the Anheuser-Busch Brewing Company, St. Louis, five 30-hp type M. N. motors, and one each 10 and 20-hp type H motors.

J. HOLT GATES & COMPANY, Monadnock Building, Chicago, has just installed a 250-hp electric power plant for the Grower Building, Chicago, in connection with Vilter-Corliss engine. A great many of the electrical people of Chicago will occupy this building, and it will be a representative plant. This firm has been very busy this winter. It has also furnished a plant to the village of Blue Island, Ill., comprising a 2500-light Warren inductor alternator with a new style, 4-valve, Ideal self-oiling engine. The series alternating arc system, made by the Manhattan General Construction Company, consisting of two 25-light regulators and two 15-kw raising transformers, was also installed, as a large number of 50-cp incandescent lamps are run in series with the arc lamps, and a fine switchboard.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports the following from recently received orders: One 250-kw three-bearing, slow speed, belted type generator for the Laclede Gas Light Company, of St. Louis, a duplicate of the machine sold to the same concern four months ago; one 80-kw generator for the St. Louis Coffin Company; one 80-kw belted generator for the Mannering Electric Light Company, of Mannering, Iowa; two 60-kw belted generators for the Carrolton Electric Company, Carrolton, Iowa; and an unusually large number of orders for small machines. Mr. Jacobs, of this concern reports increasing inquiry and business in the line of municipal plants.

THE MARINETTE IRON WORKS, of Marinette, Wis., through Mr. A. L. Hamilton, the secretary, write us: "We are making extensive improvements in our plant, building a 120-ft. addition to the machine shop, installing an electric crane there and large boring mills. We are also installing a Taylor gas producer, manufactured by R. D. Wood & Company, of Philadelphia. In connection therewith we are putting in our own engines throughout the plant. We have recently built a large pattern shop, introducing modern machinery to aid us in conjunction with our gas engines. We are overcrowded with orders for engines, not only from the United States, but also from several foreign countries."

NEBRASKA POWER.—The Niobrara Irrigation & Power Company has been organized with a capital of $100,000 to develop an extensive water power from the Niobrara River. Mr. Arnold C. Koenig, Associate Member A. S. C. E., of Grand Island, Neb., has been engaged as chief engineer. The dam will be about 2000 ft. in length and the canal, 7 miles long, will be designed to furnish sufficient water to develop 1500 horse-power on the turbine shafts, with provisions for future enlargement. The power will be transmitted electrically to points in the surrounding territory, including 35 miles of new electric railway.

RUSSELL-TOMLINSON ELECTRIC COMPANY.—A reorganization in the Russell-Tomlinson Electric Company, of Milford, Conn., has resulted in the election of Mr. N. Burton Rogers, Danbury, Conn., as secretary and treasurer, and Arthur J. Baldwin of New York City vice-president. W. E. Russell remains president, as before. This company has made a great success of selling telephone instruments at low price, and has gained the reputation of turning out very good products.

FUEL ECONOMIZERS.—The Rhode Island Suburban Railway of Providence, R. I., has contracted, through the New England office, at 53 State Street, Boston, Mass., of the Green Fuel Economizer Company, for their equipment of heaters to 7000 horse-power of water-tube boilers. The Cambridge Electric Light Company, Cambridge, Mass., will have a Green Economizer in the new modern power station they are building.

FORT WAYNE APPARATUS.—The Cincinnati office of the Fort Wayne Electric Works reports the sale of a 200-kw high-frequency Fort Wayne alternator to the city of Greenfield, Ohio, an increase of a plant established about six years ago. At the same time the city purchased a 500-hp Greenwald engine and a Laidlaw-Dunn-Gordon pump.

ORDERS FOR BALL ENGINES.—The Lake Erie Iron Company, Cleveland, Ohio, has recently installed an electric power plant, the engine being 175 horse-power, self-oiling type, built by the Ball Engine Company, Erie, Pa. The Northern Pacific Railway Company has also recently purchased from the Ball Engine Company a 150-hp self-oiling engine for electrical purposes.

IRISH TROLLEYS.—The Kerry County Council has approved the scheme of the Irish Electric Railway Company to construct an electric railroad between Castletownbere and Kenmare, Ireland. The construction of the road involves $3,500,000, and bids for equipment and material will be called for early in April next.

BIDS are being received by the Imperial Wheel Company, of Flint, Mich., for dynamos of 125 to 250 kilowatts; motors, 200 to 400 horse-power; engine capacity of 400 horse-power; four 150-hp water tube boilers and electric wiring.

BALDWIN LOCOMOTIVE WORKS, of Philadelphia, reported that they built 48 electric locomotives during 1900. Their total output was 1217 engines, of which 363 were exported.

General News.

THE TELEPHONE.

DUBLIN, GA.—Clark Grier has petitioned the city for authority to establish an exchange here.

LEESVILLE, LA.—The Cumberland Telephone Company has applied for a telephone franchise.

HARRIMAN, TENN.—The Cumberland Telephone Company has purchased the Harriman Exchange.

NEW DECATUR, ALA.—A company is being organized to establish an independent telephone system.

LIMAVILLE, OHIO.—The Stark County Telephone Company has obtained a franchise for a local exchange.

NORTH LEWISBURG, OHIO.—The people of this place are agitating for an independent telephone exchange.

SALT LAKE CITY, UTAH.—The Home Telephone Company has asked for a franchise to establish a system in Ogden.

DAVILLA, TEX.—The Davilla Telephone & Improvement Company has been incorporated with a capital stock of $10,000.

SOUTH BEND, IND.—The companies in this city using overhead wires have agreed to place all their wires underground.

DURANT, I. T.—The Denison & Choctaw Telephone Company has sold its line and exchange here to Capt. Hughes, of Bonham.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company is considering the issuance of improvement and extension bonds.

PENSACOLA, FLA.—J. L. Hayes, of Tallahassee, and associates, have applied for a franchise to establish an independent telephone system here.

COLUMBUS, OHIO.—The Franklin County Telephone Company has just opened exchanges of 100 lines each at Canal Winchester and Westerville.

SALEM, OHIO.—The Columbiana County Telephone Company is installing a branch at New Springfield. Free service will be given throughout the county.

ALBANY, N. Y.—The Queen City Telephone Company was incorporated recently with a capital stock of $500,000, to operate a telephone system in Buffalo.

FINDLAY, OHIO.—The Findlay Home Telephone Company has been granted a franchise for an exchange at Rawson. A number of farmers' lines will be built.

GAFFNEY, S. C.—The Gaffney Telephone Company has permanently organized and will construct a complete system of 150 instruments, for which it is now in the market.

GALION, OHIO.—The Galion Telephone Company, which commenced business a short time ago, is experiencing a steady growth. It now has 350 telephones installed.

ELLICOTT CITY, MD.—The Howard Telephone & Electric Lighting Company wants cross-arms, insulator pins and brackets, No. 9 and No. 14 wire, telephones and switchboards.

HARTFORD CITY, IND.—A bitter war has begun between the Indiana Telephone Company, of this city, Marion and Montpelier, and the Bell Company, accompanied by rate cutting.

COLDWATER, MICH.—There are 348 telephones in use in this city, the popular rate of $2 per month for business places and $1 per month for residence having trebled the list of subscribers.

HOOPER, NEB.—The Hooper Independent Telephone Company has been formed, and some 40 telephones have already been subscribed for. Several extensions will be made to rural districts.

HUNTINGTON, IND.—The United Telephone Company has closed a contract for the erection of a telephone toll line from this city to Wabash, 50 miles, and also for a line from Wabash to Rochester.

WAUSEON, OHIO.—The Northwestern Telephone Company, with headquarters in this city, has increased its capital stock from $20,000 to $40,000. P. J. Lenhart is president and F. J. Spencer secretary.

ST. LOUIS, MO.—The American District Telegraph Company of Missouri was incorporated March 5. The capital stock is $100,000. The incorporators are H. A. Bennett, T. P. Cook, G. J. Frankel and others.

MINERAL CITY, OHIO.—The Exchange Construction Company, of Cleveland, has just completed the new exchange of the Tuscarawas Home Telephone Company, of this city. It starts with 200 subscribers.

ALBANY, N. Y.—A bill compelling all telephone, electric light and telegraph companies to place their wires in underground subways in the cities of the first and second classes has been introduced in the Assembly.

MARTINSBURG, W. VA.—The Maryland Telephone Company is extending its line from Hagerstown to this place, where it will connect with the Winchester system. This will make three telephone lines in this place.

CHICAGO, ILL.—The Union Telegraph & Telephone Company ordinance has been recommended for passage by the committee. "It is regarded as a boodle scheme. There is no fear that the line will actually be built."

KNOXVILLE, TENN.—The Cumberland Telephone Company has entered into the fight for patronage and is offering residence telephones free for three months. The People's Company has not made any concessions.

UPPER SANDUSKY, OHIO.—C. D. Juvenall, the well-known telephone promoter of this city, has obtained franchises for local exchanges at Jewitt and Scio, Ohio. Independent companies are being organized in these places.

CARROLLTON, OHIO.—The Stark Telephone Company has obtained a franchise for a new independent exchange. The system built here some years ago was sold about two years ago to the Central Union Telephone Company.

LEXINGTON, KY.—The citizens of this place are excited over the apparent overplus of telephone companies. A third franchise is asked for, and rates to be charged are as low as $1.50 for residence and $2 for business telephones per month.

WOLFSVILLE, MD.—A telephone company has been organized, with Dr. Alvey J. Smith, president; Ashbury E. Hoover, secretary, and William E. Hankman, treasurer. The company will construct a telephone line from Myersville to Wolfville.

SALEM, OHIO.—The Columbiana County Telephone Company has closed a contract with the Pennsylvania Railway Company to place telephones in all passenger and freight stations and telegraph offices owned by the company within the county.

DELAWARE, OHIO.—The Citizen's Telephone Company has found it necessary to order an extension to its switchboard, giving an additional capacity of 100 drops. The company now has 540 subscribers. About 7000 ft. of cable will also be installed.

NEWCASTLE, IND.—The Henry County Telephone Company has been organized here with a capital stock of $10,000, which may be increased at the discretion of the directors to $20,000. Many farmers are subscribing to the stock of the new company.

MEMPHIS, TENN.—The new Memphis Telephone Company has closed a contract with Wm. Gest & Company, of Cincinnati, for the construction of a new telephone and conduit system for the city of Memphis. The contract involves an outlay of about $250,000.

TOLEDO, OHIO.—Two independent telephone franchise ordinances are now before the City Council. Dr. Watson, acting for the newly organized Toledo Telephone, Telegraph & Messenger Company, and Frank F. Graves, acting for the Toledo Home Telephone Company, are the petitioners.

FINDLAY, OHIO.—The Findlay Home Telephone Company has placed a large force of men at work in the equipment of its exchanges and system in this city. Several hundred subscribers have been secured, and when the plant is completed the company will have nearly 1000 subscribers.

CAIRO, ILL.—The Cairo Telephone Company has sold its telephone system to John S. Ainsthorpe, M. C. Wright and others. The change of ownership will take effect April 1. It is announced that the new management will continue the system as an independent line, and will place it in first-class condition.

WHEELING, W. VA.—The farmers of this county are holding meetings and agitating the installation of rural telephones. The Ohio County Farmers' Institute has prepared papers endorsing the idea of a rural telephone system, and has sent out broadcast invitations to corporations interested, inviting them to install offices.

RAVENNA, OHIO.—The business of the Ravenna Home Telephone Company has increased 100 per cent since it commenced operations two months ago, and extensions have been made necessary. In order to carry out contemplated improvements the company has doubled its capital stock, increasing from $100,000 to $200,000.

YOUNGSTOWN, OHIO.—Word comes from Seattle, Wash., that Youngstown capitalists have received a telephone franchise there and will proceed to establish an independent telephone exchange. The company will be known as the Seattle Telephone Exchange Company. It is said that contracts to the number of 16,000 have been secured.

FARBER, MO.—The citizens of Farber and vicinity have organized a company to construct a telephone line from Farber to Hutchinson, a distance of 11 miles. The company is known as the Farber Telephone Company and was organized with R. E. Sisk as president, W. J. Crow vice-president, C. A. Devault secretary and William Lake treasurer.

LA CROSSE, WIS.—La Crosse is to be placed in direct communication with Milwaukee and Minneapolis over the telephone systems of the independent companies. The Boyden Telephone Company, recently organized at Baraboo, will string a line from Milwaukee to La Crosse and thence to Minneapolis. The independent companies will pool issues.

AKRON, OHIO.—The Akron People's Telephone Company is preparing to cover the entire county with farmers' party lines, giving a $12 rate with a charge of 5 cents for connection with Akron subscribers. Branch exchanges will be established at Tallmadge, Twinsburg, Peninsula, Pomeroy, Macedonia, Liberty, Clinton, Loyal Oak, Sharon and East Liberty.

SANDUSKY, OHIO.—The Home Telephone Company (Bell) opened its new exchange in this city a few days ago. The change was effected in 30 seconds and the patrons of the system were not inconvenienced in the least. The new switchboard has 1500 lines connected, with room for double that number. New instruments will be furnished all subscribers as soon as possible.

DETROIT, MICH.—A deal has been closed whereby the independent telephone franchise secured some time ago by J. W. Martin has been secured by Messrs. Everett, Pack, Moore and others, of Cleveland. A new company will be formed of which Mr. Pack will be presedent. It has been announced that about $500,000 will be expended in equipping the new line and in making connection with the United States Telephone Company's long-distance service, which is controlled by the same parties.

DETROIT, MICH.—The management of the Detroit Telephone Company, which was absorbed by the Michigan Company some time ago, but whose exchange is still in operation with a few hundred subscribers, announces a reduction of rates to $32 for business and $20 for residence telephones, thus cutting under the rates which the new People's Telephone Company intends to charge. When the People's Company plant is finished next fall Detroit will have three telephone systems.

NORTHVILLE, MICH.—The Northville Independent Telephone Company has secured the right to string wires on the Detroit & Northwestern Electric Railway Company's poles to Farmington and Pontiac, and on the Detroit, Plymouth & Northville Company's poles to Plymouth, and from there the Plymouth independent company continues on to Wayne, where connection will be made with the independent line running to New Boston, Romulus, Willow, Waltz, Carleton, Flat Rock and Rockwood. The Northville exchange has over 100 subscribers, Plymouth 98, Farmington and Wayne about a dozen, and this, with the Pontiac exchange, will give connections with about 1000 subscribers.

STORM IN MICHIGAN.—A dispatch from Detroit of March 10 says: "Over 10,000 telephones were rendered useless to-day by the rain, which fell and froze during the entire morning. The 30-mile-an-hour wind which accompanied the rain raised havoc with the wires, weighed down, as they were, by ice. Officials of the Michigan Telephone Company to-night estimated their loss in the State at $20,000. Street car service was greatly impaired during the morning by ice. The storm was general throughout the southern part of the State, wires suffering everywhere." All through the Middle and Central Southern States a wind storm is reported, with a loss of thousands of telegraph and telephone poles. Chicago suffered severely.

ELECTRIC LIGHT AND POWER.

CULPEPER, VA.—The city will erect an electric light plant.

CLAYTON, ALA.—The city will issue bonds for electric light and water works.

WARRENTON, VA.—A charter has been asked for an electric light plant here.

HAGERSTOWN, IND.—This city has taken steps to secure a new electric light plant.

MADISON, NEB.—The municipal electric light plant has just been completed and accepted.

HENRIETTA, TEX.—The Henrietta Gin & Light Company will erect an electric light plant.

MARION, ALA.—A franchise has been granted a company for an electric light and power plant.

THORPE, WIS.—It has been decided to construct a $6,000 municipal electric lighting plant at once.

ROANOKE, ALA.—The city will issue bonds for the erection of an electric plant and water works.

COUSHATTA, LA.—Frank Pierson is interested in the establishment of an electric light plant here.

HASTINGS, NEB.—John N. Burke has just completed the Hastings municipal electric light plant.

DICKSON, TENN.—The city is considering the issuance of bonds for water works and an electric light plant.

BELLS, TENN.—The Empire Planing Mill Company will probably install an electric light plant to light the town.

RAVENSWOOD, W. VA.—The city is making investigations relative to the establishment of an electric light plant.

CENTERVILLE, ALA.—Ex-Sheriff Vance has asked for a franchise to build an electric light plant and water works.

CANTON, OHIO.—The Canton Light, Heat & Power Company has increased its capital stock from $150,000 to $225,000.

NECK CITY, MO.—Frank O. Chesney contemplates developing water power and installing an electric transmission plant.

CHICAGO, ILL.—A bill is in the Illinois Legislature to prevent discrimination by gas and electric light companies in their rates .

THESSALON, ONT.—The Town Council has decided to install an electric light plant, to be owned and operated by the town.

WHEELING, W. VA.—A bill has been introduced in the Legislature authorizing the establishment of a municipal electric light plant.

TULLAHOMA, TENN.—The town has authority to issue bonds for the proposed water works, electric light plant and sewerage system.

SANDERSVILLE, GA.—Holt & Brother contemplate building an electric light plant and a cottonseed oil mill. A stock company is being organized.

HAGERSTOWN, IND.—Sylvester Schaffer, of Muncie, has made a proposition to Hagerstown citizens to establish an electric light plant here to cost $7,000.

DENTON, MD.—Henry W. Hughes, S. Frank Cole and associates have applied for a franchise for the establishment of a light, heat and power plant for the town.

CARTERSVILLE, GA.—The Etowah Milling Company has made a proposition to install an electric light plant in its new mill, with sufficient power to light the city.

MERIDIAN, MISS.—The Meridian Light & Railroad Company has been chartered, with capital stock of $235,000, by John Kamper, R. W. Stoutz and William Ambrecht.

LAKE PROVIDENCE, LA.—Edward J. O'Beirne, of Birmingham, Ala., has received the contract, at $18,000, for the construction of the electric light plant and water works at this place.

SOUTH MILWAUKEE, WIS.—The Bucyrus Company has contracted for enlarging its present electrical plant. A 100-kw direct-connected unit and complete switchboard will be added.

NASHVILLE, TENN.—The West Nashville Power & Light Company has been incorporated with a capital stock of $15,000. Mark S. Cockrill, L. H. Davis, John H. Bell and others are the incorporators.

BUCYRUS, OHIO.—The Bucyrus Gas & Electric Light Company has been incorporated with $150,000 capital stock by W. C. Lemert, James B. Gormely, John W. Gwynne, Isaac Baxter and F. P. Kaler.

ROCKWOOD,TENN.—George E. Sylvester, of Davenport, Mass., has secured the contract for the construction of water works and electric light plant at Rockwood, for which $20,000 of bonds were recently voted.

TWO RIVERS, WIS.—The electric lighting and water works plant being installed here will be under municipal control. At a special meeting the city has voted on a bond issue arrangement which will bring the city into control of the plant on its completion.

PINE BLUFF, ARK.—The Citizens' Light & Transit Company has been organized with a paid-up capital of $200,000. The stockholders are all local capitalists. The company has been granted a 15-year contract for city lighting to the amount of $6,000 a year.

READING, PA.—The People's Light & Power Company has applied for a charter in this place. Those interested are James K. Getz, Alfred Gunkel, Ellsworth Leinbach, Milford N. Ritter, Frederick M. Yeager, Frank Brobst, A. L. Roth, Daniel J. Driscoll and Albert Webber.

FAYETTEVILLE, N. C.—This city has purchased the plant, machinery, etc., of the Fayetteville Electric & Gas Company for $13,500. The affairs of the company have been in the hands of a receiver and an order of the Court will be necessary to a sale. After this bonds will be issued.

PINE BLUFF, ARK.—The two companies, each of which recently applied for a franchase for an electric car line and lighting plant, have consolidated and will be granted a franchise under the name of the Bluff City Lumber Company. M. A. Austin, Alphonse Brewster, William J. Galbraith, William H. Langford and others are among the stockholders.

RICHMOND, IND.—The efforts of several taxpayers to prevent the construction of the municipal electric light plant has proven a failure. In the suit to enjoin the construction on the ground that the contract price ($144,000) was too high, the judge sustained the demurrer holding that the indebtedness would not exceed the constitutional limit. The work of building the plant will now proceed.

WINNIPEG, MANITOBA.—On Feb. 17, 1900, Winnipeg inaugurated a municipal system of electric street lighting. According to a report presented by Commissioner Stuart, the cost to the city per light per night has been less than 19½ cents. The year preceding the cost was 45 cents per light per night. In addition to the enormous reduction in the cost, from 45 cents per light per night to 19½ cents, the light furnished has been very greatly improved.

NEWBERRY, MICH.—The municipality of Newberry, Mich., has just started a 1200-light Warren inductor alternator, direct connected to an Erie Ball engine at a speed of 300 r. p. m. The council has been very much pleased with the outfit, which also operates two street lighting circuits of 40 50-cp incandescent lamps each. There is not an oil cup on the outfit and it is almost entirely automatic. The apparatus was furnished by J. Holt Gates & Company, Monadnock Building, Chicago.

SAN FRANCISCO, CALIF.—It is reported that Eastern capitalists, represented by R. G. Hanford, have secured from President C. W. Quilty the Mt. Hamilton water rights of the Electric Light, Power & Heating Company. A large impounding dam will soon be commenced on Smith's Creek, in the Santa Ysabel Valley, about 15 miles from San José, Calif. There is a fall of 1400 ft. in 18 miles, and it is estimated that 5000 horse-power can be developed for electric power purposes. It is claimed that the entire output has been contracted for by a large electric lighting company in San Francisco.

MONTREAL, QUEBEC.—Messrs. Henry W. Garth, L. J. Tarte, J. O. A. Laforest, E. S. Manny and J. A. Thivierge, all of Montreal, Quebec, are seeking incorporation from the Dominion Parliament as the Laval Electric Power Company, with a capital of $100,000. The object of the new company is to supply electric power, light and heat. The power house is to be located on Riviere de Prairie, where 10,000 horse-power can be readily developed at small cost. The expectation of the promoters is that their company will furnish light for all the villages along the north shore in that neghborhood and ultimately they expect to reach and do business in Montreal.

THE ELECTRIC RAILWAY.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company will extend its road to Boonsboro.

ELWOOD, IND.—The Union Traction Company will erect a $15,000 freight and passenger station in this city.

CINCINNATI, OHIO.—The Cincinnati & Cleveland Railroad Company is asking for a franchise in this city.

BERKLEY, VA.—The town council of Berkley has granted a franchise to the Norfolk Railway & Light Company.

CINCINNATI, OHIO.—The cars of the new Toledo, Fostoria & Findlay Electric Railway Company will be equipped with telephones.

BUCYRUS, OHIO.—The Buckeye Traction Company has secured a franchise in Crawford County for its line from Bucyrus to Norwalk.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has been granted a franchise to build an electric railway in this place.

CINCINNATI, OHIO.—The Zanesville, Adamsville & Coshocton Electric Company is after a franchise for a road between Coshocton and Zanesville.

CRAWFORDSVILLE, IND.—A company of home capitalists has been given a franchise by the City Council to operate an electric street car line here.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company is contemplating building a second line to Berea by the way of the Wooster Pike.

PORT CLINTON, OHIO.—The Lakeside, Napoleon & Western Electric Railway has been organized here by Eastern capital. The road will be 50 miles in length.

CINCINNATI, OHIO.—The Millcreek Valley Street Railway is considering the purchase of the Hamilton & Lindewald Electric Transit Company's plant at Hamilton.

NORWALK, OHIO.—A local company will be incorporated within a few days to build an electric railway from Tiffin to Norwalk, passing through Republic, Franks and Monroeville.

WASHINGTON, IND.—Z. F. Grayham, of this place, announces that he will build an electric railway to Loogootee, 17 miles east of Washington. Cincinnati capitalists are interested.

CINCINNATI, OHIO.—The Cincinnati & Lebanon Traction Company has been incorporated. Bids will be received and contracts awarded immediately on the completion of the surveys.

CINCINNATI, OHIO.--The Millcreek Valley Street Railway has accepted the franchise granted by the Butler County Commissioners over the Hamilton, Springdale and Carthage Pike.

PAINESVILLE, OHIO.—The Lake County commissioners have granted a 30-year franchise to C. W. Goodrich, P. W. Tuttle and L. B. Stanley for an electric railway from Geneva to Painesville.

DEFIANCE, OHIO.—The Toledo, Napoleon & Defiance Electric Railway Company has agreed to the terms of the Defiance county commissioners and has secured a 25-year franchise through the county.

CLEVELAND, OHIO.– Senator Martin Dodge, promoter of the Cleveland & Warren Electric Railway Company, organized about a year ago, has revived his project and states that the road will surely be built

CLEVELAND, OHIO.--The Cleveland Electric Railway Company and the Cleveland City Railway Company have united in submitting plans to the Union Depot Company for the extension of their tracks to the railway station.

LEXINGTON, KY.—An Eastern capitalist has been in this city conferring with local people with reference to an electric railway from Harrodsburg to Junction City. He also proposes building an electric light and ice plant.

SANDUSKY, OHIO.—The village council at Milan has granted a new franchise to the Sandusky, Norwalk & Southern Electric Railway Company, which will enable it to shorten the route between Sandusky and Norwalk and avoid several grades.

COLUMBUS, OHIO.—The Columbus, Winchester & Lancaster Traction Company has secured franchises in Winchester and Groveport, completing the franchise through Franklin County. A franchise has been asked for in Fairfield County.

NIOBRARA, NEB.—About 35 miles of electric railway in Knox and Boyd Counties are contemplated. The power will be furnished by the Niobrara Irrigation & Power Company, of which Arnold C. Koenig, Grand Island, Neb., is chief engineer.

MONTREAL, QUEBEC.—The Grand Trunk Railway has under consideration a plan to run electric cars of its own over the Victoria Bridge, across the St. Lawrence, at Montreal. The cars will connect with other electric lines on both sides of the river.

RAVENNA, OHIO.—The Portage County Commissioners have granted a franchise to the Northern Ohio Traction Company for the extension of its line between Kent and Ravenna. The Portage Lakes Traction Company also has a similar franchise.

DAYTON, OHIO.—The stockholders of the Dayton & Northern Traction Company met last week and approved the resolution adopted by the directors to issue bonds to the amount of $150,000 at 5 per cent for the completion of the line from Dayton to Greenville.

ST. LOUIS, MO.—At the regular monthly meeting of the St. Louis Railway Club, on March 8, at the Southern Hotel, Prof. George D. Shepardson, of the University of Minnesota, read a paper on "Electric Train Lighting." The paper was illustrated with the stereopticon.

NEW YORK CITY.—At the annual meeting of the stockholders of the Rapid Transit Subway Construction Company the following directors were elected to serve for a term of three years: W. H. Baldwin, Jr., August Belmont, James Jourdan, W. G. Oakman, Cornelius Vanderbilt.

COLUMBUS, OHIO.—The Columbus & Southern Electric Railway Company is placing contracts for the construction of the road. E. P. Roberts & Company, Cleveland, will be the engineers. The Westinghouse Electric & Manufacturing Company has the contract for electrical equipment

CLEVELAND, OHIO.—The Cleveland, Painesville & Eastern Railway Company is buying a private right of way for an extension of its road from Painesville to Ashtabula. The road will pass through Madison and Geneva, paralleling the Lake Shore Railway, and fast time will be made.

CLEVELAND, OHIO.—M. J. Mandelbaum & Company, of this city, promoters of the Aurora, Wheaton & Chicago Railway, have secured franchises in Batavia and Geneva, opening the way for an extension of the road from Elgin to Aurora. The extension will be known as the Elgin City, Carpenterville & Aurora Railway.

PORTSMOUTH, VA.—The Central Labor Union has declared a boycott on the Portsmouth Street Railway on account of the action of the company in the case of certain of its employees who have allied themselves with the local Street Railway Employees Union. The discharged men have since been placed on the list of substitutes.

CLEVELAND, OHIO.—The Cleveland & Southern Railway Company, which was organized about a month ago, has increased its capital stock from $10,000 to $1,000,000. Franchises have been secured as far as Medina and construction work will start from Berea as soon as possible. Options for the right of way to Wooster are being secured.

NEW HAVEN RAILROAD.—The New Haven Railroad is said to be trying to purchase the roads operated by the Old Colony Street Railroad Company, its revenues baving been impaired by the trolley roads between Newport and Boston. The New Haven is also preparing to complete its electric car service from Newport to Providence and Boston.

EAU CLAIRE, WIS.—Boston and Chicago capitalists are said to be working on a plan to combine the Chippewa Valley Electric Railway, the Eau Claire Light & Power Company, the Eau Claire Gas Light Company, the Eau Claire Water Works and the Chippewa Falls Water Works & Lighting companies. It is expected that the deal will go through soon.

CHICAGO, ILL.—The syndicate organized by Blair & Gompany, of New York, to take over the interests of Charles T. Yerkes in the Chicago elevated roads, is understood to include Thomas F. Ryan of New York, Marshall Field and Norman B. Bean of Chicago, as well as the Widener-Elkins street railway interests. The purchase price is reported at about $5,000,000.

INDIANAPOLIS, IND.—The Indianapolis & Lebanon Traction Company, just incorporated, has franchises for two routes between the two cities and will decide between them soon and begin the work of construction. The promoters say the line will ultimately be extended to Frankfort and Lafayette. The promoters and incorporators are all Indianapolis and Lebanon men.

BARBERTON, OHIO.—A. E. Townsend, promoter of the Barberton, Doylestown & Massillon Electric Railway, who secured a franchise about a year ago, has asked for an extension of time in which to commence work. He claims that additional capital has been secured and that a contract for construction work has been placed with the Knickerbocker Construction Company, of New York.

SAN FRANCISCO, CALIF.—It is stated that the recent consolidation of the street car lines of Oakland was accomplished by the Pacific Improvement Company selling all of tbe lines of the Oakland Railroad Company to the Oakland Transit Company. The sum paid is placed at $1,500,000. E. H. Rollins & Company, of Boston, will undertake the work of bonding and financing the new street railroad system.

CINCINNATI, OHIO.—The Cincinnati, Milford & Hillsboro Railroad will use the roadbed of the old Cincinnati & Fayetteville Railroad. The company, which is incorporated for $10,000, is officered as follows: W. F. Roudebush of Batavia, president; W. D. Murphy of Milford, vice-president; M. McKeehan, treasurer, and H. L. Wiggins, secretary. Connection with the Cincinnati Traction Company will be made at Linwood.

CLEVELAND, OHIO.—The Cleveland & Eastern Electric Railway Company is making additions to its power house at Gates Mills in anticipation of proposed extension. Contracts have been placed with the Westinghouse Electric & Manufacturing Company for a 250-kw rotary converter, with switchboard and other equipment for the main power house, and for a 200-kw rotary converter to be installed in a new substation at the junction.

NEW YORK RAPID TRANSIT.—It was recently reported that the Pennsylvania and Long Island Railroad interests proposed to sumbit a plan to the city authorities by which these interests could obtain possession of the proposed extension of the Rapid Transit Subway from City Hall to the Long Island Railroad's Flatbush Avenue terminus in Brooklyn. This report has been denied, however, by President Orr, of the Rapid Transit Commission.

SCRANTON, PA.—There is danger of another street car strike in this city, all on account of a passenger eating garlic on one of the cars of the Scranton Street Railway Company. The conductor ordered the offender to desist; a fight ensued, the conductor of the car being the aggressive party. The conductor was discharged. The Street Railway Union has taken the matter up and the company has been formally notified that the conductor must be reinstated.

TOLEDO, OHIO.—The Toledo & Northwestern Electric Railway Company has organized as follows. Directors: J. L. Yost, J. Q. Adams, I. Hubert, I. H. Collins, Wm. P. Heston, H. C. Warren, Ellis Bartholomew of Lima, E. W. Frink of Cleveland, G. L. McKibben of Van Wert, president, F. H. Collins, secretary, W. P. Heston; treasurer, John Q. Adams; Ellis Bartholomew, general manager. The road will be built by the Northern Ohio Electric Construction Company.

JANESVILLE, WIS.—Articles of incorporation have been filed by the Janesville, Beloit & Delevan Lake Railway Company. H. H. Clough of Elyria, Ohio, is the capitalist most actively interested in this interurban electric line. Options have been secured on the right of way between this city and Beloit and between Beloit and Rockford. It is the purpose to build the line between this city and Rockford at once, to extend the line from Beloit to Delevan Lake next year, and to arrange the location of the terminus in this city so that ultimately an extension may be easily built to Madison. The nominal capital stock of the company is $100,000.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Railroad Company, in its contest with the United Gas Improvement Company of Philadelphia, controlling the Connecticut Railway & Lighting Company of this State, won an initial success before the railroad committee at Hartford, which voted to give a hearing at which the attorney for the New Haven company said he would attack the financial condition of the trolley syndicate. President Hall of the New Haven Company says that his corporation will fight the syndicate on broad as well as technical grounds, and one of tbe longest and hottest railroad controversies in the history of the State seems certain.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company, which has absorbed the properties of the Lorain & Cleveland, the Sandusky & Interurban and the Sandusky, Norwalk & Southern, will have a total capitalization of $4,000,000, of which $1,500,000 will be in 5 per cent preferred stock, and the balance, or $2,500,000, in common. Bonds to the value of $3,000,000 will be issued and the money thus obtained will provide for the double tracking of the Lorain & Cleveland Railroad, completing the Sandusky & Interurban, including the Norwalk division, and the rebuilding and extending of the Sandusky, Norwalk & Southern. The property purchased also includes the local Norwalk lines. It is reported in Cleveland that the next move toward the consolidation of all the local interurban roads into one company will be the consolidation of the new Lake Shore Electric Railway Company with the Cleveland, Painesville & Eastern and the Northern Ohio Traction Company

THE AUTOMOBILE.

BOSTON, MASS.—The proposed automobile show, scheduled for last week, did not come oft.

CHICAGO, ILL.—A show is to be given at the Coliseum March 23 to 30. At present there are about 30 intending exhibitors.

WATERVILLE, N. Y., is a good name for a prohibition town. Mr. L. D. Edwards, principal official of the village of Waterville, N. Y., has issued an order forbidding the use of the streets of that town to automobiles. The reason assigned is that they frighten horses and so prevent farmers from coming to the village to do their trading. This cuts off the business of the traders. It is said to be the first instance where the automobile has been prohibited from using the public streets.

ILLINOIS.—Out in Illinois the farmers are taking up the automobile, and it is expected that during the coming summer the horseless carriage will be a common sight on the country roads in some portions of that State. The automobile manufacturers are receiving large orders from rural purchasers. This is an unexpected development of the trade. It shows, for one thing, that some of the Western farmers are up to date in their recognition of a real improvement. Another thing shown is that Western farmers are prospering.

NEW INDUSTRIAL COMPANIES.

THE STEIN & LANGLOS ELECTRIC MANUFACTURING COMPANY of New York City has been incorporated; capital, $10,000. Directors: George Stein, W. V. Langlos and C. F. Kabisch, New York City.

THE PACIFIC ELECTRIC CORPORATION has been incorporated, with San Francisco as the place of business. Directors: B. Hienrich, H. J. Summerhayes, T. Charlton, T. K. Wittich and E. H. Stearns. Capital stock, $50,000.

LEGAL.

THREE-CENT CAR FARE LAW VOID.—At Cleveland, Ohio, on March 11, a decision by Judge Ricks of the United States District Court was handed down declaring unconstitutional the 3-cent street car fare ordinance passed by the City Council two years ago. The Judge maintained that the ordinance interfered with existing contracts. The suit to restrain the city from carrying into effect the terms of the ordinance was brought by the local street car companies. Director of Law Hogsett states that the suit will be carried to the higher courts as soon as possible.

RAILWAY PATENT SUITS.—On page 406 of last week's issue were digested the three railway decisions in Thomson-Houston Company vs. Bullock and Nassau, and Lorain Steel Motor Companies. In both cases Messrs. Betts, Betts & Sheffield & Betts represented the complainants (the General Electric Company actually), and Mr. Frederic Betts argued the cases first before Judge Thomas, then before Judge Wheeler, and in the Circuit Court of Appeals before Judges Wallace, Shipman and Lacombe. Messrs Harding & Harding, of Philadelphia, represented the defendants in all the cases, Mr. C. V. Edwards, of New York, representing the defendants in the case against the Bullock Electric Company. Mr. William H. Kenyon argued the magnetic blow-out cases first before Judge Thomas, then before Judge Wheeler, and in the Circuit Court of Appeals. Mr. George J. Harding and Mr. F. S. Busser argued the Knight interlock case first before Judge Wheeler and afterward before the Circuit Court of Appeals. These decisions dispose of all three of these patents, as there is no further appeal.

OBITUARY.

MR. GILBERT WILKES, head of the firm of consulting electrical and mechanical engineers, of Denver, died there on March 11 from lung trouble. The body will be taken to Detroit. Mr. Wilkes, who was, we believe, the grandson of Admiral Wilkes, served 11 years in the United States Navy as ensign and then resigned to enter the electrical field. For several years he was commander of the Detroit (Mich.) Naval Militia, and served throughout the war with Spain on the Yosemite. He was elected a member of the American Institute of Electrical Engineers in 1890. Mrs. Wilkes is the daughter of Charles Denby, ex-Minister to China.

MR. ERIC E. ERICKSON, president of the Erickson Electric Equipment Company, Boston, died at his home in Boston Feb. 14 at the age of 50 years after a short illness. He was well known among the older members of the electrical fraternity, having been connected with various interests since 1885. In the early days of the Edison isolated lighting system he was connected with the Boston department at 50 Oliver Street. In later years he was identified with the production of the Aetna railway insulation, well known in every large electric railway equipment. Three years ago he organized the firm of the Erickson Electric Equipment Company, for the purpose of installing complete lighting and power plants, and the success of this enterprise has been proven throughout New England.

CAPT. GEORGE N. STONE, president of the Cincinnati Bell Telephone Company, died on March 8 of general collapse resulting from an abscess in the abdomen, for which he had been operated upon. He was 60 years old. He was a large stockholder in the telephone company, also in the street railway and gas companies. His management of the telephone company was so successful that no rival company had ever been able to get a foothold in Cincinnati. He was born in Stark, N. H. He was a lieutenant and captain in the 7th Rhode Island Regiment during the Civil War and finally served on Gen. Schofield's staff. As a lover of horses he made the discovery of Maud S., the celebrated trotting mare—named after one of his daughters. The daughter referred to is the wife of Mr. A. A. Cary, the well-known mechanical engineer and expert, of New York City.

SENATOR C. L. MAGEE, of Pittsburg, editor, statesman, philanthropist and financier, died last week at Harrisburg, Pa., after an illness of more than two years. His death was unexpected, as it was generally believed by his friends that he was improving in health. Mr. Magee was born in Pittsburg in 1848. Through the death of his father, when the boy was 15 years of age, he was obliged to go to work to help support his mother and three younger children. After a period as office boy he obtained a clerkship, and in 1869 was made cashier in the City Treasury and in 1871 was elected City Treasurer and was re-elected in 1874. He was elected State Senator in 1892, and was twice re-elected. He was a director in numerous Pittsburg banks, trust companies and insurance companies, and at the time of his death was the principal owner of the Pittsburg *Times*. He was widely known in electrical circles through his connection with trolley railway enterprises.

F. O. MATTHIESSEN.—Private dispatches announce the death in Paris of Francis O. Matthiessen, who for several years was a director of the American Sugar Refining Company. Mr. Matthiessen retired from active business about a year ago and has since spent his time in travel for the benefit of his health, which for some time before had been failing. He was a native of the duchy of Holstein, where he was born on Dec. 23, 1833. He was educated in the city of Altona and subsequently was employed in a sugar refining factory in Hamburg. After learning the sugar refining business Mr. Matthiessen came to the United States in 1859. For the next four years he was employed in this city and Boston, and in 1863 he went into business for himself. Forming a partnership with W. A. Weichers, he opened a refinery in Jersey City, the firm being known as Matthiessen & Weichers. Subsequently the establishment was transferred to a company, Mr. Matthiessen being retained at the head of its management. In 1887, when the American Sugar Refining Company was formed, Mr. Matthiessen's company was merged into it and he became a director and chairman of the manufacturing committee. The disagreement with H. O. Havemeyer which was the cause of the retirement of John E. Searles as treasurer and as a director of the American Sugar Refining Company, was followed by the retirement of Mr. Matthiessen in the latter part of 1899. He and Mr. Havemeyer differed upon questions of policy concerning the administration of the company's affairs, and also as to the management of the Matthiessen refinery. When he resigned, Mr. Matthiessen disposed of the greater part of his holding of sugar shares. Mr. Matthiessen married in 1865 Miss Emma Boyles, of Philadelphia. They had two children, a son who died in childhood, and a daughter who died when she was about 20 years old. Mr. Matthiessen was a director of the Goubert Manufacturing Company and the New Jersey Street Railway Company, and was president of the Weston Electrical Instrument Company, of Newark, N. J.

PERSONAL.

MR. MARCONI is due here this week on the White Star liner "Majestic."

MR. C. T. YERKES has sailed for England to look after his London underground railway deals.

MR. A. MILLER BELFIELD, hitherto associated with the patent law firm of Charles A. Brown & Cragg, of Chicago, has been admitted to partnership.

MR. EUGENE GRIFFIN and Mr. W. J. Clark, of the General Electric Company, have both left for Europe, the former, it is said, for rest and recreation.

MR. J. P. MORGAN is booked to sail for Europe on the "Oceanic" on March 27 to be absent longer than usual. It is understood that he will take a complete rest.

MR. F. SARGENT, the electrical engineer of Chicago, has been in New York on professional matters and purchasing apparatus for a new plant which he is constructing.

DR. LOUIS DUNCAN and Dr. Cary T. Hutchinson have been appointed electrical experts to assist Mr. W. B. Parsons, chief engineer of the Rapid Transit Commission of New York City.

MR. THOMAS E. MITTEN, general superintendent of the Milwaukee Electric Railway & Light Company, has resigned to accept a position in the operating department of the International Traction Company, Buffalo.

MR. T. HERBERT MINSHALL, borough electrical engineer of the town of Croydon, Eng., is due to arrive in this country during the present week. He will look into the matter of American engine building while here.

DR. PARK BENJAMIN is doing the work of his life in behalf of the plan to place a fine Dewey triumphal arch at the Battery, a plan to which large sums of money are already pledged. He is the life and soul of the movement.

MR. FRANK CHAPMAN, formerly purchasing agent of the Stuart-Howland Company, Boston, has severed his connections with that concern and will now be associated with the Belcher & Loomis Hardware Company, of Providence, R. I.

MR. JOSEPH P. ORD, who recently resigned as vice-president of the General Electric Company, has joined the firm of J. P. Morgan & Company. Mr. Ord went into the General Electric Company at the instance of Mr. Morgan, whose confidence he has long enjoyed.

MR. WILL F. HAYES, who, it will be remembered, suffered an attack of illness which caused his retirement from business for several months, is again in Cincinnati and apparently completely restored to health. His friends hope to see him soon installed in business.

MR. PHILIP W. MOEN, third vice-president of the American Steel & Wire Company, will not oppose the consolidation of the company as a part of the United States Steel Corporation. He says that the Worcester interests, formerly identified with the Washburn & Moen Manufacturing Company, will not stand in the way of the consolidation.

MR. H. C. HUTCHINSON, for several years general superintendent of the Cincinnati Edison Electric Company, has been promoted to be assistant general manager. W. E. Hopton, of Jersey City, N. J., becomes general superintendent. Mr. Hopton went to Cincinnati from Chicago, where he was identified with the work of the North American Company.

MR. W. H. PELTON, a well-known Cleveland electrical engineer, and head of the Pelton Engineering Company of that city, has been confined to his bed for a month past as the result of a severe shock received while inspecting an arc lighting plant which the company recently installed at Lakewood, Ohio. He is still in a very weak condition, so that it will probably be some time before he can take up active work.

MR. JOHN E. SEARLES, who has been well known in electrical circles from his occasional ventures in the electrical field, has gone into bankruptcy. It is said that his assets exceed liabilities and that he will have some portion of his fortune left. The number of his enterprises was legion, and while by no means always judicious in his investments, he deserves credit for his readiness to see the merits of a new thing and his willingness to help it along. There was hardly a branch of industry with which he did not have financial associations.

PROF. S. W. STRATTON, of the University of Chicago, who has been appointed director of the new Treasury Department, Division of Standard Weights and Measures, is professor of physics at the University of Chicago. He was asked about a year ago to reorganize the office of weights and measures to meet the demand for scientific work. Prof. Stratton was born in Litchfield, Ill., in 1862, and was graduated in 1884 from the University of Illinois, where he was professor of physics and electrical engineering until 1892, when he went to the University of Chicago as a member of the department of physics.

SIR HENRY McCALLUM, the new governor of Natal, South Africa, is an old telegraph engineer and has been stationed in Newfoundland. He was with Kitchener at the War College, graduating in 1871, when he became superintendent of military telegraphs for the southern district of England. He is able to build a bridge, a highway or a conduit, to construct a railroad, to set up, run and repair a locomotive; to operate electric wires and control a telegraph system, to survey a territory, to build forts and plan defenses, to organize and preside over a municipality, and to administer a territory as large as the British Isles. His record, in college or in the colonies, is a unique one, and few of the British colonial staff can show a round of such conspicuous and unbroken success in so many diverse capacities.

EDUCATIONAL.

THE UNIVERSITY OF PENNSYLVANIA has issued circulars of information regarding its electrical engineering and mechanical engineering courses.

THE SIBLEY JOURNAL.—The February number of the Sibley *Journal of Mechanical Engineering,* which is published by the students of Sibley College, Cornell University, Ithaca, N. Y., contains an article by Prof. Harris J. Ryan on the three-phase alternators of the Metropolitan Street Railway Company of New York. The article is illustrated.

THE ELECTRICAL ENGINEERING LABORATORY of the University of Nebraska is now well equipped for the illustration of commercial conditions in the transmission of power by alternating currents, and for original work in that line. New apparatus, as follows, has recently been added: A 15-kw General Electric two-phase, three-phase stationary armature generator of 60 frequency; a two-phase 220-volt Westinghouse converter and an induction motor, each of 10 kilowatts; a pair of Packard transformers, each of 10-kw capacity, specially wound for experimental work, with both primaries and secondaries divided into four separate coils, readily adaptable to the production of every commercial voltage from 50 to 2000, and with full current capacity at practically every step, also permitting (through regulation of the generator) the production of any desired voltage within the above range. An imported electric furnace has also just been set up, making the equipment for experimental work very extensive.

Trade Notes.

THE ATLAS CEMENT COMPANY, Northampton, Pa., is now using eight Cross oil filters, purchased from the Burt Manufacturing Company, Akron, Ohio.

THE LINCOLN ELECTRIC COMPANY, of Cleveland, is furnishing 12 of its recharging motors and controllers to a newly organized concern in Chicago for the manufacture of electric vehicles.

THE STURTEVANT ENGINEERING COMPANY, LTD., of London, Eng., notifies us that to accommodate its growing business it has taken the building at 147 Queen Victoria Street, E. C. Mr. George A. Mower is managing director.

THE TUDOR BOILER COMPANY, of Cincinnati, Ohio, has commenced the construction of the Babcock & Wilcox type of boilers. This company has just sold three 300-hp water tube boilers to the Chicago Iron Works at East Chicago, Ind.

THE GEO. C. TOWLE MANUFACTURING COMPANY, of Lancaster, Pa., has opened an office and salesroom at 74 Cortlandt Street, New York, where it is showing a full line of the newest types in fan motors; also small power motors in various sizes.

NEW ELECTRICAL CONCERN.—L. W. Thies and Dr. Carl Markt have organized a company in Hamilton, Ohio, to manufacture several electrical inventions brought out by the former gentleman. They will also do a jobbing business in electrical supplies.

THE BICKFORD DRILL & TOOL COMPANY, Cincinnati, Ohio, reports a good volume of business, the principal demand being for multiple drills of the heavier types. Three multiple drills have just been shipped to the Baltimore & Ohio shops at Baltimore.

CIRCULAR LOOM.—The Western office of the American Circular Loom Company, now located at 141 South Clinton Street, Chicago, will move to 130 West Jackson Boulevard, the Electrical Building, corner of Desplaines Street. Mr. Thos. G. Grier is Western manager.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, reports an unusually large demand for power generating machinery, some of it going abroad. A recent order is for a 600-kw engine type direct-current generator for the Belfast shipyards, Belfast, Ireland.

THE AMERICAN BRIDGE COMPANY will furnish the steel work, amounting to 3000 tons, for the new Astor Building, at the corner of Fifty-fifth Street and Fifth Avenue, New York City, and also about 2000 tons of the same class of work for the new Custom House in New York City.

THE RICHMONDT WIRE CONDUIT COMPANY, Milwaukee, Wis., has arranged to occupy the Wisconsin Central's old shops at Waukesha and will at once equip the plant. The company will make its own steel pipe and finish the product complete, ready for market. It reports a tremendous business and its conduit receiving universal support.

THE ADAMS-BAGNALL COMPANY, of Cleveland, is equipping the plant of the Link-Belt Manufacturing Company, of Chicago, with an arc lighting system of 120 lamps. It is making several shipments of various kinds of lamps to Japan and Southern China. The company states that its business for February was 25 per cent greater than the corresponding month last year.

DEMAND FOR CARBONS.—The United States Carbon Company, of Cleveland, Ohio, reports that its business at present is extraordinary for this time of year. Usually the demand for arc light carbons begins to fall off about Feb. 1, in anticipation of the longer spring days, but thus far this year there has been no decrease in the demand, which bids fair to hold up steady into the spring months.

THE VAN DORN-ELLIOTT ELECTRIC COMPANY, of Cleveland, which has succeeded to the business of the electrical department of the Van Dorn & Dutton Company, of that city, has elected officers as follows: J. H. Van Dorn, president; F. Schneider, vice-president; W. A. Dutton, secretary and treasurer, and W. H. Elliott, manager. The company is at work on a large amount of repair work.

MR. JOHN L. MILTON, of the Sterling Electric Motor Company, Dayton, Ohio, reports a steady growth in the company's motor business, which proved a success from the start, and announces that it has booked several good contracts for the coming season. This company has given its entire time and attention to the plan of building only small motors, with special tools and processes which enables it to furnish these at the very closest price.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports orders running principally to small machinery. One is for a 300-kw slow-speed belted machine for the Bradley Estate, Cleveland, Ohio. Other orders are for a 100-kw slow-speed belted generator and motors for the Easton Silk Mills, Easton, Pa., and a 200-kw direct-current generator for the Globe-Wernicke Company, Norwood (Cincinnati) Ohio. The latter is a duplicate of a generator ordered about a year ago.

THE GILLILAND ELECTRIC COMPANY, Adrian, Mich., informs us that its factory is running full time and that it is loaded up with work. Among other orders it has received a large one from the A. B. Dick Company, manufacturer of the Edison mimeograph, for cabinet work for that class of apparatus. It expects to be prepared to take care of any kind of special wood or metal work and to manufacture at a low cost a complete line of electrical specialties, telephone parts, etc.

NEVER HAD AN EQUAL.—Competent judges say that the Pan-American Exposition will be superior to anything of its size ever seen on this continent, and it is within 12 hours' ride of over 40,000,000 people. How can it fail to be a success when you consider that it is reached from all directions by the New York Central Lines, which comprise the New York Central, Boston & Albany, Michigan Central, Lake Shore, Big Four, Pittsburg & Lake Erie and Lake Erie & Western railways?

THE WESTERN ELECTRIC COMPANY, Chicago, is receiving many favorable reports from the different plants using its series enclosed alternating arc lighting system. The economy of operation and ease of management, together with the many special features of excellence, are said to be winning the enthusiastic approval of station managers. Long life, reliability in action and freedom from accidental injury are some of the points which the system affords under all conditions met in practice. Many plants are being installed.

THE MILWAUKEE ELECTRIC COMPANY, Milwaukee, Wis., has been awarded the contract for the electrical equipment of the C. Reiss Coal Company's coal docks at Sheboygan, Wis. It is said that these docks will be the most thoroughly electrically equipped in the Northwest. Messrs. Keelyn & Smith, of Milwaukee, have the contract for the necessary switchboard and construction work. The machinery contract calls for one 200-kw 250-volt generator, direct connected to a Ball 200 r. p. m. engine; one 40-kw 250-volt belted generator, and motors aggregating 335 horse-power.

THE STANDARD MACHINERY & EQUIPMENT COMPANY, of Cleveland, Ohio, dealers in second-hand power and electrical equipment, has recently bought up the plants of the Lorain Lighting Company, Lorain, Ohio, and the Ceramic City Light & Power Company, East Liverpool, Ohio. It has recently sold three large engines to the Hawley Electric Light Company, of Scranton, Pa., a 375-kw General Electric generator to McDowell & Foster, Pittsburg, Pa., and two arc machines to Blonkins Brothers, Milwaukee. The company reports the demand for second hand electrical equipment largely in excess of the supply.

THE ST. LOUIS AUTOMOBILE & SUPPLY COMPANY, Twenty-third and St. Charles Streets, St. Louis Mo., desires to announce that it now has the following representatives in New York, Chicago and Hartford: Messrs. Chas. E. Miller, 97 Reade Street, New York; Ralph Temple, 291 Wabash Avenue, Chicago, Ill., and Messrs Post & Lester, Hartford, Conn. The St. Louis Automobile & Supply Company manufactures Dyke's automotorette, Dyke's float feed carburetter, Dyke's tool set, Dyke's new flexible running gear, gasoline engines from 1 to 10 horse-power, transportation devices, etc., and carries a full line of automobile supplies.

SEAMLESS BRASS TUBE.—We learn that the U. T. Hungerford Brass & Copper Company, New York, has lately secured some large contracts for supplying the United States Government with seamless brass tubes. The United States Government subjects all tubes it purchases to very critical tests, and the fact that the U. T. Hungerford Brass & Copper Company is able to furnish material satisfactory in every way to the Government inspectors is a high endorsement of its product. We also learn that the same company is furnishing considerable quantities of seamless brass and copper tubes to contractors now engaged in the construction of war vessels for the Government.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "chloride accumulator," has found it necessary to open a sales office at San Francisco, Calif., to take care of the increasing volume of business in the Pacific Coast States and extreme western territories. The office, which is located at Nevada Block, has been placed in the charge of Mr. R. B. Daggett, who has for a long time been connected with the staff of engineers at the Philadelphia office, and his experience gained there will enable him to handle the various problems of modern storage battery practice arising in the new district with skill and promptness.

A "STARTLING" CIRCULAR is issued by the Onondaga Dynamo Company, Syracuse, N. Y. As the innocent recipient unfolds it, it proves itself "living literature" by flopping about in a weird manner and emitting a loud buzz. An investigation shows it to be but a clever application of the "buzzer" toy of boyhood days—a disk of cardboard, a rubber band and a piece of wire—carefully "set" when the circular is folded and placed in the envelope, and ready to fix the attention of the man who opens it. It is attention fixed in a good cause, however, as the circular illustrates and describes several types of the Onondaga dynamos and motors in an interesting manner.

OLDS FACTORY ON FIRE.—A dispatch from Detroit, Mich, of March 9 says: "The Olds Motor Works, manufacturers of gas engines, automobiles and other vehicles, located at 1308 to 1318 Jefferson Avenue, was completely destroyed by fire this afternoon, entailing a loss of over $100,000. The building, which was a three-story brick structure covering half a square, was erected about a year ago. The plant was shut down at 12 o'clock, noon, for half a day, and the fire broke out soon afterward. Two tanks of gasoline were located in the building, and it is supposed that these exploded and caused the fire. In less than an hour the structure was practically destroyed. The entire season's output of the Olds Works, which was stored in the large building, was destroyed. The plant was insured for $65,000."

A SUMMERY SUGGESTION.—A cheap and satisfactory way of spending a pleasant summer is pointed out in a booklet issued by the Emerson Electric Manufacturing Company, of St. Louis, Mo. The old notion that it is necessary to fly from home and business to cooler latitudes in order to find comfort during the heated term is exploded by the Emerson Company. It points out that equal comfort can be obtained at home and at business by using Emerson fans. The booklet gives illustrations of the different styles of the fans manufactured by the company, so that it is an easy matter to select one to suit the conditions of each case. These fans are made in desk and ceiling types, and it is evident that it will cost less to be cooled by a fan that to migrate to strange places and submit to the incidental annoyances and deficiencies which are inseparable from excursions of this character.

THE SAFETY ELECTRICAL MANUFACTURING COMPANY, of New Orleans, when called upon recently by a representative of the Electrical World and Engineer, was found to be in a most prosperous condition and is doubling its floor space for the manufacturing and supply business. Besides being agent for a number of manufacturers, and carrying supplies, a large switchboard manufacturing business is carried on. The company has four experienced engineers as its principals, and is prepared for taking complete contracts for electric light and power plants in its territory. The electrical equipment of sawmills will be given special attention. There is certainly room for a strong contracting and supply house of this kind in the New Orleans territory, and this concern, judging from its rapid growth since last August, is filling the place well. One commendable feature of this company's work is that of employing only engineers competent to size up a situation and make estimates as traveling salesmen.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, of Cleveland, Ohio, is now located in new quarters at 24 Viaduct Building, that city. Of late this company has devoted considerable attention to the manufacture of telephones and parts, and not long ago found its factory entirely inadequate to its needs. At present the company is occupying the entire floor of a large building at the address mentioned, and expects to make still further additions which will give it a floor space of 16,000 square feet. The new quarters are in the best part of the business and manufacturing portion of the city, convenient for customers, and having excellent shipping facilities. The Century Company has recently bought out the plant and business of A. M. Taylor & Company, Ravenna, Ohio, manufacturers of the Taylor terminal head and lightning arrester. The Ravenna factory will be abandoned and the two specialties will be manufactured at Cleveland. Mr. A. M. Taylor will be identified with the Century Company, representing it in the East.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, New York and San Francisco, announces that it has more than doubled its working capacity, and has installed new and complete machinery for the purpose of turning out its well-known specialties. It expects to place on the market in the near future various improvements upon its standard line of fuses, fuse boxes, lightning arresters and connectors. The American Company also manufactures a complete and fine line of both silk and magnet wire and carries a stock of all sizes constantly on hand. Its Eastern office is at 116 Nassau Street, New York, in charge of Mr. W. B. McCurdy. The office is completely stocked with a full line of fuses, fuse wire, lightning arresters, connectors, etc. The Western office, at San Francisco, Calif., will be conducted on the same line as the Eastern office. The company calls attention especially to the completeness of its stock, the high quality of its goods and the reasonableness of all its prices. With enlarged facilities and increased capacity, the American Electric Fuse Company expects to give even better service than it is doing at present. Catalogues, samples, or any desired information will be furnished.

VENTILATION AND HEATING COMBINED.—Experience has clearly demonstrated that in this climate no system of ventilation can be successfully operated by itself and independently of the method of heating that may be adopted. It is, in fact, a vital element of success that the two systems be most intimately combined, for they are clearly independent, and when properly applied are so interwoven in their operation and results that disunion is certain to bring about failure. For the purpose of ventilation the fan was first applied upon a practical scale about the middle of this century, but only to a limited extent, and it was not until the fan and the steam heater in marketable form were introduced by B. F. Sturtevant, of Boston, Mass., that the so-called "blower system" became a reality. The system, of which these two elements are the most important factors, as originally made by this house, has naturally been known as "The Sturtevant System." This system is at once practical, successful and economical; for, air being the natural conveyer of heat, it may, when properly warmed and supplied, perform the double office of heating and ventilating. As applied, the Sturtevant system forces the air into the apartment by the pressure or plenum method.

TECHNICAL EDUCATION BY MAIL.—Ambitious men who desire to obtain better positions and higher wages should investigate the very interesting free scholarship offer made by the American School of Correspondence, Boston, Mass. This well-known school has among its instructors men who are regular teachers in several of the great technical schools of Boston, and has unusual advantages for teaching the theory of trades and engineering professions. Its free scholarship offer for engineering and mechanical drawing is a feature which should attract attention. Without leaving home or losing time from his regular work, the student pursues a thorough course of study under the direction of able instructors. Papers guiding him in his work are prepared and delivered to him. These papers, free from the technicality which usually encumbers text-books, are clear and concise in language and much superior to the ordinary text-books on the subjects on which they treat. Besides this, special information concerning any difficulties which may arise in their course is furnished to the students. Altogether the course of study outlined is exceedingly attractive, and long experience has shown that no other method so fully meets the requirements for men who have but little time for study as that of teaching by mail.

THE PELTON WATER WHEEL COMPANY, San Francisco, recently furnished equipment for plants as follows: Keswick Electric Power Company, California, head, 1200 ft., three units of 1600 horse-power each, for electric transmission; British Columbia Electric Railway Company, Victoria, B. C. (second station), head 700 ft., one unit of 900 horse-power for electric transmission and lighting; Big Creek Power Company, California, head 920 ft., 900 horse-power, driving two generators for power and light (second station); 100-hp plant for Pigeon Bay, New Zealand, operating an electric light generator; 75-hp installation for a tea estate in Java, electric light plant; 2000-hp unit under 500-ft. head for electric transmission plant in Colorado; 150-hp wheel, 250-ft. head, operating flour mill and electric light plant in Utah; 75-hp wheel, 400-ft. head, operating electric light plant in Borneo; 50-hp wheel, running generator for mine in Idaho; double unit of 250-hp capacity, electric transmission plant near Auburn, Calif.; 30-hp wheel, electric lighting plant, Apia, Samoa; 30-hp wheel and transmission machinery for electric light plant, Guatemala; 30-hp wheel for electric lighting, Sydney, N. S. W., and a 6-ft. wheel, 200 horse-power, for a silk mill in Japan.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 5, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

669,072. TELEPHONE APPARATUS; P. C. Burns, Chicago, Ill. App. filed July 31, 1899. This invention provides for automatically operating the signal bell or other signal indicating device by means of one of the necessary parts of the telephone set.

669,085. BATTERY ELECTRODE; G. Heidel, St. Louis, Mo. App. filed March 21, 1900. Insulating plugs are inserted in the edges of the plate to separate it from the walls of the cell.

669,094. TELEPHONE APPARATUS; W. O. Meissner, Chicago, Ill. App. filed May 2, 1898. Details.

669,100. PHYSICIANS' ELECTRIC LAMP; P. M. Randall, New York, N. Y. App. filed May 16, 1900. A small lamp, mounted at the end of a pencil-like handle, to which a circuit closer is attached.

669,101. INCANDESCIBLE BODY; Henry Reeser, Paris, France. App. filed July 3, 1899. (See Current News and Notes.)

669,102. COMBINED SWITCH AND RHEOSTAT; H. E. Reeve, Brooklyn, N. Y. App. filed July 2, 1900. Details of construction.

669,114. SUPPORT FOR TELEPHONE RECEIVERS; J. J. Hartl, Chicago, Ill. App. filed Oct. 26, 1900. A bracket strapped to the transmitter arm for holding the receiver.

669,130. MANUFACTURE OF ELECTRICAL HEATING APPLIANCES; Adolph Vogt, Westminster, Eng. App. filed May 23, 1900. (See Current News and Notes.)

669,149. CAPILLARY ELECTROMETER FOR RELAY PURPOSES; Albert C. Crehore, Tarrytown, N. Y., and Geo. O. Squier, Washington, D. C. App. filed Oct. 20, 1899. (See Current News and Notes.)

669,151. ELECTRIC LAMP SOCKET; J. H. Trumbull and H. Trumbull, Plainville, Conn. App. filed Dec. 16, 1899. The socket contains a push switch operated by two buttons, one being white and the other black. The position of the buttons and the condition of the main circuit will show whether the filament is complete or not.

669,155. LIGHTNING ARRESTER; Herbert C. Wirt, Schenectady, N. Y. App. filed April 30, 1897. (See Current News and Notes.)

669,198. ADVERTISING DEVICE; W. E. Fowler, J. Owen and S. H. Metcalf, Seattle, Wash. App. filed April 17, 1900. A wheel carrying a series of signs is rotated step by step by a solenoid.

669,271. ART OR PROCESS FOR MAKING PHOSPHORIC ACID; Frank P. Daubergh, Buffalo, N. Y. App. filed April 20, 1896. (See Current News and Notes.)

669,218. ELECTRIC RAILWAY; H. Hirst, London, Eng. App. filed Jan. 29, 1901. The branch conductor leading to a section of the working conductor contains an electromagnet which prevents a particular section ahead from becoming energized to prevent the movement of any car that may be on the section ahead and thereby avoid collision.

669,240. ELECTRODE PLATE FOR ELECTRIC AUTOMOBILES; H. F. Hobel, Berlin, Germany. App. filed Oct. 20, 1900. The plate comprises a frame having a series of bars from which two series of leaves project; one series extending from the central portion of the bars to the front and the other series to the rear.

669,291. CURRENT INTERRUPTER; Elihu Thomson, Swampscott, Mass. App. filed Dec. 26, 1899. (See Current News and Notes.)

669,299. DYNAMO ELECTRIC MACHINE; N. C. Bassett, Lynn, Mass. App. filed Dec. 12, 1899. A motor provided with two sets of commutator brushes in combination with a controller provided with contacts for regulating the speed of said motor, and contacts for closing the motor circuit through either of said sets of brushes.

669,306. INCANDESCENT LAMP; John W. Howell, Newark, N. J. App. filed Nov. 28, 1898. On details of telephone switchboard lamps.

669,310. ELECTRIC METERING SYSTEM; Eustace Oxley, Lynn, Mass. App. filed Oct. 12, 1899. A meter for arc light circuits capable of recording at a plurality of rates. The meter has one of its circuits in series with the translating constant current devices, and the other in shunt relation; means controlled by the same circuit which supplies the translating devices vary the potential at the terminals of the shunt coil to change the recording rate of the meter.

669,336. METHOD OF LOCAL APPLICATION OF ELECTRIC TREATMENT TO THE HUMAN BODY; H. Behrendt, Worms, Germany. App. filed Sept. 18, 1900. Electrotherapeutical treatment which consists in subjecting a part of the human body to action of static electricity while the blood is drawn to the surface of such part by producing a vacuum thereon.

669,338. ELECTRIC CLOCK; S. Fisher, New York, N. Y. App. filed June 8, 1900. Details of a clock whereby a magnet stores power in the spring at short intervals.

669,358. INSULATED ELECTRIC CONDUCTOR AND METHOD OF MAKING SAME; Chas. P. Steinmetz, Schenectady, N. Y. App. filed July 30, 1900. (See Current News and Notes.)

669,362. REGULATING DEVICE FOR ELECTRIC CURRENTS; W. Emmott, Halifax, Eng. App. filed Dec. 28, 1897. The invention consists of the combination with any ordinary switch of an impedance coil or a coil with a movable core or a coil divided into separate circuits, so arranged that the current can readily be switched onto the lamps direct or so as to be more or less impeded.

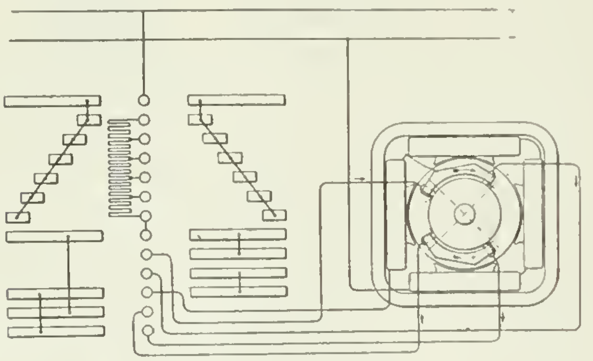
669,366. TELEPHONE SYSTEM; C. Malthaner, Minneapolis, Minn. App. filed March 16, 1900. According to this invention the attention of the called operator is attracted by the ringing of a bell and at the same time by the lighting of a supervisory lamp indicating which trunk to answer, and doing away with the extra lamp and buzzer at present employed in a local circuit, the supervisory signal at the calling operator's exchange being controlled over the same wires that are used for talking, no third wire or ground being employed.

669,438. MAGNETIC BLOW-OUT BRUSH HOLDER; A. C. Eastwood, Cleveland, Ohio. App. filed Dec. 3, 1900. The pole pieces of the magnet form two sides of an inclosure containing the brush; this affords a uniform direction of the lines of force through the arc, which more quickly ruptures it.

669,439-40. ELECTROLYTIC PROCESS FOR RECOVERING METALS; Hans A. Frasch, Hamilton, Canada. App. filed July 30, 1900. Relates to the production of an electrolyte of great purity, by providing for the direct extraction of such metals whose hydro-oxides are soluble in a solution of alkali or ammonia. By the direct action of an electric current upon a solution of a salt of ammonium in the presence of an anode bearing the metal to be extracted, such as copper or nickel, the corresponding ammonium salt of the metal is obtained at the anode, while the metal itself is deposited on the cathode and the ammonium salt originally employed is recovered. The second patent relates to apparatus for carrying out the above method.

669,441. METHOD OF PRODUCING ALKALI BY ELECTROLYSIS; Hans A. Frasch, Hamilton, Canada. App. filed Aug. 16, 1900. Halogens or mineral salts are separated from corresponding alkali salts by binding the acids or chlorine in nascent state to metals which form a part or the whole of an anode in an electrolytic bath.

669,442. PROCESS OF RECOVERING AND SEPARATING METALS BY ELECTROLYSIS; Hans A. Frasch, Hamilton, Canada. App. filed Sept. 15, 1900. The metals represented in the anode are brought in solution, and by electrolyzing this solution there is deposited from it at a given tension of an electrolytic current, certain metals upon the cathode; at the same time the electrolyte is constantly resaturated by passing it repeatedly through anodes of the same composition.



669,299.—Dynamo-Electric Machine.

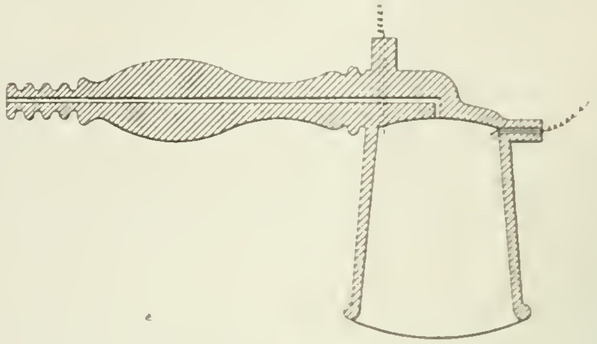
669,459. ELECTRIC RAILWAY; C. E. Fournier, New London, Conn. App. filed June 7, 1900. Details of an overhead trolley switch.

669,471. TELEPHONE KEY; E. E. Yaxley and C. C. Cadden, Chicago, Ill. App. filed Sept. 22, 1899. The key consists of a lever carrying an insulating roller at the end, which may be thrust between the ends of a series of spring contacts to close certain circuits and open others.

669,486. SECONDARY BATTERY; H. C. Porter, Chicago, Ill. App. filed Dec. 27, 1898. A battery plate separator for storage batteries, consisting of a plurality of vertical posts provided with notches, and a plurality of horizontal strips secured in the notches in each of the posts on the opposite sides thereof, said posts and strips being composed of insulating material, and said strips being staggered relatively to each other on opposite sides of the posts.

669,487. BATTERY PLATE OR GRID; H. C. Porter, Chicago, Ill. App. filed Feb. 5, 1900. The grid is made of a series of vertical bars embraced on each side by series of horizontal bars.

11,893. PROCESS OF OPERATING TWO LOCAL PRIMARY BATTERIES, AND REGENERATING ELEMENTS THEREOF; Henry K. Hess, Albert J. Shinn and Carl Hering, Philadelphia. Original, No. 649,841, dated May 15, 1900. App. for reissue filed Jan. 24, 1901. (See Current News and Notes.)



669,336.—Method of Local Application of Electric Treatment to the Human Body.

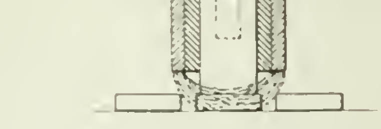
The following patents, issued Feb 4, Feb. 12 and Feb 26, were delayed in transmission from the Patent Office:

667,324. SHADE HOLDER FOR ELECTRIC LAMPS; Geo. M. Lane, Newark, N. J. App filed Sept. 17, 1900. A base plate has offstanding ears, at opposite ends to which are pivoted clamps. Between opposite clamps are springs which force the jaws of the clamps inward to engage positively with the shade or globe the clamps serving also to prevent lateral displacement of the shade.

667,435. CARTRIDGE FIRED BY ELECTRICITY; Wm. Friese-Greene and Percy Edwin Knell, London, Eng. App. filed Dec. 30, 1899. A charge consists solely of metal wires to be vaporized by the passage through the same of a current of electricity, whereby explosive energy is generated.

667,508. AUTOMATIC SWITCH; Joe D. Edwards, Washington, D. C. App. filed Oct. 30, 1900. A switch-operating device mounted upon the ordinary plow of an electric car, with a lever mechanism for operating the switches. There is a series of pivoted switch points, a trip lever connected therewith and located below the surface of the track, a plow carried by the car, a spring-controlled bar slidably mounted on the car and having a trip thereon for engaging the trip lever, a roller mounted on the plow holder and a cable passing through and attachably connected to the bar.

667,714. AUTOMATIC APPARATUS FOR FEEDING SHEETS OF PAPER TO PRINTING MACHINES; Max Koenig, Guben, Germany. App. filed May 15, 1900. An arrangement for feeding paper which includes an electromagnetic device by means of which the feeding apparatus is kept at a standstill until the sheet that has been pushed forward is removed from the pile by means of the press laying on arrangement.



669,438.—Magnetic Blow-Out Brush Holder.

668,446. ELECTRIC LIGHT FOR SHOW WINDOWS; Sig Hirsh, New Haven, Conn. App. filed Oct. 10, 1900. Electric light conical reflectors with the lower edges flush with the ceiling of the show window.

668,842. APPARATUS FOR ELECTROLYTICALLY EXTRACTING AND DEPOSING GOLD AND SILVER FROM THEIR ORES; Albion M. Rouse, Denver, Colo. App. filed May 28, 1900. The apparatus consists of the combination of a series of tubs having anodes and cathodes arranged therein, an agitating tube in communication with the tubs at both upper and lower ends, an agitator located in the tube provided with means for elevating the ore pulp therein, and perforated conduits located in the upper ends of the tubs adapted to receive the ore pulp from the tube and discharge it into the tubs.

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GOVERNMENT TELEGRAPHS.

No American who has used the governmental telegraph systems of Europe will be in any wise enthusiastic about them, but there still remain a great many untraveled folk who believe and a swarm of socialistic agitators who insist that those telegraphs are better than the service owned by the Western Union or Postal companies. It is fortunate, therefore, that once in a while so eminent and competent an authority as Vice-President Clark, of the Western Union Company, has an opportunity to come before the public and show what the truth and the facts are, with arguments that are not less interesting than irrefragable. There is no secret of our own view that, with the proverbial tendency of a large organization to conservatism and inertia, the Western Union has slowed down unduly in its improvements of late years, and does not develop all the opportunities for new business that changing conditions present, but this opinion reflects all the more strongly on the situation in Europe, where rates and difficulties are endured that no American, in spite of his good nature, would tolerate for a minute. For example, in this country, as Mr. Clark shows in his statement which impressed the Industrial Commission so forcibly in Washington last week, we have a mile of wire to every 67 people, while in much-vaunted Switzerland there is only one mile to every 220. Europe has nearly five times our population, but we have two-thirds as much wire mileage. It costs $2.41 to send a message from London to St. Petersburg. Here the cotton merchant in Galveston reaches New York, the same distance, with a message as long, for 75 cents. Yet, on the whole, this is a dearer country to live in than Europe. Evidently, therefore, the Government telegraph systems have nothing to teach as to facilities and cheapness.

One hears from some government ownership advocates wild talk about over-capitalization of private enterprises. Mr. Clark points out, on the contrary, that the capitalization of the government lines in Great Britain is twice as great as in the Western Union system. Moreover, the British system has a debt that is now about $40,000,000, and is growing apparently about $2,500,000 a year. As Mr. Clark pertinently suggests, in a country like ours, 26 times as big as Great Britain, what a fine old deficit the government telegraphs would roll up! There would be no overflowing treasury then, and there probably would be a serious check to the development which has brought nearly 40,000 places in the United States already into telegraphic communication with each other, in a new country, with scattered population. We cannot but believe that there remain many years of profitable usefulness to the Western Union system as a private enterprise in spite of the fact that the growth of the telephone has tended to check its former rate of expansion for the present, though in the long run this must stimulate it to open up new fields of work of even greater public benefit than the old. There has been a general idea that the telegraph system is lacking in elasticity, but it has a great many elements in its favor, not the least of which is the ability to crowd an immense quantity of matter over the wires in a very short time. The percentage of machine telegraphic work is to-day quite small, but it must be obvious to any one who studies the subject that the telegraph in the near future will not be limited by the manual capacity of an operator with one wire. To an institution such as the Western Union, under men like Messrs. Eckert, Clark and Brown, we may surely look for the demonstration that private enterprise can be depended upon to pursue the steady march of improvement.

The Invention of the Telephone

Elsewhere in this issue we print an interesting article giving the claims of one William A. Skinkle to the inevention of the telephone. A reading of the article will show, however, that the so-called invention is merely a duplication of the Philip Reis make-and-break telephone, involving no principle identified with the telephone invented by Gray and Bell. The unfavorable opinions on the device which were offered by Dr. Gray and his patent attorney, to the effect that it contained nothing new, was without doubt based upon a knowledge of the work of Reis. The claim that Gray profited from his knowledge of the Skinkle suggestion is absurd in view of the nature of the device and the radically different principle involved in Gray's invention. The conception of Gray and Bell was the production of an unbroken and undulatory current corresponding in form to the variations in the vibrations set up by speech. Gray realized this fundamental principle of the telephone by mounting on a vibratory diaphragm a metal needle which extended into a conducting fluid. The vibrations of the diaphragm caused changes in the resistance of the path through the fluid and corresponding changes in the strength of the current.

The Skinkle matter brings out one point of interest, for, according to the documentary statement made by the claimant in 1879, Gray as early as Jan. 22, 1877, stated that he had well-developed ideas on the transmission of speech and intended soon to file an application or caveat. This, in view of the radical difference between the Reis device claimed to have been invented by Skinkle, and the device described in the caveat of Gray, renders entirely unjustifiable the charge of Skinkle that "Elisha Gray had never thought of a telephone, or, at most, never thought of it as a practical possibility, before my disclosure to him on Jan. 22, 1876." If Skinkle really believed that he was the prior inventor of the telephone, in justice to himself, he should not have kept silence for 24 years; and in justice to Dr. Gray he should not have deferred his charges until death had closed the lips of the latter.

Our readers can, however, judge of the matter for themselves, on the evidence before them, from Mr. Skinkle himself. On the whole, it is fortunate that these matters can thus be sifted out, and a reasonable opinion formed of the validity of such claims, as with the charges of Gray himself in regard to Bell, who certainly has not suffered from the recent discovery of the fact that up to the moment of his death Dr. Gray nourished the belief that unfair advantage had been taken of him in regard to priority of telephone invention. It is better to have these claims, suspicions and accusations dragged to the light, so that all men may judge as to their validity, usually with the result of dismissing them as not sufficient to disturb the previous verdicts. Our readers will recall many cases of this kind in electrical history alone. Perhaps one of the latest was that of Goebel and the incandescent lamp; while to go back into the record of telephony itself the Drawbaugh episode will at once come to mind. There is a serious lesson in all such matters, namely, that no inventor has any right to bury his "talent" in a napkin. His battle-cry must ever be "diligence." An intelligent public will always be slow to believe that a man who has a great invention will long sleep on it, long conceal it, or swear away his own right to it.

Graphic Methods for Engineering Computations.

Graphic methods for solving the problems of the engineer continue to grow in interest and value. Their main defect lies, perhaps, in their relative roughness or degree of inaccuracy, but not only is an approximate result in many cases sufficient, but it may also be that an exact computation would not be possible or applicable under the circumstances. Graphic methods have formed a most important branch of computation in the history of mathematics, and were relied upon by the Greek mathematicians for results which arithmetic at that time was powerless to furnish. In the hands of Isaac Newton, graphics constituted an analytical method of enormous power, and they are steadily gaining ground in technical education for the solution of complex problems in engineering. Their great advantage is that they appeal directly to the eye, and that errors in the magnitudes are more readily detected than when numbers are solely depended upon as in arithmetic.

An interesting application of graphics to the selection of a storage battery capacity, sufficient to comply with a required load-diagram, appeared in our columns on page 396, of March 9, in Dr. K. Norden's article. If a storage battery had a discharge-capacity independent of the discharge-rate, it would be a simple matter to determine the battery required for a given load expressed as a definitely varying number of amperes for a given number of hours. Thus, if a battery of 2000 ampere-hours capacity would give 2000 amperes for one hour, as readily as 200 amperes for 10, the simple area of the load-diagram in ampere-hours would determine the size of the battery required. Since, however, as electrical engineers know only too well, the capacity of a storage cell or battery is considerably reduced by rapid discharge, it is necessary to make allowance for the effect of the load peak upon reducing the capacity of the battery.

Dr. Norden's graphical method of accomplishing this result consists in establishing, from the data supplied for the battery, a vector diagram of current and capacity discharge by a simple graphical process, in such a manner that the radius vector of any given discharge current shall intersect with a straight line at a distance representing the capacity of the battery at that rate of discharge. By the summation of vectors corresponding to the successive rates of discharge the total ampere-hour capacity required is then arrived at. The above process assumes that the relative exhaustion of the battery by a given current, maintained, say, for quarter of an hour, is independent of the period of lifetime at which it is applied; or, expressed in another way, if a moderate current for, say, two hours, followed by a powerful discharge for one hour will just exhaust the battery, then the reversed conditions of a powerful current for one hour followed by the moderate current for two hours will exhaust the battery.

While we do not think that this is rigorously correct, as we believe that the exhausting effect of a heavy discharge varies slightly with the period of life of the battery at which that discharge is applied, yet the results are, probably, sufficiently nearly uniform to make Dr. Norden's graphical method a satisfactory one, and there can be no doubt that by its use a considerable amount of arithmetic can be avoided.

Stationary Current Rectifiers.

A disadvantage of alternating-current systems of electric light distribution from constant potential mains, lies in the fact that there is no alternating-current storage battery, and the pressure cannot be so readily maintained as in the case of direct-current systems to which a storage battery is connected. Two methods for attempting the interconnection of a storage battery with an alternating-current system without the use of rotating commutators are described in our Digest this week. Both are based upon the same fundamental principle; namely, that the iron core of an induction coil or transformer is artificially magnetized in one and the same direction by a separate local direct-current source; and the transformer, thus rendered dissymmetrical in its magnetization, favors the passage of current impulses in one direction relatively to those in the opposite direction. If such a system could be commercially developed it would have the advantage of requiring but very little attention, and would be distinctly superior to the rotating machines now known as converters. Until, however, satisfactory practical results shall have been obtained with dissymmetrical transformers, we are inclined to think that appearances are against them, and that such transformation will be either ineffective or inefficient.

There is certainly one application for dissymmetrical transformers which is in satisfactory use for some purposes. When a choking coil is placed in a direct-current circuit, subject to minor rapid fluctuations or pulsations of current, it is well known that the latter are damped-out by the choking effect of the coil, while the steady current only encounters the ohmic resistance of the winding. The step from a suppression of minor fluctuations in a direct current to the transformation of an alternating into a direct current is, however, very wide. A steady current means constant flow of energy, whereas, a simple alternating current means a pulsation of energy flow, and any apparatus which can deliver a direct current from an alternating current by a process of transformation must necessarily be an apparatus which stores energy. Energy can certainly be stored in iron cores in the form of magnetic flux, but the waste of energy entailed by hysteresis has hitherto been sufficient to make such a transformation inefficient.

THE GANZ THREE-PHASE SYSTEM.

The alleged decision to use alternating motors on the London Underground lends added interest to the accounts of the Ganz road now being installed elsewhere, which were published in our columns last week. Should the reported award of this great contract be confirmed, it will be a drastic dose to American engineers and contractors, but in the long run we believe it would do the art good. Of course, something of the result could be charged up to cheap foreign labor, and something more to the determination of Continental manufacturers to regain their lost prestige even at the cost of foregoing a trivial profit. But with all due allowances, the principal factor in American defeat would be the *laissez-faire* policy of American engineers towards polyphase traction systems. There have been plenty of broad hints given them even in these very columns, and no one who has closely followed foreign practice during the past two or three years could fail to see the tendencies there active, to which we, in this country, have apparently been indifferent. It is, of course, by no means certain that the new system would prove an unqualified success, but if it is put in successful application, we have the choice between taking our lesson to heart or going out of the heavy tramway business east of the Atlantic. It is perfectly hopeless to buck up against a well developed high-tension polyphase motor system with 500-volt apparatus fed from converter sub-stations. The commercial success of the latter has been based upon the imperfections of the former. We well remember the ill-concealed contempt with which the original alternating-current lighting system was received, the gloomy predictions of failure, the desperate efforts to throttle the newcomer by legislation when the handwriting on the wall was all too evident. We remember, too, the doubt and hesitation when the polyphase system was fighting for a footing on this side of the big water.

Its present title to existence he who runs may read. There is no electrical panacea, and good engineering consists in the skillful adaptation of means to ends, even in electric railroading. Obviously the successful use of polyphase motors on the London system would not imply the general or exclusive use of the same methods here, but it would clearly prove the adaptability of the new apparatus to those cases of heavy tramway work in which economy of installation and operation is of greater moment than interchangeability of rolling stock with roads different equipped. It would show that on long lines doing the work now done by steam, on extensive subway systems and on elevated and important suburban roads, the polyphase system would have to be seriously considered, and not turned down off hand as not in accord with standard practice. The Ganz plans for the equipment of the London system have not as yet been made public and we may be assuming too much in taking for granted that they will, broadly, follow the lines of those developed for the Lecco-Chiavenno road, which we described in considerable detail last week. Under such an assumption, however, there is much to commend and much to criticize. Part of the detail of the system appears to have been very carefully worked out. The method of taking current from the working conductors seems to have been established as thoroughly feasible, and to have obviated the serious objections to the use of two working conductors. With trolley wires at 3000 volts, the supply of adequate energy becomes comparatively simple, and there is little doubt that the insulation can be properly maintained. On the other hand, we very much doubt whether the employment of gearless motors even at the very low frequency adopted, will prove in the final issue to be wise or necessary except in case of very high speeds. It means needlessly heavy motors and considerable trouble in keeping up a good power factor, in order to gain a rather dubious advantage. The loss of power in well-cut and well-lubricated gears is so small as to furnish a rather inadequate excuse for the use of motors of extreme multi-polar design.

More than this, the use of a complete duplicate motor equipment for the sake of employing the concatenated connection at low speeds seems somewhat ill advised. It is certainly a desperate remedy for the difficulties of speed regulation that seem to form the chief objection to polyphase motors for traction purposes. The whole question of regulating the speed of such motors is one which, up to the present time, engineers have shied at, and the problem has never yet been worked out on its merits. Even in direct-current motors economical speed regulation is a pretty serious matter, and the solution of the difficulty has cost years of effort. In the case of polyphase motors there is little reason to expect an easier task, but a double equipment of which one-half is out of use when the car is at speed seems to us distinctly bad on general principles. It may be a disagreeable necessity for the present, but we cannot regard it as by any means the final solution of the problem. The frequency adopted, only 15 cycles per second, is, of course, a part of the gearless motor programme, but it is undesirably low, and with geared motors might be doubled with advantage, both to the distribution and to the system at large. Whatever the outcome of the proposed London installation, if actually carried out, its results must be valuable from an engineering standpoint. If its worth is proved, the resources of the art would be enlarged, and even in case of failure an invaluable lesson would be taught concerning what to avoid. But we are far from predicting failure on any evidence now at hand. The proposed system will not be adopted without careful investigation, and Sir William Preece's judgment in other electrical matters the world has already learned to treat with respect. The engineers of Ganz & Co. have long been favorably known to the profession, and we feel sure that if they should fail in London it would be from no lack of skill or resource. But, as already intimated, the brief, obscure report of the award of the contract remains unconfirmed.

Government Telegraphs and the Western Union.

At Washington, on March 14, in the course of some four or five hours of statement and discussion, Mr. Thomas F. Clark, vice-president of the Western Union Telegraph Company, testified before the Industrial Commission concerning the relations of the telegraph to the public. He devoted much of his time to the consideration of the wisdom of Government ownership of the telegraph. He expressed the opinion that those who advocate Government control base their advocacy upon the fact that the Governments of Great Britain, Belgium and Switzerland control the telegraph lines in those countries, but he argued that the conditions, geographic, social, administrative, are so entirely different as to render useless in this country deductions drawn from considerations in those countries.

He first compared the geographic areas, showing that where there are only 67 people in the United States to each mile of wire, there are in Great Britain 130 people to the mile, in Switzerland 220, and in Belgium 321. He said that in the United States there are 1,118,086 miles of wire, and 1,585,267 miles in all of Europe. Mr. Clark mentioned the fact that the telegraph lines in the United States cover many sparsely settled sections, saying that while the returns from such sections are comparatively small, the cost of construction and maintenance is greater than in more densely populated sections. In Montana, for instance, with a population of only one person to the square mile of territory, there are 292 telegraph and telephone stations.

All told, he said, there are 39,000 places in the United States reached by the telegraph companies, while in Great Britain there are only 10,816 places thus reached. In this country almost 50 per cent of the post offices have telegraph connections, while in Great Britain only about one-quarter of them are thus equipped.

While admitting that rates on local messages in Europe are lower than in the United States, Mr. Clark contended that on through messages they are incomparably higher. He pointed out that in Europe addresses and signatures are charged for. As a comparison in long-distance messages, he pointed out that an ordinary message covering 10 words of text would cost about $2.41 if sent from London to St. Petersburg, a distance of 1774 miles, while a message sent from New York to Galveston, about the same distance, would cost only 75 cents.

The capitalization of the Western Union Company, Mr. Clark stated, amounts to $703 per mile of poles, or $141 per mile of wire. In Great Britain the capitalization was about twice as great. Referring to the consolidation of the various original lines into the Western Union system, he said it had been necessary, in order to secure unification of rates and to facilitate through business. The result also had been a vast reduction in rates of transmission, the present maximum rates being in many cases not more than one-tenth of the rates in 1866. Now the rates are as reasonable, he said, as they could be made consistent with good business management. He said it could not be expected that the owners of telegraph lines would sell at the mere cost of production. They, like the owners of any profitable property, had a right to expect something for good will, etc. He also argued that the cost of construction of a telegraph system is not confined to the lines throughout the rural districts, but is due largely to city conditions—the construction of buildings and underground conduits and the securing of other terminal facilities. He estimated that there had been spent upon the Western Union system since 1866 not less than $50,000,000 or $60,000,000, entirely outside of construction

He quoted the Chancellor of the Exchequer of Great Britain as saying in 1893 that there had been a loss to the Government of about $22,000,000 on the telegraph system of that country, and stated that the deficit now amounts to about $40,000,000. If there had been such a deficit there, what, Mr. Clark asked, could be expected in a country like the United States, 26 times as large?

Mr. Clark claimed that the Western Union rates were reasonable and the result of very careful study and adjustment. He thought any radical reduction would be followed by disaster to the stockholders and would result in no benefit to the public at large. There certainly would be a deficit, and in case of Government ownership the burden simply would be shifted from the stockholders to the people.

"Didn't you meet the rates of the Baltimore & Ohio telegraph line when it was in operation?" was asked.

"Yes," the witness replied, "and the Western Union stopped dividends, while the Baltimore & Ohio became bankrupt."

Mr. Clark said that in carrying the Government business between the United States and Cuba, the International Company, which is under the control of the Western Union, and which carries Government business free of charge, had carried more messages for the United States in one year than it had carried for Spain in 30 years Mr. Clark closed his statement with another reference to Government ownership, saying that unless there could be a permanent civil service public ownership would result in a serious deficit, and he believed that no good would be served in the end.

Telephone, Telegraph and Cable Company of America.

A special meeting of the stockholders of the Telephone, Telegraph & Cable Company of America will be held at the office of the company, No. 55 Montgomery Street, Jersey City, N. J., on March 26, 1901, at 12 o'clock. The advisability of reducing the capital stock from $30,000,000 to $9,000,000 by reducing the par value of the shares from $50 to $15 will be considered. The action of the company in reducing its capital stock to $9,000,000 by reducing the par value to $15 eliminates the assessment feature and leaves the company with a fully paid-up capital of $9,000,000.

Discussing this situation the New York *Sun* says: William J Latta is no longer president of the Telephone, Telegraph & Cable Company of America—an independent telephone combination—and it is reported that his retirement was due to a shake-up over the deal by which the company for a time had possession of the Erie Telephone system. This deal is alleged to have proved a white elephant, as it tied up all the working capital of the company, leaving nothing for the development of other properties and resulted finally in the Erie system being let go of at a loss. A circular to the company's stockholders has been issued, calling a special meeting to be held in Jersey City on March 26, at which it is proposed to terminate the assessable feature of the stock by reducing its par value to $15, the amount that has been called on the present par value of $50 a share. As there are 600,000 shares this will make the paid-up capitalization $9,000,000. There are many delinquent stockholders, and they are asked to pay their assessments in arrears on or before April 2. The circular states that "the office of president is left vacant for the present." It is signed by Henry R. Wilson as vice-president.

It is said that Mr. Latta, whose home is in Philadelphia, has been traveling in the West. No definite statement is obtainable regarding the reasons for his resignation. He is still a director and a member of the company's executive committee.

Iowa Telephone Association.

The fifth annual convention of the Iowa Telephone Association was held at Des Moines on March 12 and 13. There was a good attendance, notwithstanding the fact that many were kept away by the severe sleet storm of the Sunday previous. Papers were read as follows: "Our Greatest Need—Through Copper Lines," by A. T. Presson; "Farmers' Lines and Our Experience with them," by O. L. Dobie; "Future of the Farm Line Movement," by George N. Bandy; "The Telephone Business Looked at as an Investment," by U. S. Alderman, Nevada; "Government Ownership of Telephone Lines," by H. C. Raney; "A Clearing House for Monthly Reports and Settlement of Toll Business," by C. F. Bennett; "Underground Construction," by O. H. Gray; "Central Energy," by C. W. Stiger. Great interest was manifested in the papers relating to farmers' lines.

The election of officers resulted as follows: President, H. C. Raney, of Fairfield; vice-president, A. T. Presson, of Iowa City; secretary and treasurer, C. C. Deering, of Boone.

Thirty-six telephone companies were represented, among which were the following: Madrid Telephone Company, of Madrid; Creston & Chariton Telephone Company, of Chariton; Russell Telephone Company, of Russell; Central Telephone Company, of Rockwell City; People's Telephone Company, of Sigourney; Chariton & Newburn Telephone Company, of Chariton; Central Telephone Company, of Des Moines; Anderson Telephone Company, of Corning; Mutual Telephone Company, of Des Moines; Grinnell Telephone Company, of Grinnell; Jasper County Telephone Company, of Newton; Marshall Telephone Company, of Marshalltown; Washington Telephone Company, of Washington; Brighton Telephone Company, of Brighton; Ainsworth Telephone Company, of Ainsworth; County Telephone & Telegraph System, of Waterloo; Corning Telephone Company, of Corning; Davis Telephone Company, of Bloomfield. The leading manufacturers of telephone apparatus were represented by exhibits.

The Hoboken Power Plant of the United Electric Company of New Jersey.

THE changing over of the station at Hoboken of the United Electric Company, of New Jersey, from a belted plant containing engines and generators of various types and capacities, which, while equal to the demands of the service at the time they were installed, would be wholly inadequate under present conditions, is interesting from the fact that the entire renovation with modern direct-connected units embodying the latest improvements in engineering practice, and the change of e. m. f. from 1040 to 2400, was accomplished without causing any inconvenience to the various industries depending upon the station for light and power, and without shutting down any circuit. All of the work of changing the voltage was done by employees of the company, mainly under the direction of Mr. H. D. King, superintendent of the Hoboken division.

The original building, which is located at Fourteenth and Bloomfield Streets, has been enlarged to double its former size, the new section being a substantial brick structure 90 by 135 ft. Nearly all of the apparatus has been removed from the old building, and the interior has been rearranged so that with the new extension all of the various departments, including the offices, power plant, machine shop, meter room, storeroom and stable for horses and repair wagons, are under one roof.

The new equipment consists of alternating and direct-current dynamos of the latest types, which supply light and power to the territory embracing Hoboken, West Hoboken, Weehawken, Union Hill, West New York, Guttenberg, North Bergen Township and Secaucus Borough; and modern direct-connected railway generators supplying power for operating all of the lines of the Jersey City, Hoboken and Paterson Street Railway Company north of Fourteenth Street, Hoboken, the Hoboken Railroad Warehouse & Steamship Connecting Company and the People's Elevator Company at Weehawken.

The steam generating plant (Fig. 1) is located in a room adjoining the engine room measuring 49 by 96 ft., and consists of five Babcock & Wilcox water tube boilers of 520 hp each. The boilers are equipped with Roney mechanical stokers, operated by two Westinghouse vertical engines. Feed water is taken from city mains, and is supplied by Worthington 8 by 12 inch and 7 by 12-inch tandem-compound duplex pumps.

At present coal is fed to the stokers by hand, but it is the intention of the company to install a coal-handling apparatus that will deliver fuel directly to the hoppers of the stokers. The plant is equipped with a Green economizer provided with a 7-hp G. E. motor and a 5-hp engine built by Cook & Co.

Induced draft is employed. The fans are 14 ft. in diameter, built by the Buffalo Forge Company, and are provided with water jacket bearings. They are operated by 12 by 16-inch horizontal engines, running at 75 revolutions.

Steam is delivered to the engines at 140-lb. pressure, and all of the steam piping is carried under the engine room floor, the boiler room being located about 8 ft. below the engine room in order to accomplish this result. The piping system was designed by Westinghouse Church, Kerr & Co., and is so arranged that steam can be delivered to any engine from any boiler.

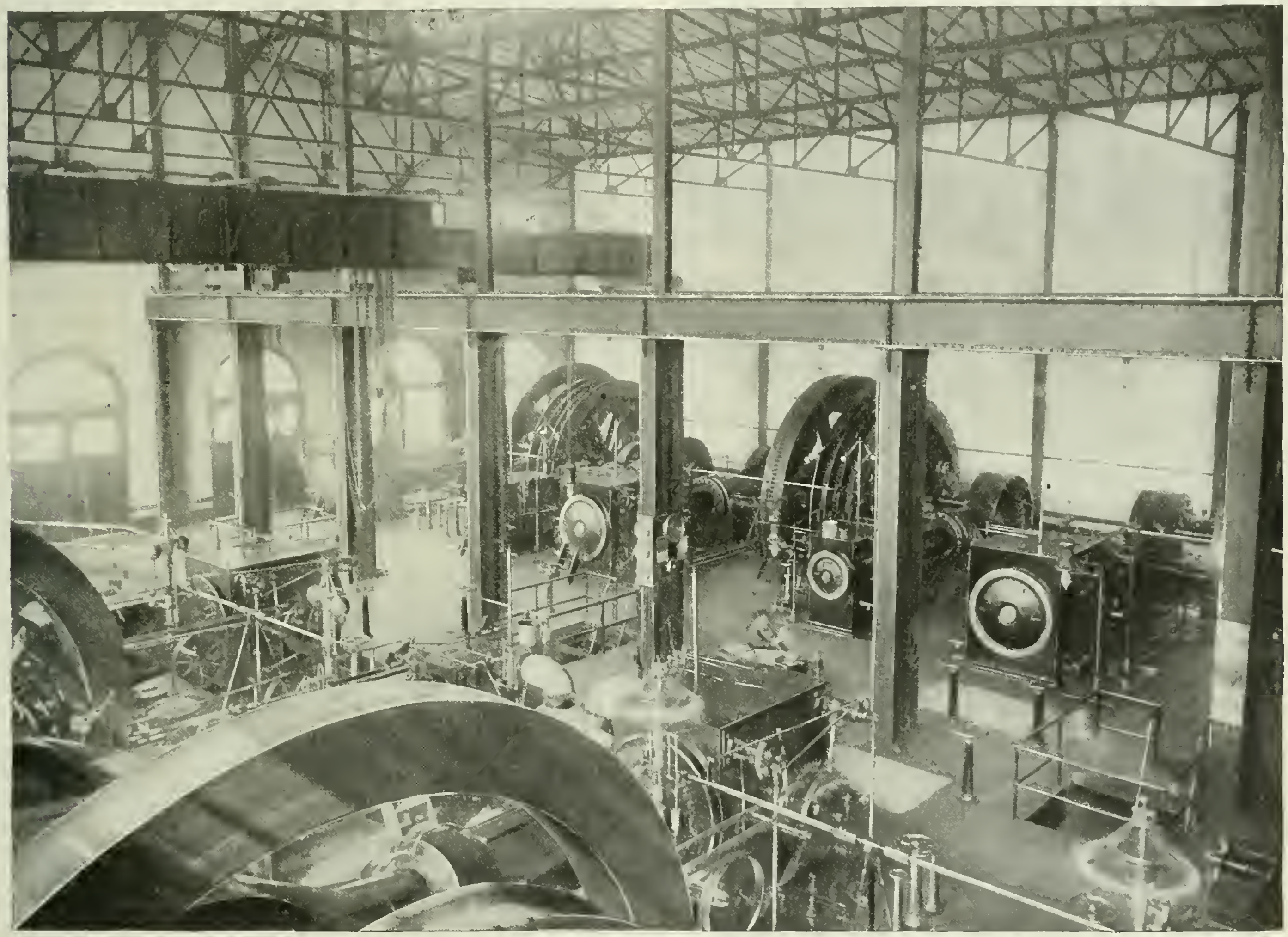


Fig. 1.—General View of Engine Room.

The engine room is 96 by 96 ft., and is provided with large windows on two sides, affording an ample light and ventilation. The arrangement of the machinery is shown in Figs. 1 and 5. The railway engines and generators occupy one-half of the room, the alternating-current machinery being located in the other half. The railway power equipment consists of two cross-compound condensing Corliss engines, built by the Pennsylvania Iron Works Company, of Philadelphia. The engines are specially designed to meet the requirements of street railway work, and embody all the latest improvements, including water jacketed bearings. The cylinders are 28 inches and 48 inches by 48 inches stroke. The flywheels are 20 ft. in diameter, with 20-inch face. Each engine is directly connected to an 850-kw General Electric 550-volt railway generator, and is run at a speed of 90 revolutions.

The plant is equipped with one Worthington and four Deane jet condensers. A very efficient oiler system has been installed, by means of which the lubricating oil flows by gravity to all of the engine bearings and thence to filters. After passing through the filters it is returned to the tank by a 3 by 2 by 3 Worthington duplex pump. The engine room is equipped with two traveling cranes of 25 tons capacity each, built by Alfred Box Company, of Philadelphia.

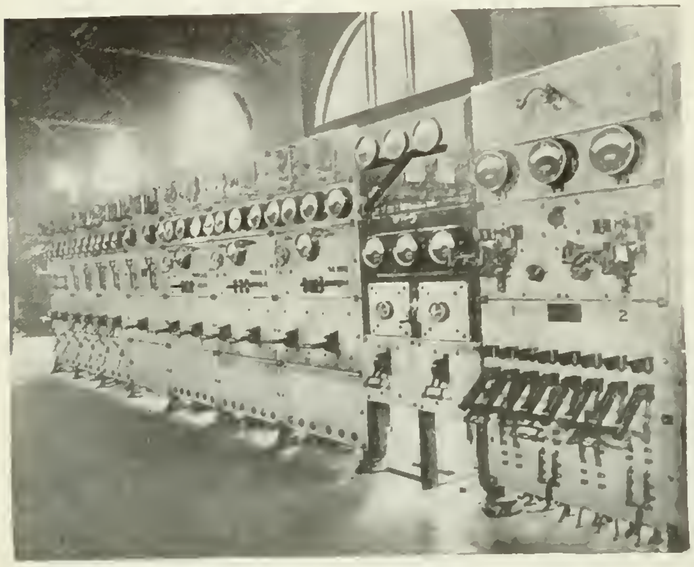


FIG. 2.—ALTERNATING-CURRENT SWITCHBOARD.

The railway switchboard is located on the second floor of the old section of the building. The panels are of slate and are fitted throughout with Weston instruments of the illuminated dial switchboard type. There are two generator panels, each provided with a field switch, field rheostat, ammeter, circuit breakers, etc. The voltmeter is mounted on a swinging arm. The feeder panels are eight in number, provided with circuit breakers and Weston ammeters. Six of these panels are devoted to the street railway feeders, one to the circuit of the Hoboken Railroad Warehouse & Steamship Connecting Company, and one to the circuit of the People's Elevator Company There is also one panel containing a totaling ammeter and two switchboard recording wattmeters, one of 5000-amperes capacity employed for the street railway lines and one of 2500-amperes capacity for the People's Elevator Company.

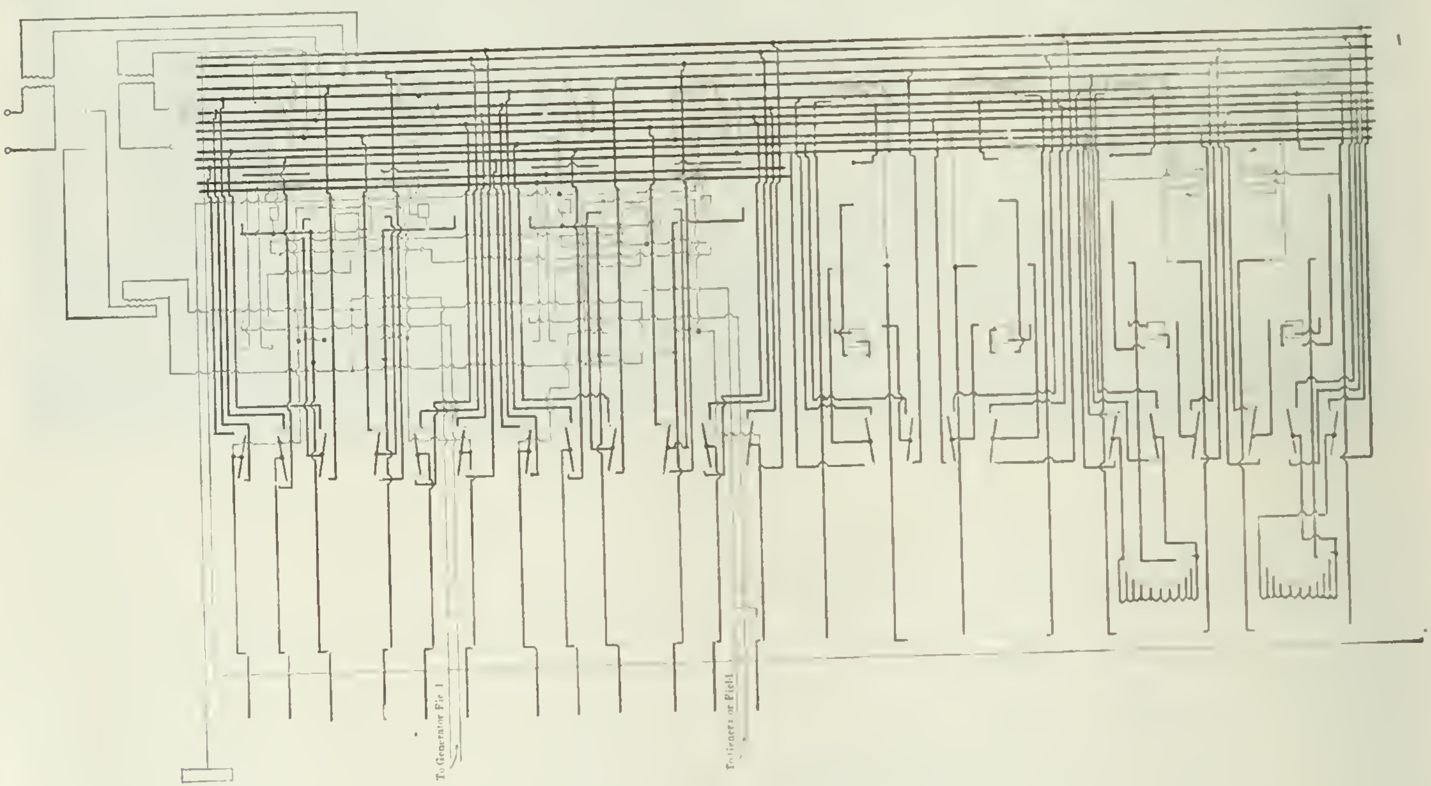


FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

The alternating-current generating equipment consists of one cross-compound condensing engine built by the Pennsylvania Iron Works Company, with cylinders 26 and 48 inches by 48-inch stroke, and flywheel 20 ft. in diameter, with 20-inch face; and two Providence Corliss engines of the same type and dimensions. Each engine is directly connected to a Stanley two phase 60-cycle 2400-volt dynamo. These machines have given excellent satisfaction, and have on several occasions sustained a load of 950 to 1000 kw for four hours and 1050 kw for three hours.

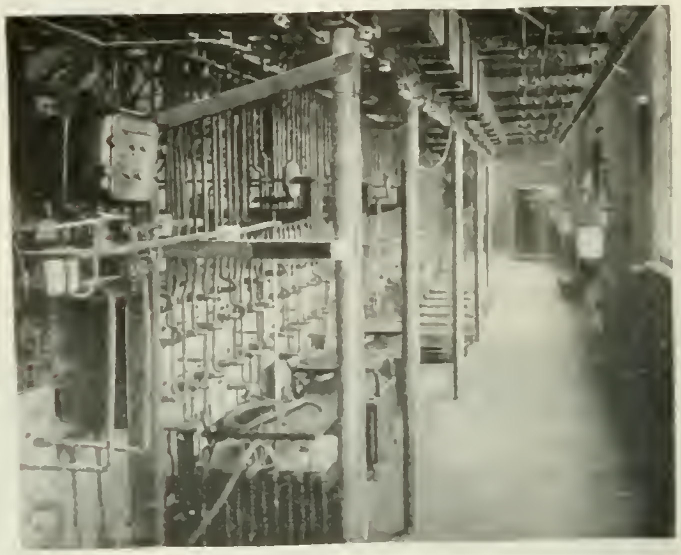


FIG. 3.—REAR OF ALTERNATING-CURRENT SWITCHBOARD.

On the second floor of the old portion of the building are four 150-kw, 2400-volt synchronous Stanley motors, each direct connected to two 125-light 2000-cp arc dynamos (Fig. 7). The connection between the motors and dynamos is made by means of flexible couplings, consisting of a four-arm spider on each motor and dynamo shaft, connection to each other being made by leather links. Each motor is brought up to synchronism by a 15-hp Sprague motor. The connection between the synchronous motor and the starting motor is made by means of a rawhide intermediate pinion secured to a lever so that it can easily be thrown in or out of gear. The exciter current for the synchronous motors is received from the same machines that supply exciting current to the dynamos, consisting of two 60-kw G. E. machines, direct-connected to the same number of

100-hp engines, built by the Harrisburg Foundry & Machine Company. Three of the Sprague starting motors are run by current from the 550-volt railway generators, and one by 125-volt current from the exciters.

In addition to the machines described above there are in this department one 100-kw two-phase Stanley dynamo, belted to a 250-hp Ball engine, for supplying the alternating current to the day circuit; and two 100-kw 500-volt motor generators.

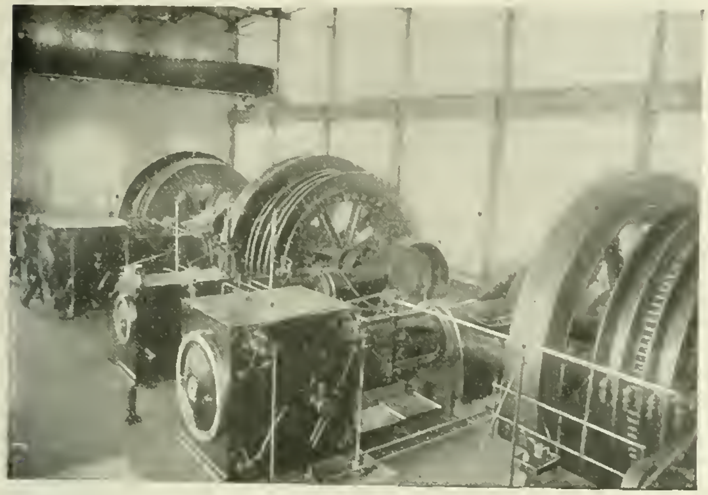


FIG. 5.—TWO-PHASE DYNAMOS.

The alternating-current switchboard, shown in Figs. 2, 3 and 4, is constructed of blue Vermont marble, and presents a very handsome appearance. The exciter board is equipped with Weston ammeters and voltmeters, a throwover switch, two I. T. E. circuit breakers, two combined generator and equalizer switches, and one bus-bar switch. The bus-bars from this panel lead direct to the three alternating-current generator panels, and to the synchronous motor panels. The generator panels are provided with Stanley static ground detectors, indicating wattmeters, ammeters and a double throw switch for each phase. The equipment is the same for each panel.

There are three circuit panels, each provided with a G. E. intergrating wattmeter, voltmeter, ammeter, circuit breaker, double-throw switch and a regulating transformer for each phase. One panel is employed for supplying current to two 100-kw Wagner step-up transformers connected on the Scott system for supplying the Jersey City division station with 6600-volt three-phase currents; at the other end the currents are stepped down by the same method to two-phase, 2400 volts.

There are four synchronous motor panels, illustrated in Figs. 6 and 8. Each panel is supplied with an ammeter on each phase, field switch and rheostat, starting motor switch and rheostat, and a two-phase single-throw switch. The high-tension current is handled by a Stanley three-switch panel, with broom-handle switches, shown on the left in Fig. 6.

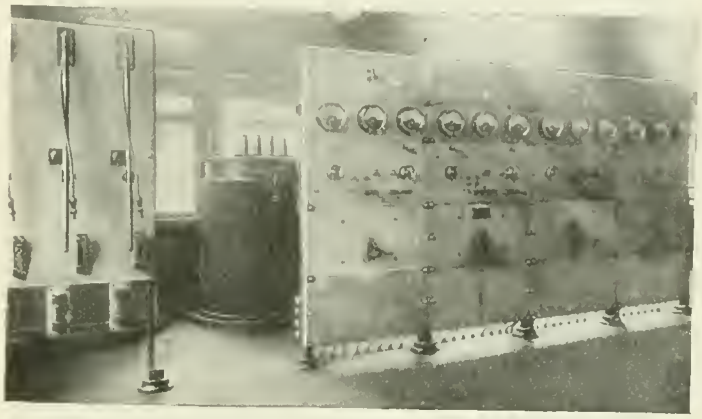


FIG. 6.—SYNCHRONOUS MOTOR PANEL, 6000-VOLT, THREE-PHASE TRANSFORMER AND HIGH-TENSION PANEL.

The series arc switchboard is of the plug and cable type, and consists of five four-circuit panels of blue Vermont marble. This board is fitted with an ammeter jack so that one ammeter and one pilot lamp can be placed in series with any machine. Thus the ammeters are easily calibrated, so that all machinery can be operated by an

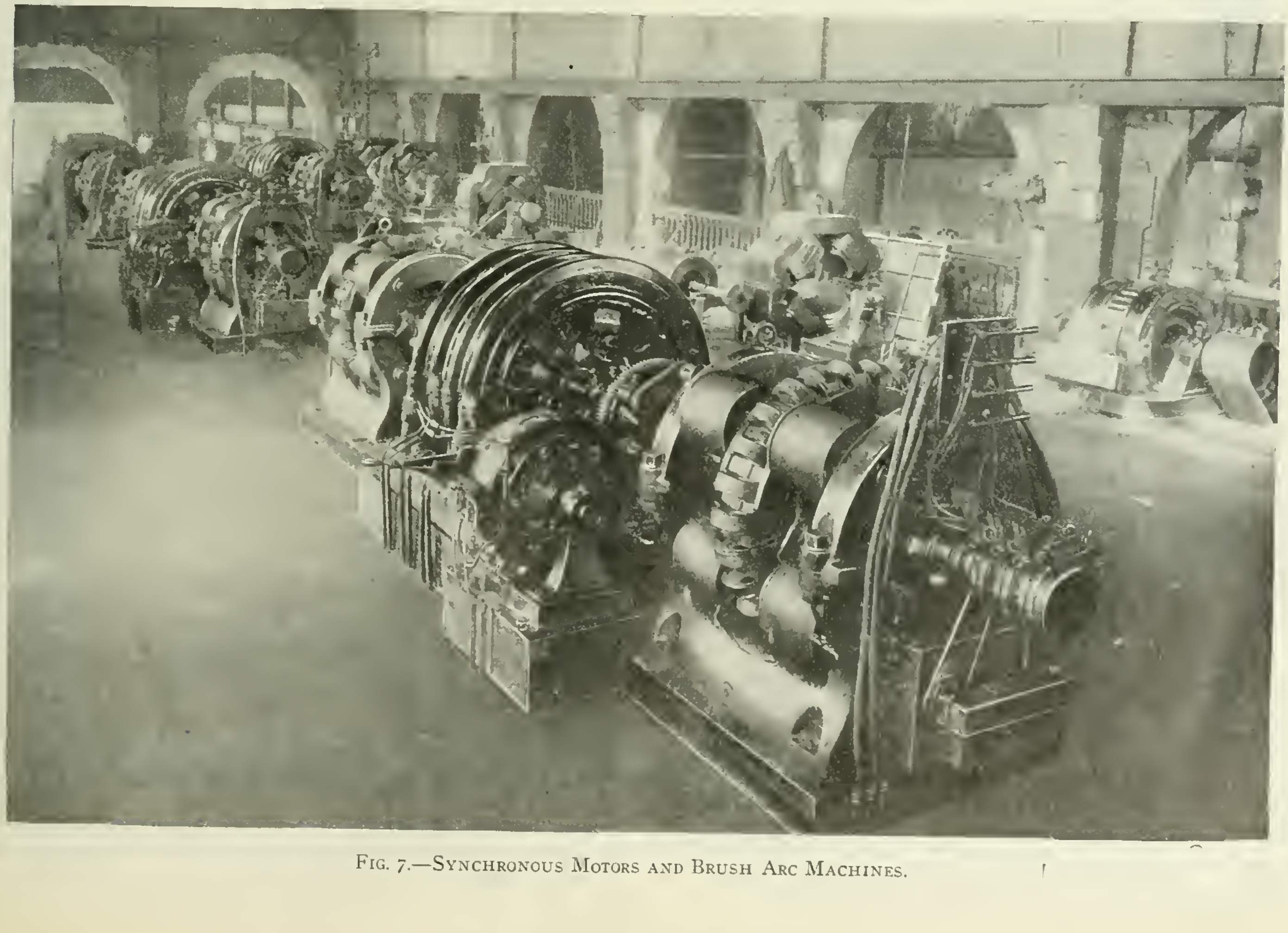


FIG. 7.—SYNCHRONOUS MOTORS AND BRUSH ARC MACHINES.

absolute standard. All of the alternating-current voltmeters and ammeters are of the Stanley hot-wire type, and are easily calibrated.

The station is a good example of a modern combination power and lighting plant, and under its present management is rendering excellent service throughout its territory. The company also operates plants at Jersey City, Newark, Orange, Elizabeth, Morristown and Boonton.

An ingenious "jumper" device, by means of which connection may be made in a few seconds between a switchboard panel and another in case of accident, is illustrated in Fig. 9. The device consists of three castings. The main part is intended to be clamped to a cable, as shown, and is provided with two projecting lugs with right-angle extension, *a a'*. The inner surfaces of these extensions are beveled and are intended to engage corresponding beveled surfaces on the projecting lugs of the portion *B*.

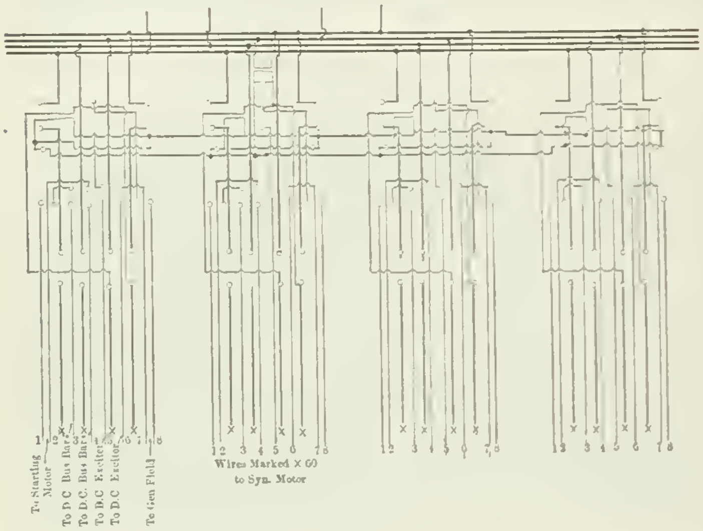


FIG. 8.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

In making the connection the section *A* is clamped to the cable, as shown, and the portion *B* is slipped over the projecting stud *b*, and given a quarter turn, thereby bringing the beveled faces together and insuring a good contact. The other end of the "jumper" cable is then connected to any desired panel of the switchboard in a similar manner. The device was designed by Mr. H. D. King, superintendent of the division.

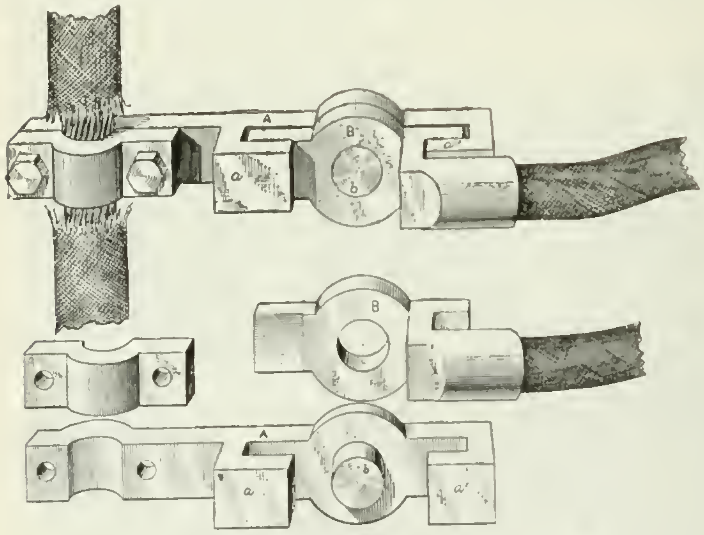


FIG. 9.—"JUMPER" DEVICE FOR TERMINAL CONNECTIONS.

Electricity in Arson Cases.

According to a recent announcement made by the Chicago City Electrical Department, certain merchants and property owners who find an occasional fire "convenient" for business reasons are making use of electric wires to produce the desired blaze. It is declared that 78 fires are known to have been caused in Chicago in the last year by electric wires, while it is supposed that many others had the same origin. While no figures are given as to the alleged incendiarism, it is stated that many of the fires were not due to accident. An ordinance to prevent careless or improper wiring has been framed and will be urged for passage by the City Council.

The Invention of the Telephone.

By George S. Davis.

THE recent death of Prof. Elisha Gray has reopened the question debated for more than 20 years without a decision as to who really invented the telephone. By the decision of the courts it was Bell, but a claim has also been put forth that the prior inventor was Gray. According to the claims of William A. Skinkle, a prominent Cleveland patent attorney, however, neither Bell nor Gray designed the first practical telephone. He claims that on Jan. 22, 1876, three weeks before the famous Bell-Gray patent application interference took place, he showed Prof. Gray a drawing and description of a practical telephone; that Gray rejected the idea, but shortly after filed his caveat, describing a device embodying the salient features of Mr. Skinkle's invention. The story of the new claimant for telephone honors adds new features to the Bell-Gray controversy.

Before going into the story the writer desires to state that for more than six years he has been intimately acquainted with Mr. Skinkle, but it was only very recently, in the course of a conversation regarding Prof Gray's death, that the latter referred to his association with the early history of the telephone. Mr. Skinkle stepped to his office vault, and from the top shelves took down a pile of dust-covered books and papers, the appearance of which were evidence in favor of his claim that they had not seen the light of day in 10 years. The recital of the story and the proofs set forth in the papers fired the writer with a desire to give the matter publicity, and after much hesitation Mr. Skinkle consented to the publication of the story of his claims. He stated that he had always felt so chagrined at the fact that he had allowed Prof. Gray to influence him from applying for a patent, that he had never cared to enter into a controversy on the subject, and that only on two occasions in patent suits had the papers been given publicity, and then only in court, where they had been buried in a mass of evidence. In a recent interview, Mr. Skinkle related his story as follows:

"I served my apprenticeship as mechanical engineer and draughtsman with the Novelty Iron Works, of New York City, leaving there at the final closing of the works in the fall of 1869. From that time until the fall of 1874 I was employed at various places in and about New York City in designing and superintending the construction and erection of various kinds of mechanical appliances. The effects of the financial panic of 1873 were felt for a long time by the iron industries, and finding it impossible to get work in New York in my line of business, I tried in vain to get work in Philadelphia and Baltimore, finally drifting to Washington, where I had friends whose influence procured me a place as clerk with a firm of attorneys.

"In November, 1875, I entered the employ of William D. Baldwin, soon after the firm of Baldwin, Hopkins & Peyton, patent attorneys, serving as draughtsman. One of the first pieces of work assigned to me was to make a patent application drawing for Elisha Gray's inventions in harmonic telegraphy, or multiple transmission and reception.

"In working on these inventions I acquired a thorough knowledge of their mechanical construction and practical operation. Previous to that time my knowledge of electricity and electrical appliances had been very superficial and crude, and my work on Prof. Gray's inventions was to me the threshold of the science. The fact which made the deepest impression on my mind in the demonstrations of his instruments was the immense rapidity with which an electric current could be broken and closed with absolute precision through a range of musical notes, that admitted of the transmission and accurate reproduction of popular airs. Some time during the holiday season of 1875 there appeared on the streets of Washington a toy then called the "lover's telegraph," consisting of two tubes, one end of each being closed by a thin diaphragm of stretched parchment with a thread connection between the diaphragms, which, when under tension would reproduce in one tube sounds and words spoken into the other. This toy interested me greatly, coming to my notice as it did at a time when my mind was saturated, as it were, with the electrical transmission of musical notes. It demonstrated that the variations of pitch and power of the human voice were sufficiently pronounced to produce distinctive mechanical results that could be mechanically transmitted through the thread and actuate a diaphragm that in turn would reproduce the original sound waves and sound that set the other diaphragm in motion. With the knowledge that an electric circuit could be interrupted thousands of times a second as demonstrated by Gray's instruments, and the further knowledge that the tones of the human voice would reproduce sound wave vibrations mechanically appreciable and capable of mechanical transmission, the two facts came together in my mind and the telephone idea was born to me.

"I at once realized the magnitude and commercial importance of my invention, and was so excited over it that for several weeks I could scarcely bring myself down to ordinary affairs of every-day life. I talked freely about it to my associates, and also to Mr. George C. Maynard, an electrician who I desired to have make for me instruments or models for an application for patent. As I recall it, I did not explain to Mr. Maynard the details of construction I had in mind, but I went far enough to draw him out and ascertain that he had both the equipment and skill to do my work if desired.

"I believed that the idea was entirely new and original with me, and that its importance warranted my seeking good advice. I knew so little of patent matters then that I did not feel competent to decide for myself, and finally on or about Jan. 15, 1876, I laid the matter before Mr. William D. Baldwin, of the firm I was employed by. Mr. Baldwin told me that the idea was not new, and that it was not practicable; that it had been tried before, but with such poor results that the experiments had been abandoned, and the subject given up as unattainable. This conversation with an employer who had always shown me every consideration and whose judgment I regarded as almost infallible, and was generally disposed to accept without question, was a terrible blow to my hopes, but as he was unable to point out to me the reasons why my devices would not operate, I could not give up my dream on mere general objections, and asked his permission to consult Mr. Gray about the matter. Mr. Gray was then living in Chicago, and was expected to visit Washington and our office on business connected with his harmonic telegraph applications for patents. I had previously made rough sketches of my devices, but in anticipation of Mr. Gray's coming I made a more careful drawing, and wrote out a full description to submit to him and to file in the patent office as an application. These were finished and executed by me on Saturday, Jan. 22, 1876, and shown by me on that day to Mr. Gray. He examined the matter carefully and listened to my description and explanation, and finally advised me that my scheme would not work, because the transmitter with its positive contact points would not respond to the variations of the human voice, and that some other means must be resorted to before successful transmission could be accomplished. This conversation with Mr. Gray completely dashed my hopes. I accepted in good faith what he told me, and as I was young with a family to support on a limited salary, and having no money to spare for speculative purposes, I put the matter aside as something beyond my means and capabilities.

"Three weeks after this, on Saturday, Feb. 12, 1876, Mr. Gray returned to Washington with his telephone invention, and under his instructions I that day prepared a drawing for his caveat, which was filed in the patent office on the following Monday, Feb. 14, and on which his claim as an original telephone inventor solely rests.

This awakened a suspicion in my mind that perhaps Mr. Gray's advice to me of three weeks before had not been wholly disinterested, and that while he had cooled me off most effectually, he had taken into his own consideration the possibilities of the great central idea I had advanced to him of the electrical transmission of speech. I firmly believed then, as I do now, that Elisha Gray had never thought of a telephone, or, at most, never thought of it as a practical possibility before my disclosure to him on Jan. 22, 1876, when the idea was at least three weeks old with me.

"However, I could not then afford to make any claims which might have made trouble between the office and a valuable client, and might have lost me my position; I, therefore, concluded to swallow my disappointment and keep quiet, as circumstances seemed to demand.

"The matter remained at rest so far as I was concerned until March, 1879, when I was asked by Mr. Baldwin to make a written statement of the circumstances connected with it, and my disclosures to Mr. Gray. On March 15, 1879, only three years after the occurrences, and while they were still fresh in my mind, I complied with Mr. Baldwin's request in a letter which reads in part as follows:

"'In compliance with your request I make the following statement about what I remember about the preparation of Prof. Gray's telephone caveat drawings and some conversations I had with him about speaking telephones several weeks before they were made. Having worked for the greater part of the time during the winter of 1875-76 on several of Prof. Gray's harmonic telegraph cases, and thereby becoming familiar with the principle of harmonic telegraphy, I was very much impressed with a small telephonic toy known as the "lover's telegraph," which appeared on the streets early in January, 1876. I examined it carefully, understood the principle on which it worked, and was struck with the close resemblance to the principle involved in Prof. Gray's harmonic instrument, and the question then presented itself to me that if the electric telegraph could transmit and reproduce the vibrations of musical tones as in Gray's cases, why not also those of the human voice just as in the "lover's telegraph"? I did not know enough of telegraphy to enable me to judge as to the practicability of my idea, so I went to see Mr. Maynard, the electrician, about it, and talked awhile with him, but came away without disclosing to him any of the details of apparatus that I had in mind, as I intended to make drawings and go to see him again, but before doing so to consult you about the matter. You may remember my speaking to you about it at that time, and the way you tried to discourage me from doing anything with it, because, as you said, the idea itself was not new, and that attempts had already been made to produce an apparatus capable of doing that very thing, but up to that time none of them had been successful. You consented, however, to my speaking to Prof. Gray, who was here at the time, about the matter, so I made a drawing, which I now have, on the 22d day of January, 1876, and on that day showed it to him. He examined it carefully, and told me that the transmitter would not work, because anything in the way of a circuit breaker having a positive stop or rigid contact point could not adjust itself to the variations of amplitude of the human voice, and that any instrument to be successful must interrupt or disturb the electric circuit by some other means than contact points, so that all variations in the rapidity and amplitude of the variations of the human voice might be taken up and transmitted. He also added that he had been thinking a great deal about the subject, and had some ideas well developed in his mind on which he intended soon to file an application or caveat. He said he expected to go away for several days, and that as soon as he came back he would start me making the drawings for him. I do not remember now whether he went away or not, but on the evening of Feb. 11, 1876, he gave me a sketch (which I now have), in which he showed me the ideas he wanted me to illustrate in my drawings. The next morning, Saturday, Feb. 12, I made his caveat drawing, which was filed with his caveat application on Monday, Feb. 14, 1876.'

"I also entrusted Mr. Baldwin with the original drawing and specifications which I had made and shown to Mr. Gray.

"After this I did nothing more with the matter, and heard nothing of it until November, 1885, when, in looking over the printed record of the American Bell Telephone Company in the case of the United States vs. the American Bell Telephone Company, brought by the Attorney-General before the Secretary of the Interior to annul the Bell patent, I discovered that my papers and drawings had been copied and were being used as a part of the record, for what purpose I do not know, but suspect it was used against Gray's claims of originality of conception.

"As this had been done without my knowledge or consent, and as I considered that I had a priority interest with which I had not parted ownership, I demurred to their use in this manner, and failing to gain any acknowledgment of my rights, threatened to bring injunction proceedings against the Bell Company to restrain it from using my private papers.

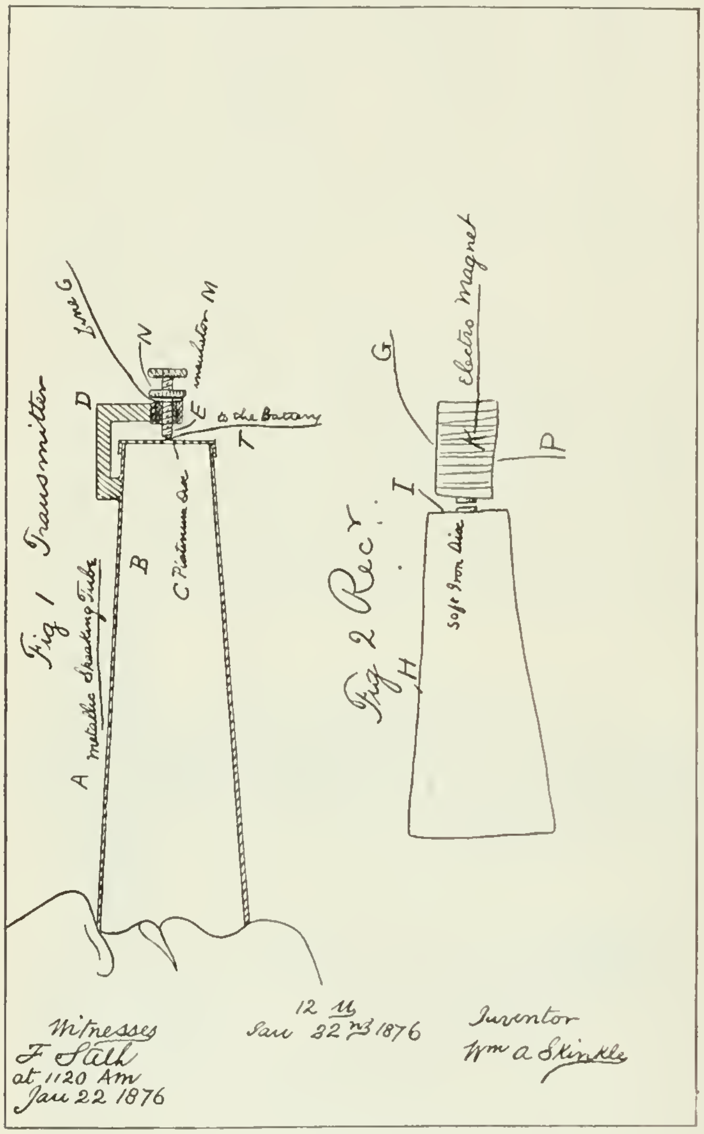
"After several interviews with Messrs. W. W. Storrow, of Boston, and Frank L. Pope, of New York, of counsel for the defendant, an arrangement was made which was satisfactory to me, and I consented to the use of the papers. Under this arrangement the original papers were filed for safe keeping with the National Safe Deposit Company, of Washington, on Nov. 27, 1885, at the expense of the Bell Company, and they are still, I believe in the custody of the Safe Deposit Company, as it was agreed that neither party should have the power to withdraw them, except with the consent of the other.

"Before filing them, however, the Bell Company had them photographed and furnished me with copies, which I now have in my possession.

"Many of the persons who knew of my telephone invention at the time it was made are now dead, or are scattered to places unknown to me, but among those still living I recall Messrs. William D. Baldwin, Marcus S. Hopkins, Edward C. Davidson and Brutus De Long, all of whom are still living in Washington. Mr. F. Stith, whose name appears as witness on my drawings and specifications, died about 10 years ago."

The photographic copies of the drawings, the claims and specifications of Mr. Skinkle's invention are as follows:

"The object of my invention is to transmit articulated sounds by an electrical apparatus. The accompanying drawing illustrates my idea of one form of transmitter and receiver. My invention is based on the well-known law of acoustics, that bodies vibrating with different rapidity produce tones of different pitch, and that a tone of a given pitch will produce a certain number of vibrations per second. In the drawing, Fig. 1, represents the circuit breaker for the transmitting end of the line, and Fig. 2 the receiving instrument. *A* is a conical tube, the large end of which is left open, it being large enough to completely encircle the mouth of the operator, as shown. The small end is closed by a membrane *B* of parchment, or any similar substance, which is drawn tightly across the opening and fastened to the tube *A*. A platina disk *C* is secured to the center of the membrane, and is connected to the battery by a wire *F*, which is so arranged as to vibrate freely with the disk. *D* is an arm or bracket securely fastened to the tube, and in its outer end opposite to the platina disk is fastened an insulator *M* (preferably of hard rubber). A screw *E* passes through this insulator and its point is brought almost in contact with the disk *C*, the desired distance being secured by moving the screw towards or away from it. *N* is a check screw, and it also serves the purpose of holding the end of the line wire *G*, which is bent around the screw *E* between the insulator and the check nut, and the latter is then screwed down upon it, thus holding it securely.



SKINKLE'S TELEPHONE.

"In Fig. 2 the tube *H* and the membrane *I* are similar to those shown in Fig. 1, but the disk *J* is of soft iron which can be readily magnetized or demagnetized. *K* is a single coil electromagnet. *G* the line wire. *P* the ground wire.

"The operation is as follows: The operator places his mouth in the tube *A*, as shown, and talks, uttering each syllable distinctly. This talking causes the membrane *B* to vibrate synchronously with the tones of the voice, with greater or less rapidity as the voice is pitched high or low, and this vibration throws the platina disk *C*, and the point of the screw *E* in and out of contact, thus closing and breaking the circuit with the rapidity due to number of vibrations which the sound or articulation would produce and thereby causing pulsations or distinct shocks of electricity to pass through the line wire *G*, and helix around magnet *K*, which being magnetized and demagnetized as often as the pulsations pass through the helix, attracts and releases the soft iron disk *J*, thereby causing the membrane *I* to vibrate in sympathy with the membrane *B* and reproduce the exact sound in the tube *H*, which was uttered in the tube *A*."

During the early 80's Mr. Skinkle was quite prominently identified with various branches of electrical trade as a patent attorney. Later he turned his attention to other lines. In 1881 Mr. Skinkle assisted in the futile attempt made by Bell to locate the bullet which ended the life of President Garfield.

Mr. Davis submitted with his article the following papers:

Six blue prints. One is a photographic print of a drawing, from which the copy for the illustration in Mr. Davis' article was traced. Three of the other blue prints are reproductions of the specifications which accompanied the aforesaid drawing, and which are quoted in the article. The letter to William D. Baldwin quoted in the article is photographically reproduced in two blue prints. The sixth print is a photograph of the envelope containing the papers on deposit in Washington.

Of the other papers, one is a duplicate of an agreement between William A. Skinkle on the one part and Frank L. Pope acting for and in behalf of the American Bell Telephone Company on the other part, relating to the deposit of papers in the custody of the National Safe Deposit Company at Washington, D. C., the date of the paper being Nov. 18, 1885. According to this agreement the papers are to be preserved in unimpeachable custody so as to be accessible if they were needed as evidence. It is agreed that in any suit or legal proceedings concerning any patent or application, the custodian, after notice to Skinkle and the American Bell Telephone Company, may exhibit the papers to any lawful tribunal investigating the matter, but shall not permanently part with the same without the consent of Skinkle and the American Bell Telephone Company. A letter dated Nov. 19 and signed by E. C. Davidson, and referring to this agreement, reads as follows: "I enclose herewith a copy of the proposed new agreement which I sent to Pope by to-day's mail. If you have any suggestion, please let me have it during the next half hour, as I shall be leaving the office for the day." A letter signed by E. C. Davidson and dated Nov. 27, informs Mr. Skinkle that "Mr. Pope returned the agreements some days ago. . . . and he adopted the agreement in exactly the form in which I drew it, and as approved by you." A letter signed by E. C. Davidson and dated Nov. 28 accompanies a certificate of the National Safe Deposit Company, of Washington, stating that "William A Skinkle, of Washington, D. C., and Frank L. Pope, of New York City, acting for and in behalf of the American Bell Telephone Company, have deposited with the National Safe Deposit Company, of the city of Washington, for safe keeping, first, a jacket or file wrapper marked "William A. Skinkle, telephone papers, 25 Grant Place, Washington, D. C." (One of the blue prints above referred to is apparently a photograph of this item.) Second, "three pages of manuscript headed 25 Grant Place, Washington, Jan. 22, 1876, and signed 'William A. Skinkle,' and witnessed 11.20 a. m., Jan. 22, 1876, Test F .Stith." Third, a linen tracing dated and witnessed as follows: "12 m., Jan. 22, 1876. Inventor William A. Skinkle, witness, F. Stith, at 11.20 a. m., Jan. 22, 1876." Fourth, a pencil sketch on bristol board marked "Drawn about Jan. 22." An India ink drawing on Bristol board marked "Drawn about Jan. 15, 1870."

Water Power in Ireland.

In the present session of the British Parliament it is proposed to introduce a bill to incorporate a company by the name of the Shannon Water & Electric Power Company, for the purpose of utilizing the water of the river Shannon for hydraulic purposes and electric motive power. The area within which the company propose to carry on business is to be so much of the counties of Clare and Limerick as are within a radius of 30 miles of the townland of Springfield. The capital of the company is to be £365,000. Upon this capital borrowing powers are sought to be exercised to the extent of £180,000 by the creation and issue of debenture stock.

Hot Water Heating from Central Stations.

By Alton D. Adams.

HOT water, which has long been a favorite means for heating in private plants, has recently been applied to heat-distribution from central stations. A public heating system for distribution by hot water necessarily includes means by which the water may be heated at a central station, pipes to conduct the heated water to the premises of consumers, other pipes of equal capacity to return the cooled water to the station and pumps to maintain the circulation of water at the required rate.

A tank or standpipe may be added to the central station to equalize the action of the pumps and the flow of water. The heated water is usually under only open-air pressure at the station end of the return pipe, and cannot, therefore, have a temperature there of more than 212 degs. The temperature of the water leaving the station may be as high as the pressure under which it is transmitted will permit. Thus at 60 lbs. gauge-pressure water may have a temperature of 307 degs. F. before expanding into steam. As a matter of practice, stations distributing heat by means of hot water have thus far raised the temperature of the outgoing supply little if any above 212 degs. or that of the exhaust steam. Water at the central station may be heated in boilers connected with the circulating system or in suitable coils or tanks by the action of exhaust steam.

In most cases where hot water is being distributed for general heating, the system is operated in connection with an electric light or power station, and the supply of water is heated to a large extent by the exhaust steam from engines and pumps. In the ordinary private plant for hot-water heating the circulation of water is maintained by the difference in the action of gravity on the water in the hot and cold pipes, but for a public supply a much larger force is necessary to secure the desired circulation, and this is obtained by pumps.

HOT-WATER HEATING FROM CENTRAL STATIONS.

If the exhaust steam resulting from the consumption of power to operate the pumps for the circulating water can all be applied to heat that water its amount is a minor matter.

The water entering distribution pipes absorbs energy to raise its temperature and also to move it against the friction of the pipes. The drop of the temperature of the water while in the pipes, and the work done to move it determine the loss from them. Thus, if the difference in temperature between the water that leaves the station and that returned to it is 50 degs., and the average fall in the temperature of the water while on the premises of consumers is 40 degs., the total loss of heat is 20 per cent of that imparted to the water at the station, plus the heat equivalent of the work expended to move the water. If the service taken from hot-water pipes is fairly uniform per unit of length, the fall of temperature at the ends most distant from the station will be twice the average of temperature in them. The loss of heat from the pipes that return the water from the premises of consumers to the station will be somewhat smaller than the loss from the outflow pipes, because the temperature of the latter is higher.

To illustrate the relative amounts of energy required to heat the water and to move it and determine a fair efficiency for hot-water distribution, a system with a pair of 12-inch main pipes may be considered. Let the pressure necessary to move the circulating water through the pipes and heating system be 80 lbs. per square inch, and the velocity in the main pipes 6 ft. per second. Take the total drop in the temperature of the water from the time it leaves until its return to the station at 50 degs. F. and 40 degs. of this drop as the loss of temperature on the premises of consumers. The area of a pipe 12 inches in diameter is .7854 of a square foot, and at the velocity of 6 ft. per second 4.76 cubic ft. of water leave the station each second through one pipe, and an equal quantity is returned through the other. The weight of this volume of water at a temperature of 212 degs. is $4.71 \times 59.8 = 281.6$ lbs. As the total fall of temperature for the circulating water is 50 degs., the heat imparted to it at the station is $(281.6 \times 50) = 14{,}089$ units per second. There is also expended on the water a certain amount of mechanical work, measured by the total pressure operating to maintain the circulation, and the velocity in the pipe. The area of a pipe of 12 inches diameter is 113 square inches, and at 80 lbs. per square inch the total pressure is $(113 \times 80) = 9040$ lbs. At the velocity of 6 ft. per second the work done to move the water during that time is $9040 \times 6 = 54{,}240$ ft.-lbs., or the equivalent of $54{,}240 \div 778 = 69.7$ heat units.

During each second there is, therefore, imparted to the circulating water energy to the amount of $14{,}080 + 69 = 14{,}149$ heat units, of which $14{,}080 \div 14{,}149 = 99.5$ per cent is received as heat and 0.5 of 1 per cent as mechanical work. This work is expended to overcome the resistance of the heating system, and is obviously transformed to heat that helps to maintain the temperature of the circulating water. As the water actually loses 10 degs. of temperature while in the distributing pipes, its total loss of heat there per second is obviously $(281.6 \times 10) + 69 = 2885$ units, of which the energy to overcome the friction of pipes is only $69 \div 2885 = 2.4$ per cent. There is some loss of heat at the station incident to the work done in circulating the water, which was found to be 54,240 ft.-lbs. per second. As 550 ft.-lbs. per second is the work of 1 horse-power, the circulating water requires $54{,}240 \div 550 = 98.4$ horse-power to maintain its motion. It seems fair to allow 35 lbs. of steam at 100 lbs. gauge-pressure for each horse-power-hour done on the circulating water by the pumps, or $98.4 \times 35 = 3444$ lbs. of steam hourly in this case. Each pound of feed water at 212 degs. that is changed to steam at 100 lbs. gauge-pressure absorbs 1004 heat units. The 3444 lbs. of steam per hour corresponds to $3444 \div (60 \times 60) = .956$ lbs. per second, which absorb $1004 \times .956 = 959.82$ heat units from the boiler per second. The engine exhaust resulting from this steam consumption may be fairly taken at 28 lbs. of steam and 7 lbs. of water per horse-power-hour, giving a total of $98.4 \times 28 = 2755$ lbs. of exhaust steam that may be used to heat the circulating water. This supply of exhaust steam corresponds to $2755 \div 3600 = .76$ lbs. per second, that will yield on condensation $966 \times .76 = 734$ heat units to the circulating water. To operate pumps for the circulating water in this case, therefore, the expenditure of heat at the station is $960 - 734 = 226$ units per second. The energy imparted to the water each second has been found to be 14,149 heat units, and this amount plus the loss by pumping at the station, gives the total heat drawn from the boilers to supply the heating system as $14{,}149 + 226 = 14{,}375$ units per second.

Of this total, the amount lost to maintain the circulation is only $226 \div 14{,}149 = 1.6$ per cent. As the 281.6 lbs. of water circulated through the system per second are to fall 40 degs. in temperature while in the pipes, and radiators of consumers, the heat there given up is $(281.6 \times 40) = 11{,}246$ units. To effect this delivery of heat, 14,375 units are expended, as has just been shown, so that the efficiency of the heating system from boilers to consumers is $11{,}264 \div 14{,}375 = 78$ per cent. With an efficiency of 80 per cent for the boiler plant, the consumer may thus receive $80 \times .78 = 62.4$ per cent of the fuel energy.

The capacity of a system of hot-water pipes to convey heat varies with the initial temperature of the water and the rapidity with which it circulates. The effectiveness of heating surface served by these pipes also varies with the initial temperature of the water and its rate of passage through the system. If with a given initial temperature of the circulating water the velocity of flow is increased, the water has less time to cool, its total drop in temperature is diminished and the average temperature of the pipes and radiating surface is increased. If with a given velocity for the circulating water its initial temperature is raised, the average temperature of pipes and heating surface is increased. For a fixed temperature of the surrounding air the heat given off per square foot of radiating surface increases directly with its temperature. It is obvious that the greater the heating effect of a unit of radiating surface, the smaller the area of the surface necessary to warm a given space.

As the owner of a building must usually provide his own radiators he will naturally prefer to have them operate as hot as possible at times when the maximum supply of heat is necessary. The maximum temperature of the circulating water is limited to 212 degs. where exhaust steam is its only heating agent. Other factors remaining equal the greater surface of distribution pipes, compared with that of the radiating surface in buildings, the greater will be the per cent of lost heat. If, therefore, the pipes for the circulating water are made very large in order to increase velocity of flow and reduce the necessary heating surface in buildings, a larger part of the total heat imparted to the water will be wasted. The required power, attendant losses and the cost of pumping machinery increase with the velocity of the water in the distribution pipes, and a point is soon reached beyond which it is not economical to go in the rate of water circulation for any particular system of pipes.

A result of these considerations is that the supply of hot water for general heating from central stations must usually give radiating surface in buildings an average temperature materially lower than could be had with steam and a littler lower than might be expected in local hot-water plants. The surface heated with exhaust steam at about atmospheric pressure is all at 212 degs., if radiators are kept free from air and water. Radiators supplied with water from local heaters, at atmospheric pressure, are subject to some range of average temperature, according to the rapidity with which circulation takes place in the local pipes. A fair figure for the drop of temperature in the pipes and radiators of private hot-water plants is about 20 degs. This with water delivered to radiators at 212 degs. makes the average temperature 202 degs. If the average fall of temperature in the supply pipe of a hot-water distribution system is 5 degs., corresponding to a maximum fall of 10 degs., and the fall of temperature in the radiators served is 32 degs., the average temperature of the radiating surface is 191 degs., provided that water is delivered to the pipe system at 212 degs.

The moderate increase of radiating surface for use with hot water from a central station, over the area necessary with local heaters, may be much more than offset by advantages of the former system. Regulation of temperature at the premises of consumers may be effected to a large degree at the central station by changes in the temperature of the outgoing water. The less the temperature of the water when it leaves the station, the lower will be the average temperature of the heating surface in buildings.

One of the marked advantages of the system of heat distribution by hot water is the facility with which heat generated at one time of day may be stored and delivered at another. This property of hot-water systems is especially valuable at electric staions. As is well known, the demands for electric energy in lighting traction and stationary motors are far from uniform during each 24 hours. The exhaust steam available at any time is nearly proportional to the total load, and its maximum rate of supply may be two or more times the average and many times the minimum.

A system of heat distribution supplied largely or entirely with exhaust steam must obviously require more heat than can be had at some times of day, and less at others, unless the fluctuations in the amount of exhaust correspond in time and amount with the demand for heat, or there is some means of storage. As a matter of fact, the largest requirements for heat occur in the first half of each day, and the greatest demands for electric energy in the last. Hot water is especially effective as a reservoir of heat where the water is the agent of distribution, because the heat is thus immediately available at any time. The circulating water enters the station on its return from consumers at a comparatively high temperature, and can be warmed by exhaust steam to about 212 degs.

Starting from the station at a temperature of 212 and returning at 162, gives the water a fall of 50 degs. in temperature, which may be replaced with stored heat. One cubic foot of water raised from 162 to 212 degs. absorbs about 3000 heat units, and as each pound of exhaust steam yields 966 units on condensation, the cubic foot of water stores the heat of $3000 \div 966 = 3.1$ lbs. of steam. Steam at atmospheric pressure occupies 26.3 cubic feet per pound, so that 3.1 lbs, require 81.5 times the space of the water that stores its latent heat. The hot-water tank in a station that operates as a pressure reserve and to equalize the action of pumps, may also well serve as a storage reservoir for surplus heat during a part of each day. The space required by such a tank at an electric station is not so great as to constitute a serious obstacle to its use.

Assume for illustration an output of 50,000 kilowatts on the average during the two hours of heaviest load at an electric station, and let it be necessary to store one-half of the heat from the exhaust steam during this period, for use at another time of day. The latent heat of exhaust steam for an output of 5000 kilowatts must thus be stored. If engines consume 27 lbs. of steam per brake horse-power-hour, and electrical equipment has an efficiency of 90 per cent, the weight of exhaust, is $27 \div .90 = 30$ lbs. of steam and water per electrical horse-power-hour of output, or $30 \div .746 = 40$ lbs. per kilowatt-hour nearly. If 20 per cent of the engine exhaust is water, there will be 32 lbs. of exhaust steam per kilowatt-hour, and $32 \times 5000 = 160{,}000$ lbs. of steam must have their latent heat stored. As each pound of this steam yields 966 heat units, the total is $(966 \times 160{,}000) = 154{,}560{,}000$ units. One pound of water is to absorb 50 heat units, and the 32 lbs. of exhaust steam yield $32 \times 966 = 30{,}912$ units, so that $30{,}912 \div 50 = 612$ lbs. of water must be stored for each kilowatt-hour. At the temperature of 212 degs. water weighs 59.8 lbs. per cubic foot, so that the space necessary to store the heat of exhaust steam per kilowatt-hour is $612 \div 59.8 = 10.25$ cubic ft. To store the latent heat of exhaust steam from an output of 5000 kilowatt-hours, in the circulating water, requires, therefore, a tank that contains $5000 \times 10.25 = 51{,}250$ cubic ft., or, e. g., a round tank 36 ft. in diameter and 50 ft. high. If the water reaches the tank at less than 162 degs. temperature the size of the tank can be reduced.

This storage tank is able to contain one-half of the heat of exhaust steam at a station operating 100,000 16-cp incandescent lamps during two hours. For a station operating 10,000 such lamps to store one-half the heat of exhaust steam during that period, the necessary capacity of tank would be provided by one 12 ft. in diameter and 46 ft. high. In the distribution of heat by hot water as well as in that by steam, the insulation of the supply pipes is of prime importance. Experiments have shown that as much as five times the amount of heat lost from a well-covered pipe per square foot of surface per hour will be dissipated by a square foot of bare pipe surface. This requirement for heat insulation also extends to the tank or stand pipe in which the hot water is stored.

Where a large storage tank is used in connection with a hot-water distribution system, it will usually be desirable to so combine pipes, valves, heating coils and the storage tank that the exhaust steam at any time may be devoted entirely to heating either the water going out to the supply mains or that in the tank, also so that any desired division of the steam between the outgoing and the tank water may be made. The portion of fuel energy that an electric station, distributing the heat of exhaust steam by circulating water, can deliver to consumers, is obviously smaller than for a simple heating station, because of the losses in machinery. At 40 lbs. of boiler steam per kilowatt-hour, the boilers must furnish $1004 \times 40 = 40{,}160$ heat units, if feed water is supplied at 212 degs. and steam at 100 lbs. gauge-pressure. If one-fifth of the engine exhaust is water, the heat available from exhaust steam per kilowatt-hour is $966 \times 32 = 30{,}912$ units. The heat that may be supplied to a hot-water distribution system by the exhaust steam of engines driving dynamos under the conditions named is thus $30{,}912 \div 40{,}160 = 77$ per cent of the heat taken from the boilers. It has been shown above that the hot-water distribution system, including the pumping machinery, has an efficiency of 78 per cent. for an average case, so that with boilers of 80 per cent efficiency hot water may deliver $80 \times .78 \times .77 = 48$ per cent of the total heat energy of the coal burned at electric stations. To obtain the efficiency of the complete station, distributing electric energy and hot water, the figure for the electric output must be added to that just found for the heat alone. One kilowatt-hour is the equivalent of 3412 heat units, and the 40 lbs. of steam at 100 lbs. gauge-pressure, taken from the boilers for its development, were found to require $1004 \times 40 = 40{,}160$ heat units above feed water at 212 degs. In this case the electric energy is thus $3412 \div 40{,}160 = 8.5$ per cent of that taken from the boilers. The combined electric and hot-water heating station and system therefore has an efficiency of $48 + 8.5 = 56.5$ per cent for the conditions named, where all of the exhaust steam is applied to heat the circulating water. The steam consumption here assumed for engines is intended to provide for 2 lbs. back pressure at the exhaust, which is enough with hot-water heating. The boiler efficiency is based on the use of economizers. Feed water is presumed to be returned from the engines to boilers at 212 degs. temperature.

Holland Submarine Boats for England.

A cable dispatch from London, of March 13, says: The British naval estimates for 1901-02 amount of £30,875,500, an increase of over £2,000,000 compared with the previous year, chiefly for shipbuilding. There is an increase of 3745 in the number of officers and man. Under the heading of submarine boats the Admiralty report says: "Five of the type invented by Holland have been ordered, the first of which should be delivered next Autumn. What the future value of these boats may be in naval warfare can only be a matter of conjecture. Experiments with these boats will assist the Admiralty in assessing their true value. The question of their employment must be studied in all its developments, and their mechanism carefully watched in this country."

Now that the British Government has admitted that it is building Holland submarine boats, Vickers, Son & Maxim have given out facts about them. They will be 63 ft. 4 inches long, have 11 ft. 9 inches beam, and have a submerged displacement of 120 tons. The main engine, of the gasolene type, will be of 160 horse-power. The boats will carry enough fuel to enable them to run 400 knots. The maximum surface speed will be 9 knots. The main motor will be electric, giving a submerged speed of 7 knots. Means will be provided for expelling torpedoes under a variety of conditions. There will be a single torpedo expulsion tube in the bow of the vessel, which will be able to carry five torpedoes, each 11 ft. 8 inches long.

Elements of Illumination—XXII.

By Dr. Louis Bell.

STREET LIGHTING.

A SPECIAL and very important department of illumination has to do with streets and other outdoor spaces. It involves not a few unusual difficulties, for there is unlimited space to deal with and an indefinite variety of natural and artificial obstructions Save in narrow streets, bordered by high buildings, one gains little or nothing from the diffusion that is so important a factor in interior lighting, and in many instances the streets are so thickly shaded by trees that the problem of adequate lighting is very difficult. Light above the horizontal plane is of comparatively little value, while the ground should receive a strong and even illumination. In the comparative freedom from reflecting and diffusing surfaces there is, however, one small gain, for this is the case in which the law of inverse squares holds good. Of course, there is some diffusion from the street—when the ground is snow covered, a considerable amount —but, broadly, one can compute the illumination with fair accuracy.

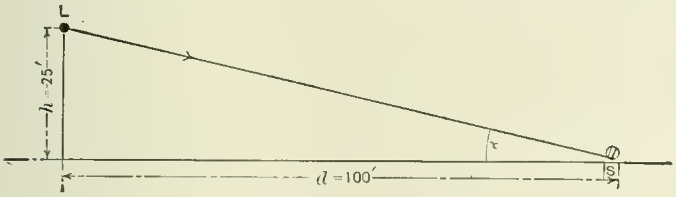


FIG. 1.—COMPUTING ILLUMINATION.

In computing the illumination, however, two radically different methods have come into use. In one of these the radiant in street lighting is supposed to illuminate a geometrical plane of which each element receives illumination depending not only on its distance from the radiant but on the obliquity of the rays which strike it. The other method assumes that in reckoning the illumination at any point the element of surface to be considered is not in the plane of the ground, but in a plane perpendicular to the direction of the ray. The first method would determine the legibility of a bit of newspaper lying flat on the pavement, the second method the visibility of a stone projecting above it. The distinction might at first appear like that between tweedle-dum and tweedle-dee, but in fact it makes an absurdly great difference in the theoretical illumination. Fig. 1 shows the conditions which arise in the two cases. Assume a light L of 1000 uniform spherical candle-power at the top of a pole 25 ft. high and then calculate the illumination at the spots, 100 ft. from the foot of the pole, by the law of inverse squares on the two hypotheses. In the first place, taking account of the obliquity, calling the illumination l, we have

$$l = \frac{L \sin a}{h^2 + d^2} = 0.023 \text{ candle feet;}$$

But considering s as on a projecting cobblestone at the same point,

$$l = \frac{L}{h^2 + d^2} = 0.094 \text{ candle feet.}$$

And the worst of the discrepancy is that it is greatest at considerable distances from the radiant where the light is feeble at best. Now in point of fact, the object of lighting streets is neither to enable one to read a page laid flat on the pavement, nor to observe a surface perpendicular to the ray. But the intensity and distance of the radiants is determined by the minimum illumination allowable midway between lights, and not by the brightness of the regions near the poles, and in these comparatively dimly lighted spaces the things which must be observed and for which the users of streets keep their eyes open are things not in the plane of the pavement, but above it. For observing these the obliquity of the light as regards the pavement does not matter; in fact, at equal intensities oblique light gives stronger contrasts than perpendicular light. Under these circumstances, however, one is justified in reckoning the illumination received from one direction only. A printed page laid on the pavement at the point s receives useful light from both the adjacent radiants, and so, if s is half way between two lamp-posts it will receive really on the first hypothesis 0.046 candle-foot. But a projecting stone or the face of a wayfarer is illuminated so far as a given viewpoint is concerned by only one of the adjacent radiants.

For these reasons, in the ensuing discussion, the illumination at a point s will be assumed to be that which falls on either hemisphere, let us say of a billiard ball at s. It will then be reckoned by the second formula,

$$l = \frac{L}{h^2 + d^2}$$

but only one radiant, or the radiants on one side only will be considered as useful.

It must not be understood from the preceding statement as to the importance of the minimum illumination that the lighting of a street should be specified in terms of this minimum only. For such a proceeding leads at once to a *reductio ad absurdum*. And this is particularly the case if the illumination on the plane of the pavement is considered. For assuming a sidewalk lighted by common candles placed 6 ft. apart and 6 ft. high, and reckoning only the first four candles on each side of a point on the pavement, the illumination based on the formula

$$l = \frac{L \sin a}{h^2 + d^2}$$

amounts to no less than 0.052 candle-foot as against 0.046 candle-foot apart. In other words, the street on this hypothesis would be better lighted by the candles giving less than $\frac{1}{60}$ the actual amount of light. A very slight effort of the imagination will picture the really vivid contrast between the two procedures.

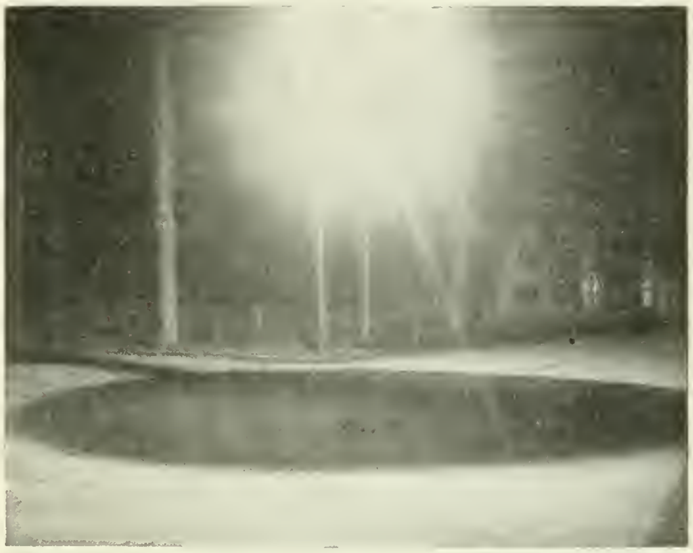


FIG. 2.—DISTRIBUTION OF LIGHT ON HORIZONTAL PLANE.

In determining the conditions with reference to the minimum illumination therefore, one must also take into account the real amount of light furnished the street as a whole. We do not judge the lighting of a street by the darkest spots so much as by the general effect. A large number of small lights give an impression of dinginess unless the aggregate candle-power be large. A few large lights, on the other hand, give in places a brilliant effect, although the minimum illumination may be rather small.

If artificial illuminants gave a spherical distribution of light the computation of street lighting would be easy, but as has already been seen, they do not. What is worse, the nominal brilliancy is generally not found in practice.

For years open arc lamps have been classified as 2000 cp or "full arc," and as 1200 cp, or half-arc lamps, but these alleged candle-powers are never obtained even in the direction of maximum illumination. The former are lamps taking about 9.5 to 10 amperes, and 450 to 480 watts, the latter are lamps taking 6.5 to 7 amperes and 325 to 350 watts. Their actual maximum luminosities are, respectively, about 1200 cp and 700 cp, located at about 45 degs. below the horizontal plane. Reduced to mean spherical measure their ordinary intensities are about 450 cp and 250 cp, respectively. In the horizontal plane these intensities fall to about 350 cp and 200 cp.

The result of this distribution is a zone of very brilliant light in a circle having its radius equal to about the height of the light, comparatively weak light within it, and rather feeble light at greater distances when the rays are more nearly horizontal. Fig. 2 shows this illuminated ring with startling distinctness. The dark area within is exaggerated by the effect of a dirty globe, the globes on open arc lamps being accessible to dust and hence difficult to keep clean. More conspicuous even than the dark space is the narrowness of the area of brilliant illumination, and the rapid fading away into darkness of such details as the picket fence merely across the sidewalk from the pole by which is carried the mast-arm for the arc lamp. This was a so-called 2000-cp arc, not kept in the best order, to be sure, but still no worse than can easily be found in any town where there are many open arc lamps.

Obviously one cannot compute the illumination from such a lamp on the theory that the distribution is even approximately spherical. In order to calculate the effect it is necesary instead of assuming L in our formulæ to be constant to treat it as a variable and use its real value at each angle below the horizontal in computing the illuminating effect at various points. In other words, the illumination at distant points must be made with reference to the distribution curve of the lamps.

Fig. 3 gives a set of distribution curves for the forms of arc lamps in common use.

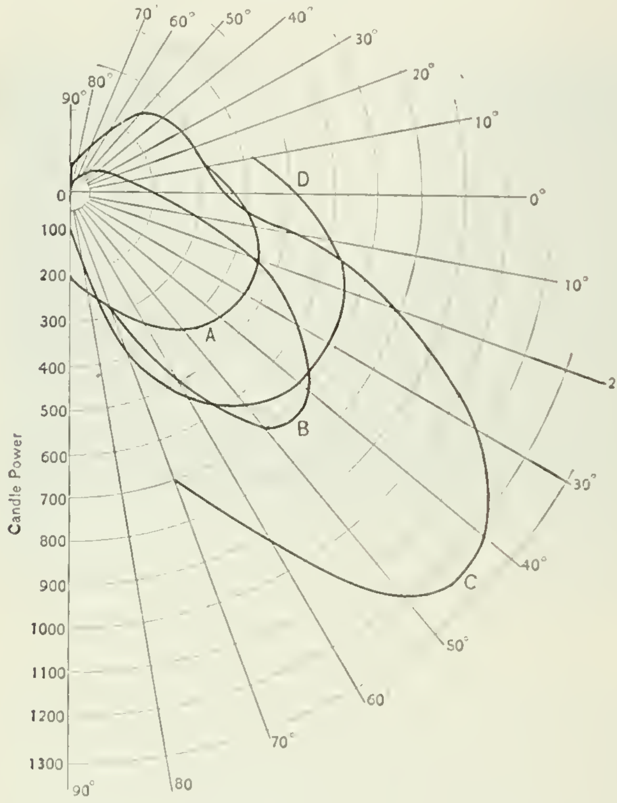


FIG. 3.—DISTRIBUTION CURVES OF ARC LAMPS.

Curve A is from a series alternating-current enclosed-arc lamp taking 425 watts with a current value of 6.6 amperes. It was with the usual opalescent inner globe and a clear outer globe and was used with a solid upper and cored lower carbon.

Curve B is from the ordinary open continuous-current arc, taking 330 watts at 6.6 amperes, and including the usual clear glass globe. This is the arc nominally rated at 1200 cp.

Curve C is from the 9.6-ampere 480-watt arc usually classed as 2000 cp. Like the preceding, it is a continuous-current arc with clear glass globe.

Curve D is from a continuous-current series arc lamp taking 6.6 amperes and 480 watts. It was provided with an opalescent inner and a clear outer globe, and was worked with both carbons solid.

Lamps A and D were provided with reflecting shades to turn outwards and downwards the light ordinarily thrown upwards. Lamps B and C could not be thus treated for the reason that so little light is thrown above the horizontal that a reflector is practically useless.

All these curves are from tests made on commercial arc lamps of recent manufacture at the same period and by the same experimenters in the laboratory of one of the large electrical companies, which manufactures lamps of each of these types. As the tests were at the time made not for publication, but for the private use of the company's engineers, and under uniform conditions, the author believes them to be more reliable, particularly as regards the comparative results from the several lamps, than even the average of tests made by different observers on lamps under diverse conditions. Such curves are of necessity only approximate because of the variations due to differing adjustments and to the peculiarities of different lamps.

Now looking at curve C, for example, we may repeat the computation made with respect to Fig. 1, using the real value of the candle-power instead of the assumed value.

Taking the arc as 25 ft. above the ground, and computing the illumination at 100 ft. from the pole, the required ray is depressed 14 degs. below the horizontal plane. The corresponding candle-power from curve C is about 620, so that putting this value for L

$$l = \frac{L}{h^2 + d^2} = 0.058 \text{ candle foot,}$$

instead of 0.094 candle-foot as in the previous example. If we take $d = 150$ ft. the result is still more unsatisfactory, for $l = 0.0433$, with the assumed 1000 cp, but since in this case $a = 9$ degs. 30 min., L is really only 490, whence $l = 0.0168$ candle-foot. It, therefore, becomes evident that with the distribution curve of C it is very easy to get good illumination not far from the lamp, but that at distances from the lamp of 4 or 5 times the height of the lamp the illumination is very deficient. A glance at curve B shows a distribution curve of very similar shape, and, in fact, all open arcs have the common weakness of giving more light than is necessary near the pole and too little far away from it. The distribution would be much improved if the curve could be swung upward about 20 degs. toward the horizontal. If there were any convenient way of getting a distribution that would give uniform illumination up to a reasonable distance it would be extremely useful. The polar equation to such a distribution curve would be

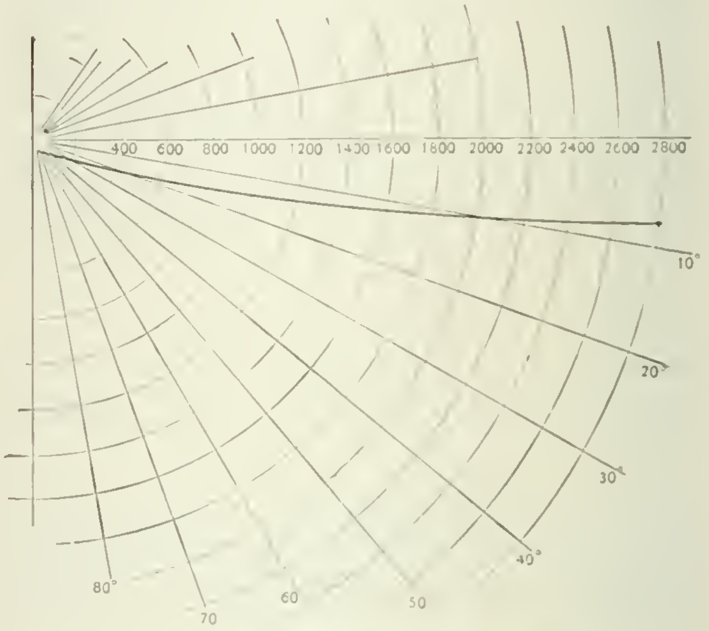


FIG. 4.—CURVE OF UNIFORM ILLUMINATION.

$$L = \frac{l\,h^2}{\sin^2 a}$$

Fig 4 shows this curve plotted for $L = 25$ and $l = 0.1$ candle-foot. The theoretical curve obviously becomes asymtotic, which no real curve could ever do, but it is not outside the bounds of possibility to construct a reflecting and refracting system after the pattern of the holophane globe, which should send out at angles not far from the horizontal most of the light which is now wasted in needlessly brilliant illumination near the light. Unhappily the arc slowly changes place in common lamps as the carbons are consumed, so as to interfere with the use of such a device. But it would be quite feasible with a focussing lamp, or with Nernst or similar lamps, although globes of the kind in question are not easy to keep clean, and would have to be kept dust-tight to obtain the best results.

Now, when we remember that the curves of Fig. 3 represent the lamps in their respective best working conditions, and not when the globes are ill-cared for or the arc abnormal in length and position, it becomes evident that if any attention is to be paid to minimum illumination even the most powerful commercial arcs cannot be very widely spaced. At 400 ft. spacing the point midway receives from an ordinary 2000-cp arc 25 ft. high just about 0.01 candle-foot, which, for practical purposes, is no light at all. Only by raising the lamp high enough to take advantage of the light at angles further from the horizontal, can adequate light at such a distance be obtained, and this is an impracticable expedient on account of the cost and trouble and the interference of trees and other obstacles. For with such arcs the maximum illumination is obtained when the height of the lamp is about 0.7 the distance to the point to be lighted. The tower system of lighting used extensively in this country, 15 years ago, but now practically abandoned, was the result of this consideration.

The important thing to be decided as a basis for all computations on street illumination is the amount of light required. There is little general agreement on this important matter. We may get an idea of the magnitude to be employed by remembering that moonlight in the latitude of the Northern States is generally from 0.01 to 0.03 candle-foot. This intensity is of some service at the maximum limit, but of little use at the minimum. When anything like complete illumination is to be furnished the minimum should not be less than 0.03 candle-foot. With this minimum derived from arc lamps the street, as a whole, will be brilliantly lighted. Under ordinary cirmustances only principal streets would be lighted to this extent, and elsewhere the minimum might fall somewhat lower.

The Long Distance Telegraph and Telephone Systems of Pupin, Thompson and Reed—II.

BY E. F. ROEBER, PH.D.

V. THE THOMPSON SYSTEM.

A LONG, uniform wire forms a loop *A B*. The whole length is $2\,l$, the distance between the transmitting end *A* and the receiving end *B* is therefore *l*. *R*, *L*, and *C*, represent the resistance, inductance and capacity, respectively, per unit length of the uniform wire (in ohms per mile, henrys per mile, and farads per mile, respectively).

At equal distances, as shown in Fig. 5, *k* equal coils *l*, 2 . . *k*, each of the resistance R_0 (in ohms) and inductance L_0 (in henrys) are bridged across the line, so that the whole loop is divided into $2\,k$ equal parts, each of the length l/k. For abbreviation we will write $z_0 = R_0 + ip\,L_0$, $z = R + ip\,L$. At the transmitting end *A* an electromotive force of the type $E\,e^{ipt}$ is impresssed upon the line.

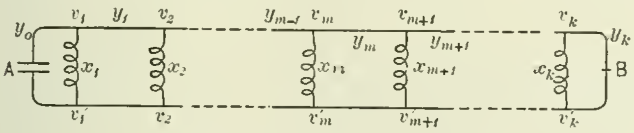


FIG. 5.—THOMPSON SYSTEM.

Let y_m be the current at any point between the coils *m* and $m+1$. Denote the distance of this point from coil *m* by ξ. The differential equation for the current y_m at any point is the same as equation (1), namely:

$$L\,\frac{d^2 y_m}{d\,t^2} + R\,\frac{d\,y_m}{d\,t} = \frac{1}{C}\,\frac{\delta^2 y_m}{\delta\,\xi^2} \qquad (6)$$

The general integral of this equation is obtained from (2)

$$y_m = K_1 \cos M\,\xi + K_2 \sin M\,\xi \qquad (7)$$

where $M^2 = -C\,(-p^2\,L + i\,p\,R)$.

If $M = \alpha + i\,\beta$, we have

$$\alpha = \sqrt{\frac{1}{2}\,p\,C\left[\sqrt{p^2\,L^2 + R^2} + p\,L\right]} \qquad (8)$$

$$\beta = \sqrt{\frac{1}{2}\,p\,C\left[\sqrt{p^2\,L^2 + R^2} - p\,L\right]}$$

The integral (7) has to fulfill *k* boundary equations, which are easily obtained from Kirchhoff's rule, applied at each point where a bridge is branched off from the uniform line. Let $x_1, x_2, \ldots x_k$ be the currents in the coils 1, 2, . . *k*, respectively. Then the *k* boundary equations[1] are:

$$x_1 = (y'_0)_{\xi = \frac{l}{2\,k}} - (y'_1)_{\xi = 0}$$

$$x_m = (y'_{m-1})_{\xi = \frac{l}{k}} - (y'_m)_{\xi = 0} \qquad (9)$$

where $m = 2 \ldots k$.

The problem is to formulate these *k* boundary equations so that they may be easily solved. This may be done by expressing the currents x_m and y_m as functions of the potential v_m at one end of the coil *m*.

The potential at one end of the coils 1, 2 . . . *k*, (on one side of the loop) may be represented by $v_1, v_2 \,.\,.\, v_k$ respectively, that on the other end (on the other side of the loop), $v_1^1, v_2^1 \,.\,.\, v^1_k$ respectively. On account of symmetry $v_1 = -v_1^1$.

$$v_k = -v_k^1$$

The electromotive force, impressed upon the line at point *A* is $E\,e^{ipt}$. Therefore, on account of symmetry and as the impedance of the transmitting apparatus is supposed to be zero, that terminal of the transmitting apparatus, which is nearest to the point v_1, has the potential $\frac{1}{2}\,E\,e^{ipt}$.

Let V_m be the potential at any point between coils *m* and $m+1$. V_m is of the form

$$V_m = N_1 \cos M\,\xi + N_2 \sin M\,\xi \qquad (10)$$

The potential is a continuous function all along the line (except at point *A*), i. e.,

$$(V_m)_{\xi = \frac{l}{k}} = v_m = \left(V_{m+1}\right)_{\xi = 0}$$

We now have for $m = 1, 2 \,.\,.\, k$.

$$v_m - v_m^1 = R_0\,x_m + L_0\,\frac{d\,x\,m}{d\,t}$$

or, as x_m is of the type $A\,e^{ipt}$, therefore $\frac{d\,x\,m}{d\,t}$ of the type $ip\,A\,e^{ipt}$, we have

$$x_m = \frac{2\,v_m}{R_0 + i\,p\,L_0} = \frac{2\,v_m}{z_0} \qquad (11)$$

where $m = 1 \,.\,.\, k$. This set of equations represents the currents $x_1 \,.\, x_k$, as functions of the potentials $v_1 \,.\,.\, v_k$. To represent also the currents $y_1 \,.\,.\, y_k$ as functions of $v_1 \,.\,.\, v_k$, we must compare the equations (7) and (10) and consider that

$$C\,\frac{d\,V_m}{d\,t} = -\,\frac{\delta\,y_m}{\delta\,\xi}\,.$$

From this we get

$$\frac{d\,N_1}{d\,t} = -\,\frac{M}{C}\,K_2$$

$$\frac{d\,N_2}{d\,t} = \frac{M}{C}\,K_1$$

From equation (10) follows for $\xi = 0$ and $\xi = \frac{l}{k}$

$$v_m = N_1$$

$$v_{m+1} = N_1 \cos \frac{M\,l}{k} + N_2 \sin \frac{M\,l}{k}$$

so that we get

$$K_1 = \frac{i\,p\,C}{M \sin \frac{M\,l}{k}}\left(v_{m+1} - v_m \cos \frac{M\,l}{k}\right)$$

$$K_2 = -\,\frac{i\,p\,C}{M}\,v_m$$

and equation (7) becomes

$$v_m = \frac{i\,p\,C}{M \sin \frac{M\,l}{k}}\left\{v_{m+1} \cos M\,\xi - v_m \cos M\left(\frac{l}{k} - \xi\right)\right\} \ldots (12\,a)$$

This equation, however, is correct only for $m = 1 \,.\,.\, k-1$, as appears from the way it has been deduced. For y_0 and y_k we have to develop separate formulas. If the impedance of the transmitting apparatus is zero, we have

$$y_0 = \frac{i\,p\,C}{M \sin \frac{M\,l}{2\,k}}\left\{v_1 \cos M\,\xi - \frac{1}{2}\,E\,e^{ipt} \cos M\left(\frac{l}{2\,k} - \xi\right)\right\} \quad (12\,b)$$

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[1] The reason why the equation for x_1 differs slightly from those for $x_2 \,.\,.\, x_k$ is that the transmitting apparatus is assumed to be in the middle of the uniform wire containing the point *A*. In this case ξ is measured from the point *A* so that the first point where a bridge branches off, corresponds to $\xi = \frac{l}{2\,k}$.

For y_k we get

$${}_k = -\frac{i\,p\,C\cos M\left(\frac{l}{2\,k} - \xi\right)}{M\sin\frac{M\,l}{2\,k}}\;v_k$$

Now we are ready to write the boundary equations so that the k values $v_1, v_2 \ldots v_k$ can be determined. Put the values of x_m and y_m from (11) and (12) into (9). Introduce the following abbreviation:

$$\sigma = -\frac{2\,M\sin\frac{M\,l}{k}}{i\,p\,C\,z_0} - 4\sin^2\frac{M\,l}{2\,k} \tag{13}$$

or,

$$\sigma + 2 = -\frac{2\,M\sin\frac{M\,l}{k}}{i\,p\,C\,z_0} + 2\cos\frac{M\,l}{k}$$

Then the set of boundary equations (9) assumes the following simple form:

$$\left.\begin{array}{l}
(\sigma + 3)\,v_1 - v_2 = E\,e^{ipt}\cos\frac{M\,l}{2\,k} \\
(\sigma + 2)\,v_2 - v_1 - v_3 = 0. \\
\ldots\ldots\ldots\ldots\ldots\ldots \\
(\sigma + 2)\,v_m - v_{m-1} - v_{m+1} = 0. \\
\ldots\ldots\ldots\ldots\ldots\ldots \\
(\sigma + 2)\,v_{k-1} - v_{k-2} - v_k = 0. \\
(\sigma + 3)\,v_k - v_{k-1} = 0.
\end{array}\right\} \tag{14}$$

This set of equations is of the same form and can be treated in the same way as the equations (6) in Section II. of Pupin's 1900 paper, if

$h_0 = h_1 = 2.$

$h = \sigma = -4\sin^2\Theta$

$D_0 = E\,e^{ipt}\cos\frac{M\,l}{2\,k}$

$n = k.$

$x_1, x_2, \ldots x_n = v_1, v_2, \ldots v_n$ respectively.

Hence the solution (7) in Pupin's paper is also a solution of our equations. We get, therefore, as solution for v_m the following equation:

$$v_m = \frac{1}{2}\cos\frac{M\,l}{2\,k}\,E\,e^{ipt}\,\frac{\sin(2\,k - 2\,m + 1)\,\Theta}{\sin 2\,k\,\Theta\cos\Theta} \tag{15}$$

This equation in combination with the equations (11) and (12) represents the solution of the problem of wave propagation over a loaded conductor of the Thompson type. Θ and $M\,l$ are complex angles, and the further calculation would consist in separating the real and the imaginary parts of the complex quantities. This is, however, not only extremely tedious, but also unnecessary for the principal purpose of this paper.

VI. *Equivalence of a Loaded Conductor of the Thompson Type to a Corresponding Uniform Conductor.*

The principal purpose for which the formulas in the last section have been developed, is to find an answer to the question: How must the shunt coils in a loaded conductor of the Thompson type be arranged to be beneficial?

For the same purpose Dr. Pupin compares his type of loaded conductor, containing inductance coils, inserted in series along the line, with a "corresponding uniform conductor," having the same total resistance and inductance. He determines the relation between the distance of two consecutive inductance coils and the wave length of the transmitted wave, which must be fulfilled, if the formulas for the current shall be the same in both conductors. If this solution, which was stated in Section IV., is fulfilled, the non-uniform conductor is "equivalent" to its corresponding uniform conductor. In other words, Dr. Pupin shows that if his loaded conductor were replaced by a uniform conductor of the same total resistance and inductance as the loaded conductor (therefore having a higher inductance than the original uniform and unloaded conductor), the equations would not be changed. That is, inductance coils placed in series at equal intervals along the line according to Pupin's rule, have the same effect as a uniform increase of the inductance along the line; and as the latter arrangement would diminish attenuation and distortion, the loaded conductor of the Pupin type does the same.

In considering the loaded conductor of the Thompson type from an analogous point of view, we meet at once a difficulty. If we want to compare a loaded conductor of the Thompson type with a "corresponding uniform conductor," we must first define this "corresponding uniform conductor." In the case of a Pupin conductor the definition is self-evident. This is not the case in the Thompson conductor. This difficulty can, however, be overcome and a successful definition of the uniform conductor which corresponds to a loaded conductor of the Thompson type, can be obtained direct from our equations in the following way, which is similar to that of Dr. Pupin:

Let us consider (13), by which Θ is determined

$$\sigma = -4\sin^2\Theta = -\frac{2\,M\sin\frac{M\,l}{k}}{i\,p\,C\,z_0} - 4\sin^2\frac{M\,l}{2\,k}$$

If $M = \alpha + i\,\beta$, where $\alpha > \beta$, the wave length on the unloaded uniform wire is $\lambda = \frac{2\,\pi}{\alpha}$ and the angular distance ω between two consecutive coils for the wave length λ is

$$\omega = \frac{l}{k}\,\frac{2\,\pi}{\lambda} = \frac{l}{k}\,\alpha.$$

If now $\sin\omega$ nearly $= \omega$, the above equation becomes

$$-4\sin^2\Theta = -\frac{l^2\,M^2}{k^2}\left(1 + \frac{2}{i\,p\,C\,z_0}\,\frac{k}{l}\right) = -\frac{l^2\,M_1^2}{k^2}$$

where the abbreviation

$$M_1^2 = M^2\left(1 + \frac{2}{i\,p\,C\,z_0}\,\frac{k}{l}\right)$$

is introduced.. We get

$$\sin\Theta = \frac{1}{2}\,\frac{l}{k}\,M_1$$

M_1 is not simply an abbreviation, but has a certain physical meaning, which is of importance for our case, and which will be brought out now. If we introduce into the equation for M_1^2 the values of M^2 and z_0 we get $-M_1^2 = C\,(-p^2\,L_1 + i\,p\,R_1)$, in which

$$L_1 = L - \frac{2\,k}{p^2\,C\,l}\,\frac{p^2\,L_0\,L + R_0\,R}{p^2\,L_0^2 + R_0^2} \tag{16}$$

$$R_1 = R - \frac{2\,k}{C\,l}\,\frac{L_0\,R - L\,R_0}{p^2\,L_0^2 + R_0^2} \tag{17}$$

We can now imagine an ideal uniform line, the inductance and resistance per unit of length of which are given by the equations (16) and (17). This line we will call the "corresponding uniform line." I will prove the justication of this name by showing that the loaded conductor of the Thompson type is really equivalent to a uniform line, characterized by the constants L_1 and R_1.

If $M_1 = \alpha_1 + i\,\beta_1$ we have

$$\alpha_1 = \frac{2\,\pi}{\lambda_1}$$

where λ_1 is the wave length for the frequency $\frac{p}{2\,\pi}$ in the corresponding uniform conductor, which we have just defined. If the angular distance λ_1 is $2\,\pi$, then the angular distance between two consecutive coils is $\omega_1 = \frac{l}{k}\,\frac{2\,\pi}{\lambda_1} = \frac{l}{k}\,\alpha_1$.

If we assume that $\frac{1}{2}\,\omega_1$ is so small that $\sin\frac{1}{2}\,\omega_1 = \frac{1}{2}\omega_1$ nearly, and $\frac{l}{2\,k}\,\beta_1$ so small that $e^{\frac{l}{2\,k}\beta_1} = 1 + \frac{l}{2\,k}\,\beta_1$, we get

$$\Theta = \frac{1}{2}\,\frac{l}{k}\,M_1$$

and our equation (15) for a loaded conductor of the Thompson type becomes identical with the analogous equation for our corresponding uniform wire, which can be easily deduced from the equations in Section III., by making $M = M_1$ and $\xi = \frac{l}{2\,k}\,(2k - 2m + 1)$

$$v_m = \frac{1}{2}\,E\,e^{ipt}\,\frac{\sin\frac{M_1\,l}{2\,k}\,(2\,k - 2m + 1)}{\sin M_1\,l}$$

In the above proof of this equivalence we have made two assumptions, corresponding to two cases, either of which may occur. When $a_1 > \beta_1$, $sin \frac{1}{2} \omega_1 = \frac{1}{2} \omega_1$ must be fulfilled, and, as a consequence of this, $e^{\frac{l}{2k}\beta_1} = 1 + \frac{l}{2k}\beta_1$ nearly. When $a_1 < \beta_1$. $e^{\frac{l}{2k}\beta_1} = 1 + \frac{l}{2k}\beta_1$ must be fulfilled, and as a consequence of this, $sin \frac{1}{2} \omega_1 = \frac{1}{2} \omega_1$ nearly.[1]

The first of these equations can be stated in this form: The loaded conductor of the Thompson type is equivalent to the corresponding uniform conductor, characterized by the equations (16) and (17), as long as the sine of half of the angular distance between two consecutive shunt coils is approximately equal to half the angular distance itself. This is, verbatim, the same rule as Pupin's for a loaded conductor of the Pupin type; but it must be carefully kept in mind that there is an essential difference between the two cases, as the "corresponding uniform conductor" is defined in an essentially different way in both cases.

Another important difference will be brought out presently. In the case of a loaded conductor of the Pupin type the "coresponding uniform conductor" has necessarily a greater resistance and a greater inductance per unit length of line than the unloaded conductor before the introduction of the coils. Increased inductance per unit length is an advantage, and is the essential purpose of the whole arrangement. Increased resistance per unit length is a disadvantage, which cannot be avoided. It is therefore the problem of the designer of a line of the Pupin type, in increasing the inductance of the line, not to increase the resistance any more than necessary, some increase in resistance being unavoidable.

In the case of a loaded conductor of the Thompson type, we see from equation (16) the inductance per unit length of the corresponding uniform conductor is necessarily smaller than the inductance per unit of length of the original unloaded conductor. This is a disadvantage of the arrangement. But an advantage may be obtained by this arrangement, which can be deduced from equation (17), viz., by proper design the resistance per unit cf length of the corresponding uniform conductor may be made smaller than the original unloaded conductor; and this decrease of resistance of the corresponding uniform conductor is as great an advantage for wave transmission as the increase of inductance in the Pupin conductor. We have in this case the important rule, which follows directly from equation (17), that is, if the Thompson arrangement shall improve wave transmission, R_1 must be necessarily smaller than R_1, i. e.,

$$\frac{L}{R} < \frac{L_0}{R_0} \tag{18}$$

The greater the difference between the two ratios the smaller becomes the resistance per unit of length of the corrsponding uniform conductor.

That the condition (18) may easily be fulfilled is at once evident. The ratio L/R is always very small in practice (this is just the disadvantage of ordinary uniform long-distance lines). It is, therefore, an easy matter to construct coils with the inductance L_6 and the resistance R_0 so that the condition (18) is fulfilled. The way in which the designer has to proceed is as follows: A certain value of β_1 is assumed as a basis of the calculation, say, .015 (in miles^{-1}) (as in Pupin's 1900 paper, Part I.). In this case, if the transmission line has a length of 250 miles, 2½ per cent of the current leaving the transmitting end will reach the receiving end. Now we have:

$$\beta = \sqrt{\frac{1}{2}\, p\, C \left[\sqrt{p^2 L^2 + R^2} - p L\right]}$$

p, C, β are known. We find from this equation, therefore, a certain value for $\sqrt{p^2 L^2 + R^2} - p L$.

where L and R are the inductance and resistance per unit length of the corresponding uniform conductor. The expression

$$\sqrt{p^2 L^2 + R^2} - p L = p L \left[\sqrt{1 + \frac{R^2}{p^2 L^2}} - 1\right] \tag{20}$$

must be smaller with the values of R and L of the "corresponding uniform conductor" than the same expression for R and L representing the corresponding quantities in the original unloaded conductor. This is what is wanted. How it is accomplished shows clearly the difference between the Pupin system and the Thompson system. In the Pupin system both L and R are increased; in the Thompson system both L and R are diminished. In both cases the effect must be that the expression (20) is diminished in comparison with the original unloaded line. I have therefore proved that a loaded conductor of the Thompson type behaves to a certain extent, like a loaded conductor of the Pupin type. There are, of course, essential differences between the two systems, but by proper designs either system may be used to great advantage for long distance telegraphy and telephony.

In the next article I will give the mathematical theory of the Reed system, and will first prove that this system may be regarded mathematically as a general system, comprising the Pupin system and the Thompson system as special cases.

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[*] The reason why we have here two conditions is that β_1 may become greater than a_1, because L_1 may become negative, as will be seen from (16.) This is always tbe case, when L, *i. e.*, the inductance per unit length of the original unloaded uniform conductor is O. With the Pupin arrangement a_1 is always greater than β_1.

Canadian Electrical Enterprise in the West Indies.

By A. V. WADE.

The large investments of Canadian capitalists in electric street railway and electric lighting enterprises in the West Indies are attracting considerable attention in Canada and the United States. In addition to the enormous undertaking of the Cuba Company, of which Sir William Van Horne is president, and which has many wealthy Canadian shareholders, companies composed entirely of the moneyed men of the Dominion have installed electric tramway and lighting plants in the capital cities of several of the British Crown colonies of the West Indies. The story of the opening up of these islands as a field for electrical enterprise is a recent and interesting one.

In 1890, Kingston, the chief city of Jamaica, possessed a street railway consisting of some 12 miles of mule tramway. An option for the purchase of this franchise was obtained, and what was practically a perpetual charter was subsequently secured from the Colonial Government, to establish an electric railway and lighing system commensurate with the needs of the city. A company was formed in Montreal, Quebec, and it was decided, in view of the great cost of coal in Kingston, and of the fact that there was a splendid water power available on the Rio Cobre River, about 25 miles from the city, to put in a hydraulic plant and transmit the electric power at a high voltage to the city. The first difficulty met with in carrying out this project was that in building the dam to get a head of water necessary for the power house, it would flood the surrounding districts. The Stilwell-Bierce & Smith-Vaile Company, of Ohio, undertook to overcome this difficulty by building a steel pipe, a mile and a quarter long, on the side of the river bed, thus giving the required 60 ft head of water at the place where the power house was erected, without making it necessary to build a dam more than sufficient to divert the river into the pipe. The power house was built at the end of this pipe, which is 8 ft. in diameter, and is equipped with three turbine wheels with General Electric generators direct connected.

From the power house there is a double transmission line, on steel poles, following the main road into the city. The power is transmitted at from 15,000 to 16,000 volts to the transformers in the city, where it is stepped down to 550 volts to operate the street railway. The company has already laid 24 miles of track with 90-lb. steel rails and steel ties. No wood is used above or below ground. The ties are embedded in concrete, and all the poles are of steel also, a necessary provision against the ravages of ants and other insects. The road was completed about a year ago at a total cost of over $1,000,000.

A Canadian company, at whose head is Sir William Van Horne, is also operating in Demerara, one of the three provinces of British Guiana. A charter was secured to install an electric tramway and lighting plant in the city of Georgetown, and a well-built street railway, covering the entire city and its chief suburbs, was completed a little over a year ago. When everything was ready to open the line a serious difficulty arose. The Government owns the telephone and telegraph systems, and there was a fear lest the heavy electric current passing over the wires would burn out the telephone system, which had no metallic return circuit. There was a delay of a year, when, on the 18th of February last the difficulty was overcome. The total expenditure made by the Canadian company on this enterprise is in the neighborhood of $1,000,000.

After the Demerara franchise had been obtained, attention was turned to the Island of Trinidad, which is probably the richest of the British possessions in the West Indies. A charter covering the city of Port of Spain and three populous suburbs has just been granted Canadian promoters, and a company is to be formed in Montreal at an early date to operate an electric tramway and lighting plant there at an estimated cost of $1,000,000. But perhaps the largest and most extensive enterprise undertaken in the West Indies is that of the Cuba Company, of which Sir William Van Horne is president. The company is composed of Canadian and United States capitalists, principally the latter. The scope of its undertakings include a trunk steam railway of some 500 miles.

Illuminating the Falls of Niagara.

By Orrin E. Dunlap.

If present plans are carried out, the Falls of Niagara will be illuminated by searchlights during the coming summer. For several years the Michigan Central Railroad has contemplated the illumination of the cataract, but never until very recently have definite steps been taken with that end in view. On March 12, General Passenger Agent W. O. Ruggles of Chicago, General Eastern Passenger Agent W. H. Underwood of Buffalo, Superintendent J. B. Morford, Superintendent Thomas, Frank J. Bramhall and others gathered at the Falls to witness tests of the illumination of the falls in order to determine the merit of such a spectacle.

The searchlight used was installed in a car, together with a generator and a small engine. This engine was connected to the locomotive in order to get a steam supply. When night had settled the locomotive drew the car and party to Falls View station on the Canadian side. This station is located on the bluff to the rear and above the Horseshoe. The apparatus worked satisfactorily. The projector was of the 30-in. type. It is possible that a 36-in. projector will be used in order that the full crest of the Horseshoe may be covered by the light beam at the same time.

According to present plans the exhibition will be conducted on the Canadian side, possibly at Falls View Station, or from some suitable point on the bluff in the rear of Victoria Park. When operated on the Canadian side the searchlight can be directed upon all parts of the falls with magnificent effect, and there is every reason to believe that it will form a thoroughly attractive feature of a visit to Niagara.

It is this early apparent that visitors to the Pan-American Exposition and Niagara Falls during the coming summer will see what will probably be the most brilliant display of searchlights ever seen in this country, and covering a wide extent of territory. The illumination of the Whirlpool Rapids will be continued, it is understood, and this was more successful last season than ever before.

A 30-in. projector is to be placed upon the observation tower on the Riverway, Niagara Falls, and this will serve to exchange signals with the projectors of the electric tower on the Pan-American Exposition grounds, 22 miles distant. All of the tower searchlights will be at a height of over 300 ft., and from this elevation the beam will be thrown from 50 to 75 miles about the surrounding country.

Copper Conductivity Tests.*

Owing to the great growth of the industries handling copper, and the higher grade of specifications for the metal, there grew up a demand for a standard conductivity bridge specially adapted to wire testing. As the result of long experience, Mr. Heath said he considers the following to be requisites for a test which is adapted to commercial work, and is yet accurate:

First. Extra and variable factors, such as all resistances of plugs, contacts and connecting wires, must be neutralized, or eliminated, so as to have no effect upon the observed resistance (or fall in potential) in the sample under test, at ordinary working temperatures.

Second. The method must be rapid enough for commercial use and yet accurate; the instrument not likely to get out of order, and most carefully checked against the Cavendish standards of England. A set of copper wires, whose resistance has been carefully determined against recognized standards should be provided by the maker of the bridge so that it may be checked from time to time and any alteration detected.

Third. The tests should be made on samples of wire not over one meter in length, so they may be laid out straight upon the instrument.

The preparation of long samples (7 to 10 meters) is too slow, and the temperature of the coil is necessarily different from the bridge. If very accurate results are occasionally required, and short pieces are being tested, several samples may be tried and the results averaged. It is a great advantage that short pieces (of less than one meter) may be placed upon the instrument and in ten minutes, or more, acquire its exact temperature. At least ten minutes is required after handling the wire with the bare hands. This is a point in manipulation that is sometimes overlooked and neglected by electricians doing this work. Even a foot or two, in distance from the observer's body (or in height on a table or shelf) will often times result in a difference of 2 or 3 degs. Fahrenheit, and every degree means a difference of over 0.2 per cent in conductivity.

Of the instruments employed in testing, one is the design of Prof. Puffer, of the Massachusetts Institute of Technology, Boston. Observed results are independent of the resistance of contacts and connectors, but a 20-ft. sample is tested, which makes the method rather too slow for rolling mills, and out of the question for most copper refineries.

Apparatus more adapted to mills and smelters is the bridge made by Siemens Bros., London, which is a modified form of Thomson's double bridge and is used by the Calumet & Hecla refineries and considerably in Europe. It is designed to get measurements of low resistances entirely independent of the resistance of the junctions between the wire to be measured and the knife-edge contacts. About 600 mm of copper wire are cut off for a test.

By allowing time for all samples to acquire the exact temperature of the bridge, using an accurate thermometer reading to 0.2 degs. F.; measuring length within 1-5 mm, and reading the resistance scale with a hand glass to 1-10 of marked divisions, check observations may be made within 1-10 of 1 per cent of each other. A possible objection to this instrument is that one has to depend on the carefulness with which the maker has tested the standard wire, of alloy, for every part of its entire length.

An instrument in more general use in America is the standard conductivity bridge made by Willyoung, Philadelphia, and used by the following American concerns, among others: Roebling's Sons Company, W. A. Clark Wire Company, Coe Brass Company, Bridgeport Brass Company, Michigan College of Mines, Pittsburg Reduction Company, Boston & Montana Copper Company, Seymour Manufacturing Company, Lake Superior Smelting Company, etc.

This test depends on the Carey-Foster method, the use of which eliminates errors due to contacts, etc., and measurements on samples of copper do not have to be corrected for temperature, since the standard wires in the machine are also of copper, and at the same temperature as the test, if enough time is allowed.

In spite of these and other comparatively accurate instruments in field, there is room for improvement somewhere, as different instruments, even from the same maker, when checked against the same samples of wire, do not always agree quite as closely as they should, or as they are claimed to do.

Notes on the Berliner Decision.

The following is reported as a telegram from Mr. J. I. Sabin, president of the Pacific States (Bell) Telephone Company, in regard to the Berliner decision: "My opinion is this will do us a great deal more good than harm, provided we all adopt a vigorous expansion policy. The Pacific Coast has to-day over 90,000 stations, a net gain of over 4000 since Jan. 1, including San Francisco, which has to-day 22,400, a net gain of over 1000 since Jan. 1. My experience leads me to an absolute conviction that the people must be reached without delay, if not by us, then by others. This decision will make us get out our deep soil plows and cultivate the telephone field as it should be, instead of scraping over the surface with the old harrow which answered the purpose ten years ago. I agree to have 30,000 subscribers in San Francisco at the end of this year and 40,000 at the end of next year; and further guarantee to destroy every dollar any opposition man wants to put into this field and this without reducing a single rate by reason of opposition. This business is an absolute monopoly; it remains to be seen whether the people want us or the other fellow."

The president of a large independent telephone company, located in the West, says that since the Berliner decision he has been able to sell bonds to the par value of $1,500,000 for construction purposes.

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* Extract from a paper read by George L. Heath before the Lake Superior Mining Institute.

Voting by Electricity.

Voting by push button is not a new idea. Edison's first invention patented was an electrical roll call for legislatures. It is proposed to place in the House of Representatives at Washington a device enabling Representatives to vote and have their votes recorded and counted and displayed by electricity. Every time a roll call is taken in the House it costs the people of the United States approximately $4,000 during a short session of Congress. The gross expense of maintaining the House of Representatives is about $5,000,000 per annum. Counting 100 days in a short session, the expense amounts to $30,000 a day of not more than five hours' length, or $6,000 an hour. The time consumed in a roll call is about 45 minutes. At the present time there are 357 members of the House. Under the new apportionment there will be 389 members. The method of roll call now in vogue is for the reading clerk to call the name of each member. At the conclusion of the call another call is made, and the names of those not responding the first time are called. During this proceeding there is confusion, so that the reading clerk is usually compelled to call each name twice, and time is lost in ascertaining whether the member has responded. The proposition of an electrically transmitted roll call originated in the mind of Representative Peter J. Otey, of Virginia. He was informally encouraged to investigate the project, it being understood that a favorable report would be followed by formal acceptance on the part of the House. The architect of the Capitol, under whose jurisdiction the proposed change would come, has reached the conclusion that the project is entirely feasible, and recommends its adoption. The architect suggests three distinct features: A visible record of the vote, a duplicate record which shall constantly be under the eye of the tally clerk, and a third record which shall be in the nature of a permanent or official record. The principal feature of the device will consist of a large board to be placed immediately above and back of the Speaker's desk, in plain view of every member. The board shall be divided into spaces so that each member shall have a space which shall bear his name and be permanently his. The name will be in black upon white porcelain glass. There would be two smaller spaces at the right of each name, one marked "aye" and one marked "nay." The tally clerk will have immediately under his eye, upon his desk, a board precisely similar to the large one, upon a scale of possibly one to five. Then, close at hand, within easy view the third or permanent official record shall be placed. This will be similar to the smaller record save that as each vote is recorded the device will punch a hole in a card in the space marked "aye" or "nay," as the case may be. It is also proposed that this last or official feature shall be provided with a mechanism for automatically counting the "ayes" and "nays" as they may be electrically sent in, so that when the last vote has been recorded the total will be immediately available for use of the Speaker in announcing the totals. The official sheet, which may also be in duplicate, may then be handed to the official reporters who place it in the proper channel leading to the Government Printing Office, where the following morning it will be inserted in the *Congressional Record.* It is proposed to place upon the desk of each member of the House a three-button panel, one marked "aye" and one "nay," and one "present, not voting."

Let it be supposed a roll call has been demanded. The officer in charge of the mechanism, presumably the tally clerk, throws in a switch which will complete half the electrical circuit, which includes the three divisions mentioned above. The same action illumines the board, or rather makes luminous the names thereon. A member desiring to vote may do so at any time within the prescribed limit, and instantly the vote will appear upon the board. In case he has voted "aye" a small red disk will appear at the right of his name. At the same time a miniature red disk will have lighted up the space on the small board under the eye of the tally clerk, and the punching device will have punched out the word "aye" opposite his name on the official or permanent sheet. In case he votes "nay" a green disk will appear on the boards and "nay" will be punched from the official sheet. In case he should be "paired" with some absent member, yet desires the record to show that he was in his seat, he will press the button marked "present, not voting," and this record will be made on all three boards, the signal in this case being white.

As a separate wire will run from each member's desk to the three boards, the vote of the entire House might be made instantaneously, provided each member pressed his button at the same moment. The device will not only save nine-tenths of the time now uselessly consumed, but it will make impossible the practice of filibustering, or killing time. Under the present system the minority may block legislation indefinitely and the majority seems powerless to prevent it. This is directly the result of the great length of time required to call the roll. Before the possibilities of parliamentary procedure are exhausted, a dozen roll calls may be demanded, and by this time the day has been consumed and nothing accomplished. Under the electrical voting system filibustering would cease, as the committee on rules could limit the time of voting to one minute if desired. It is estimated that the device at its installation would cost approximately $15,000. On the basis of a saving of $4,000 on each roll call, the new electrical device would pay for itself within two days. The new device may be in working order when the Fifty-seventh Congress convenes next December.

Slight Improvement in Telegraph Earnings.

The Western Union Telegraph Company reports as follows for the quarter ending March 31, the figures for the current year being partly estimated:

	1901 (Est.)	1900 (Act.)	Changes.
Net revenue.......	$1,500,000	$1,318,384	Inc. $181,616
Bond int.	239,040	*233,917	Inc. 5,123
Balance	$1,260,960	$1,084,467	Inc. $176,493
Dividend	1,217,000	1,216,996	Inc. 4
Surplus	$43,960	Def.$132,529	Inc. $176,489
From July 1 to March 31:			
Net revenues	$4,918,585	$4,564,437	Inc. $354,148
Bond int.	717,120	*682,157	Inc. 34,963
Balance	$4,201,465	$3,882,280	Inc. $319,185
Dividend	3,651,001	3,650,983	Inc. 19
Sur., 9 months.....	$550,464	$231,297	Inc. $319,167
Prev. sur.	8,458,204	8,066,927	Inc. 391,277
Total sur.	$9,008,668	$8,298,224	Inc. $710,444

*Includes $9,797 sinking fund.

The actual net revenues for the quarter ending Dec. 31, were $1,712,830. Bond interest took $239,040, and dividends $1,217,000, leaving a surplus of $256,790.

The company is making an improvement in its position. For three-quarters of 1900, there was a surplus of $231,293. The same three-quarters of the fiscal year 1901, including the estimate of the current quarter, show a surplus of $584,614, an increase for nine months of this year over last of $253,318.

If the profits of the current quarter are as good as those of the same quarter last year, the surplus for the year will be about $694,516, against $391,277 last year. Indications are that earnings in the last quarter of this year will be better than those for the same quarter last year. At the same time, the fact remains that the company's net earnings are some $80,000 less than for the corresponding current quarter of 1893.

A Hawaiian Cable Romance.

Cæsar Celso Moreno, for years a familiar character in Washington, has just died there from a stroke of paralysis. Moreno had a picturesque and adventurous career. He was a native of Italy, saw service in the Crimean War, and while in Sumatra was instrumental in a movement for inciting the natives to revolt against Holland. Later he was sent to Tonquin by the French Government in some official capacity, and thence drifted to China, where he organized the first steamship company under the Chinese flag. Shortly after the Civil War he landed at San Francisco and was successful in securing the enactment of the Moreno laws for the protection of coast fisheries. In 1872 he organized a Trans-Pacific Cable Company, in which Leland Stanford was interested, and finally a charter was obtained from Congress for constructing a cable estimated to cost $10,000,000.

Shortly thereafter Moreno again went to the Orient and subsequently to the Sandwich Islands, where he gained the confidence of King Kalakaua. The latter, angered at the refusals of the Cabinet to approve a loan of $1,000,000 by the Hawaiian Government for the building of the proposed cable, dismissed the members and selected four new Councillors, Moreno being designated as Prime Minister.

Moreno carried things with a high hand, and after five days of power was forced to give up the position. He was still a favorite with the King, however, and the latter secretly commissioned him as Minister to the United States and every Court in Europe, but these commissions were soon revoked.

CURRENT NEWS AND NOTES.

MILWAUKEE ELECTRICAL EXHIBITION.—The board of directors of the Milwaukee Industrial Exposition are considering a plan to make the Exposition this year one of purely electrical character.

MULTIPLEX TELEGRAPH.—A Cincinnati correspondent informs us that a Mr. Henry D. Bartholomew, of Newark, Ohio, has invented a system of multiplex telegraph which has been tested between Newark and Pittsburg and proved to be successful.

IN MEMORY OF LORD ARMSTRONG.—Mr. Watson Armstrong has given £100,000 ($500,000) to the Victoria Jubilee Infirmary at Newcastle-on-Tyne, in memory of Lord Armstrong. The foundation stone of the infirmary was laid last June by the Prince of Wales.

AUTOMOBILES AS "FIRST AID."—It is noted from Boston that a new use was made there recently of an electric automobile, which was employed to pull a horse out of a hole which it had fallen into in the street. As "first aid to the wounded," the automobile is a success.

CONSOLIDATION OF INDEPENDENT TELEPHONE COMPANIES.—A movement has been inaugurated in York, Pa., having in view the organization under one management of all the independent telephone lines in Pennsylvania, Maryland, Virginia and West Virginia. The new company, it is stated, will be capitalized at $27,000,000, and the promoters claim that it will ultimately embrace under one management all the independent lines in the United States.

EXTENSION OF ROYAL ELECTRIC PLANT.—At a cost of nearly a quarter of a million dollars, the Royal Electric Company, of Montreal, has purchased land and will erect buildings which will enable the company to about triple its present production. Thirty thousand electrical horse-power will be developed, of which the Montreal Street Railway will take 10,000, and lighting 20,000 horse-power. The capacity of the existing works is only about 10,000 horse-power.

ALUMINUM ALLOY.—Consul Albert writes from Brunswick in regard to magnalium, a new alloy of aluminum and magnesium, with a percentage of from 2 to 30 per cent of the latter metal. Magnalium, it is said, is free from the bad qualities of aluminum, while it retains its light weight, firmness and tenacity. It is especially applicable in the automobile industry, in electro-technics, aeronautics and dentistry. It can be worked with the file, lathe and planing machine; it is also admirable as a solder, and its pliability adapts it as a border for lenses and eyeglasses. Magnelium is absolutely weather-proof and does not rust.

ELECTRIC COMBINATION IN MONTREAL.—The proposed amalgamation of all of the lighting and power companies of Montreal under the name of the Montreal Lighting & Power Company, which was referred to in our columns of last week, has come to naught. A Canadian correspondent informs us the Lachine Rapids Hydraulic & Land Company has definitely decided to have nothing to do with the new combination. The Lachine Company is capitalized at $2,000,000, and most of the stockholders wanted $4,000,000 for the property, or at the rate of 200 for their stock. It is stated that a few shareholders held out for 250. The combination considered this price too high, and declined to pay it, thus breaking off the negotiations.

TELEGRAPH SUIT.—A great telegraph case is before the Court of Appeals, in Toronto, Ont. The plaintiff is George Morrow, a Boston broker, and he is suing to set aside a transfer of stock in the Montreal Telegraph Company to the Great Northwestern Telegraph Company, whereby the Western Union Telegraph Company secured control of both companies. He failed before the lower court. It is said that $20,000,000 of securities are directly and vitally involved in the result of the action and appeal. It is claimed, incidentally, by the plaintiff that the Great Northwestern Company is not earning the 8 per cent dividend it pays annually to the Montreal Telegraph shareholders, and that the Western Union is making up the deficit and charging it against the Canadian companies.

DEVICE FOR CAUSING END PLAY OF SHAFTS.—Two patents were issued May 12 on devices for causing end play of magnets, the patentees being Henry Geisenhoner and Andrew E. Averrett, respectively. The first mentioned device is solely mechanical in its operation, and consists of a plate supported opposite the end of the shaft and inclined with relation to the axis of the same. A steel ball is contained within a circular groove in the face of this plate. When the shaft under the normal bias given by the magnetic field settles into contact with the ball, mechanical engagement causes the latter to roll around the groove in the inclined surface, thereby giving the shaft a positive thrust outward. This movement disengages the ball, which rolls to the bottom of the groove. When the shaft again settles back it comes again into contact with the ball when the same process is repeated. In the second device mentioned, impulses of current are sent through a disk-like electromagnet applied at the end of a shaft on one of the bearings, by means of which the shaft, which normally recedes from the magnet, is attracted at definite intervals. In order to obtain a convenient number of impulses, a small commutator is mounted on a worm wheel to which motion is given by a worm driven by the shaft.

FOR THE BLIND AND DEAF.—Dr. Dussaud, of the Psychological Institute of Paris, gave a lecture recently at the Hospital des Sociétés Savantes on the education of the blind and deaf. A large audience witnessed interesting experiments founded on his method of supplementing the senses of these two classes of unfortunates. The cinematograph for the blind is a machine which passes under the fingers of the blind a series of reliefs representing the same object in different positions—the branch of a tree, a bird, or any other object. The blind person has the illusion of moving scenes just as photographs passing over a luminous screen lend the illusion to those with sight. Dr. Dussaud has also arranged an electric vibrator for the use of the deaf who are incurable. This gives them the notion of musical rhythm. For those not entirely deaf he has invented a "gradual amplifier of sounds," which supplements the organs of hearing and in some instances improves them. The doctor gave a number of statistics already furnished by him to the Academy of Medicine and the Society of Biology, showing that these methods had been applied during the last four years to more than 300 patients affected either with blindness or deafness, and that in most cases the results obtained had been extremely satisfactory.

ELECTRICAL SEPARATION OF CONDUCTORS FROM NON-CONDUCTORS.—A process relating to the separation of particles that are conductors from particles that are non-conductors is the subject of a patent granted Feb. 26 to Prof. Lucien I. Blake. The principle of the invention is based upon the facts, first, that when a mixture of conducting and non-conducting particles or grains is brought into an electrostatic field, the conductors acquire their inductive charge instantly, while the non-conductors require an appreciable time to become charged; and, second, that conductors of one potential when brought in contact with conducting surfaces of different or opposite potential, instantly acquire the same potential as the conducting surface and are repelled therefrom, while non-conductors require an appreciable time of contact before being repelled. The invention consists in submitting a mixture of conducting and non-conducting particles to the action first of an electrostatic field of one potential and then to the action of an electrostatic field of opposite potential. As illustrated, the particles are carried on an endless belt above which is a surface kept at a positive potential. As the mixture falls from the belt when the latter passes around its roller, it strikes a surface also positively electrified, opposite to which is a surface negatively electrified. The conductive particles are thus repelled by one surface and attracted by the other and fall on one side of a separating piece,, while the non-conducting particles continue falling in approximately their original direction and drop on the other side.

THE ENGLISH PACIFIC CABLE.—A Canadian correspondent informs us that the Canadian House of Commons has passed a bill providing for Canada's share of the cost of the new Pacific cable. Canada will pay 5-18 of the total cost, which will be £2,000,000.

THE FRANKLIN INSTITUTE.—The stated meeting of the electrical section of the Franklin Institute, Philadelphia, Pa., will be held at 8 p. m., March 21. Mr. Charles Wirt will read a paper on "Theater Dimmers and Stage Lighting." There will also be a discussion of the paper of Dr. J. W. Richards on "Secondary Reactions in Electrolysis."

BUFFALO MAIL AUTOMOBILES.—The Second Assistant Postmaster-General has accepted the bid of the Buffalo branch of the New York Electric Vehicle & Transportation Company, to carry United States mail between the Buffalo post office and the Pan-American Exposition branch post office and the Government post office railway car, which will form part of the exhibit at the coming Exposition.

WIRELESS TELEGRAPHY IN THE NAVY.—A Washington dispatch states that the Navy Department will experiment with the system of wireless telegraphy now being installed by the Weather Bureau, with a view to its adoption for use in the navy. This system has been developed by Prof. Fessenden, who is now engaged in installing stations for the Weather Bureau along the Atlantic seaboard. Among the stations already completed are one at Cape Hatteras and another at Manteo, Roanoke Island, between which communications are now regularly exchanged.

DAMAGE BY BLIZZARD AND WIND.—On March 10 a fierce blizzard swept over the Northwest, which was followed by a sleet and windstorm. The storm was the most severe ever experienced in that territory, and caused tremendous damage to telegraph and telephone lines throughout that section. Milwaukee as well as various other cities were isolated from the outside world for several days. The local systems in various cities were crippled extensively. Pole lines, weighted down with ice, were blown to the ground for miles. It is estimated that the total damage is between $100,000 and $200,000. Several lines will have to be entirely rebuilt.

PHILADELPHIA GAS PLANT.—The Philadelphia Gas Works are now managed by the United Gas Improvement Company, under lease. During 1900 the company sold 3,911,599,400 cubic feet of gas at $1 per thousand. Of gross collections the city gets 10 per cent. It is already found, according to the *Iron Age*, that the company can make gas considerably cheaper than it was made for the city, that the quality is better, the service much improved, the main system greatly extended, the leakage materially reduced and the pressure increased. Before the works were transferred the leakage ranged between 800,000 and 900,000 cubic feet per mile of main per annum. These improvements have cost a great deal of money, but the business, on the basis of cost represented by the city reports for a number of years, 50 cents a thousand, pays the city $375,000 per annum, and shows net earnings of about $1,000,000. The abandonment by Philadelphia of the ownership and control of its gas business is a conspicuous and interesting exception to a well defined tendency of American cities.

AUTOMATIC BRUSH ADJUSTMENT.—In a patent issued March 12 to C. A. Parsons and G. G. Stoney, of Newcastle-upon-Tyne, England, an automatic brush-adjusting device is described for use on direct-current dynamos, having for an object to automatically change the angular position of the brush according to a change of load. The specifications state that in the Parsons type of steam turbine the output in horse-power is proportional to a small fixed quantity plus a quantity proportional to the steam pressure acting upon the turbine. To automatically shift the brushes, advantage is taken of this fact, the brushes being actuated by means of a piston in a cylinder having a connection to a part of the engine or turbine where the steam pressure varies with the load on the engine and consequently on the dynamo which it drives. It is found that when this invention is applied to steam turbines governing by the usual method of longer or shorter blast of steam, there is a slight pulsating movement imparted to the piston of the brush regulator, which keeps the piston free and prevents hunting, both mechanically and electrically.

SEARCHLIGHTS AT NEWPORT.—The Harbor of Newport is to be provided with powerful searchlights at each of the new fortifications and garrisons. The work already has taken definite form, and a gang of mechanics about Fort Adams are erecting a power house to contain generators for the purpose of lighting the batteries, the post, and to supply the searchlights. An appropriation of $20,000 is available for the work at Fort Adams. The manoeuvres of the navy last summer demonstrated one important fact, if nothing else, and that was the blinding effect of searchlights upon the crews of the ships. The men at the wheel were unable to steer their boats safely, and in these tests they were declared "put out of action" by the searchlights and captured. During the manoeuvres next fall in New York Harbor and about the Narrows by the army and navy, tests will be made by the searchlights on the forts and those operated on the ships which will attempt to force an entrance into the harbor. Similar tests will be made here next summer by the North Atlantic Squadron carrying out some of the problems the War College will have arranged.

ELECTROLYTIC CELL.—A patent issued March 12 to A. Nodon, of Paris, France, describes an electrolytic cell for use in converting alternating into direct currents. The electrolyte is formed of a solution of phosphoric acid, in which are plunged two electrodes, the one of graphite or plumbago, and the other of an alloy of zinc and aluminum. This cell interpolated into an alternating circuit will arrest one of the phases of the alternating current while allowing the other phase to pass freely. The addition of ammonia to the electrolyte is useful, owing to its protective action in preserving the electrolyte from abnormal attacks by the phosphoric acid. In order to effect the continuous converting of alternating current into direct current, it suffices to arrange in parallel two similar couples having their electrodes exposed in a reverse order. In this manner it is possible to collect two direct and distinct currents corresponding respectively to each of the phases of alternating current. It has been found by experience that two couples organized in this manner admit of converting alternating current having a mean e. m. f. up to 200 volts. To illustrate the application of the invention to driving street cars, it is assumed that one of the latter has a mean energy of 8 to 10 kilowatts at a voltage of 500. In this case there will be required in all 10 couples of electrolytic devices grouped in parallel series of 5 couples, the two series having their respective poles arranged inversely to each other. With these conditions the total weight of the battery will not exceed 550 lbs.

POLYPHASE TRANSFORMER.—In transforming three-phase currents by the use of so-called static transformers, it is a common practice to employ two separate transformers with their primaries connected across two sides respectively, of the three-phase system, and with the mains connected in a similar manner to the respective secondaries. In a patent issued May 12 to E. W. Rice, Jr., it is stated that a considerable economy in iron may be secured by locating the primary and secondary coils on a single core of such a nature that the flux due to the action of one primary and its corresponding secondary may pass through a part of the iron core common to the magnetic circuit of the other primary and its secondary. The resultant flux passing through that part of the core common to both magnetic circuits is of necessity the resultant of two equal fluxes differing in phase from each other by an angle of 120 degs., and is therefore equal in value to each of its component fluxes. The portion of the core carrying the resultant flux may, therefore, be the same in cross-section as those portions of the core carrying the individual fluxes, thus affording a saving in iron over the arrangement employing separate transformers, but without increasing the core loss. As illustrated, the transformer is made up of rectangular laminations having therein two rectangular perforations; that is, the three limbs united at the top and bottom. Of these limbs the middle one is unwound and serves as a magnetic shunt for the limbs on either side. Each of the latter carries a primary and secondary coil, one primary being connected across one leg of the three-phase circuit, and the other across another leg. The secondary windings may be subdivided so as to obtain more than one ratio of transformation. The application of the transformer to use in connection with an induction motor is illustrated. In prior arrangements, to subdivide the secondaries of three-phase transformers, the number of leads from the transformer secondaries to the motor has usually been equal to three times the number of working positions of the controller. With the present arrangement the number of leads is reduced, without interfering with the action, to twice the number of working positions plus one.

A BATTERY STIMULANT.—At some athletic sports held in New York City last week by the Eighth Regiment, N. Y. S. N. G., some of the contestants were stimulated by shocks from electric batteries, just as race horses are said to be. In this case, however, the electrical treatment was given in full view of the spectators.

NEW YORK ELECTRICAL SOCIETY will be the guest on March 27 at the remarkable new headquarters of the New York Electric Vehicle & Transportation Company on Eighth Avenue and Forty-eighth Street, where 1000 automobiles can be handled. The members and friends will be received by President Sanderson, Mr. G. H. Condict and others, and will be given the freedom of the whole interesting establishment. The meeting will be open to ladies.

COMBINED TELEPHONE AND ALARM SYSTEM.—A patent issued March 12 to Angus S. Hibbard, describes a combined telephone and fire alarm system. In case of a fire, by automatic or direct means the telephone circuit in a subscriber's house is cut out, the line and a brake-wheel mechanism is cut in. The alarm signal thereby transmitted from the break wheel may be received at the central, or by plugging in on a fire-alarm system may be transmitted to fire headquarters. Provision is made for testing the line, and numerous details conducive to the best operation of the apparatus are described.

PRODUCTION OF STEEL BY ELECTRICITY.—Consul Nelson, of Bergen, under date of Jan. 30, 1901, reports a successful attempt to produce steel by electricity in Sweden. The Consul says: "The experiments are being carried on at Gysinge factory, Sweden, and about 25,000 lbs. of steel are produced in six drafts daily. The steel is of an excellent quality and meets with ready sales at high prices. On account of the relatively cheap method of production, the profits are large, but as the electrical power is limited, the output is insignificant. To overcome this drawback, plans have been formed for the erection of a large electric plant near the Dalalfuen River, the water power of which will be utilized. This will enable the company to carry on the manufacture of steel by electricity on a large scale.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—At the meeting on March 22, Mr. H. G. Stott, formerly of the Buffalo General Electrical Company, but just lately appointed superintendent of motive power for the Manhattan Elevated electric system, will read a paper on "The Transformation and Distribution of Received Currents." The Institute announces also that it will hold its first conversazione in the Engineering Building, Columbia University, New York City, on Friday evening, April 12, 1901. It is arranging for the exhibition of many novel inventions, etc., by C. L. Clarke, Clift, Edison, Hammer, Hewitt, Marconi, Nichols, Perret, Pupin, Ryan, Tesla, Thomson and Townsend, also by members connected with the General Electric and Westinghouse Electric & Manufacturing companies. As most of these exhibits will be shown for the first time, the occasion will be of special interest. The Institute has 1240 members, of whom 690 are located in New York, Pennsylvania, Massachusetts, New Jersey and Connecticut.

DEVELOPMENT OF CANADIAN TELEGRAPHS.—The beginning of the Canadian telegraph system was made fifty-four years ago when a line was established between Quebec and Toronto. The mileage of Canadian telegraphs to-day is something over 35,057 miles, 18,286 miles of which are controlled by the Great Northwestern Telegraph Company, 8886 by the Canadian Pacific Railway Company, 4973 by the Dominion Government and 2912 by the Western Union Company. It is calculated that this represents some 86,000 miles of wire and more than 2700 offices. With the exception of the Yukon telegraphs and the extension on the north shore of the St. Lawrence towards Belle Isle, the lines included in the Canadian Government Telegraph service were almost all established and equipped between the year 1880 and 1882. Three years ago, contracts were given for the supply of poles and for construction of the land line to connect with the proposed cable to Belle Isle off the Labrador coast. But for the loss of the Government cable steamer last fall this cable would have been laid. When completed it will practically reduce navigation between Canada and Europe to three days, the oceanic distance being reckoned from land to land, where passengers can be placed in communication with the world. This will be effected when steamships can receive and send telegraphic messages at Belle Isle.

ELECTRIC LAMPS.—Among the patents of March 12 are three on constructional details of electrolytic glow lamps. One of these relates to the disposal of the resistance which it is necessary to place in series with the burner of this type of lamp. There are four resistance or "ballast" wires enclosed in an air-tight glass chamber filled with dry hydrogen. One end of each resistance wire is provided with a plug whereby connection may be made with the burner. The upper ends are secured to a metallic support, these ends thus being in electrical connection. Should a ballast wire in connection with the burner become destroyed, another of the ballast wires can be plugged in, each burner thus having a magazine of four ballast wires. One of the advantages of this disposition is that in case the gas in the chamber contains traces of oxygen or other gases injurious to the iron ballast wire, the chemical reaction which may result in the gradual destruction of one of the ballast wires will remove from the atmosphere within the chamber all or a portion of injurious gases, thus reducing the tendency to disintegration of the remaining wires. A patent issued to M. W. Hanks is on a means for lighting up all the glowers of the multiple lamp and insuring the safety of the heater employed for this purpose. As illustrated, there are three glower elements in parallel with a fourth or controlling glower. This latter is of larger section than the former, and in series with it is a solenoid controlling the heating coil. When current is turned on, the heater cut-off is closed and current will traverse the same, thereby heating up all the glowers. The controlling glower, however, is made of such material or dimensions, or both, that it will not be heated to a conducting temperature until a predetermined length of time after the smaller glowers have become conductive, when the current passing through it will operate the solenoid and throw the heater out of circuit. By this means the lighting of all the main glowers of the lamp will be insured. Moreover, if all of the main glowers should be destroyed by reason of long use or accident, the currents flowing through the controlling glower would serve to keep the heater circuit open and thus prevent needless waste of current and deterioration of the heater. The third patent was issued to A. J. Wurts and M. W. Hanks, and relates to the treatment of glower blanks and forming glowers therefrom. Current is allowed to pass through the glower before it is made to assume final form, in order that shrinkage shall be provided for.

Letter to the Editors.

Ammeter Shunts.

To the Editors of Electrical World and Engineer:

Sirs:—I would like to make a few comments on the article by Mr. Theodore W. Freet, which appeared in your March 9th issue, and in which it is suggested that provision should be made on every switchboard for the insertion of standard shunts in each line leading through an ammeter so that such shunt could be inserted and the switchboard ammeter checked at any time with the aid of a portable millivoltmeter calibrated for use with the standard shunt.

It seems to me that this gentleman is approaching the subject from the wrong standpoint, and that the onus should be on the instrument manufacturers and not on the builders of the switchboard. If a plan were adopted such that every shunt, no matter what its capacity, gave exactly the same drop in millivolts across the contact studs with full rated load passing, it would only be necessary to have a standard portable millivoltmeter at hand whose scale is calibrated for that number of millivolts and with the aid of which any capacity of ammeter could thus be checked without removing either the switchboard meter or the shunt from its place. This plan has the further advantage that should the switchboard instrument be found inaccurate, it alone need be returned to the makers without involving the troublesome and sometimes dangerous work of putting in a jumper and taking down the shunt to accompany it. The portable can further be left attached to the shunt while the larger meter is away and would still allow readings to be made.

Another advantage is in the matter of cost of the standard, as no set of shunts for it would be required. The standard could, moreover, be made with a calibrating coil so that it could be checked directly with the calibrating coil of a standard portable voltmeter such as Mr. Freet recommends as a necessity for large plants

With properly constructed shunts having no soldered joints whose resistance might vary, the plan I have outlined is perfectly feasible, and, in fact, is coming into wide use. The adjustment of the shunts for this uniform drop is not a particularly easy matter, but has, nevertheless, been accomplished, and is now a standard practice of at least one company manufacturing electrical instruments.

The matter may be carried a step further than I have outlined in the case of those plants having several ammeters on their board. As each instrument is really a millivoltmeter of identical range with the others, the leads of all could be detached from their respective shunts when a checking up is desired, and all connected in parallel to a single cell of ordinary dry battery, sufficient resistance being interposed to cut down the potential to a point where all give full scale. Should then any one of the set of meters indicate more or less than full scale, it evidently is out of calibration by the percentage error so shown. This involves no extra cost whatever for standards.

F. W. Roller.

New York.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS. MOTORS AND TRANSFORMERS.

Large Generators.—Rothert.—An article on the modern design of generators. He compares in detail the dimensions of a machine described by Parshall, with those of one of his own design. While Parshall, in designing, starts from a given value of the efficiency, Rothert calculates the efficiency last. He thinks the principal points of importance for a good design are the magnetic saturation of the teeth and the saving of material. He discusses in detail the current, heat in the armature, the current density in the armature, the saturation of the teeth, the cooling surface per watt loss, etc. Parshall allows a temperature increase of 30 degs., while he allows one of 35 degs. He remarks that the number of poles used by American firms is rather small compared with European practice; he refers to a 225-kw machine of the Gen. Elec. Co., running at 120 r. p. m. and having six poles; "such a machine becomes extremely heavy and requires much material, copper as well as steel and iron plates, but it renders excellent service as a tramway generator with over compounding. The more poles chosen, the cheaper a large machine becomes, but only in certain limits, *i. e.*, as long as the diameter does not become too large and the armature reaction not too small. The air space must not surpass a certain limit, and, therefore, a machine with too great a number of poles, needs too much excitation and requires too much copper in the poles." He recommends highly the American practice of designing a machine especially for traction purposes, in such a way that it can be tested at ten times the normal voltage. He also compares Parshall's and his machines with a 1000-kw dynamo which was exhibited at Paris by Siemens & Halske, of Vienna. He concludes that there are as many principles of design, as there are designers; but common to all designs discussed by him is the wish to build the machines as small and compact as possible. Siemens & Halske use a strong field, Parshall a weak field; Rothert is midway between them. Rothert puts the larger part of the armature losses into the copper, Siemens & Halske into the iron; Parshall makes both equal. All these machines are modern types with a compact and well ventilated armature, built for severe service, and running with carbon brushes, without having to shift them.—*Elek. Zeit.*, Feb. 28.

Rectifying Alternating-Currents with Self-Induction Coils.—Zell; Puerthner.—Two short illustrated descriptions of methods for changing single or multiphase alternating currents into direct currents, with the aid of self-induction coils having polarized cores. The first, by Zell, is merely a modified construction of a known system. The transformer is magnetized by a continuous current or by a permanent magnet, almost to saturation, and contains windings connected between the alternating-current source and the continuous current mains. These offer little inductive resistance to current impulses, which strengthen the existing magnetism, as no great change in the number of lines of force can follow. The current impulses in the opposite direction, however, are claimed to be completely choked off. There are two transformers shown and the connections are duplicated so as to be able to use both of the alternating currents. A similar arrangement is used for converting a multi-phase into a direct current, or for converting the latter into either single or multiphase currents. The second arrangement by Puerthner also makes use of the same principle of a self-induction coil which is claimed to act only in one direction. For small values of the alternating voltage the self-induction of such coils is so small that the counter-direct current, as from accumulators, for instance, could flow into the alternating-current circuit. To prevent this, a condenser is inserted in the direct-current circuit, the capacity being such that it balances the larger self-induction. It consists simply of a core with two windings through one of which a continuous current from an outside source flows, so as to polarize the core, while the other circuit is the one through which the alternating current flows. The currents which flow in the same direction as the exciting current, have to produce no or nearly no magnetization, while the others have to demagnetize the core, and this unequal magnetization energy corresponds to the self-induction which is therefore different according to the direction of the current. The condenser prevents a back current from flowing from the battery. The capacity should be such that its accelerating action should equal the lagging action of the larger self-induction. In order to use both currents two such arrangements are connected in parallel and the two direct currents join and flow back together.—*Zeit. fuer Beleucht*, Feb. 20.

Short-Circuited Armature.—Osnos.—A theoretical paper on the theory of induction motors with short-circuited armatures. He simplifies somewhat the results formerly obtained by Roessler, and compares them with those of Fischer-Hinnen. He also compares a short-circuited armature with a phase armature of the same size; if the same copper is used in both cases, he determines the increase of resistance of a bar by the short-circuiting metal rings in one case, and by the connections of the terminals in the other case. He finds that with equal increase of resistance about 2.5 times as much copper is required for the connections of the terminals of a phase armature than with a short-circuited armature.—*Elek. Zeit.*, Feb. 21.

Synchronous Motors.—Colard.—A contribution to the theory of synchronous motors. "The method used by the author, in which the x-co-ordinate is proportional to the square of the motor e. m. f., the y-co-ordinate to the square of the current, and the z-co-ordinate to the power, enables us to study graphically the behavior of a synchronous motor without the necessity of using quartic curves such as those employed by Steinmetz."—*Assoc. Ing. El. Liege, Bull.*, Sept. 30; briefly abstracted in *Science Abstracts*, Feb.

REFERENCE.

Transformers.—Woodhouse.—The conclusion of his illustrated paper on "The designs of transformers." He shows how to calculate the pressure drop, describes the general method of design and gives a numerical example of design of a core transformer.—Lond. *Elec.*, Mar. 1.

LIGHTS AND LIGHTING.

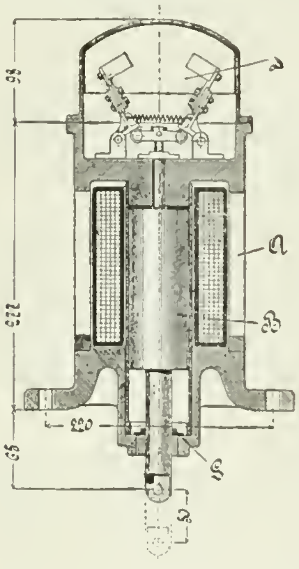
Open and Enclosed Arcs.—Hoppe.—A comparison of the economy of open and enclosed-arc lamp service. He gives detailed estimates of the cost of service for a plant which requires 100 enclosed arcs of 5 amperes. As long as only the consumption of carbons and the cost of trimming is compared, there is a great advantage on the side of the enclosed arc. Other tables show, however, that this economy of the enclosed arc disappears if the higher energy consumption and interest and amortization of the first cost of installation are taken into consideration. He claims that the considerable consumption of energy by enclosed arcs has such an important influence that, even with a low value of the annual hours of burning, a great saving is obtained with ordinary arc lamps. He agrees, however, that enclosed arcs may be used to advantage in show windows, on railway stations, in all cases where the lamps are distributed over wide areas, so that the trimming takes considerable time; in damp rooms and at the seacoast, for advertising purposes and signal lamps, and in general in all cases where the general illumination is of more importance than intensive illumination of the floor.—*Zeit. fuer Beleucht,* Feb. 10.

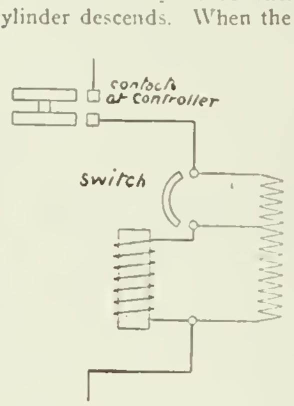
Enclosed Alternating Arc Lamp—An illustrated description of an enclosed arc lamp made by a British company for running in series on an alternating current circuit. It is of the clutch type, the principal feature being the use of a subsidiary and rather powerful brake, operating on the striking lever and taking the place of the usual dash pot. This brake comes into play on the striking of the arc and whenever the current exceeds the normal. The lamp is shunted with a choker which takes the whole of the current, should the arc break.—Lond. *Elec., Elec. Eng.*, Mar. 1; *Lightning,* Feb. 28.

Lighting of the Thames Embankment.—An illustrated article on the recent opening of the electric lighting of the Victoria Embankment in London. The plant contains four 70-hp gas engines, driving dynamos giving 70 amperes at 500 volts. There are 67 arc lamps; the lamps take 6 amperes and are run on six circuits of 10 lamps and one of 7 lamps. The lamps are of the open, double carbon clutch type, and burn for 40 hours without retrimming.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Mar. 1; *Lightning,* Feb. 28.

POWER.

Direct Current Brake Electromagnets.—VOGELSANG.—An illustrated article on direct current shunt brake electromagnets. Their good construction is of the greatest importance for cranes. In order to obtain a certain tractive force with an electromagnet, a relatively great number of ampere windings is required at the beginning of the attraction, the magnetic lines of force passing through a long air space, while after this air space has been overcome, a very small number of ampere windings is required for holding the weight. He describes the shunt brake electromagnets built by the Helios Co. For starting the brake, there is a strong current in the electromagnet, while for the time during which the armature is kept by the magnet the current strength is considerably smaller. For this diminution of the current after the brake has been started, a special switch is used, and this switch is operated by the magnet itself. When the armature is almost at the magnet it operates a switch hy which a resistance is connected in circuit, which was short circuited before. The magnet is illustrated in the adjoining figure. In the iron case *A* there is the steel cylinder *B*. At *G* there is a simple valve, which allows air to enter when the cylinder is raised, while it is automatically closed when the cylinder descends. When the cylinder is raised, in the last moment it opens the switch *S*. This switch is closed again by a spring, when the cylinder sinks down again. As will be seen from the second diagram, a series resistance is inserted into the circuit by the switch. Another resistance is always in shunt with the magnet coils; it is necessary to receive the current of self-induction in the moment of disconnecting. In this way it is possible to connect and disconnect the magnet safely by a simple switch. These magnets are made in three sizes, all raising the armature by 50 mm, the attracted weight being 20, 50 and 100 kg. respectively. In one of these magnets the current is seven or eight times smaller after the resistance has been switched in by the armature than at the start.—*Elek. Zeit.*, Feb. 21.





FIGS. 1 AND 2.—BRAKE ELECTROMAGNETS.

Electric Power in Work Shops.—GEIPEL.—The conclusion of his illustrated paper, the first part of which was noticed in the Digest Mar. 16. He thinks the two most suitable systems for an electric power supply in workshops are the two-wire direct-current system and the three-phase system, using star winding, so that lamps may be connected between the neutral and the phase wires. The direct current is probably more suitable for small works, where the number of motors is few and the commutators are of less importance. For larger works there are advantages in the use of the three-phase system; the generator is more mechanical; there is no commutator required beyond that on the exciter; there is less difficulty in effectually insulating armature bars and connections than in the case of direct current dynamos. As to the motors, the three-phase induction motor is of a stronger mechanical design, more particularly in the revolving parts; the current in the revolving part has no electrical connection with the circuit; it may have a very low tension; in the case of the direct current motor there is not only the commutator difficulty, but the rotating armature must be wound with a large number of small windings, and must be insulated to stand the full pressure of the supply. "In the case of variable speed, where large torque is required, at low speeds, the direct current series-wound motor is perhaps more suitable; if it is not a desideratum that the torque should be largely increased, then the three-phase motor is equally suitable; and it has the additional advantage that the speed controlling apparatus has no connection with the main circuit, while, in the case of the continuous current, the controller must be very carefully designed and operated on account of its being in the main circuit, and subjected to the full pressure thereof." He recommends the automatic circuit breaker and describes the Ward Leonard method of reducing the speed of motors and at the same time increasing the torque.—Lond. *Elec. Rev.*, Mar. 1

TRACTION.

San Francisco.—FOSTER.—A well illustrated article on recent electric tramway construction in San Francisco. The principal electric railway line there has recently changed 11 km of cable line to electric. The slot rails were removed, but the conduit was left in place and filled up, and a new track rail was installed. The company is operating motor cars on a 17½ per cent grade. This is believed to be the steepest grade for self-propelled cars. Cars are run up and down this grade without trouble or accident. On another line electric cars are run on 25 per cent grades, but here they are assisted both up and down by a cable. The standard car of the company measures 40 ft. over all, and is equipped with four 25-hp motors. The company also has a number of shorter cars with two motors. Tests at different speeds with these short cars show that to run 26.7 per cent faster requires only 3.84 more kilowatt-hours per car mile. He discusses the standard brake used to a considerable extent, as he considers that to it is largely to be attributed the immunity from accidents which the company has had in operating its cars on the very steep grades which exist in San Francisco. One principal feature is that the brake shoe operates on the track instead of on the wheels The second feature is that the brake is applied by means of a long lever instead of by a rotating handle. In addition to the steep grades the weather in San Francisco is very foggy, making the rails very slippery, and safety gates are not used on the cars as in most Eastern cities, yet the company's expenses for accident damages amount to only about 1 per cent of its gross earnings instead of from 3 to 7½ per cent, as in many Eastern roads. He believes that by means of a lever a motorman can apply the shoes more quickly than by the revolving handle, can get more pressure by it and can graduate the pressure more easily. These points are elaborated. The headlight lamp is peculiar in that the carbon filament is wound in the form of a conical spiral instead of as an ordinary loop. In this way the light is concentrated at one point, which can be located in the exact focus of the parabolic reflector, and the available light has been shown to be 16 times that of the ordinary lamp of the same candle-power.—*St. R'y Jour.*, March 2, and Int. Ed., March.

Conduit System.—An illustrated description of a new conduit system which is claimed to be much cheaper than other conduit systems. While it requires a maximum excavation of only 18 inches, it is said to have all the advantages claimed for the deep conduit without necessitating its outlay. The top of the slot is made and maintained throughout its entire length the highest part of the road. The sides of the conduit and slot are formed by pairs of specially designed rolled steel Z-shaped sections of suitable length, separated at the ends, and about every 6 ft. these are bolted down to iron sleepers set in a concrete bed. The tram rails rest on the raised portion of the bed, and are securely bolted to the iron sleepers, being also tied to the sides of the conduit by tie bars. Interposed between and bolted to the ends of each pair of Z-shaped sections are iron frames which form the sides of the conduit between the sections. Iron access doors are hinged to these frames so that when closed they complete the continuity of the road surface and slot in the intervals between the pairs of Z-shaped sections, and when open, give free access to the conduit for clearing, etc. The bed formed by the sleepers and concrete and the Z-shaped sections is so proportioned that the top of the slot is maintained at a higher level than the tram rails, so that the surface water drains away from it. Some critical remarks are added, in which the practicability of the system is greatly questioned.—Lond. *Elec. Rev.*, March 1.

Storage Batteries in Traction Plants.—Grindle.—An abstract of a paper read before the Manchester section of the Brit. I. E. E. He discusses the following methods: The battery is used either at the power station or at an outlying sub-station; the battery may be coupled as a whole across the mains or bus-bars; a portion of it may be used as regulating cells; it may be used in conjunction with an ordinary booster; it may be used in conjunction with a differential or reversible booster. He speaks in favor of the last method, in which the field of the booster, which is in series with the battery, is automatically controlled by the battery pressure in such a way that the pressure across the terminals of the battery and booster is kept constant; the battery controlled by the booster serves to take charge of practically the whole variation, whether above or below the normal or mean load, so that the generator works at practically a steady constant load, the difference between the load and the mean charging into the battery when the line load falls below the mean, and the battery discharging to line whenever the load exceeds the mean. The generator load will naturally be adjusted to be the mean load required to generate the total average output for the usual period of work. He thinks the battery should take the sole and entire charge and control of the whole, even to the extent of not excluding the engine; the engine should be run without a governor on a constant steam pressure and constant valve admission. He believes that the best curves, obtained in traction stations with batteries, might be still better under these circumstances, and that the small generator variations that do occur are due to the governor attempting to follow the load instead of leaving it entirely to the battery to compensate for, as should be the case. —*Lightning*, Feb. 28.

REFERENCE.

Polyphase Railways.—Perkins.—Continuations of his illustrated serial on polyphase electric railways in Europe. These parts deal with the Jungfrau R'y and the Strausstadt-Engelberg R'y.—*El'ty*, Mar. 6, 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capacity in Alternating-Current Working.—An editorial of Mordey's recent Brit. I. E. E. paper and the discussion which followed. Regarding the dielectric hysteresis loss, it is said that the weight of evidence put forward in the discussion tends to show that the loss by dielectric hysteresis has been computed by Mordey at from four to six times its probable value. Testing one rubber-insulated cable, he came to the conclusion that its power factor, or the ratio of the real power spent in the cable to the product of the volts and amperes which is carried, was 0.124. Subsequent experiments have shown this ratio to be more in the order of 0.2 or 0.3. The cables now generally used for high voltage being insulated with oiled paper, bitumen or impregnated fibre, their capacity is lower and the volt-amperes therefore less, so that for the same power factor the waste watts are again diminished, thus "instead of a loss of 1200 watts per mile with a 6000-volt 37/15 cable at a frequency of 50 periods per second, we may reckon about 200 watts. Taking a light and power distribution system with this size cable as an average and, say, 50 miles of it constantly charged, we have a waste of 10-kw" during the day. Mordey's method of measuring capacity is said to be unreliable in most cases without the use of elaborate corrections to the simple formula enunciated. For the formula to be applicable, a true sine-wave curve is necessary.—Lond. *Elec.*, March 1.

WIRES, WIRING AND CONDUITS.

Self-Induction and Capacity in a Network of Concentric Cables.—Julius.—A description of experiments made on the network of mains at St. Petersburg where the total length of the mains is 146 miles, and the total capacity 87.8 mfd. The pressure used is 2000 volts, the frequency 42.5, and the capacity current works out at 46.8 amperes. With all the transformers in circuit, the wattless transformer current is 270 amperes, so that to reduce the angle of lag to zero, it would be necessary to increase the capacity of the system more than fivefold. He gives a table of the power factors for various outputs at St. Petersburg, the wattless component being taken as invariable. For a load of 230, 400, 600, 1000, 1800 amperes the power factor is .553, .874, .946, .981 and .994, respectively.—*Bull. Montefiore Soc'y*, Feb.; briefly abstracted in Lond. *Elec.*, March 1.

Note on Wires.—Appleyard.—An article in which he discusses the following question: Suppose it is required to know the change in weight of the conductor or the change in weight of the dielectric of a cable core, corresponding to a change of 1 mil in the diameter of either of them. This change may be determined by a graphical method by means of a curve for a certain material, in which the weight and the diameter are the co-ordinates. This curve is a parabola. There is, however, a much simpler method, namely, the change in weight, corresponding to a change of 1 mil in the diameter is equal to the diameter (in mils) multiplied by a factor which is a characteristic constant of the substance and which is called by him the "mil" constant." He gives a table of this constant for various substances.—Lond. *Elec. Rev.*, March 1.

ELECTRO-PHYSICS AND MAGNETISM.

Electro-Dynamics and Cremieu's Experiment.—Pocklington.—A brief theoretical paper, in which he deduces the equations of the electromagnetic field from the results of experiment combined with the simplest possible assumptions, and uses them to discuss the question whether a moving charge produces a magnetic field, and whether the sudden charging of a rotating disk will cause an induced current in a coil surrounding it. As noticed before in the Digest, Cremieu had failed to find in his experiments a magnetic field due to a moving charge. The result of the present paper is that Hertz's form of Maxwell's equations can be obtained with the aid of assumptions so simple as to be almost beyond doubt, and with them the theorem that a moving charge produces a magnetic field, but it is somewhat doubtful whether an induced current should theoretically be observed in Cremieu's experiment. Cremieu's experiment does not afford any decisive evidence of the want of truth of the hitherto accepted equations of the electromagnetic field.—*Phil. Mag.*, March.

Power Loss in Choking Coils.—Clinker.—A communication in which he gives some results of measurements showing that it is not safe to calculate the loss of energy due to ohmic resistance in an ironless choking coil from the measured resistance, except in the case of a small conductor where the eddy currents are negligible. In the case also of transformers with very thick conductors, it is well known that a wattmeter measurement of this loss greatly exceeds that calculated from the resistance of the winding. Especially is this the case if the transformer has a large magnetic leakage.—Lond. *Elec.*, March 1.

Electric Deformation of Dielectrics.—Sacerdote.—A mathematical note, referring to a paper of More, in which he gave an account of experiments on the elongations experienced by a glass tube forming the dielectric of a cylindrical condenser when the condenser was charged. As he had not observed any elongation or contraction of the tube, More had concluded that no electric deformations of dielectric exist. The present author shows theoretically that by the very disposition of More's experiments the tube should not experience any appreciable elongation. Thus the negative result of his experiments merely proves that they were carefully performed.—*Phil. Mag.*, March.

Coherer.—Shaw.—A long paper giving the results of an experimental investigation of the "simple coherer"; by this term he means a coherer which has only two surfaces in contact. He uses the simple coherer in order to reduce the problem of coherence to its simplest possible terms; nevertheless the results obtained are much involved and very complex. The insulating layer between the surface of the contact is of importance before the first coherence has occurred. A condenser air-layer might produce all the well-known resistance. Oxide as such asserts itself when strong currents pass with certain easily oxidized metals. There is actually a bridge in certain cases, but he uses the term bridge throughout to express the region between one metal and the other. The molecular change which he calls orientation is the most interesting result of his investigation; it points in the same direction as the results obtained by Bose, as mentioned before in the Digest.—*Phil. Mag.*, Mar.

Air Subjected to Roentgen Rays.—Villari.—An abstract of a Brit. Phys. Soc. paper on the subject "How air subjected to Roentgen rays loses its discharging property, and how it discharges electricity." Air made active by X-rays in passing through a long tube coiled in many turns, loses much more of its discharging power than it does in passing through the same tube if straight. During this process the tube charges itself to a certain potential. Active air by streaming against an electrified body is reduced either to ordinary air or to air charged with the electricity which disappears. He supposes that the active air, in rubbing upon the metallic surfaces, develops the two electricities, one of which manifests itself upon these surfaces and the other goes to reduce the active air to ordinary air, and therefore has not becomes manifest.—Lond. *Elec.*, Mar. 1.

Magnetic Images.—Jaeger.—An account of a series of experimental researches on magnetic images. His first experiments were made with a linear conductor and thick steel or iron plates. He showed that the latter modified the field as if there were another linear current in the positive of the optical image of the first as reflected in the plate. This is the well-known magnetic image effect. He proved further with the aid of a solenoid instead of a linear conductor that the property of ferromagnetic substances, by virtue of which they produce magnetic images, is a function of their hardness. As the mechanical hardness increases, the image effect decreases. An interesting development of the magnetic image is the "kaleidoscopic" effect obtained by the author by means of two plates inclined at an angle to each other, between which the conductor passes. The resulting field is the same as if further conductors were placed in the positions of the multiple optical images of the real conductor. He suggests the examination of curved ferro-magnetic mirrors.—*Ann. der Physik,* No. 2; abstracted in Lond. *Elec.*, Feb. 22.

REFERENCE.

Magnetic Precession.—Schuster.—A reprint in full of the second of his two Brit. Phys. Soc'y papers, abstracts of which were noticed in the Digest, Jan. 12.—*Phil. Mag.*, March.

Electro-Chemistry and Batteries.

Normal Electrodes and the Absolute Potentials of Metals.—Ostwald.—The use of a hydrogen-electrode (as recommended by Nernst) as standard in place of calomel and decinormal potassium chloride, has the disadvantage that such an electrode is far more troublesome to set up; but the chief disadvantage is that the acid (or alkali) which must be used introduces two ions which differ enormously in their velocity of migration, and so must necessarily set up a potential difference when brought into contact with other solutions: this source of error is a minimum in the case of potassium chloride, the ions of which have almost exactly the same velocity of migration. The hydrogen-electrode has also the disadvantage of a large pressure-coefficient, 0.029 volt per atmosphere, which would be affected by the vapor pressure of the solution, and the temperature co-efficient, though small, is not accurately known.—*Zeit. f. Phys. Chem.*, Nov. 2; abstracted in *Science Abstracts*, Feb.

REFERENCES.

Electrolytic Laboratory.—Schramm.—An illustrated description of the electrolytic laboratory of the University of Penna.; it provides for 16 students. The storage batteries, switchboards and instruments are used.—From a pamphlet published by the Univ. of Pa.

Estimation of Metols by Electrolysis.—Nathan.—The first part of an article on this subject. After some historical notes, he discusses the apparatus for such purposes and the general arrangements. It is of the utmost importance that the e. m. f., current and resistance be carefully attended to. The e. m. f. determines whether a certain electrolyte shall yield up its ions. It is on the current that the rate of deposition depends.—*The Elec. Chem and Met.*, Feb.

Osmotic Pressure.—Noyes.—A theoretical paper on the exact relation between osmotic pressure and vapor pressure. A formula representing this exact relation is developed by a new cyclical thermodynamical process, and also by the consideration of the equilibrium conditions of an osmotic pressure.—*Phys. Zeit.*, Feb.

Electrolysis in Organic Chemistry.—Hewitt.—The first part of a serial on applications of electrolysis to organic compounds. The article is more of a chemical nature. He discusses first and briefly direct electrolysis of certain organic compounds, and then the indirect methods depending on the reduction or oxidation of an organic compound in a cathode or anode cell, respectively.—*The Elec. Chem. and Met.*, Feb.

Electrolytic Pigments.—A summary of the most successful methods of pigment making in which electricity is used. He describes briefly the methods of making Scheele's green, Mitis green, malachite green, cadmium yellow, vermilion, chrome yellow, also 11 different electrolytic processes of making white lead.—*The Elec. Chem. and Met.*, Feb.

Sterilization of Water by Ozone.—Abraham.—An illustrated paper read before the Internat. Soc'y of Electricians in Paris. He gives a review of the different systems suggested for the industrial production of ozone for the sterilization of water, and describes more especially his installation in Lille.—*Bull. de la Soc Int. des Elec.*, Nov.

Units, Measurements and Instruments.

Electro-Radiophone.—Tommawina.—A description of a new instrument for detecting and studying distant thunder storms. It consists essentially of a self-decohering carbon coherer, placed in circuit with a dry cell and an ordinary telephone receiver. The carbon is in grains, prepared from arc carbons, thoroughly dried by heat and sealed up hermetically in a glass tube attached to the telephone magnet, so as to lie horizontally when the telephone is put to the ear.—*Phys. Zeit.*, Feb. 9; abstracted in Lond. *Elec.*, Mar. 1.

Recording Instruments.—An illustrated description of new direct current recording ammeters and voltmeters, made by a British company; they are of the permanent magnet moving coil type. To reduce the friction, a special hinged pen arm is used; the pen arm hangs from pivots fixed to the axis of the moving coil, with the result that while the pressure is perfectly even, the weight of the system is reduced to a minimum.—Lond. *Elec.*, Mar. 1.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—An illustrated article on Guarini's wireless telegraph experiments in Belgium. Some information is given about the air wires used by him. The sensitiveness of a coherer for a particular wave increases on diminishing the local current in its circuit by using appropriate resistances. He also made experiments to determine the importance of the earth connection. If neither of the stations were connected to earth, or if the receiving station only was connected to earth, no good signals could be transmitted, but with the ordinary earth connection at the transmiting station, he found the results better when the receiving wire was not connected to earth than when it was. He thinks that the earth acts as a large capacity and not as a conductor, this large capacity being advantageous to the transmitter, but harmful in the case of the receiver.—Lond. *Elec.*, March 1.

Telegraph Receiver.—A long illustrated description of a new telegraph, receiver of Siemens & Halske, especially adapted for high-speed service. A strip of sensitive paper, which receives the telegrams, is moved and lighted at the same time by cathode rays which are deviated by a coil supplied with the current from the telegraph line. Several methods are described. In one of them the light passes through a transparent screen, which bears opaque letters in proper position. The message is then received in ordinary characters.—*Elek. Rund.*, Jan. 15.

Bare Telephone Wires in Snow.—Ricco and Janssen.—A communication stating that telephonic communication has been maintained between the Ætna Observatory and Nicolosi by the expedient of laying the bare wire over the frozen snow. The experiment has been perfectly successful.—*Comptes Rendus*, Feb. 11; abstracted in Lond. *Elec.*, March 1.

REFERENCES.

Long-Distance Telephony—Lendi.—An article in which he discusses in general the difficulties of long-distance telephony and the means of overcoming them.—*Rose Technic*, Feb.

Michigan.—Ware.—A paper on the present telephone situation in Michigan, especially on the growth of the independent companies.—*West. Elec.*, March 9.

Fire Alarm.—An illustrated description of the installation in Pforzheim, Germany, of the fire-alarm system of Mix & Genest.—*Elek. Zeit.*, Feb. 14.

Miscellaneous.

Blaze Current.—Waller.—A brief abstract of a Royal Soc'y paper on the value of the electrical "blaze current" as a sign of vitality. By "blaze current" he denotes "galvanometrical token of an explosive change locally excited in living matter." He arrives at the conclusion that "if the after currents aroused by single-induced currents of both direction are in the same direction, the object investigated is alive." Both animal and vegetable life are included, and the test appears conclusively to settle the question as to the vitality of any tested seed.—Lond. *Elec.*, March 1.

REFERENCES.

Electric Furnaces.—Cromwell.—An article of a general nature. He briefly discusses the production of calcium carbide, the chemical reduction of compounds and the artificial manufacture of diamonds.

One great advantage of the electric furnace is its power to confine the heat in a very small space. If a powerful electromagent is placed in the immediate region of the arc, it will repel or attract the arc and thus direct its heat to any part of the furnace.—*Yale Sc. Mo.*, March.

Graphical Tables.—Eichhorn.—An illustrated article on the construction of graphical tables of the slide rule type, and their application to various physical and engineering problems.—*West. Elec.*, March 9.

Paris Exposition.—Armagnat.—A long and well illustrated description of measuring instruments exhibited in the French Section. —*L'Eclairage Elec.*, Feb. 9.

Reyval.—Illustrated descriptions of a 1375-kilovolt ampere three-phase alternator of the Oerlikon Company, a 350-kilovolt ampere single-phase alternator of the Oerlikon Company, a 700-kilovolt ampere three-phase alternator of Ricter & Co., and the electric clock of Thury.—*L'Eclairage Elec.*, Feb. 16.

Reyval.—Illustrated descriptions of a 1530-kw direct-current dynamo of Siemens Brothers, and a 330-kw direct-current dynamo of Scott & Mountain.—*L'Eclairage Elec.*, Feb. 23.

Montpellier.—A well illustrated description of two 800-kilovolt amperes, three-phase alternators, exhibited by the company "Electricite et Hydraulique."—*L'Elec.*, Feb. 2.

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New Books.

BOOKS RECEIVED.

Primi Nozioni Fondamentali di Elettrochimica. Di Alfonso Cossa. (Hoepli manual). Milan: Ulrico Hospi. 113 pages, 9 illustrations. Price, 1.50 lire.

L'Annee Electrique. Electrotherapique et Radeographi que. Par Dr. Foveau de Courmelles. Paris: Ch. Beranger. 334 pages. Price, 3.50 francs.

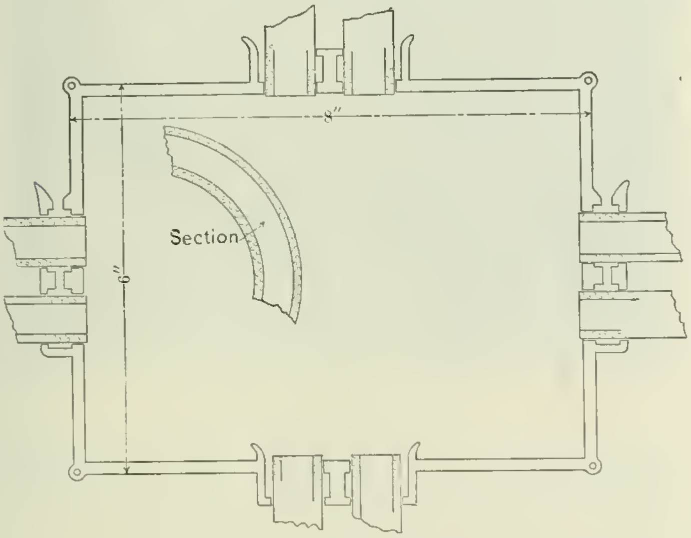
Etude Sur Les Paratonnerres. Par A. Della Riccia. Liege: Leon de Thier. 81 pages, 41 illustrations.

Junction Box and Conduit.

By E. E. Clock.

The junction box shown in the accompanying illustration is made of cast brass with nozzles for holding a sealing compound consisting of lead or spelter, which is poured in while hot. As the nozzles are tinned on the inside, this makes an air-tight seal. The conduit is made of steel, wire and lead, there being two windings of wire properly spaced, and a filling of lead.

The object is to make a conduit that is flexible, air-tight and a protection to the wires against mechanical injury, and which is flexible and rust proof. In connection with the junction box a system is formed that is complete and permanent, and which allows wires to be drawn in or out and renewed. The conduit is easy of erection and especially adapted to submarine work and to subway purposes where it might be an advantage to keep the system under a pressure of dry air.



JUNCTION BOX AND CONDUIT.

Pan-American Exhibitors.

The following is a complete list to date of the exhibitors in the electrical section at the Pan-American Exposition. This list includes all in the electrical section as well as those concerns which are placing their apparatus about the grounds in the service of the Exposition:

General Electric Company, Schenectady, N. Y.; Morris Electric Company, New York, N. Y.; H. B. Camp Company, Akron, Ohio; Bossert Electric Construction Company, Utica, N. Y.; American Electric Telephone Company, Chicago, Ill.; American Vitrified Conduit Company, New York, N. Y.; Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; Clark Automatic Telephone Switchboard Company, Providence, R. I.; Gould Storage Battery Company, Depew, N. Y.; C. C. Holland, New York, N. Y.; Incandescent Electric Light Manipulator Company, Boston, Mass.; National Carbon Company, Cleveland, Ohio; National Automatic Telephone Company, Chicago, Ill.; Peru Electric Manufacturing Company, Peru, Ind.; The O. C. White Company, Worcester, Mass.; Waite & Bartlett Manufacturing Company, New York, N. Y.; Bettini Phonograph Company, New York, N. Y.; Power Installation Company, Buffalo, N. Y.; Stanley Instrument Company, Great Barrington, Mass.; Northern Electrical Manufacturing Company, Madison, Wis.; Stanley Electric Manufacturing Company, Pittsfield, Mass.; Electric Storage Battery Company, Philadelphia, Pa.; Crocker-Wheeler Company, Ampere, N. J.; Edison Manufacturing Company, Orange, N. J.; Bullock Electric Manufacturing Company, Cincinnati, Ohio; Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Jandus Electric Company, Cleveland, Ohio; Kellogg Switchboard & Supply Company, Chicago, Ill.; R. W. Wagner & Co., Chicago, Ill.; B. & E. Hanfield, New York, N. Y.; Safety Insulated Wire & Cable Company, New York, N. Y.; Miller Signal Company, Chicago, Ill.; Phelps Company, Elmwood, Ill.; Eureka Electric Company, Chicago, Ill.; Mason Monogram Company, New York, N. Y.; C. B. Rowell, M. D., Buffalo, N. Y.; B. J. Arnold, Chicago; Lea Electric Manufacturing Company, Elwood, Ind.; Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.; Keystone Electric Company, Erie, Pa.; D'Olier Engineering Company, Philadelphia, Pa.; E. G. Bernard Company, Troy, N. Y.; C. J. Toerring, Philadelphia, Pa.; Syracuse Electric Fuse Company, Syracuse, N. Y.; Onondaga Dynamo Company, Syracuse, N. Y.; National Gramophone Company, New York.

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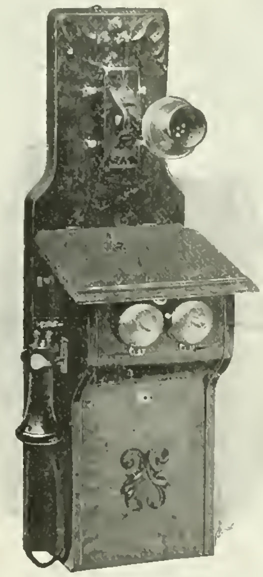
Improved Telephone.

Among the latest improved telephone apparatus placed on the market is the instrument illustrated herewith. It is manufactured by the Central Telephone & Electric Company 909 Market Street, St. Louis, Mo. Among the features claimed for this instrument, in addition to excellent workmanship and material employed in its manufacture, is the position of the transmitter, which is placed on a level with the mouth. The receiver and generator are on a level with the arm. In the manufacture of this instrument convenience has been given as much attention as serviceability and finish—a matter which all telephone users will appreciate.



IMPROVED TELEPHONE.

Hotel Telephone Equipments.

In the modern hotel or apartment house telephones are quite as necessary as the elevators and mail chutes. The new Hotel Essex, corner Fifty-sixth Street and Madison Avenue, New York City, is equipped with Ericsson telephones and switchboard, which give quick communication from every suite and hall to the office, and place the management within easy reach of every patron. The room telephones are all of the hand microtelephone pattern (Fig. 1) and are ornaments to the finely finished suites. Each telephone is fitted with a flexible cord of sufficient length to enable the patron to call the office, or to answer a call, if desired, without rising from bed. When through using, the releasing of a lever in the handle makes and breaks all necessary connections, and it is not necessary to replace the instrument on a hook, as in ordinary telephones.

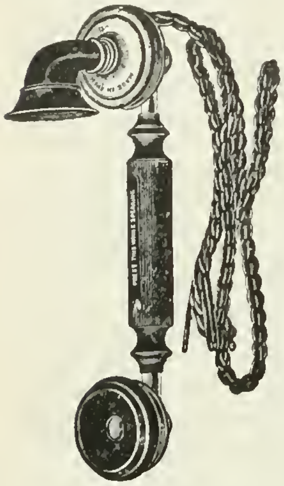


FIG. 1.—HAND MICROTELEPHONE.

In operation, the office is called by simply pressing the contact in the handle of the hand microtelephone, which act throws the drop at the switchboard. The operator connects in the usual manner, answering the call, and, if desired, calls some other suite and enables the two to converse. The call to the suite is made by a small musical gong placed near the ceiling, which, while loud enough to call a person, is not harsh enough to disturb one. As shown in Fig. 2, the wall telephone for use in the halls is neat, compact, and takes small space. It is fitted with the standard Ericsson receiver and transmitter. It is used in the ordinary way, the act of taking the receiver from the hook sending the call for the operator in the office. With both instruments, when the line is released, the operator is at once notified of the fact and disconnects. The switchboard is shown in Fig. 3. Besides being positive and rapid in operation, it is of excellent mechanical construction, is very durable, is handsomely finished, and, while occupying very little space compared to its capacity, is of a peculiar design which distinguishes it from ordinary boards. The system is operated by centralized batteries and is so arranged that, when desired, a motor generator can be thrown into circuit for calling. The apparatus used in this installation is of the Ericsson Telephone Company, 296 Broadway, New York.

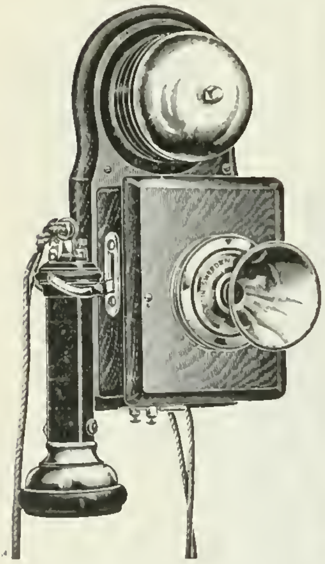


FIG. 2.—WALL TELEPHONE.

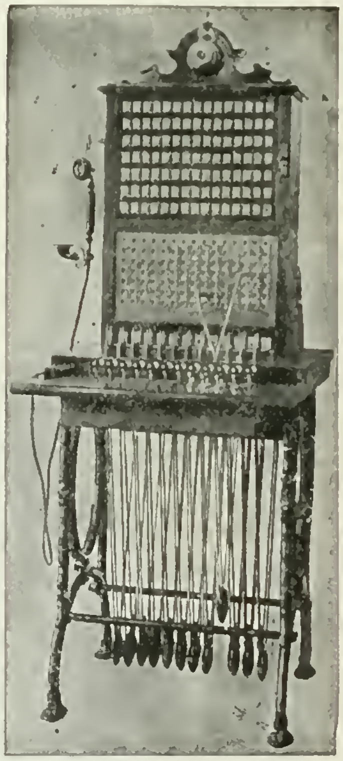
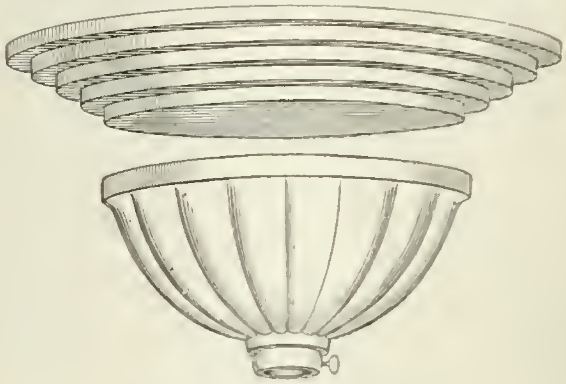


FIG. 3.—SWITCHBOARD.

Fixture Block.

The fixture block shown in the accompanying illustration is one which the makers feel confident will be appreciated by contractors and gas fixture houses, for whose use it has been brought out by by the H. C. Roberts Electric Supply Company, 831 Arch Street, Philadelphia, Pa. It is provided with four steps to fit as many different sizes of canopies, the diameters of the steps being 3, 3½, 4 and 4½ inches.


FIXTURE BLOCK FOR CEILINGS.

It is evident that a canopy cannot slip sidewise when it is set on one of these blocks, and that it is necessarily held in a central position about the fixture stem. The utility of this simple device is obvious.

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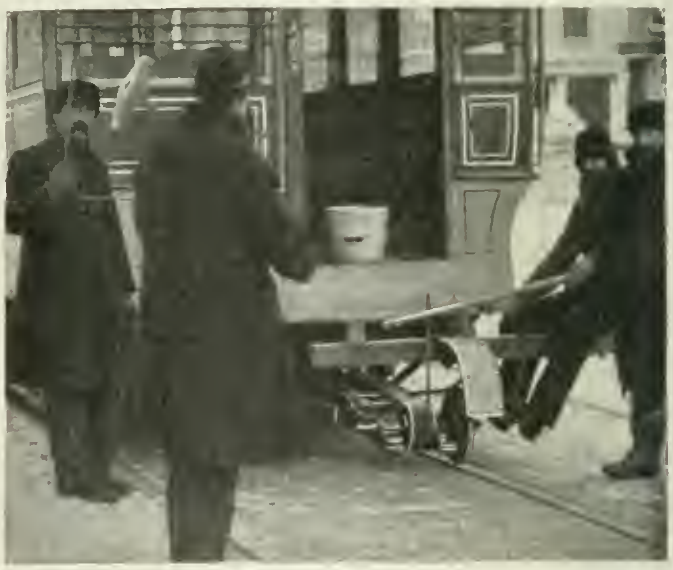
Grinding Grooves in Rails.

One of the difficulties developed in the operation of interurban cars over city lines was the inadequacy of the flat rails on the latter lines to accommodate the wheel flanges of the interurban cars. The flanges of these cars are deeper and broader than those on the ordinary city street cars, and a sufficiently deep groove on city rails is not always found. In Muncie, ind., some of the rails were grooved and some were not, and the Union Traction Company, not wishing to go to the heavy expense of laying grooved rails over the entire system, adopted an expedient which solved the problem in a satisfactory manner. The solution was found in grinding out a groove on the old rails to the necessary depth and width. The means of doing this is illustrated in the accompanying illustration. The device was invented by the company's electrician, Mr. Chas. Fansler. At one end of the car is a swinging frame on which is supported an emery wheel belted to a car motor which has been disconnected from the trucks. A water rheostat furnishes the necessary resistance for the speed of the abrasive wheel, which is about 1400 r. p. m. The device is operated by a workman seated at the side of the car, as shown. Although the process is a very slow one, it is regarded as more feasible than any known at the present time. Under the best conditions it requires three to four weeks' time to properly cut out the grooves in 300 ft. of track.


GRINDING GROOVES IN RAILS.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2½ per cent. Time money during the week was in fair demand, the rates being 3 per cent for 60 days, 3½ per cent for 90 days, 3½@4 for four, five and six months. Mercantile paper was not very plenty; in fact, the output was unusually light for this season. The rates are 4 per cent for 60 to 90 days' indorsements, 4 to 4½ per cent for choice, four to six months single names and 5 per cent for others. Bank clearings for the week aggregated $2,105,217,139, a decrease of 31 per cent over the corresponding week of a year ago. Outside of New York the decrease was 10 per cent over the previous week, but the gain over a year ago was 21 per cent. In the stock market generally favorable conditions, including continued easy money, gave strength to securities, although the speculation was mainly professional. Manipulative public buying of investment securities was, however, large, and bond prices are higher. Traction securities were strong on support and covering, and gas stocks advanced. The steel industrials were dull and strong. There was considerable activity in Brooklyn Rapid Transit during the week, the sales—191,750—being greater than any recorded for several weeks. The quotations ranged from 78, the lowest, to 82⅜, the highest, at which latter point the stock closed. This represents a net gain of 3¾ points on the week's business. While the transactions in Metropolitan Street Railway were only about one-half of those of the week previous, the tone was stronger, the stock closing with a net gain of 2⅜ points. General Electric was weaker, transactions being light. The number of sales was 4400 shares. The quotations were on the downward scale and the stock closed with a net loss of 2½ points. Western Union was a little firmer and closed with a net gain of 1⅛ points, although the sales of 16,440 shares were only about one-half of those of the preceding week. In the list of outside securities the steel stocks practically monopolized the attention of the brokers at the close. Electric Vehicle common is higher; Electric Boat common fell off 1 point, and Telegraph, Telephone & Cable of America gained 1¾ points. The following are the closing quotations at the four financial centers:

NEW YORK.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
General Electric........	215	211½	Electric Vehicle.........	14	15
Brooklyn Rapid Transit..	78⅝	82⅜	Electric Vehicle, pfd....	—	25
Metropolitan Street Ry..	165	167⅜	General Car.............	2¼	2
American Tel. & Cable...	95	—	Illinois Elec. Veh. Tran..	1	1
Western Union Tel......	87⅞	88½	Hudson River Tel......	120	120
American Dist. Tel.....	36	36½	N. E. Elec. Veh. Tran...	3	2⅞
Commercial Cable.......	—	—	N. Y. Elec. Veh. Tran...	4	4
Electric Boat...........	25	24	Tel. & Tel. Co. of Am..	4¼	6
Electric Boat, pfd.......	50	50	N. Y. & N. J. Tel......	180	178
Electrical Lead Reduc'n.	—	5⅛			

BOSTON.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
New England Telephone.	135	—	Erie Telephone.........	51	53½
Mexican Telephone......	*2⅞	3¼	General Electric, pfd....	—	—
Westinghouse Electric...	60	62	Am. Tel. & Tel.........	160	160
Westinghouse Elec., pfd.	—	71	Boston Electric Light...	—	—

PHILADELPHIA.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
Electric Storage Battery.	74	72	Philadelpbia Elec.......	6⅛	6
Elec. Storage Bat., pfd..	76	76	Pa. Electric Vehicle.....	1½	*1
Elec. Co. of America....	8½	8⅜	Pa. Electric Vehicle, pfd.	1	*¾
General Electric Auto...	—	—	Am. Railways...........	34½	38½

CHICAGO.

	Mar. 9.	Mar. 16.		Mar. 9.	Mar. 16.
Chicago Edison.........	150	154½	Chicago Telep. Co.......	260	260
Chicago City Ry........	260	270	Union Traction.........	15½	16
National Carbon........	16	15¾	Union Traction, pfd.....	56	56½
National Carbon, pfd....	83	82½	Northwest. Elev. Com....	35½	39

*Asked.

DIVIDENDS.—The executive committee of Western Union has recommended the declaration of the regular quarterly dividend of 1¼ per cent. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway, a dividend rental of 1¾ per cent ($1.75 per share) will be paid West End common stockholders on April 1. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent, payable April 15, on the preferred stock. The directors of the Seattle Electric Company have declared the first regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1. The United Traction & Electric Company, of New Jersey, has declared the regular quarterly dividend of 1 per cent, payable April 1.

COMMERCIAL CABLE.—Baring, Magoun & Co. offer at 101 and interest $2,000,000 first mortgage 4 per cent gold bonds of the Commercial Cable Company, incorporated under the laws of the State of New York. These bonds constitute the final issue of the authorized mortgage of $20,000,000, covering the entire property of the Commercial Cable and the Postal Telegraph companies. The net earnings for last year were $2,678,666, out of which $500,000 was added to the reserve fund, aggregating now $4,466,642, invested in United States Government and first-class American railroad bonds. The bonds are exchangeable into sterling debenture stock at £206 for each $1,000 bond. The stock of the Commercial Cable Company pays 8 per cent dividend yearly. As we go to press it is stated that the whole issue has been sold.

NEW YORK & NEW JERSEY TELEPHONE.—On March 15 the New York & New Jersey Telephone Company filed with the Secretary of State at Albany a certificate of increase of its capital stock from $8,000,000 to $15,000,000. The company has a paid-in capital of $7,500,000 and debts and liabilities of $2,588,247. As announced in this department of our issue of March 9, the increase of capital will be devoted to improvements in existing plant and extensions.

CINCINNATI CONSOLIDATION.—The North American Company, now controlled by J. P. Morgan & Co., will obtain control of the gas and electric light companies in Cincinnati, and consolidate them into one corporation. The companies concerned are the Cincinnati Gas Light & Coke Company, capital $9,000,000, no bonded debt, and Cincinnati Edison Electric Light Company, capitalization $1,000,000 stock and $2,000,000 bonds. There has been considerable antagonism between the two.

MEXICAN TELEPHONE.—The annual meeting of the Mexican Telephone Company will be held May 8 in New York. The annual report for year ended Feb. 28, 1901, will show a surplus not far from the surplus of the previous year, which was $26,519. The net earnings for the year just closed were the largest in the history of the company but heavy expenditures have been made for construction, this item showing an increase of over $30,000, as compared with the previous year, and charged to earnings.

CHICAGO ELEVATED.—Secretary Higgison of the Metropolitan Elevated Railroad Company has issued a circular to stockholders announcing the desire of the management to issue $1,400,000 additional bonds for the purpose of completing the extensions to the road recently outlined by the president of the company. A special meeting of the stockholders has been called for April 8 to authorize the issue of these bonds.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has declared its regular quarterly dividend of 1¾ per cent on preferred to stockholders of record April 1. The directors have voted to issue $3,000,000 par value of recently authorized increase in capital stock, price, terms and conditions of issue to be determined upon recommendation of special committee at regular board meeting to be held March 27.

THE SEATTLE ELECTRIC COMPANY.—The directors of the Seattle Electric Company have declared the first regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1. This company was organized in January, 1900, by Messrs. Stone & Webster, of Boston, to take over and operate nine trolley railways and three light companies of Seattle. Its capital stock consists of $5,000,000 of the common stock, $1,250,000 of preferred.

MUNICIPAL TRAMWAYS IN BERLIN—Under date of Jan. 31, 1901, Consul-General Guenther writes from Frankfort: "The Local-Anzeiger, of Berlin, states that on Jan. 30, 1901, the city paid $2,380,000 to Koenen & Co., thereby becoming proprietor of the Siemens & Halske street car lines. The shares of stock have been delivered to the magistracy."

MASSACHUSETTS ELECTRIC COMPANIES.—Steps are being taken to secure a New York market for the securities of the Massachusetts Electric Railway Company, which controls some 35 street railway lines in Massachuseets north and south of Boston, and a few others extending into New Hampshire and Rhode Island. At present these securities are only on the Boston market.

GENERAL ELECTRIC.—It is again stated on good authority that the directors have informally decided to authorize a stock dividend at the annual meeting in May, giving one share for three; and to increase the dividend rate to 10 per cent. The annual report, about completed, is said to show a gross business of $32,000,000, with net profits upwards of $7,000,000, or about 32 per cent on the present capital stock.

CARBORUNDUM.—The Carborundum Company, of Niagara Falls, N. Y., has called a special meeting of stockholders for May 14, to take action on a proposed increase in the capital stock from $300,000 to $600,000, and an increase in the bonded debt from $75,000 to $400,000.

BELL TELEPHONE COMPANY, of Canada, has doubled its capital stock to $10,000,000, and a bond issue of $2,500,000 has been voted.

CHICAGO TRACTION DISPUTE.—An attack on the operating agreement by which the bonds of the Chicago Union Traction Company were exchanged for the stock of the Chicago Consolidated Traction Company by Charles T. Yerkes and others on April 16, 1900, is made in a bill filed in the United States Circuit Court at Chicago on March 16, by I. & S. Wormser, of New York. The Court is asked to declare this agreement illegal and to make an accounting in favor of the stockholders of the Chicago Union Traction Company. The defendants named in the bill are the Chicago Union Traction Company, the Chicago Consolidated Traction Company, the Equitable Trust Company, Charles T. Yerkes, John R. Walsh, Harvey T. Weeks, Benjamin Lamb, L. S. Owsley, Emile H. Grigsby, W. F. Furbeck & Co., A. L. Dewar, Dewar & Yerkes, John M. Roach, Jesse Spalding, Walter Wilson, C. L. Hutchinson, C. G. K. Billings, William Dickinson, James H. Eckels, P. A. B. Widener and J. V. Clarke. The complainants are bankers in New York City and are the owners of $475,000 worth of preferred stock and $250,000 worth of common stock of the Chicago Union Traction Company. The bill asks, should the agreements between the Chicago Union Traction and the Consolidated Traction companies be upheld, that the bonds in question be returned to the former company, now in control of the north and west side lines, and in case the Court finds the transaction was void, then it is asked to adjust the rights and equities of the plaintiffs and other stockholders of the Chicago Traction Company. It is alleged that earnings were seriously misrepresented.

Commercial Intelligence.

THE WEEK IN TRADE.—Developments in trade during the week were not characterized by any distinctive features, although it can be said that the improvement noticed during the past few months continued, and that the outlook for the future is very promising. Firmer prices are reported in a number of staples, except in the iron trade. In the latter reports indicate exceptionally prosperous conditions. The earnings of railways continue to show large increases. Collections are good and money remains easy. *Bradstreet's* says that the general situation is without important change, the events of the week appearing to accentuate heretofore prevailing conditions. Distributive trade and speculation in securities continue large in volume with prices rising in the more favored industries, and drooping in those suffering from depression. As types of these movements the iron and cotton goods industries are pre-eminent. In most other industries the reports are quite favorable. Railway returns continue highly favorable, the gross for the month of February aggregating $52,812,365 on 104 roads, a gain of 7.6 per cent over a year ago. The Southwestern roads show the largest gains (22 per cent), followed by the Southern roads with an increase of 10.8 per cent. Conditions in the domestic iron and steel demand recall the boom of 1899, and it becomes more and more evident that an enormous consumptive demand, discouraged by the high prices of a year ago, is now coming freely into the market. Bar and structural material are firm, and heavy hardware is active and advancing. Foreign reports are as blue as domestic advices are bright, but it is noteworthy that a very large order for pipe is reported captured by Americans despite strenuous efforts by foreigners. The Government report of wheat in farmers' hands amounting to 30,000,000 bushels less than a year ago, was regarded as a bullish feature, and coupled with light Northwestern receipts caused a rise, which was, however, taken advantage of to realize, and the net change for the week was slight. *Bradstreet's* reports the number of failures for the week as 217 against 208 the previous week, and 205 the corresponding week last year. R. G. Dun & Co. computes the liabilities for the two weeks of March at $4,253,646, against $6,206,491 the corresponding week last year. The copper market was very dull and prices were kept at the previous rates. Lake is quoted at 17 cents and electrolytic and casting stock at 16⅝ cents.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended March 6: Antwerp—1 package electrical machinery, $25; 10 packages electrical material, $1,556. Argentine Republic—95 packages electrical material, $4,038; 16 packages electrical machinery, $1,993. Bristol—1 package electrical machinery, $100. British East Indies—1 case electrical machinery, $100. British Possessions in Africa—200 packages electrical machinery, $19,482; 19 crates auto vehicles, $4,288. Brussels—12 packages electrical material, $163; 8 cases electrical machinery, $900. Brazil—958 packages electrical material, $31,274; 13 packages electrical machinery, $8,127. British Australia—62 packages electrical material, $15,590; 16 packages electrical machinery $1,405. British West Indies—64 cases electrical material, $500. Cuba—59 cases electrical material, $6,480. Central America—337 packages electrical material, $2,951. Chili—25 packages electrical material, $1,371. Copenhagen—1 case motor vehicles, $1,500. Dundee—3 crates trolley wagons, $350. Dutch West Indies—13 packages electrical material, $462. Ecuador—73 cases electrical material, $774. French West Indies—1 box electrical material, $15. French Possessions in Africa—1 case electrical material, $38. Glasgow—97 packages electrical material, $1,021; 53 reels electric cable, $20,655; 3 cases motors, $182; 7 cases electrical machinery, $1,500; 75 reels electric cable, $24,246. Genoa—1 case electrical material, $64. Hayti—2 packages electrical material, $38. Hamburg—2 packages electrical machinery, $315; 106 packages electrical material, $7,743. Havre—60 packages electrical machinery, $4,950; 45 packages electrical material, $1,455. London—129 packages electrical machinery, $10,960; 63 packages electrical material, $1,604; 34 packages motor vehicles, $14,700. Liverpool—75 packages electrical machinery, $17,803; 238 packages electrical material, $2,747; 3 packages motor vehicle parts, $275; 4 packages auto registers, $150. Mexico—90 packages electrical material, $1,017; 11 cases electrical machinery, $110. Milan—3 cases electrical material, $220. Manchester—4 packages electrical material, $895; 4 crates trolley wagons, $5,750. Marseilles—1 case electrical machinery, $40. New Zealand—1 package electrical machinery, $700. Naples—1 case electrical material, $2,301. New Castle—10 packages electrical machinery, $1,000. Peru—31 cases electrical material, $2,301. Rotterdam—1 package electrical material, $75. Southampton—13 cases electrical material, $489. Stockholm—2 cases electrical material, $61. Sheffield—2 cases electrical material, $138. Siam—41 packages electrical material, $1,641. United States of Colombia—2 packages electrical material, $20; 1 case electrical material, $562. Venezuela—180 packages electrical material, $1,269; 1 package electrical machinery, $62. The exports of electrical material from New York for the week ended March 13, were: Antwerp—2 packages electrical machinery, $500; 12 packages electrical material, $340. Argentine Republic—105 cases electrical material, $4,535; 33 packages electrical machinery, $3,516. Bristol—230 packages electrical machinery, $29,063. British Guiana—28 cases electrical material, $309. British East Indies—7 packages electrical material, $180; 8 cases electrical machinery, $900. Berlin—20 packages electrical machinery, $622. Bordeaux—80 cases electrical material, $4,000. British Australia—33 cases electrical machinery, $3,300. Brazil—10 packages electrical machinery, $1,320; 2 packages electrical material, $45. Barcelona—5 packages electrical material, $100. British Possessions in Africa—86 packages electrical material, $14,060. British West Indies—44 packages electrical material, $458; 2 cases cables, $163. Chili—4 packages electrical material, $90. China—3 cases electrical material, $58. Cuba—8 cases electrical machinery, $1,026; 144 packages electrical material, $2,803; 6 packages telephone supplies, $1,246. Glasgow—103 reels electric cable, $28,294; 3 packages electrical material, $134; 25 packages electrical machinery, $2,595. Gibraltar—8 packages electrical machinery, $776. Genoa—126 packages electrical material, $272. Hamburg—4 packages electrical machinery, $223; 3 packages electrical material, $851. Hong Kong—82 packages electrical material, $2,567; 1 case electrical machinery, $105. Havre—9 packages electrical machinery, $575; 28 packages electrical material, $1,767. Japan—52 cases electrical machinery, $7,061; 148 packages electrical material, $15,940. London—297 packages electrical machinery, $30,380; 146 cases electrical material, $11,817; 1 case cables, $100; 18 packages motor vehicles and parts, $8,750. Liverpool—174 packages electrical machinery, $25,720; 246 packages electrical material, $18,719; 3 packages motor carriage material, $287. Manchester—11 packages electrical machinery, $2,420; 3 cases electrical material, $356. New Zealand—7 cases electrical material, $315. Naples—1 box electrical material, $60. Peru—3 cases electrical material, $70. Patras—12 cases electrical material, $740. Rotterdam—2 packages electrical machinery, $183. Southampton—68 packages electrical material, $1,900; 1 case electrical machinery, $53. Sheffield—5 cases electrical material, $150. United States of Colombia—51 cases electrical material, $980. Venezuela—1 package electrical material, $17.

THE WATSON-STILLMAN COMPANY, of New York City, is now completing orders for a number of reversed cylinder presses and special machines for installation in the shops of the Brooklyn Navy Yard and the Frankfort and Rock Island arsenals. The Edward P. Allis Company, of Milwaukee, has requisitioned for several special electric bending machines, which are to be driven by small motors. F. H. Stillman states that he has all but decided to move the present plant in East Forty-third Street, and is looking into the matter of a suitable location. The new works will have nearly double the capacity of the existing plant.

THE CITIZEN'S ELECTRIC LIGHT & POWER VOMPANY, of Rochester, N. Y., of which W. E. Crane is chief engineer, is placing some important contracts for equipment, etc. Thayer & Co., of New York City, have secured the boiler contract. Eight Cahall boilers, aggregating 6000 hp, have been requisitioned for. The engine contract has not yet been given out.

NEW POWER BUILDING IN CINCINNATI.—Mr. George T. Alter will erect a large building on the corner of Eighth and Sycamore Streets, Cincinnati, Ohio, for the exclusive use of small manufacturers. It will be equipped with a very large and complete electric power plant.

PURCHASES FOR BROOKLYN TROLLEYS.—The Brooklyn Heights Railroad Company has just determined on some important contracts for power-house equipments. In its new generating station at Third Avenue and Gowanus Canal, Brooklyn, 24 double-deck Cahall horizontal water-tube boilers, aggregating 16,000 hp, have been ordered through Thayer & Co., of New York City. This contract will incur an expenditure not far short of a quarter of a million dollars. The Dickson Manufacturing Company, of Scranton, Pa., has secured the engine contract for the same plant. The equipment will consist of five vertical cross-compound condensing Corliss engines, each having an i. h. p. of 4000, the maximum being 6000 hp. These engines, each of which will be direct connected to a 2700-kw Westinghouse generator, are to have a 16-inch stroke, 42-inch high pressure, and 86-inch low-pressure cylinders; piston rods, 8 inches in diameter, while the crank-pins will be 15 inches in diameter by 15 inches in length. The flywheels are to weigh 240,000 lbs. each. The combined weight of the five engines will be about 2500 tons. The Dickson Company has also obtained a contract calling for two engines of a similar description, which are to be installed in the Kent Avenue plant. President Zehnder, of the Scranton concern, states that the value of the combined engine contracts is about $550,000. The Brooklyn company has begun to build some of its own cars in the company's shops, located at Fifty-second Street and Second Avenue. They are at present engaged in the construction of 20 open and 5 closed cars. Contracts for the building of 50 elevated cars are about to be placed outside.

NICARAGUA.—The Compania de Transportes de Matagalpa, Limited, has completed its survey of the route from Momotombo to Matagalpa, finding the distance to be but 79 miles. The maximum grade will be about 10 per cent, and the engineers say there are no obstacles to be encountered, even for railway construction. The company has proposals from numerous manufacturers of traction motors and wagons, and unless a railway project should develop, work will be commenced on road building when the present crop of coffee is out of the way. A line to navigable water on Lake Managua would cover but 45 miles at most, and on only 9 miles of this distance will grading be required. The rest is over perfectly level country, and, as water power is plentiful, there is some talk of abandoning the traction idea and laying a light electric road instead. This road, which would reach the lake near San Francisco del Carnicero, would pass through a good farming and grazing country, and, it is believed by many, would be remunerative. The coffee planters would give a company organized to build this road a good bonus in the way of survey grades, ties, money and provisions.

THE YOUNGSTOWN ENGINEERING COMPANY of Youngstown, Ohio, will be incorporated within a few days with $50,000 capital stock, to manufacture cranes and conduct a general foundry and machine works. The promoters of the company are Harry A. Boyd, Hugh Ferguson, S. J. Wainwright, Jr., and John Runnette of Pittsburg, and B. F. Boyd of Youngstown. A site with an area of about 2½ acres has been secured near Haselton, where a large plant will be erected. The foundry building will be 80 ft. x 160 ft., of steel frame filled with tile. The machine shop will be 90 ft. x 160 ft., of the same construction, and there will also be a pattern shop, power house and office building. The machinery will all be electrically driven by independent motors. Contracts for the buildings and equipments have not yet been closed.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Tucker Electrical Construction Company, of New York, for the installation of a battery of chloride accumulators for the estate of Henry Villard at Dobbs Ferry, N. Y. The battery is to be used for residence lighting, and consists of 68 elements, having a discharge at the normal rating of 280 ampere-hours, and will be operated in connection with two 12½-kw dynamos driven by two 20-hp gasolene engines. For the ordinary requirements the battery will be charged during the day, and will carry all the lighting load, but on special occasions will be operated in parallel with the dynamos. This battery is to replace a smaller installation made by the company in October, 1896, and destroyed by lightning last summer.

CHICAGO CONDUITS.—At a recent meeting in Chicago of the representatives of the Western Union and Postal Telegraph companies, the Chicago Edison Company, the Chicago Telephone Company and the City of Chicago, an agreement was reached by which the various interests involved will build a conduit for joint use for one-half mile in Archer Avenue, and probably a similar plan will be adopted on many more miles of street. The companies met the city half way in the matter, as it is felt that underground construction is becoming desirable on many of the outlying streets where there has been none before. The city will own the conduit, but the four companies will have rights equal to the city with the exception of positive ownership.

THE NEW JERSEY FOUNDRY & MACHINE COMPANY, of New York City, has been awarded an important contract for the installation of a special hoisting longitudinal and cross-conveying plant in the works of Walter Baker & Co., of Milton, Mass. The equipment, which, it is stated, will be the first of its kind in operation, is to be electrically driven. The C & C Electric Company, of New York City, has obtained an order for three 5-hp and the same number of 3-hp motors. The machinery is to be utilized for the handling of cocoa. Two men will unload the bags from the cars onto the upright conveying apparatus. The machinery will then automatically load a building at the rate of six bags a minute. Nearly 2500 ft. of track will be used.

PROJECTED ELECTRIC ROAD IN BARCELONA.—Consul-General Lay reports from Barcelona: "I am informed that Messrs. Corady y Cia. have obtained from the municipality of Barcelona a concession to build an electric railway 8 kilometers (4.9 miles) in length around the mountain of Montjuich. I understand the rails have been contracted for in Belgium. The line is not to be constructed on the trolley system; the cars are to be drawn by electric engines. The chief engineer is the Marquis Armand de Bourbon Neilson, and his address is 'care of Messrs. Corady y Cia., Boria, 1 plaza Angel, Barcelona. Our electrical supply and equipment companies should correspond with him. He states that engines, accumulators and cars are required.

THE BURDETT-ROWNTREE MANUFACTURING COMPANY, of New York City, reports a steadily growing increase in its exports of electric dumb-waiters, particularly to England. Twelve equipments, valued at $16,500, are about to be shipped to R. Waygood & Co., of London. Builders in the British metropolis having recently begun the construction of high buildings, the Londoners are just awakening to the possibilities of the many American elevator time-saving contrivances, and fair-sized shipments of automatic elevator door-operating attachments are being forwarded to Continental Europe.

BULLOCK ELECTRIC.—A report was very persistently circulated last week to the effect that either the General Electric or Westinghouse interests had bought control of the Bullock Electric Manufacturing Company. Upon inquiry being made, the report was denied in all quarters as utterly without foundation. Mr. R. T. Lozier, who represents the Bullock interests in this section of the country, said, just before leaving to close a large contract in Canada, that there was absolutely nothing in the rumor. On the contrary, the Bullock headquarters in New York were being enlarged in order to keep pace with the increased staff and growing business.

THE CHICAGO COATED BOARD COMPANY, of Chicago. Ill., is about to place some important contracts for the equipment of its new factory which will be built at Piermont, N. J. In the projected works which are to be utilized for the manufacture of cardboard will be installed a 1500-hp steam plant. There will be a number of electically-driven elevators, while several machine tools are also to be driven by similar power. The plant is to be lighted by electricity. President Williams is now in New York City, at the Waldorf-Astoria, for the purpose of placing the requisite contracts.

GENERAL ELECTRIC AND COPPER.—A report that the General Electric Company had just completed a deal involving the purchase of some 80 copper mines in Southeastern Arizona, is without any definite foundation. The General Electric Company has for some time past been investigating a small number of mines and prospects in that region, but no conclusion has been reached in regard to them, and nothing will be decided upon within four months from now at the earliest.

ELECTRIC RAILWAY EQUIPMENT WANTED.—A company is being formed at Hopkinsville, Ky., to build and operate an electric railway from that point through the town of Cadiz., Ky., to Canton on the Cumberland River, also a street railway in the city of Hopkinsville. lighting, etc. Messrs. Bassett & Co. desire to be put in communication with the best supply dealers and receive all information relative to such a project.

WESTINGHOUSE CAR EQUIPMENTS.—The Cleveland office of the Westinghouse Electric & Manufacturing Company has received a contract for 10 car equipments for the new line being built from Richmond to Petersburg, Va., by Cleveland and Akron people. The cars wll be equipped with four motors of 40-hp each. The company will not build a power house.

PRICES OF TELEPHONE APPARATUS.—The Boston News Bureau says: "The Western Electric Company is preparing a new schedule of prices for material it furnishes the Bell subsidiary companies, quoting a large reduction in prices. The discounts vary from 2 per cent to 50 per cent." Officials of the company are not talkative, however, not even over the telephone.

THE LIDGERWOOD MANUFACTURING COMPANY, of New York City, has secured a contract for the furnishing of some large double-drum electrc hoist equipments, which are to be shipped to the Dutch East Indies, where they will be utilized for mining operations in the vicinity of Celebes.

General News.

THE TELEPHONE.

HILLSBORO, ALA.—A company has been organized to construct a telephone system from Hillsboro to Moulton.

TOLEDO, OHIO.—The Northwestern Ohio Telephone Company has increased its capital from $20,000 to $40,000.

BEDFORD, IND.—The council of this city has granted franchises to three new telephone companies, the Hoosier Company being the largest.

BALTIMORE, MD.—The Hughes Telephone Company has been chartered, with capital stock of $100,000, by Charles C. Hughes and J. Murray Burrell.

ALBANY, N. Y.—The Queen City Telephone Company has been incorporated with a capital stock of $500,000, to operate a telephone system in Buffalo.

BEAUMONT, TEX.—Lawrence Harrison, T. C. King and S. E. Chapan have incorporated the Southwestern Telephone Company, with a capital stock of $50,000.

LAFAYETTE, TEX.—The Union Telephone Company has been incorporated with capital stock of $5,000 by H. C. Smith, H. N. Donoho, John B. Dalton and others.

PRESTON, TEX.—The Preston Bend Telephone Company has been chartered with a capital stock of $5,000 by A. G. Noble, Hamp Willis, R. A. Owen and J. T. Watkins.

MILWAUKEE, WIS.—The Wisconsin Telephone Company's South Side exchange is being equipped with a new switchboard which will greatly increase the capacity of the station.

ST. CHARLES, MO.—The City and the Kinloch Telephone Company made a contract on March 11. The company is granted the right to place its wires above the city wires on the city poles.

CRAWFORDSVILLE, IND.—The Bell Company has started a telephone war in this city by cutting in two the rates of the Home Company and making an aggressive canvass for subscribers.

BLOOMDALE, OHIO.—The Central Union Telephone Exchange at this place has doubled the number of its subscribers since this time last year, and is constantly adding new ones to the list.

DES MOINES, IA.—Articles of incorporation were filed by the Gladbrook Telephone Company. Its capital stock is $10,000. Samuel B. Montgomery, F. W. Browne and A. R. Kroh are the incorporators.

CADIZ, OHIO.—The new exchange of the Harrison County Telephone Company at this point will commence operations about April 1. Toll lines are being built to St. Clairville, New Athens, Flushing and other points.

WABASH, IND.—The Home Telephone Company of this city has four copper wires to Marion. Recently unknown persons cut and carried away a quarter of a mile of each wire, thus destroying communication for 24 hours.

PITTSBORO, IND.—The Pittsboro Telephone Company of Pittsboro has been incorporated. Capital stock, $3,000. Incorporators: Charles P. Sowder, W. D. Lewis, Samuel Janes, John T. Bell, E. W. Sawyer and A. A. Surber.

TOLEDO, OHIO.—The Harrison Telephone Company (Bell) is preparing to install an exchange and system in East Toledo. It is stated that 300 subscribers have thus far been secured. Rates will be $30 per year for business and $24 for residences.

ELWOOD, IND.—J. J. Netterville, president of the Anderson Telephone Company, has applied for a franchise for his company to build and maintain an exchange in this city. The Bell Company has no opposition here, and is operating 500 telephones.

NASHVILLE, TENN.—The Cumberland Telephone & Telegraph Company and the Cincinnati Company will build new lines connecting Cincinnati with the important cities of the Central South. The Cincinnati Company will build about 300 miles of new lines.

PORTAGE, WIS.—The Portage Telephone Company has decided to build its new long-distance line from Portage to Merrimac as soon as poles can be set. A branch line will also be extended to Durward's Glen. The Portage-Merrimac line will cover a distance of 18 miles and will run through Caledonia and Alloa.

ALBANY, N. Y.—The Hudson River Telephone Company has filed a certificate of increase of capital stock from $3,000,000 to $4,000,000. The additional capital will be employed in extensions and improvements. At the annual meeting of the company, Walter C. Humstone, of New York, was elected a director of the company, to fill a vacancy.

AMERICAN TELEPHONE & TELEGRAPH.—The annual meeting of the stockholders of the American Telephone & Telegraph Company will be held at the office of the company, 15 Dey Street, New York, on Tuesday, March 26, 1901, at 12 o'clock. The question of "conveying to certain licensee companies certain lines" will be considered, among other things.

CEDAR FALLS, IA.—The farmers of Lake View, in order to compete with the Bell Telephone Company and secure better service, have organized a company among themselves and elected Charles Irwin president and B. Broughton secretary. The exchange at Lake View will be placed at the free disposal of the public for connection with Wall Lake, Sac City, Early and Odebolt.

FREDERICK CITY, MD.—The Catoctin Telephone & Telegraph Company has been organized at Wolfsville, Md. The object of the company is to build a telephone line from Myersville to Wolfsville, via Ellerton and Middlepoint. The incorporators are Dr. Alvey J. Smith, president; Ashbury E. Hoover, secretary; William E. Hankman, treasurer; Upton Grossnickle and Cyrus Flook.

MARTIN, TENN.—The Weakley County Telephone Company has 300 subscribers and a switchboard capacity of 350 drops. It uses the apparatus of the Stromberg-Carlson Company and other concerns. The company expects to add 200 new subscribers in the near future. It is building lines to two separate towns, where connection will be effected with 1500 subscribers of other independent companies.

ST. LOUIS, MO.—The dime slot is being plugged and the nickel slot opened in the pay telephones of the Bell Telephone Company, in compliance with an order of the company which went into effect March 1. The tolls on all city messages are reduced. The change has already been made in about 150 of the 300 pay telephones in use throughout the city. The rates on out-of town messages will remain unchanged.

CHICAGO, ILL.—The council committee on gas, oil and electric lights has recommended for passage a 25-year franchise for the United Telegraph, Telephone & Electric Company. It is stated that the new company will charge half of the present telephone rates and 5 cents per message for public pay stations. The company was formerly the Hyde Park District Telegraph, Telephone & Electric Company, and is now operating 600 telephones in Hyde Park.

HOOPER, NEB.—The Hooper Telephone Company has been organized with a capital stock of $50,000. It is an independent company. The following directors were elected for the first year: T. W. Lyman, Jerry Denslow, A. M. Tillman, B. Monnich, M. E. Shipley, E. O. Spielberg, and J. Howard Heine. The officers are: T. W. Lyman, president; B. Monnich, vice-president; J. Howard Heine, secretary; Jerry Denslow, treasurer; M. E. Shipley, general manager.

HARTFORD CITY, IND.—The warfare between the Central Union and Indiana Telephone Companies here has reached a point where talk is as cheap as silence. The former company has maintained an exchange here for ten years, beginning with $5 and $4.50 rates for business houses and residence, respectively. The Indiana Company organized and rates went down to $2 and $1.50, and now the Central Union has made a dollar rate and the Indiana Company will meet it

PHILADELPHIA, PA.—The authorities of Pensauken Township in New Jersey recently cut down the poles and lines of the Delaware & Atlantic Telegraph & Telephone Company, because, it is alleged, the company had never obtained permission to erect them. The township committee several times requested the company to remove the poles, but no attention was given to these notices, hence the action of the authorities. One hundred and sixty-seven poles in all were chopped down.

SKAGUAY, ALASKA.—The Alaska General Electric Company has an exchange of 110-drop capacity and uses apparatus of the American Electric Telephone Company. It has 103 subscribers at the present time, 50 of whom were added during the past year. The company has been in operation only 13 months. It expects to start two more exchanges, one of 100-drop capacity at Juneau, and one of about 50 drops at Valdese. It will also complete a toll line during the next summer to connect Skaguay with Hains' Mission at Porcupine, about 75 miles distant. Mr. E. O. Caswell is the manager of the company.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company, with large stations in Minneapolis and St. Paul, after laboring under financial difficulties for the past two years, has recently been reorganized and will operate in the future under the name of the Twin City Telephone Company. The officers are Minneapolis men and the entire reorganization has been accomplished by local capitalists. Eder H. Moulton, of the Farmers & Mechanics' Savings Bank, will be president, and Joseph Lockey, of the National German American Bank, St. Paul, vice-president. The other officers are William M. Kerkhoff, of St. Paul, secretary and treasurer; Edward E. Webster, Minneapolis, general manager, and C. H. Judson, Minneapolis, general superintendent. New lines will be projected in all directions.

COLUMBUS, OHIO.—The annual meeting of the stockholders of the Columbus Citizen's Telephone Company was held last week. Officers and directors were chosen as follows: Henry A. Lanman, president; Henry A. Everett, vice president; Edwin R. Sharpe, secretary and treasurer; Frank L. Beam, general manager; Maxime Reber, consulting engineer; H. D. Critchfield and Frank A. Davis, counsel. Directors—Henry A. Lanman, H. A. Everett, E. R. Sharpe, H. D. Critchfield, J. B. Hanna, E. W. Moore, J. B. Hoge, James M. Thomas, W. A. Hardstey. It is of especial interest to note that while the company was organized in 1899 and commenced operations Aug. 1, 1900, a 3 per cent dividend on the capital stock of $750,000 was declared, payable April 1. The Columbus Company has about 4600 telephones in operation. Seventy per cent of the stock in the Columbus Company is controlled by the Federal Telephone Company, of Cleveland.

ELECTRIC LIGHT AND POWER.

LEXINGTON, MISS.—The Ice, Light & Water Company will install an electric light plant.

SPARTA, TENN.—The Gainesboro Telephone Company will erect an electric light plant here.

RAVENSWOOD, W. VA.—The city will soon let the contract for the erection of its electric light plant.

LITTLE ROCK, ARK.—The city will enlarge and improve its electric light plant at a cost of $16,000.

THORNTON, IND.—A new $10,000 municipal electric light plant was recently put into operation in this city.

CENTREVILLE, ALA.—Robert Vance will erect an electric light plant and construct a system of water works.

CLARENCE, MO.—The city will hold an election on the question of issuing $5,000 of bonds for an electric light plant.

GREENWOOD, IND.—The board of trustees of this town has granted to L. K. Davis a franchise for an electric light plant.

WALLOWA, ORE., will have a new electric lighting plant installed. The original plant will be set up again in Island City.

FAYETTEVILLE, N. C.—The city has purchased the plant of the Fayetteville Gas & Electric Light Company, and will operate the same.

BLOOMFIELD, IND.—A franchise has been awarded to E. H. Dugger and J. E. Merridith by the Council of this city for an electric light and power plant.

THE DALLES, ORE.—The City Council recently granted an electric lighting franchise to E. Kurtz, who will install a plant and sign a contract for city lighting.

ORD, NEB.—The Fairbanks-Morse Company will build and operate an electric light plant here. Work will begin as soon as material can be placed upon the ground.

ANDERSON, IND.—The City Council has reported favorably on the proposition of a loan of $200,000 to this city by Indianapolis capitalists to enlarge and improve the city electric light plant.

CAPE MAY, N. J.—Master in Chancery Norman Grey, of Camden, has sold to Henry Robb, of Philadelphia, the plant and franchise of the Franklin Electric Light Company, of this city, for $40,100.

TRENTON, N. J.—The Delaware Power Company, capital $2,000, has been incorporated. Incorporators: Lewis I. Fletcher, Easton, Pa.; Charles E. Griffiths, New York; Jacob S. Stewart, attorney, Phillipsburg, N. J.

SAN FRANCISCO, CALIF.—Among the recently incorporated companies is the Butte County Power Company of California. The directors are Henry U. Roedinf, A. W. Linforth, F. H. Pierson, H. R. Noack, H. Benedict, Jr., E. M. Cooper and F. V. Keesling.

WASHBURN, WIS.—The town board has taken action toward securing the Washburn Electric Light & Power Company's plant by purchase, under the terms of the contract through which the original franchise was granted. The town is paying $4,800 annually.

ELKHART, IND.—Leading business men and capitalists are organizing a new electric light company at Elkhart, and a petition for a franchise is now before the Council. It is claimed the Council will grant the franchise and also the contract for the city lighting to the new company.

RICHMOND, IND.—The bill authorizing incorporated cities not acting under special charter to create boards of electric light commissioners was passed, but not in time to prevent the letting of the contract for a new municipal electric light plant to cost $144,000. The commission, however, will have charge of the new plant.

LOS ANGELES, CALIF.—The Mount San Bernardino Power Company was recently incorporated, with Los Angeles as the principal place of business. Directors: F. H. Ringe, C. H. Howland, A. I. Cammon, E. P. Mapel, C. A. Leavens, W. F. Botsford and G. I. Cochran. Capital stock, $200,000; fully subscribed.

SOUTH BEND, IND.—Representatives of the St. Joseph Hydraulic Company are closing up the purchase of land that will be submerged by the building of a new dam 21 ft. high to obtain power for an electric power and light station at Needham. Electric energy will be transmitted to South Bend, Mishawaka, Elkhart and other nearby towns.

LOUISIANA, MO.—R. H. Goodman, representing the Louisiana Carbon Light Company, closed a deal March 7 transferring the Louisiana gas works and arc and incandescent light plants to L. M. Hall, of St. Louis. The company has issued stock to the amount of $25,000 and bonds to the same amount. The new purchaser, it is said, will make extensive improvements in the plant.

OLD ORCHARD, MASS.—The Old Orchard Water Works and the Old Orchard Electric Light plant have passed into the hands of George F. Haley, a Biddeford attorney. The purchase of these two plants involves nearly $200,000. It is understood that the water service and also the electric light service will be extended to Grand Beach and other adjacent resorts during the coming summer.

EGG HARBOR, N. J.—Surveyors are at work running out a tract of land surrounding the old paper mills at Weymouth, along the great Egg Harbor River. The water power is said to exceed 10,000 horse-power, and will be utilized at a power station for generating electricity for distant towns, and, it is said, will supply power for lighting and trolley for Vineland, Pleasantville, Atlantic City and this city.

SAN FRANCISCO, CALIF.—It is reported that a company has been formed by a syndicate of Boston capitalists to utilize the water power of the Grand Ronde River. In Asotin, Wash., a water right was recently filed, and it is said that the main power station will be located three miles from the mouth of tbe Grand Ronde River and that electric power will be transmitted 25 miles, to Lewiston, Idaho, and Snake River Valley points.

COLUMBUS, OHIO.—Dr. Gladden, chairman of the Council Lighting Committee, has made a detailed report as to his investigations regarding the cost of a municipal lighting plant. He calculates that a plant to furnish 1050 arcs lamps would cost about $120,000, and estimates that light could be furnished at a cost of $60.73 per lamp. He suggests that portions of the equipment of the Columbus Electric Company be purchased. Acting on the report the city clerk has been instructed to advertise for bids. Director Kauffman has prepared plans and specifications covering all kinds of lighting, and bids will probably be opened within the next two weeks.

CINCINNATI, OHIO.—The consolidation of the Cincinnati Gas Light & Coke Company's plant with its various subsidiary properties with the Cincinnati Edison Electric Light Company's interests is practically completed. Four of the lesser companies are owned and controlled by Gen. Hickenlooper, president of the gas company, the officers of three being the same throughout. The companies and officers are as follows: The Cincinnati Edison Electric Light Company—President, George Bullock; general manager, William F. White; assistant secretary and treasurer, Alfred Knight; superintendent, Harry C. Hutchinson. The Queen City Electric Company—Same officers. The First Cincinnati Edison Electric Light Company—President, A. Hickenlooper; vice-president, C. F. Hesser; secretary, H. A. Barnhorn; treasurer, Harold Ryland; office, corner Fourth and Plum Streets; power station, Elm Street, between Fourth and Fifth Streets. The Hauss Electric Lighting & Power Company—Same officers; office, corner Fourth and Plum Streets; power station, 1018 Broadway. The Brush Electric Company—Same officers, office and power station. The Jones Brothers' Electric Company—President, C. E. Jones; secretary and treasurer, H. R. Hooper; office and power station, 120-126 East Court Street.

THE ELECTRIC RAILWAY.

LANSING, MICH.—The Caro & Lake Huron Electric Railroad Company, capitalized at $200,000, has been incorporated.

NEWCASTLE, IND.—The Muncie-Newcastle Traction Company has secured the entire right of way between the two cities.

MAUMEE, OHIO.—The village council has granted a franchise through town to the Toledo, Napoleon & Defiance Railway Company

MARION, IND.—The Union Traction Company has decided to extend its line from this city to Converse and thence to Peru, 20 miles beyond.

CANAL WINCHESTER, OHIO.—A franchise has been granted to the Columbus, Winchester & Lancaster Traction Company through this place.

UPPER SANDUSKY, OHIO.—The promoters of the Tiffin & Southwestern Electric Railway Company have secured the right of way from Kenton to Marseilles.

ALBANY, N. Y.—The Richmond Beach Railway Company of Richmond Borough, New York City, has been incorporated. The company has a capital of $20,000.

MUNCIE, IND.—The Muncie Interurban Railway Company has secured the right of way for a road from this city to Hartford City and Red Key, and connecting a number of intermediate towns.

SPRINGFIELD, OHIO.—Representatives of interurban roads running into this city are looking over the field with a view to obtaining a site for a union interurban passenger and freight station.

CHARLESTON, S. C.—The Charleston Suburban & Summerville Railway Company has been commissioned. J. J. O'Connell of Charleston and others are interested. The capital stock is placed at $600,000.

DAYTON, OHIO.—It is stated that a deal has been effected whereby the Dayton & Xenia Electric Railway and the Dayton & Xenia Rapid Transit Company have been consolidated under one management.

WORCESTER, MASS.—The Worcester Traction Company has decided to dispose of its preferred stock, amounting to more than $3,000,000, to the syndicate now controlling all of the street railways of the city.

FRANKFORT, IND.—The Indianapolis & Frankfort Interurban Electric Railway Company has asked the county commissioners of Clinton County for a right of way over the highways of the county for a line from Indianapolis to this city.

HAMILTON, OHIO.—The County Commissioners have granted a franchise over the Hamilton, Springfield and Carthage turnpike to the Mill Creek Valley Street Railway Company, which is building a road between Cincinnati and Hamilton.

CLEVELAND, OHIO.—The committee appointed by interurban roads radiating from Cleveland has selected a site for an interurban passenger and freight station, and plans are being prepared for the building, which will be erected as soon as possible.

TOLEDO, OHIO.—The Toledo & Northwestern Ohio Electric Railway Company has secured a franchise from the county commissioners for its road between Holland and Swanton. Applications are now pending in Holland, Swanton, Bryan and Wauseon.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Traction Company has been incorporated by James M. Loren, O. J. Mitchell, Herman G. Dennison, James M. Shooler and Lorenzo M. Baker, all of Columbus. Temporary capital stock, $10,000.

WINSTED, CONN.—Mr. Ross Judson, of New York City, is at the head of a project to build an electric railway from the Massachusetts State line to Bridgeport, thus forming a continuous electric railway from New York to Pittsfield, Mass., a distance of 175 miles.

JANESVILLE, WIS.—The Beloit, Delavan Lake & Janesville Railway Company has filed articles of incorporation. Thomas A. Nolan, Jesse Earle and Edward H. Peterson, all of Janesville, are the incorporators. The capital stock of the company is placed at $100,000.

CLYDE, N. Y.—A franchise has been granted to the Clyde Electric Railway to construct a direct line through this village. This is part of a Rochester syndicate's plan for an electric road to connect all villages between Rochester and Syracuse and to light all the towns.

PHILADELPHIA, PA.—A bill in equity has been filed, requesting the appointment of a receiver for the Philadelphia, Morton & Swarthmore Street Railway Company. The petitioner is Mr. A. R. White, Jr. He is stated to be the owner of one share of the company's stock.

KANSAS CITY, MO.—The Independent Electric Railway of Kansas City, with a capital stock of $2,000, has been incorporated. Tbe incorporators are A. M. Hayes of Kansas City, Kan., and J. W. Crowley and Sidney Moore of Kansas City, Mo. Judge E. L. Scarritt is counsel..

CLEVELAND, OHIO.—Work has been started on the extension of the Chagrin Falls & Eastern Electric Railway between Troy and Garrettsville, which will be completed about June 1. After April 1 six cars will be operated to Middlefield eacb day instead of three, as at present.

TRENTON, N. J.—The Lancaster County Railway & Lake Company has been incorporated; capital, $2,000,000. Incorporators: Samuel R. Shipley, Philadelphia; William W. Griest, Lancaster; William B. Given, Columbia; Philip B. Shaw, Williamsport, and Lindley M. Garrison, Jersey City.

LYONS, N. Y.—The Lyons & Sodus Bay Railway Company was incorporated with a capital of $400,000. The directors are Daniel B. Platt, Ira M. Ludington, Charles Van Voorhis and Stephen G. Hollister, Rochester; Sanger W. Case, Sodus; James D. Bashford, Calvin Hotchkiss, Charles P. Williams and Daniel Parton, Lyons.

COLUMBUS, OHIO.—The Findlay & Southeastern Electric Railway will be incorporated within a few days. It is promoted by R. Rosenstock of Cleveland, O. J. Odenbaugh of Sandusky and M. W. Hammond of Mt. Blanchard, and it is proposed to build a line from Findlay to Delaware. With connections now building, this will make a through line from Columbus to Toledo.

CLEVELAND, OHIO.—On March 10 a trolley funeral attracted much attention on the streets through which it passed. It conveyed the body of Frank A. Heinline, late paymaster of the Big Consolidated Railway Company, to Lakeview Cemetery. There were seven cars in the procession, the first one being the company's regular funeral car, and the others being filled by employees and friends.

CLEVELAND, OHIO.—The Everett interests have practically closed a deal for the consolidation into one company of the Lorain & Cleveland Electric Railway, the Sandusky & Interurban Railway and the Sandusky, Norwalk & Southern Railway. The consolidated company will be known as the Lake Shore Electric Railway Company and it will be capitalized at $4,000,000. Barney Mahler, of Cleveland, will be president of the company, and the offices will be in this city. With extensions now being built, the system will have a mileage of over 120 miles. A traffic arrangement has been made with the Toledo, Fremont & Norwalk Railway so that passengers and freight will be carried from Cleveland to Toledo.

THE AUTOMOBILE.

DINNER TO AUTOMOBILISTS.—The DeDion-Bouton Motorette Company gave a dinner on March 16 to the members of the Automobile Club of America and the Long Island Automobile Club at its plant at Bath Beach. About 50 members of the two clubs rode to the dinner in their automobiles. In New York the start was made from the clubhouse on Fifth Avenue.

PERSONAL.

MR. JOS. E. LOCKWOOD, president of the Michigan Electric Company, Detroit, Mich., paid Chicago a visit last week.

MR. H. H. CUTLER, of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., was a visitor at Chicago last week.

MR. H. C. MARSH, who for the past year has been identified with the Seattle office of the Westinghouse Electric Company, has been transferred to the Cincinnati office. He is regarded as one of the Westinghouse people's best salesmen.

MR. W. KELSEY SCHOEPF, manager of the Cincinnati Traction Company, has been elected president of the Pittsburg Traction Company, succeeding the late C. L. Magee. His new duties will not involve his position with the Cincinnati Company.

MR. A. EDW. NEWTON, president of the Cutter Company, of Philadelphia, has been in New York a good deal during the past month. The growing business of this company now extends over a large part of the civilized world, and international connections require no small amount of attention.

MR. OSCAR T. CROSBY, of the Potomac Electric Company and the Washington traction system, has just published in the *National Geographic Magazine* a very interesting account of his explorations last year in new territory of the Abyssinian hinterland, unknown hitherto to the white man's foot. As an old engineer officer, Mr. Crosby was able to make observations of unusual value.

MR. GEORGE CLAPPERTON has recently been elected a director of the Postal Telegraph Cable Company, in whose service he has long been an able and efficient officer, his latest position being that of traffic manager of the entire Commercial Cable system. He is an Englishman by birth and has been active in railway and telegraph work since 1866, coming first to this country for the Direct United States Cable Company in 1874.

MR. F. P. FISH.—An authoritative report from Boston says that Mr. F. P. Fish, of the law firm of Fish, Richardson & Storrow, has been offered the presidency of the American Telegraph & Telephone Company and has the matter under consideration. Mr. Fish is general counsel for both the General Electric and American Telegraph & Telephone companies, and for years has been a leading authority on electrical patent questions and the commercial problems therewith connected.

MR. FRANK MARTIN, having been examined and found qualified for appointment as "electrician" under the provisions of Navy Yard Order No. 189, has been appointed as such in the department of yards and docks, Navy Yard, New York, vice Paul Bigelow, resigned. Mr. Martin was for many years with the Edison Electric Illuminating Company and the Madison Square Garden Company, in charge of electrical plants, and will find a good field for his endeavors in the new berth.

MESSRS. F. HIRD and R. Dumas, engineers of Siemens Bros., Ltd., of London, sailed for England on Saturday last. These gentlemen spent a busy month in America, visiting a number of prominent manufacturing establishments, where they met a hearty welcome. They also studied American tools, lighting stations, railway plants, etc. Before sailing, as a felicitous return for courtesies shown, they gave a charming dinner at the Fifth Avenue Hotel, at which the conversation would have done credit to an international electrical congress.

MR. C. T. YERKES.—The London *Evening News* prints an interview in regard to his investments in London underground railways. Mr. Yerkes is quoted as saying: "I have not bought anything except the charter of the Hampstead and Charing Cross Tube Company, and I do not contemplate purchasing anything else. One railway is enough at present. Mr. R. W. Perks, M. P., our solicitor, is also counsellor for the underground roads. Perhaps the story that I had purchased the entire underground system of London arose from that fact."

MRS. ISABEL FIELD JUDSON has just sent to the National Museum the half American, half British flag used by her father on board the United States frigate Niagara in 1856-57, in laying the first Atlantic cable. This flag, which is 45 ft. long, having a triangular division of the flags of the two countries, completes an already fine Field collection now in the museum. It was made under Field's immediate direction, and in addition to waving from the Niagara at the laying of the first cable, floated from the Great Eastern in 1866 and 1867 when the second cable was laid.

MR. G. MARCONI has arrived. He expects to stay in America a month and will visit the New England coast and Nova Scotia to find sites for receiving stations for his system. He says he has equipped 28 British 4 Belgian and 3 German warships with signaling and receiving plants. The North German Lloyd steamship Kaiser Wilhelm der Grosse is equipped with the Marconi system and there will be a special room aboard the line's new swift steamship Kronprinz Wilhelm, which will be in commission next September, for signaling through space. In regard to Tesla's declaration that he soon will be able to communicate with Europe without wires, Mr. Marconi says: "I do not see why that may not be accomplished in time. The possibilities of the field are almost infinite."

MR. T. H. MINSHALL, borough electrical engineer of Croydon, one of the most important towns in the vicinity of London, is at present on a visit to the United States. Mr. Minshall, who also acts as one of the consulting experts of the Metropolitan Lighting Company of London, has come to this country with a view to acquiring some knowledge of our large electrical and shop installations. He is now inspecting the Niagara Falls power station and intends to go from there on to Pittsburg and Chicago, returning to New York City in about a fortnight. While Mr. Minshall does not expect to actually place any orders for equipment during his sojourn here, it is suggested, through usually well-informed channels, that his present visit will result in the all but immediate placing of substantial contracts for American electrical machinery, etc., required for an extension of the Croydon and other British traction systems with which he is identified.

Trade Notes.

S. MORGAN SMITH COMPANY, York, Pa., maker of water wheels, etc., will equip a large addition to its works with electric cranes, etc.

THE CALUMET & HECLA MINING COMPANY, Calumet, Mich., is now using seven Cross oil filters, purchased from the Burt Manufacturing Company of Akron, Ohio.

BANQUET TO EMPLOYEES.—The Colonial Electric Company, Ravenna, Ohio, gave a banquet to its employees on March 15, celebrating the first anniversary of its removal from Warren to Ravenna.

THE BERGGREN HALF SHADE, for which the Electric Appliance Company, Chicago, is selling agent, is a device whereby the shade is attached direct to the socket, thus doing away with the necessity of a shadeholder.

ENGINE LATHES.—The Sebastian Lathe Company, Cincinnati, Ohio, describes and illustrates its engine and speed lathes in a pamphlet of recent issue. The company deals in shapers, drill presses, machinists' tools and supplies.

WARD LEONARD MOTOR STARTERS.—The Ward Leonard Electric Company, Bronxville, N. Y., has issued a leaflet giving specifications for Ward Leonard motor starters of the sand-box type, having "no voltage" automatic release.

LEATHER BELTING.—The Charles Munson Belting Company, Chicago, Ill., in a late circular, calls attention to its Eagle brand of leather belting. The Munson belt dressing and belt cement are also referred to, and their good qualities explained.

MILLING MACHINE.—The Kempsmith Manufacturing Company, Milwaukee, Wis., announces that it has purchased the Kempsmith Machine Tool Company from Mr. Frank Kempsmith. The new company will continue the manufacture of standard milling machines.

THE PHELPS COMPANY, of Elmwood, Ill., makers of the Hylo incandescent lamps, which comprise two filaments in one bulb, one filament being of 1 candle-power and the other 16 candle power, has opened a New England office at 170 Summer Street, Boston, in charge of J. L. Russell.

ELECTRICAL PRINTING INK.—In response to several inquiries with regard to an article in these pages recently, we beg to state that the address of the concern is Mr. Friese Green, care of the Electrical Inkless Printing Syndicate, Ltd., Clifton Mansions, Cold Harbor Lane, London, England.

BALL ENGINES.—The Marion Electric Light Company, Marion, Ohio, has recently installed a 250-hp engine in its plant. The engine was built by the Ball Engine Company, Erie, Pa. The Ball Engine Company is installing a 500-hp self-oiling cross compound engine, direct connected to two 150-kw generators in the Norfolk Navy Yard.

BRANCH TELEPHONE FACTORY.—It is reported that the American Electric Telephone Company, of Chicago, will establish a branch factory at York, Pa. This report is connected with that of the proposed consolidation of independent telephone companies in Pennsylvania, Maryland, West Virginia and Virginia, which is noted elsewhere in this issue.

LUNDELL MOTORS.—In Bulletin No. 205 of the Sprague Electric Company are described Lundell motors of various types. Lundell motors are made in sizes from 1-20 horse-power to 400 horse-power and are wound for wide range of speed and voltage. The illustrations show the various types of machines, and diagrammatic illustrations are also given.

A GAS MOBILE.—Those interested in gasoline automobiles will find pertinent information on the subject in a neat catalogue just issued by the Automobile Company of America, 32 Broadway, New York. The various types of machines of this company's make are very clearly illustrated. The pamphlet also gives views of the various departments of the works.

X-RAY APPARATUS.—Queen & Company, 1010 Chestnut Street, Philadelphia, have issued a large folding sheet giving useful information on their standard X-ray apparatus. Various illustrations of this apparatus are shown and a list is given of the catalogues issued by the firm. From this it appears that 20 separate publications of this character are issued by this house.

NATIONAL CARBON. A special dispatch from Cleveland, Ohio, of March 18 says: "A terrific explosion of chemicals in the laboratory of the National Carbon Works at West Madison and Highland Avenues early to-day partially wrecked the large brick building. Fire broke out immediately after the explosion, but was soon quenched. Loss, $70,000, partially covered by insurance."

TRAVELING CRANES.—The Theodore Kuntz Company, of Cleveland, Ohio, has recently installed in its log storage department a special two-motor electric traveling crane of five tons' capacity for handling logs. This crane is of special design, with a double hoist, and was manufactured by the Northern Engineering Works, Detroit, Mich. By means of this crane a great reduction in the cost of handling material is accomplished.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports among recent sales a 200-kw three-bearing belted type machine for the Laclede Gas Light Company, St. Louis, a duplicate of a machine sold that company about four months ago; five motors of the direct-connected type to Benedict Brothers of Baltimore; another, of 80 kilowatts, sold through the St. Paul agent, and for two complete steamboat plants.

INTERIOR AND EXTERIOR DECORATION.—The H. W. Johns Manufacturing Company, New York, has issued a new pamphlet containing suggestions for exterior decoration. These are in the form of color combinations. The paints used are the H. W. Johns liquid paints. A leaflet also issued by the same company gives some colored samples of porcelain finished interior enamel. These enamels are adapted for interior work where a rich finish is desired.

TELEPHONE TALK.—Couch & Seeley, 24 Binford Street, Boston, Mass., is making a line of telephone apparatus which is well known for its high grade and finish. In a recent leaflet issued by the company, considerable interesting information is given regarding the construction of the company's tubular drop, combined jack and tubular drop, combined ringing and listening key, metallic jack and plugs. Those interested in telephone apparatus would do well to have a copy of this circular.

INTERIOR CONDUIT.—The complete line of electric conduits and accessories manufactured by the Sprague Electric Company, New York, constitutes the subject of a catalogue of 144 pages just issued by that concern. The conduits illustrated and described are for use in every climate and under all possible conditions. For each type of conduit described a complete line of outlet boxes, plates and fittings is listed and illustrated. The catalogue contains a telegraph code and very complete indexes.

SEARCHLIGHT PROJECTORS.—The General Electric Company has recently designed a new line of projectors, including sizes ranging from 9 ins. to 36 ins. in diameter. The projectors combine all the late improvements in this class of apparatus and are built to withstand the hard usage to which all marine apparatus is necessarily subjected. In a recent bulletin issued by the General Electric Company these projectors are illustrated and described. The company has also issued price lists of G. E. porcelain knobs and cleats, fuse plugs for 250 volts and single-pole primary switch fuse boxes.

LAMPS FOR STREET RAILWAYS.—A new incandescent lamp is announced by the Franklin Electric Manufacturing Company, Hartford, Conn., maker of the already well-known "Femco" lamp. This new lamp is an addition to the company's regular line, and is specially adapted for use on street cars. The filament used is carefully selected with a view to withstanding the extra amount of vibration to which a lamp so placed is subjected, and is very strongly anchored. The "Femco" lamps all have an enviable reputation as givers of a bright light with small consumption of current.

FUSE HINTS.—A pamphlet recently issued by the American Electric Fuse Company, of Chicago, contains some valuable hints to telephone men regarding fuses. The subject matter of the pamphlet is the outgrowth of hundreds of inquiries received by the company, and its aim is to answer most of them. The various styles of telephone fuses are described and illustrated. While the information contained in the pamphlet is quite full, the company will be glad to answer further inquiries at any time. The conception of the pamphlet is a good one, and no doubt a copy of the work will be very much appreciated by all practical telephone men. Any one desiring a copy of the book may obtain it by addressing the company.

IMPORTANT INSTRUMENT ORDERS.—Mr. James G. Biddle, of Philadelphia (sole agent for Morris E. Leeds & Company), has recently taken some important orders, among which may be mentioned the following: Outfit for testing conductivity of aluminum, Pittsburg Reduction Company; outfit for testing conductivity of copper, Baltimore Copper Rolling & Smelting Company; portable cable testing outfit, Bell Telephone Company, Philadelphia; portable cable testing outfit, Campania Explotadora de Las Fuerzas Hidro-Electricas, Mexico; six Leeds portable testing sets, United States Engineer's Office, Willets Point, N. Y.; testing laboratory equipment for the new Philadelphia mint, including Anthony type resistance box and Wheatstone bridge, high sensibility D'Arsonval galvanometer with accessories.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has recently issued Bulletin No. 2, describing some of its designs in switchboards which are suitable for small exchanges. These include types which are adapted for use with the magneto system, local batteries or central battery. The Kellogg "Express" switchboard for small exchanges, the "Universal" switchboard for medium-sized exchanges, and the "Desk Style" switchboards for branch exchanges in office buildings are described at length, and also such switchboard parts as strips of jacks, lamp, rotary and drop signals, the Kellogg self-restoring drop, ringing and listening keys, order-wire keys, switchboard plugs and cords, etc. The Kellogg hook-switch, which was inadequately treated in Bulletin No. 1, is also shown and explained. The booklet contains about 24 pages and is illustrated with about 20 half-tone cuts. It will be sent free to any one interested in telephone work.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 12, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

669,501. SUPERVISORY SIGNAL APPARATUS FOR TELEPHONE SWITCHBOARDS; O. A. Bell, New York, N. Y. App. filed July 31, 1899. A supervisory apparatus whereby the operator can inform herself as to the condition of any line which may be connected at the central office.

669,511. PUZZLE DEVICE; E. V. Dahis and F. A. Dahis, Philadelphia, Pa. App. filed July 16, 1900. A box containing a ball magnet and a number of iron plates; the thing to be done being to carry the plates to certain points by means of the ball, and deposit them there.

669,517. BINDING POST FOR ELECTRICAL CONNECTIONS; A. Fischer, New York, N. Y. App. filed Feb. 19. 1900. The post has a longitudinal opening in which the split end of the wire is held by means of a cap screwing over the post.

669,536. ELECTRIC SWITCH; T. G. Meinema, Morton Park, Ill. App. filed March 1, 1900. The switch arm is held in position by a flexible pawl which is under the control of an electromagnet.

669,543. ELECTRIC GAS IGNITER; O. Von Morstein, Berlin, Germany. App. filed Dec. 8, 1896. Details.

669,544. APPARATUS FOR PARTY TELEPHONE LINES; F. R. McBerty, Downers Grove, Ill. App. filed May 21, 1898. The object of the invention is to avoid the loss or obstruction, occasioned by some appliances, of current designed to operate other appliances simultaneously connected with the line at the same station.

669,545. APPARATUS AND CIRCUIT FOR TELEPHONE SWITCHBOARDS; F. R. McBerty, Evanston, Ill. App. filed June 12, 1899. Consists in means for avoiding cross talk in the cables of a switchboard, while maintaining the static balance of the lines to prevent inductive disturbances in the line.

669,546. PORTABLE ELECTRIC LAMP; M. Newgold, New York, N. Y. App. filed March 8, 1900. The lamp holder is attached to the battery casing by a pivotal connection, so that the rays of light can be variously directed.

669,573. DYNAMO ELECTRIC MACHINE; A. R. Bliss, Lowell, Mass. App. filed June 25, 1900. The armature spider and the field magnet frame are constructed with a certain relation to each other, so that they can be easily connected together and the armature accurately centered.

669,574. DYNAMO ELECTRIC MACHINE; D. M. Bliss, Lowell, Mass. App. filed Feb. 19, 1900. A modification of the preceding invention.

669,575. DYNAMO ELECTRIC MACHINE; D. M. Bliss, Lowell, Mass. App. filed July 9, 1900. The polar shoes of like polarity of a multipolar dynamo are connected together by a support of magnetic material.

669,577. CASING FOR ELECTRIC MOTORS; C. A. Eck, Newark, N. J. App. filed Oct. 30, 1900. The casing is provided with relatively sliding parts, like a damper, so that access to the interior can be obtained by merely exposing the opening.

669,594. MAGAZINE BALLAST FOR ELECTRIC LAMPS; H. N. Potter, Pittsburg, Pa. App. filed June 4, 1900. (See Current News and Notes.)

669,595. ELECTRICAL CONTROLLER; C. R. Reynolds, Hartford, Conn. App. filed March 2, 1900. Details of Construction.

669,610. METALLIC GLOWERS FOR ELECTRIC LAMPS; A. J. Wurts and M. W. Hanks, Pittsburg, Pa. App. filed June 7, 1900. (See Current News and Notes.)

669,612. DEVICE FOR CAUSING END PLAY OF SHAFTS; Andrew E. Averrett, Schenectady, N. Y. App. filed Jan. 27, 1899. (See Current News and Notes.)

669,613. DYNAMO ELECTRIC MACHINE OR ELECTRIC MOTOR; N. C. Bassett, Lynn, Mass. App. filed Jan. 18, 1900. The machine is inclosed in a casing provided with an opening to admit the field magnet and another opening to admit the armature.

669,619. DEVICE FOR ADJUSTING ELECTRIC APPLIANCES TO THE HUMAN BODY; J. Charles, Richmond, Ind. App. filed Jan. 14, 1901. An arrangement of straps.

669,630. END PLATE DEVICE FOR ROTARY MACHINES; H. Geisenhoner, Schenectady, N. Y. App. filed Jan. 20, 1900. (See Current News and Notes.)

669,640. ELECTRICALLY OPERATED PUMP; E. M. Hewlett, Schenectady, N. Y. App. filed Dec. 4, 1899. On starting up the pump the pressure is reduced, so that the pump will run comparatively free until it gets up its speed.

669,644. SIGNAL ALARM; P. M. Jerrarrd, Johannesburg, South African Republic. App. filed Oct. 5, 1900. An electric bell in which the operating mechanism is placed inside of the gong.

669,662. MULTIPHASE TRANSFORMER; E. W. Rice, Jr., Schenectady, N. Y. App. filed Dec. 14, 1898. (See Current News and Notes.)

669,663. TRANSMITTING AND STEERING MECHANISM FOR MOTOR VEHICLES; A. Reigel, Paris, France. App. filed Oct. 9, 1900. The lever which operates the steering gear at the same time throws into and out of circuit electromagnetic clutches which permit the driving wheels to turn independently of each other.

669,670. ELECTRICAL MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. App. filed June 25, 1900. An electric measuring instrument having its movable element controlled by a coil supported eccentrically in a magnetic field.

669,691. INSULATOR FOR ELECTRIC WIRES; M. Harloe, Hawley, Pa.

App. filed Sept. 19, 1900. An insulator is provided with certain notches adapted to engage and hold the wire without the aid of tie wires.

669,706. ELECTRIC SWITCH; W. F. Richards, Buffalo, N. Y. App. filed Nov. 20, 1895. Details.

669,706. ELECTRIC SWITCH; W. F. Richards, Buffalo, N. Y. App. filed Nov. 20, 1899. Details.

669,707. TELEPHONE EXCHANGE SYSTEM; C. E. Scribner, Chicago; Ill. App. filed Nov. 12, 1894. Apparatus for automatically transmitting signals for connection and disconnection between sub-stations and the central station.

669,708. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Feb. 28, 1895. Comprises two co-operative features which concern respectively the transmission of signals from the substation of a telephone line to the telephone switchboard and the indication of the free and busy condition of a line to an operator making connection with it.

669,709. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill. App. filed Nov. 25, 1895. Improvements in the common battery board.

669,710. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed Nov. 13, 1897. In a common battery telephone system the core of an induction coil and an accumulator, such as a condenser or an equivalent device, are associated by certain circuits with a transmitting telephone whereby, it is claimed, speech transmission of unusually high efficiency may be attained.

669,723. MAGNETIC GAME; J. R. Davis, Parkersburg, W. Va. App. filed Jan. 23, 1901. A game played with magnetized and non-magnetized arrows and a series of magnets secured in the face of the board.

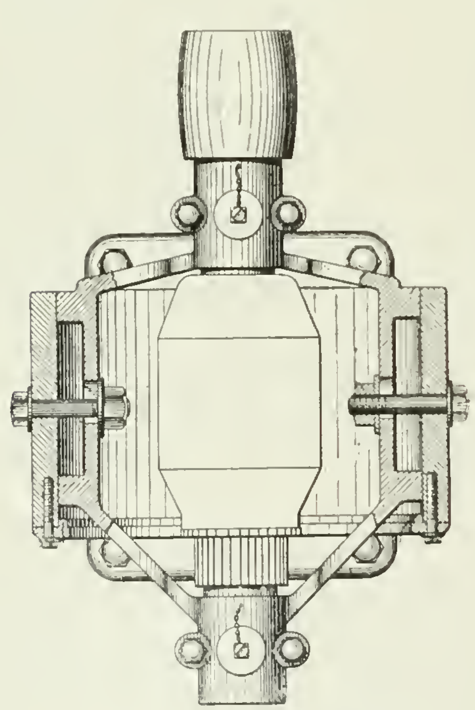
669,752. ELECTROLYTIC APPARATUS; P. W. Knauf, Philadelphia, Pa. App. filed July 17, 1900. A group of trays of similar construction adapted to be telescoped into each other.

669,755. CONTROLLER; C. F. Lundenberg, Hartford, Conn. App. filed July 17, 1900. Means for holding the finger contacts out of connection with the drum while it is moving from point to point.

669,759. ELECTRIC MOTOR; C. Milde, Paris, France. App. filed Aug. 22, 1900. Two armatures keyed to two independent shafts each driving a wheel of a vehicle, the magnetic fields of the armatures being symmetrical and in equilibrium.

669,792. COMBINED TELEPHONE AND ALARM SYSTEM; A. S. Hibbard, Chicago, Ill. App. filed Feb. 7, 1900. (See Current News and Notes.)

669,795. CABLE CLIP; B. Hurd, New York, N. Y. App. filed Jan. 12, 1901. A strap adapted to pass around the cable and the supporting wire and having an open ended clip to fasten the strap between the supporting wire and the cable.



669,574.—Dynamo Electric Machine.

669,800. TELEPHONE RECEIVER HOLDER; G. S. Meyer, Newburg, N. Y. App. filed Dec. 8, 1900. A bracket for attachment to the transmitter arm.

669,802. ELECTRICAL DEVICE FOR CONVERTING ALTERNATING CURRENTS; A. Nodon, Paris, France. App. filed Sept. 6, 1900. (See Current News and Notes.)

669,803. DYNAMO; C. A. Parsons and G. G. Stoney, Newcastle-upon-Tyne, England. App. filed Dec. 15, 1900. (See Current News and Notes.)

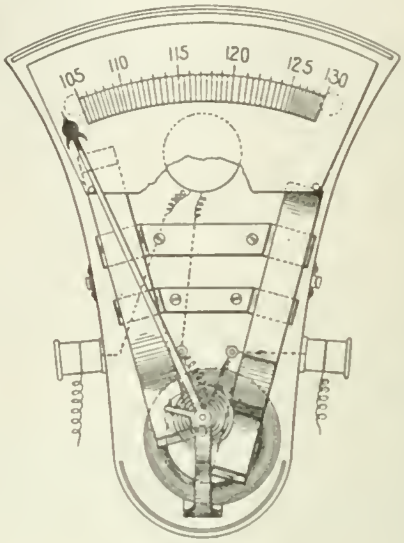
669,823. ELECTRIC LAMP CONTROLLER AND RHEOSTAT; A. H. Dreijer, Brooklyn, N. Y. App. filed April 23, 1900. Construction of the resistance and contacts.

669,832. COMBINED TELEPHONE AND FIRE ALARM APPARATUS; A. S. Hibbard, Chicago, Ill. App. filed Sept. 7, 1900. (See Current News and Notes.)

669,834. PRIMARY BATTERY; C. A. Hussey, New York, N. Y. App. filed July 24, 1900. An oxidizing salt is placed between the carbon and the porous cylinder in such a manner that the products of decomposition can pass off and collect in the lower part of the jar.

669,850. SYSTEM OF ELECTRIC PROPULSION; R. B. Painton, Williamsport, Pa. App. filed April 11, 1899. Each axle carries a motor which is convertible into a generator; one or more of the machines can be used for propelling while the others will be used to charge the battery.

669,900. TELEPHONE SERVICE METER AND CIRCUIT; D. S. Hulfish, Chicago, Ill. App. filed Dec. 18, 1900. The meter is combined with substation circuits of the common battery or relay type.



669,670.—Electrical Measuring Instrument.

669,901. SYSTEM OF CENTRAL SUPPLY FOR PRIVATE LINE TELEPHONE CIRCUITS; M. C. Rorty, Dedham, Mass. App. filed Oct. 4, 1900 A system enabling private lines to participate in the advantages of the common battery system.

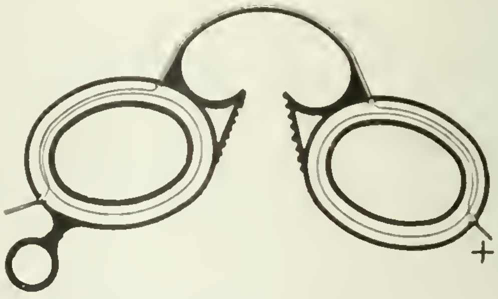
669,922. MEANS FOR THE PREVENTION OF INCRUSTATION IN BOILERS; J. Gottlob, Cologne, Germany. App. filed Feb. 3, 1900. A series of electrodes are suspended in the water from a stretched wire.

669,926. PROCESS OF ELECTROLYTICAL EXTRACTION OF METAL; Carl Hoepfner, Frankfort-on-the-Main, Germany. App. filed Sept. 27, 1899. A metallic anode is used which is insoluble in dilute acids and less electropositive than zinc. The cathode is of the metal to be deposited. The electrolytes are separated by diaphragms into anode and cathode cells and between the two is a solution designed to prevent the bad effect of diffusion from the anode to the cathode electrolyte.

669,940. RECTIFIER FOR ELECTRIC CURRENTS. F. M. Gilbert, St Paul, Minn. App. filed Dec. 17, 1898. A circuit changer operated automatically by a double solenoid.

669,941. ELECTRIC SWITCH; F. M. Gilbert, St. Paul, Minn. App. filed Dec. 17, 1898. Details of construction of a potential switch adapted to throw the battery into and out of the dynamo circuit.

669,942. SYSTEM FOR GENERATING AND DISTRIBUTING ELECTRIC CURRENTS; F. M. Gilbert, St Paul, Minn. App. filed Dec. 17, 1898. A modification of the preceding.



669,949.—Facially Supported Lighting Device

669,944. TELEPHONE; A. P. Merrill and J. W. Hays, San Francisco, Calif. App. filed Jan. 10, 1900. Sound amplifying devices intended to render audible telephonic messages in any part of a room containing the receiver.

669,949. FACIALLY SUPPORTED LIGHTING DEVICE; J. B. Underwood. Fayetteville, N. C. App. filed July 7, 1899. A pair of tubular casings joined by a tubular bridge piece, the whole being formed of glass and in the shape of a pair of spectacles, a filament being located in the tubes and connected with a source of electricity, whereby light can be created near the eyes and enable them to be examined by a physician.

669,968.—INDUCTION COIL; L. G. Woolley, Kenton, Ohio. App. filed July 18, 1900. Details.

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BELL TELEPHONE FIGURES.

The array of figures presented in the annual report of the Bell telephone system, and set forth on another page, are interesting evidence of the growth of a great electrical industry. The fact that for the first time in some twenty years the Bell report is read in New York instead of Boston is in itself an event that would give unusual importance to the annual meeting of the American Telephone & Telegraph Company, and can only be regarded as indicative of a determination to expand and to be freed from the shackles that have been imposed in Massachusetts upon the financial management of the company. Such a system must grow, and it will go where the conditions most favor that growth, presumably finding them in the financial center of the country. Some of us who witnessed the migration of the old Bell Telephone Company from its modest quarters in Reade Street two decades ago cannot but be glad to welcome back the present organization which has witnessed the creation of the great telephone industry in the interval, and which looks forward to a growth unequaled by any record of the past.

The growth of telephone revenue is in extraordinary contrast to the inertia of telegraph revenue, to be observed on contrasting the figures of this report with those of the Western Union system, for example. It would appear that in the three main items of dividends from sub-companies, rental of instruments and telephone traffic, the system took in about $9,300,000 or $1,873,000 more than in 1899, and this in spite of keen independent opposition and a smaller output of new instruments. There is obviously great strength and vitality in such a system, and so far from being injured by the active competition to which it is now subjected, the claim might well be made that it had braced up and been benefited. Some of the growth shown was doubtless due to the abnormal boom in the now waterlogged Erie system which seems likely to skip dividends, but there was genuine growth and prosperity in the Bell network throughout large sections of the country.

It is nevertheless curious to note these figures and then recall the fact that so rapid has been the growth of the telephone opposition the latter now serves more telephone subscribers than does this parent system. Mr. Cochrane's report shows about 800,000 Bell subscribers. The independents claim 1,500,000, and after liberal pruning and discounting, the number does seem to be somewhere over 1,000,000 to 1,200,000, which, if added to the 800,000 would give this country more than three times as many telephone subscribers as all Europe. It is also interesting to bear in mind that in Europe as here, the spectacle is being presented of competing exchanges in operation in different centers, although the old theory has been that only one exchange can exist in any given community. One thing is certain, and it bodes no ill to the art, namely, that the telephone habit is being cultivated at a rate never before approached, and that when learned it means more business and a larger revenue to all concerned.

LONG DISTANCE TELEPHONY.

The interesting article of Dr. Roeber, of which the third and concluding part is published in this issue, is a notable contribution to a timely subject, and of particular interest from the fact that it discusses on the same basis all three of the methods which have been proposed to enable the length of telephone lines to be increased without increasing the size of the line wire, or to enable the wire to be made smaller for the same length of a line—in general to enable smaller line wires to be used without affecting the telephonic transmission, thereby saving largely in line copper. Heaviside has shown that an increase of the inductance in such lines has the same effect as a decrease in the resistance, and that the ideal condition is attained if distributed inductance be inserted in the line. This ideal condition would be, however, expensive even if practicable, and therefore methods of non-uniform distribution sufficiently approximate for practical purposes have been proposed in the three systems discussed in the article. These three methods differ in the way the distribution is effected and also somewhat in the results likely to be obtained from their application. In the Pupin method, which has attracted so much attention recently, inductances are inserted in series; in the Thompson method, which was presented before the Chicago International Electrical Congress in 1893, they are placed in parallel; and in the Reed method, which was patented a number of years ago, an equivalent of a combination of induction coils in series and in parallel is proposed.

Dr. Roeber in his article applies to the Thompson and to the Reed systems a mathematical analysis analogous to that used by Dr. Pupin for his system. He thus discusses all three systems in a similar way, and arrives thereby at some interesting comparative results. It is shown that by the Pupin system, while the inductance is increased, the resistance is thereby necessarily increased also; by the Thompson system it is shown that the resistance is decreased, but the effective inductance is decreased also; while by the Reed system it is shown that the inductance is not only increased, but the resistance is at the same time decreased. It should be added, however, that the invention of Dr. Pupin involves, besides the use of inductances in series relation, a method of distributing the same in a perfectly definite relation to the capacity and the length of the line.

◆

The Distribution and Conversion of Received Currents.

A number of interesting practical observations and deductions appear in the paper read by Mr. Stott last week before the American Institute of Electrical Engineers. The Niagara power plant has passed through the stage in which the generators were the immediate object of concern. The transmission lines have also become well accustomed to their work at 11 kilovolts, although they may still show interesting features of behavior under 22 kilovolts transmission. The interest of this paper centers in the distribution of the power between a number of sub-stations in Buffalo and the means whereby break-downs in one sub-station or section of the city distributing system may be prevented from stopping the transmission to the other sub-stations or sections of the system. An interesting fact is that with 18 inches between the high-tension transmission wires at 11 kilovolts virtually, or 15.5 kilovolts maximum potential difference, an arc once established would travel backwards over the wires to the power house. For such pressures a distance between the wires of 3 ft. seems both practical and desirable.

Another interesting feature is the use of relays in the line very similar to telegraphic relays, and operated by small current transformers with a time interval or delayed contact through the mains of which a circuit breaker is operated after a definite interval of overload. Not only is the relay used for this purpose, but some of the relays are polarized and consist of little motors of the direct-current type, the fields being excited by small potential transformers, and the armatures from small current transformers, whereby either one of the two duplicate supply cables may be automatically cut off in the case of a fault developing underground. It is interesting to observe that as the result of two years' experience one-quarter-inch rubber insulation has been found insufficient for a pressure between adjacent wires of 11 kilovolts, but 9-32 inch is sufficient. Assuming that this is a correct generalization, the value of an extra 1-32-inch of an inch of rubber is significant. Another very interesting observation is that whereas converters have been found more economical and satisfactory than motor-generator sets for transforming from high-tension alternating to railway direct-current service, the reverse has been the case for the supply of Edison three-wire lighting systems. In the latter case the close rgulation required seems to have demanded a greater flexibility and facility of pressure control afforded by the motor generator.

Some curious freaks in the behavior of frequency changers are described in connection with the operation of 60-cycle arc lamps from 25-cycle, high-tension supply. These frequency changers are synchronous motor generators, the motors having fewer poles than the generators. Consequently, when such sets are operated in parallel, the motors may be running in synchronism and yet the generators may be very seriously dephased by a constant large angle, and it becomes necessary to shake the motors from one synchronous linkage to another until the generators are exactly right. In order to do this, it is said to be necessary to make the motors hunt, or see-saw, such as is possible at the start, until the suitable equilibrium has been obtained. As a rule, hunting between synchronous motors in parallel is an unmitigated inconvenience, and is avoided by all possible means. Here hunting is fostered in the initial stage of throwing a new set into parallelism. The method of starting synchronous motors described in the paper is of considerable interest and importance. A difficulty frequently encountered in the starting of such motors lies in the powerful e. m. f. induced in the field windings by the armature under the influence of the considerable difference between the actual and synchronous speed of the same. This induced e. m. f. in the fields is utilized as a test to determine whether synchronism has been reached before the field is excited. At speeds below synchronism the field circuit will produce visible sparking through a non-inductive resistance, and at synchronism this sparking vanishes.

◆

Rotation From Electric Sparks.

An interesting series of experiments by Mr. Dell is printed in another column. It seems that when a disk of shellaced mica is freely supported upon a vertical axis and close above an induction coil spark-gap, so that the sparks pass underneath one edge of the disk, the disk tends to be set in rotation. It is not at all clear that Mr. Dell has fully accounted for the rotation he observed. The phenomenon seems to be very complex; in fact, it is only necessary to read the account of the very variable results observed to appreciate the complexity which exists in the forces at work. Such forces may be thermal, as from the heat of the sparks, or electrostatic in advance of each discharge as from a greater proximity of the disk to one or other terminal of the gap. Again, there may be a convection effected from the negative electrode, whereby elctrified air is caused to pour from the terminal and impinge against the edge of the disk. Again, there may be some cathode-ray action, whereby negatively electrified particles are discharged from the cathode against the disk as in the Crookes tube. Finally, there might be an electromagnetic disturbance in the neighborhood of sudden discharges accompanied by mechanical forces in the front of each wave of disturbance. In the face of so many possible causes belonging to known phenomena, besides whatever causes may yet be unknown or unrecognized, it would be rash to attempt to diagnose the rotary action described. It can certainly be said that the phenomena offer an interesting field of experimental research, whereby the various forces may be analytically separated and the active ones determined.

The whole subject of the discharge of electricity through gases is bristling with difficulties and unsolved riddles. An interesting paper on this subject, "Gases Regarded as Dielectrics," has recently been written by M. E. Bouty. It is a most remarkable fact that whereas the ether or space devoid of gas seems to be a perfect insulator, and also that whereas gases at ordinary temperature and pressure of the atmosphere seem to insulate perfectly for pressures below a certain critical value, yet at certain low pressures the conductivity of gas by volume is about the same as that of a good electrolyte, such as sulphuric acid in water; and if referred to mass instead of volume, their conductivity is apparently even better than that of copper. It would seem that in gases the laws of electric conduction in electrolytes or solutions are operative, and that in all gas containing a certain number of ions per cubic centimeter the conduction is of the same nature as in a solution containing ions, allowance being made for the difference of freedom in motion of the ions in the two gases. But as it seems that in electrolytes ions are always present in abundance, or that the salt in solution is largely or even wholly broken up into ions in free gases, there may be only very few ions present, and that preliminary action of some sort is necessary to produce the ions. In other words, ether is a non-conductor because it has no ions, and gases are normally insulators because they contain no ions. If, however, ions are produced in a gas either by ultra-violet light or by X-rays or by the action of an electrostatic field, conduction commences to take place by convection or according to the laws of electrolysis, and when the number of ions present is sufficiently great, disruptive discharge will occur. If this is a correct view of the subject, electrolytic conduction is only the electric convection of gases occurring under the modifying circumstances of liquid aggregation, and the convective discharge in gases only a special form under altered physical conditions of electrolytic conduction. Disruptive discharge is a special phenomenon which may occur either in liquids or in gases, and which is subject to complex laws of its own.

The Status of Automobilism.

We greatly regret that there seems to be a tendency to abandon in part the electric automobile service in one or two places. Notably the public carriages in Chicago and the delivery wagons leased to various firms in Boston are reported as to be abandoned, mainly for lack of profitable patronage. The discontinuance of these vehicles has doubtless been determined by entirely adequate reasons, but it is nevertheless a pity, and its effect upon the progress of the art is assuredly for the time being unfortunate. Of course, inadequate patronage and heavy repairs are discouraging, but both these conditions were encountered in the early days of electric railways, and both have been outlived. Automobiles of every kind are in their infancy, have often been rushd upon the market without adequate tests in the factory and on the road, and one and all are well known to be frequent candidates for the repair shop. Batteries give out with painful frequency, but so also do the minor parts of steam outfits and the explosion mechanism of vapor motors. With equal or anywhere nearly equal likelihood of breakdown and liability to annoying and costly repairs, we must confess our personal predilection for sitting over a storage battery rather than a high-pressure steam boiler, or a tank of gasolene. No motive power other than electricity gives the same simple and complete speed regulation, the same freedom from noise and smell, or anything like the same simplicity of mechanism. In steam and gasolene vehicles trouble may and does occur in a variety of places, and it takes something of a mechanic to locate the fault or to correct it. With the electric automobile the chances of breakdown outside of the battery are small, and the mechanism can be made nearly fool-proof, a great desideratum in apparatus intended for use by the community in general.

We have never been accused of undue optimism regarding the storage battery, and have tried to preserve a thoroughly conservative view of its possibilities, but, frankly, we do not believe that there is any inherent reason why the electric automobile should not be entirely successful, particularly in its chosen field of urban service. We well remember when a man with an improved storage battery was looked upon by a large part of the public as ex-officio a charlatan, but the battery has steadily forced its way into central stations for lighting, into isolated plants and finally into electric railway stations. Over and over it has failed when put to work at electric traction, but each failure has taught its lesson and the problem has steadily grown less discouraging, until the most conservative engineers are willing to admit that the battery has a fighting chance even there. The situation in this respect has grown steadily better rather than worse. So in automobile work there have undoubtedly been frequent troubles and discouragements, but in view of past events we are disposed to regard them as natural and temporary concomitants of the growth of new applications, not to be regarded with sinister distrust but with patient hopefulness. Experience in the manufacture of special batteries will work wonders, and in particular we believe that automatic charging devices for the batteries and also automatic safeguards against their abuse will go far toward keeping the electric automobile in the very front rank. It has already scored some really wonderful performances, and we should be very sorry to see the reduction of unprofitable service here and there charged against it as a failure.

As to the other matter, lack of public appreciation, we are inclined to think this a temporary rather than a permanent difficulty. Public carriage service in this country is notoriously at once the worst and the most expensive in the civilized world, chiefly because street car service is so cheap and so good, and so ubiquitous. American practice in this respect has forced the public to look upon cab service not as an every-day necessity, but as a luxury of dubious utility. This is the secret of the enormous popularity of street cars. They may be crowded and stuffy, but they can at least be boarded rather easily anywhere, run at good speed and demand only the payment of a fixed and moderate fare. If the conductors were abusive and drunken and held up their passengers for half a dozen times regular fare in case of rain or if there were ladies in the party at such times, street cars would soon come to be in evil repute. From the general ill odor into which public carriage service has come, a new line of carriages, even automobiles, has a hard task in winning popularity and the accompanying dollars. When an automobile service is brought out on a large scale, modeled not on our present horse cab methods, but on the public carriage systems of London or Berlin, it will surely win its way to popular appreciation and success. But unless worked on a plan obviously more popular than existing competitors it will of necessity have to bear, however well administered it may be, part of the opprobrium that they have honestly earned. The public must be taught how good and useful such a service can be, and its distrust rooted out by experience, before automobiles can take the place we believe they are destined to fill. As the art in general advances and the general difficulties disappear, there will be more encouragement to take up the good work of public education on an adequate scale, and success will be a necessary consequence.

Bell Telephone Annual Report.

A novel feature of the presentation of the annual report on the Bell Telephone system is that the stockholders' meeting to receive it, of the American Telephone & Telegraph Company, on March 26, was held in New York City, the contract room of the New York Telephone Company, on the ground floor of the building in Dey Street, being used for that purpose. The report was signed by Mr. Alexander Cochrane, acting president, who referred to the loss sustained by the company in the death last October of Mr. Hudson, who had been president since 1889, and an official of the company since 1880.

The report, dated for the year ending Dec. 31, showed that while the number of instruments in the hands of licensees in 1891 was 512,407, the number in 1900 was 1,952,412, a gain over the previous year of 372,311, while the year 1899 had showed a gain of 455,255. The miles of extra territorial and toll pole line on Jan. 1, 1901, were 101,087, a gain of 11,795; and of toll-line wire, 607,599 miles, a gain of 105,767. The average daily number of toll connections was 148,528, and the year total 47,800,000, yielding a revenue of $8,972,030. At the beginning of the year 1901, there were 1348 Bell exchanges and 1427 branch offices, an increase respectively of 109 and 240. The miles of wire on poles were 627,897; on buildings, 16,833; underground, 705,269; submarine, 4,203; giving a total of 1,354,202, or an increase of 337,425 miles over 1899. The exchanges reported 508,262 circuits, 32,837 employees, and 800,880 stations, the last figure indicating a gain of 167,934. The estimated number of daily exchange connections was 5,688,986, giving a total for the year of 1,825,000,000. This gives an average per subscriber of from 1 to 15 9-10 calls per day, or an average throughout the United States of 7 1-10, at a cost per connection of from 1 to 9 cents.

The "long-distance" system, if treated as a separate entity, comprises 12,427 miles of pole line and cable, with 167,410 miles of wire, connecting 359 offices, reaching 697,674 stations, of which 438,222, or 62.81 per cent, have metallic circuits.

It is stated that during the year the new construction of the parent company and its two score sub-companies amounted to $28,862,970, while an additional $2,349,103 was expended on real estate. The entire expenditure on the whole Bell system to the end of the year for construction and real estate is put at $168,474,517; while estimates already made indicate that extensions this year will require further expenditure on a large scale.

The growth of the system is thus accounted for: "The general adoption of the measured service system and metallic circuit party lines, with corresponding lower rates, has attracted many thousands of subscribers, both business and residence, who were previously deterred by the higher cost of other classes of service." Reference to the new conditions of competition is made as follows: "It is doubtless true that in certain localities, rates too low to cover current expenses and necessary allowance for renewal have been offered, to meet similar rates offered by competitors. We believe, however, such conditions cannot be lasting; and the growth throughout the country, as a whole, has been of a healthy and substantial nature." The recent decision for the defendants in the Berliner suits is referred to with the briefest possible reference, but the statement is made that an appeal will be taken. The purchase of the Pupin patents is passed over without notice.

Some figures are presented as to telephonic development here and abroad. The latest reports that can be obtained for 1899 and 1900 show the countries next in order to the United States, as respects the development of telephone service, to be the German Empire, 229,391 stations; Great Britain, 171,660; Sweden, 73,500; France, 59,927; Switzerland, 38,864; Austria, 32,255; Russia, 31,376, and Norway, 29,446. The total for all Europe is less than 700,000 stations, while the Bell system has over 800,000, with 40,000 private line stations.

In this connection the report says: The year just passed rounds out the quarter century, within which is compassed the discovery and application of the art of transmitting speech by telephone. A brief review of the development and growth of this new industry, which has become so important a factor in commercial and social life, seems appropriate at this time. Twenty-five years ago the wonderful invention of Professor Bell was made known to the world. Twenty-three years ago the first telephone exchange in the world was established in the United States, and from that beginning has been built up the great system of exchanges and the network of connecting lines over which conversation can be held between points over a thousand miles apart.

Twenty years ago there was 47,880 telephone subscribers in the United States, and 29,714 miles of wire in use for telephonic purposes. At the end of last year, there were 800,880 exchange stations equipped with our instruments, and 1,961,801 miles of wire were employed for exchange and toll line service.

The United States has, from the beginning, held the leading place among nations in respect not only of the extensive development of the business, but in the employment of modern and improved appliances, tending to greater efficiency of service.

Treasurer W. R. Driver presented the subjoined balance sheets, dated March 26, in each case.

LEDGER BALANCES, DEC. 31, 1900.

ASSETS.

Construction, Equipment and Supplies	$ 16,152,020 72	
Telephones	4,311,928 75	
Real Estate	1,567,018 85	
Stocks and Bonds	71,719,324 01	
Patent Account	24,101 00	
Machinery and Tools	31,477 94	
Cash and Deposits	1,078,071 70	
Bills and Accounts Receivable	5,240,640 27	
American Bell Telephone Co.	22,110,400 00	

LIABILITIES.

Capital Stock		$ 89,100,500 00
Surplus		1,813,199 74
Bonds		10,006,000 00
Reserves		2,416,363 34
*Bills and Accounts Payable		2,928,709 91
Contingent		15,970,210 25
	$122,234,983 24	$122,234,983 24

*Of this amount, $1,252,27[illegible] is for the dividends payable Jan. 15, 1901, to stockholders of record Dec. 31, 1900.

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

EARNINGS.

	1899	1900
Dividends	$3,[illegible]44,[illegible]5 8[illegible]	$3,846,821 67
Rental of Instruments	1,714,526 54	2,427,037 52
Telephone Traffic	2,6[illegible]8,350 [illegible]1	3,027,171 85
Real Estate	4[illegible],2[illegible]5 11	31,824 67
Interest	217,3[illegible]1 53	201,643 50
	$7,687,381 08	$9,534,499 21

EXPENSES.

	1899	1900
Expenses of Administration	$591,826 34	$746,259 48
Legal Expenses	103,748 46	85,134 07
Interest and Taxes	1,234,275 83	1,376,199 94
Telephone Traffic	1,487,021 88	1,840,847 86
	$3,416,872 51	$4,048,441 35
Net Revenue	$4,270,508 57	$5,486,057 86

Net Revenue, 1900		$5,486,057 86
Dividends Paid		4,078,601 25
		$1,407,456 61
Carried to Reserve	$93[illegible]	
Carried to Surplus	47[illegible]18 30	
		$1,407,456 61

N. B. The foregoing statement for 1899 is for the purpose of comparison and is made up of the transactions of The American Bell Telephone Company and the American Telephone and Telegraph Company in the same form as those which appear above for 1900.

The old board of directors was re-elected.

•

Industrial Scholarship.

The Manufacturers Association of New York has appropriated $2,000 for an industrial scholarship, including the cost of tuition for four years and incidental expenses. Boys desiring to compete for the scholarship may make application in writing to Jas. T. Hoile, secretary of the Manufacturers Association of New York, 198 Montague Street, Brooklyn, N. Y. The applicant must be a resident of the City of New York and at least 17 years of age. He must have received not less than three years' high school instruction or an equivalent education. His application must be accompanied by at least two references for scholarship and two for character. Each applicant must present a physician's certificate of good health. The successful candidate will be permitted to make his choice of the school or college he desires to attend, from a list approved by the association. The scholarship will be awarded only to such candidate as is unable to pay his own way through college. Applications should be filed not later than April 20, 1901.

Power Transmission in Utah.

RESULTS AND LESSONS FROM THE OPERATION OF THE LONG-DISTANCE POWER TRANSMISSION AND DISTRIBUTION SYSTEMS OF THE UTAH LIGHT & POWER COMPANY

By J. R. Cravath.

The various transmission plants and the distribution systems of the Utah Light & Power Company in and near the cities of Salt Lake and Ogden, Utah, are among the oldest and most important of their kind, and much can be learned from the experience of this company which is of value to those about to undertake long-distance transmission and distribution from water powers as well as from more recently installed transmission plants. For the many practical points here given as to the working of this company's system, acknowledgment is due to the kindness of R. F. Hayward, chief engineer of this company and consulting engineer for numerous other plants in Utah. Mr. Hayward's extensive experience, covering six years in this work, and his opportunities for observation, constitute him an authority on this branch of electrical engineering, and the readers of this article will appreciate the professional courtesy which has prompted him to furnish such complete information on a class of subjects about which none too much is generally known.

The system of the Utah Light & Power Company comprises three water-power plants, several high-tension transmission lines, and also light and power distribution apparatus in and near Salt Lake City and Ogden, Utah, together with one sub-station for supplying the Salt Lake City Railroad, and some reserve steam plants. Probably in no other city of its size in the United States has electrically transmitted power reached such a relatively important place in the community as at Salt Lake City. The development not only started early, but has been very rapid. The snow-fed mountain streams of the Wasatch Range, to the east of the Salt Lake Valley, offered opportunities to the hydraulic and electrical engineer which were not neglected. To understand the situation a short historical review will be necessary. Although coal is not excessively high, being from $2 a ton for slack to $4.50 for best lump, the proximity of water-power with high head to such a market as Salt Lake City and its surrounding smelters and other power consuming industries led to the erection several years ago of three different water-power plants by three different companies. The Big Cottonwood Power Company completed a plant in the Big Cottonwood Cañon, 14 miles southeast of Salt Lake City in June, 1896. The Pioneer Electric Power Company started its plant in the Ogden Cañon near Ogden, 37 miles from Salt Lake City in July, 1897. The Utah Power Company in 1897 built a plant in the Big Cottonwood Cañon for transmitting power for the Salt Lake City Railroad. These three plants finally became consolidated with the electric lighting interests of Salt Lake City, and are now operated as parts of one complete and comprehensive system, owned by the Utah Light & Power Company, covering a district extending north and south about 60 miles, including Ogden, Salt Lake City, and a district 13 miles south of the latter place, including some large smelters. The accompanying map (Fig. 1) shows the district covered and the lines and power houses.

A brief review of the equipment and location of the three water-power stations will be necessary to a full understanding of the situation.

POWER HOUSE EQUIPMENT.

The plant at Ogden gets its water from the Ogden Cañon, a narrow gorge about 6 miles long (see map, Fig. 1), through which a stream flows, draining a rather large area of high ground. At the head of the cañon is a level valley 4 by 5 miles, which would make a good storage reservoir. At present, however, there is a dam 300 ft. wide and 20 ft. high across the cañon, making a 5-acre reservoir. From this reservoir the water is drawn through two 5-ft. gates into a massive concrete tower, from which it flows in a pipe 6 ft. in diameter, 6 miles to the power house. Five miles of this pipe is wooden stave, and the last mile is steel, taking the water from the wooden pipe at 100-ft. head and delivering it at 450-ft. head. At the power house the pipe line divides into two 6-ft. diameter receivers, one along each side of the building, with 2-ft. delivery pipes running into the power house for each water wheel. This power house (see Figs. 2 and 3), is designed for 10 generators of 750 kilowatts, each direct connected to a waterwheel. Five of these have been put in. The waterwheels are the Knight impulse pattern,

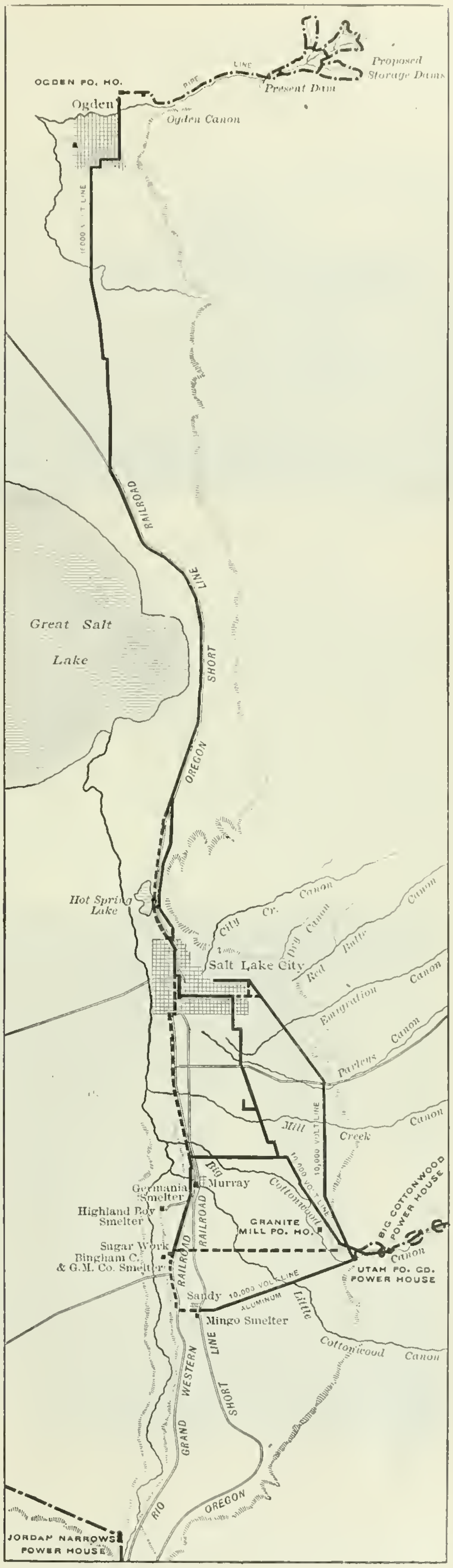


FIG. I.—SYSTEM OF UTAH LIGHT & POWER COMPANY.

running at 300 r. p. m., and have Knight automatic electric relay governors. The generators are General Electric 60-cycle, three-phase, revolving armature, 750-kw machines, generating at 2300 volts. The exciters are two 500-volt, 100-kw generators direct connected to waterwheels. A Venturi watermeter is placed in each receiver just outside the power house, so that the water consumption can be measured continuously. The distribution in Ogden is direct from this station at 2300 volts. For transmission to Salt Lake City there are nine 250-kw air-blast transformers arranged in delta connection, stepping up to 16,000 volts. The transmission line is 36½ miles long, and consists of two circuits of three No. 1 bare hard-drawn copper wires on the same pole line. The insulators are porcelain. The poles are from 35 to 50 ft. long. For 16 miles the pole line is just outside a railroad right of way, and the rest of the distance passes over open country.

FIG. 2.—EXTERIOR OF OGDEN POWER HOUSE.

The Big Cottonwood plant, which is southeast of Salt Lake City in the Big Cottonwood Cañon, leads its water from a small reservoir through a 4-ft. steel pipe line, which passes first through a tunnel 500 ft. long, and then down a steep slope to the power house. The pipe line is 1800 ft. long and the head is 380 ft. The receiver at the power house is the same diameter as the pipe line. There are four 600-hp Pelton waterwheels running 300 r. p. m., each with two nozzles. One nozzle is opened and closed by a gate valve, the other has a hood operated from a lever in front of the switchboard for regulation. The regulation is all done by hand. The generators are General Electric, 60-cycle, 500-volt, three-phase, 450-kw. There are two exciters separately driven by waterwheels. On the upper floor of the power house are six 250-kw transformers, air cooled, stepping up from 500 to 10,000 volts. The transmission line to Salt Lake City consists of two three-phase circuits of No. 2 wire (see Fig. 1), 14 miles long, part over rough, mountainous country and part along a country road. Porcelain insulators are used. Part of the distance these circuits are now run on the same poles as the line from the Utah station.

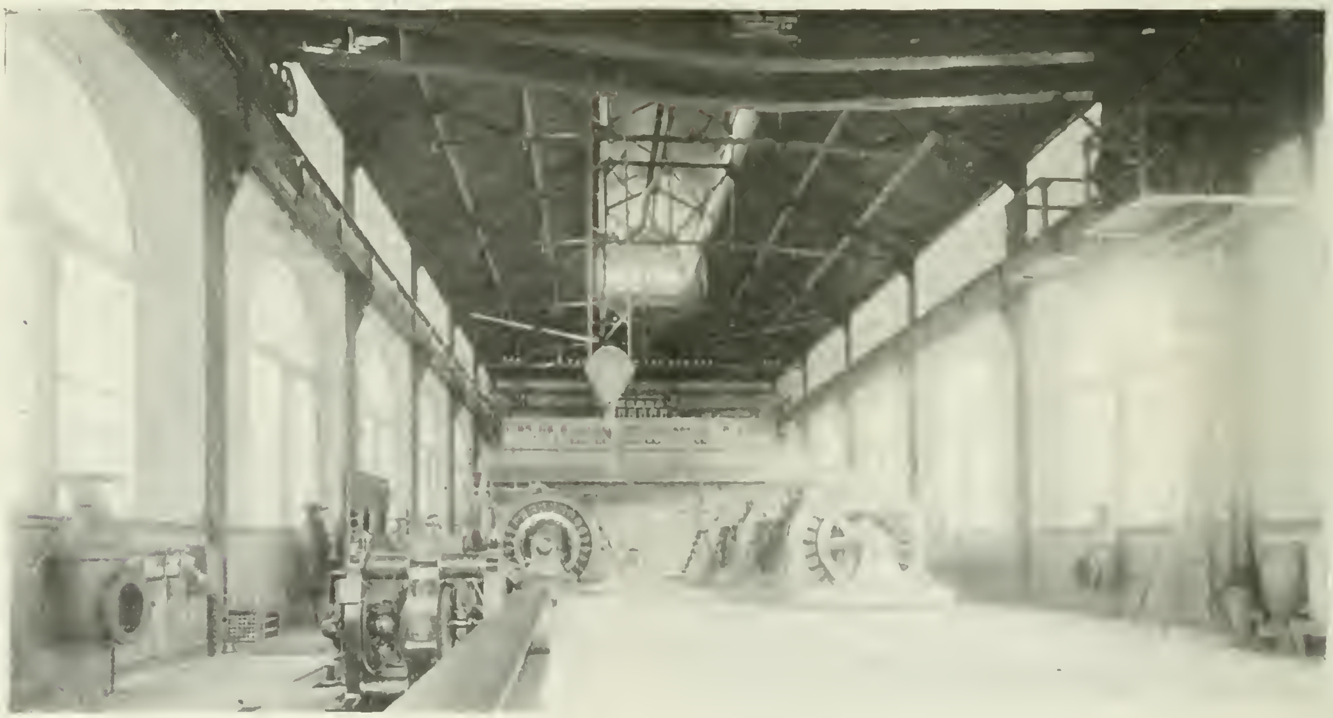


FIG. 3.—INTERIOR OF OGDEN POWER HOUSE.

The Utah station is also located in the Big Cottonwood Cañon, and gets its water from a small wooden dam just below the tail race of the other station. For 1¾ miles the water is taken in a wooden flume 4 ft. wide by 3 ft. deep, and is then delivered to a steel pipe 4 ft. diameter, and giving a head of 450 ft. The power house has two 1000-hp Pelton waterwheels running 300 r. p. m., direct connected to 750-kw, two-phase, 60-cycle, 500-volt Westinghouse generators. Exciters are independently driven. The main waterwheels are regulated by a Replogle relay governor, acting on a throttle valve. Step-up phase-changing transformers raise the voltage from 500 volts, two-phase to 11,000 volts, three-phase. The transmission line has two three-phase circuits of No. 3 bare copper wires on porcelain insulators, and is about 12 miles long. This station is operated in parallel with one generator in the Big Cottonwood plant to supply the Salt Lake City Railroad through a sub-station near the middle of the city.

The railway sub-station just mentioned has two two-phase, 300-kw rotary converters supplied from step-down transformers. One of the rotaries is usually sufficient to carry the load. The paralleling is, of course, necessarily done on the three-phase high-tension lines.

The light and power distribution at Salt Lake City is accomplished through the medium of another sub-station near the middle of the city. Here the high tension lines are run in from both the Ogden and Big Cottonwood plants. Both are stepped down to 2300 volts, and the 2300-volt lines are thrown in parallel, thus putting the Ogden and Big Cottonwood plants in parallel through the medium of the 2300-volt secondaries.

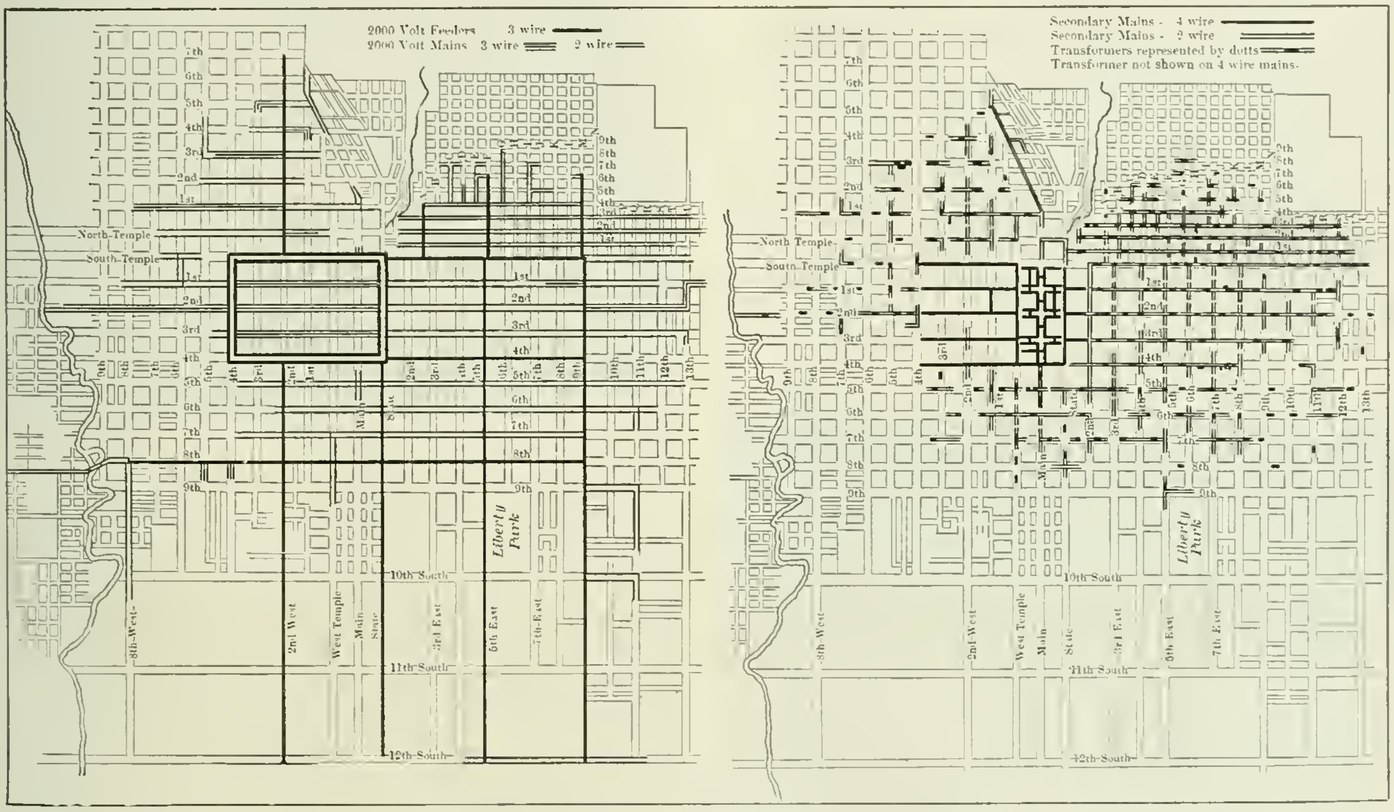
DISTRIBUTION.

It has been Mr. Hayward's aim, ever since the consolidation of interests made it possible, to bring everything under one uniform simple scheme of generators and distribution. Fortunately the frequency of all the plants was the same (60 cycles), but there the uniformity ended. As the secondary system is now uniform, so that the plants can be operated in parallel, the difference in transmission voltage is no great inconvenience save as it necessitates greater reserve capacity in transformers at the sub-station, and prohibits paralleling high-tension lines. However, it is contemplated to raise the transmission line voltage on both the Ogden and Big Cottonwood lines to about 24,000. This can be done on the Ogden line without rewinding transformers by changing from the delta to the Y method of connection. The Big Cottonwood transformers will have to be rewound. From the light and power sub-station a network of 2300-volt mains is fed. This network is shown in Fig. 4. The primaries of the street transformers are connected delta-fashion, but the secondaries are on Y-connection. When motors under 10 horse-power are to be run they are connected between the outside legs of the Y, which give 200 volts. Motors over 10 horse-power are put on separate transformers. The lights are balanced between the outside legs and the neutral on 115 volts. This makes a very satisfactory scheme of distribution. Six transformers are placed to a block, at opposite corners, and they feed into secondary mains running around the block. Adjacent blocks are tied together through fuses, so that the secondary system in the down-town district is also a complete network. This secondary network is shown in Fig. 5. In the residence district two secondary wires (a leg and a neutral) are first run down a street, balancing one street against another, and as customers increase the third and fourth wires are put in and connection is made with adjacent secondary systems, everything working toward the network idea. Mr. Hayward believes in network and parallel running throughout, as the only ways to secure reliability of service and minimum voltage variations.

At the sub-station there is a small steam plant in reserve which it is expected to increase as the system grows, to reduce as far as possible the chances for interruption of service. There is also an old electric light station near the sub-station which can be run in case of emergency. At present there are in this latter station some synchronous motors driving series arc-light machines. These motors can be run as generators on short notice. It is expected in time to replace all series continuous-current arcs with constant-potential alternating arcs. The series-alternating arc is not liked, because of the complications in the way of high-tension circuits on pole lines which it involves. It is desired to keep the circuits as few and simple and safe as possible. On all pole lines carrying 2000-volt mains, the inner wires between which linemen must climb are at the same potential, and everything possible is done to make it safe for linemen in their dangerous duties. In case constant-potential alternating arcs are run for street lighting, a magnetic switch will probably be used by which all the lights on a section of street can be turned on at once by an inspector. About 500 constant potential alternating commercial arcs are in use in Salt Lake and Ogden.

In order to bring the voltage right on the 2300-volt mains in both Salt Lake City and Ogden and allow for line loss between Ogden and Salt Lake, the step-up transformers on the Ogden line are wound 7 to 1 and 6 to 1 on the step-down. A certain degree of regulation at Salt Lake can be obtained by varying the exciter motors driving arc-light machinery. With heavy load on the line, a variation of 10 per cent can be obtained in this way. Regulation of voltage at Salt Lake City is also obtained by varying the exciting current at the Big Cottonwood generators. As explained elswehere, the waterwheels at the Big Cottonwood plant have no automatic regulators. Those at the Ogden power house have. The hand regulators at the Big Cottonwood power house are, therefore, left untouched, so that they supply constant power, and the variations in demand are taken up by the governors at Ogden. But the exciting current on the Ogden generators is maintained nearly constant, except that such adjustment as necessary is made to regulate the voltage on the Ogden distributing circuits. If the Salt Lake City voltage is to be raised, the Big Cottonwood generators have their fields strengthened. The regulation is controlled by telephone from the Salt Lake sub-station.

It is of value to note the ease with which the different stations having types of alternators are run in parallel. At light loads there is a slight interchange of current between the two stations sometimes, but at heavy loads all these induction and resonance effects are drowned out.



Figs. 4 and 5.—Distributing System, Salt Lake City.

SWITCHBOARD CHANGES.

All of the power houses were originally built with the transformers and transformer switching arrangements on a different floor from the generators and generator switchboard. Under the circumstances, this is an undesirable arrangement. In the Big Cottonwood and Ogden plants, the transformer switches will be moved down onto the main floor where they can be got at quickly by the men attending the waterwheels and generators. Both economy of labor and reliability of service demand this. The high-tension 16,000-volt switchboard at the Ogden plant, as it is at present, is shown in Fig. 6. The low-tension 2300-volt board is shown in Fig. 7.

WATER SUPPLY.

The securing of a reliable supply of water is the cause of much thought and anxiety in connection with an enterprise of this kind. Of course, with several different plants, the liability to interruption decreases, but the experience in Utah as well as elsewhere shows that the constancy of water supply is something about which little was known when the first plants were built. In Utah, where the power houses are located in cañons from 4000 to 5000 ft. above the sea.

where the temperature reaches 40 degs. Fahr. at times, and where the snow falls heavily in places there is a constant menace to water power plants from snowslides and ice dams, this being the more serious because of the small actual volume of water in the streams. In the Big Cottonwood Cañon, for example, two or three snowslides may be expected each year, which will dam the stream partially for 20 hours. On the other hand, in the dry season, the irrigation, which has the right of way over everything demands the entire flow of the stream. For these reasons it is important both for power and irrigation to construct large reservoirs for storage of water. This is more easily said than done in some of these Wasatch cañons, owing to the difficulty of finding bed rock. A large storage dam contemplated for the Ogden plant was never built because of the great depth of bed rock upon which to found it. To provide for irrigation and allow water to be used with economy at Ogden a storage reservoir has been built below the plant so that water need not be wasted by the plant to provide irrigation, as had at first to be done. It is, of course, desirable to have storage reservoirs away from the current of the main stream to prevent them filling up with boulders in flood seasons, but so far the construction of such reservoirs has not been possible for these plants.

The load has had a remarkable growth. That at Ogden, for example, has doubled in two years. Plans are under way for the enlargement of the water storage capacity in both the Ogden and Big Cottonwood Cañons. The great depth of bed rock has made worthless many of the original plans for storing water. Unless a dam is sunk to bed rock there is an immense amount of leakage. In the Ogden Cañon the plan is to build four low inexpensive dams, as shown by the accompanying map, farther up the river than the originally proposed dam. These will give within 25 per cent of as much water as the one big dam originally contemplated, and cost far less. The locations of these proposed dams are shown in Fig. 5.

At Ogden, where the velocity of the water around the intake is slow, owing to the volume of standing water at that point, there is little trouble with ice around the screens, but in the Cottonwood Cañon, where there is a temporary intake and high velocity of water, there is trouble with ice forming on the screens. The reservoir originally constructed for the Big Cottonwood plant could not be used, because of its porosity, but a concrete dam is contemplated, which will give a good intake.

In regard to methods of conveying water the open flume has proven rather unsatisfactory for use around these steep cañons, where falling rocks or snowslides are liable to carry away the whole structure that happens to lie in their path, and cut off the supply of water completely. The "Utah" plant of this company is supplied through a flume, which several times has been broken by falling rocks so that the plant had to shut down until repairs were made. Mr. Hayward believes in general that if the development of a water power is so expensive in proportion to the power produced that the cheapest construction must be chosen on account of its cheapness, the water power is not worth developing. Reliability is essential to the success of every power-transmission scheme, and any pipe line or flume for conveying water to the plant should be thoroughly protected from snow and landslides, and a tunnel or buried pipe line will often be found more economical than a flume or ditch. Mr. Hayward finds that the examination of smooth, gentle slopes at the foot of cliffs shows that these smooth places are frequently caused by snowslides, and are places to be avoided, and in such cases nothing but a buried pipe line or flume heavily timbered over the top should be used.

One of the largest wooden pipe lines ever built is that at the Ogden plant. It is 6 ft. diameter outside and 5 miles long. It is laid in an earth-and-rock cut on the south side of the Ogden Cañon. Unlike many pipe lines it was not laid to hydraulic grade, but drops below the level of the intake in some places as much as 100 ft. For protection from falling rocks a shed of 8-inch by 8-inch timbers covered with 3-inch planking has been built over the pipe most of its length. The shed has an angle of 20 to 30 degs. to the horizontal. It has saved the pipe many times, but has frequently to be repaired, as a result of this duty. Once by falling rocks (on one of the innocent-looking smooth slopes previously mentioned) two staves on the upper side of the pipe were damaged, but not sufficiently to necessitate shutting down the plant until several hours later, when it was convenient. A patrol is kept constantly on the pipe line. Blow-off valves to take out sediment during flood seasons are put at the low points in the pipe line, and air valves put at the high points. Just before the pipe line becomes covered with snow in winter there is some liability of these valves freezing, but after the snow comes there is no trouble. No ice forms inside the pipe even in the coldest weather.

The use of two receivers at the power house, as at Ogden, instead of one is emphatically recommended after experience with both plans.

The Venturi watermeters in the supply pipes at the Ogden plant have given some very valuable practical results in the operation of the plant. Economy of water is quite an object in this plant, because of the limited supply. Formerly it was the practice to run more generators than were necessary, and run them underloaded much of the time. After records began to be kept of the output in kilowatt-hours as compared with the mechanical horse-power of the water delivered by the wheels, the calculated efficiency obtained from the wheels in every-day running was raised from 38 per cent to 60 per cent. The men in charge of the station are held responsible for the efficiency, and they see to it that machines are not run underloaded. While the figures given may not be absolutely accurate, they are probably relatively accurate, which is all that is necessary under the circumstances. The plant is now carrying 600-kilowatts more load than formerly, and using no more water.

WATERWHEEL REGULATION.

In the matter of waterwheel regulation, which is a bugbear in many water plants, the results attained seem to be fairly good. The variable load is, however, but a small per cent of the total, except the railway load, and the supply pipes are large for the load that is being carried. As said before, there are no automatic regulators at the Big Cottonwood plant, but it is run in multiple with the other stations, which have automatic regulators on the waterwheels and consequently they furnish all the regulation. In the case of the railway load the variation in speed does not exceed 2 per cent on the waterwheels in the Utah plant, which furnish the regulation. Replogle governors are employed at this plant.

SWITCHING.

The switchboards at all the plants and at the sub-station have double sets of bus-bars and double-throw switches all through on both high and low-tension sides of transformers, on generators and on feeders, so that flexibility and reliability is assured as to switching arrangements. Figs. 6 and 7 show the Ogden switchboards. One peculiarity of this company's system, as at present operated, lies in the absence of fuses save on the street transformers and secondary distribution. Many other Western transmission plants have adopted the same practice. There are no fuses at the power house in the high-tension transmission circuits or on the 2300-volt street network, save at transformers. Mr. Hayward considers the blowing of a fuse without cause on a large system of this kind as too likely to cause serious results in the way of a general shut down for a few moments to be worth the risking. Of course, an alternating current system distributing current to rotaries, synchronous motors and large induction motors is not a pleasant thing to shut down, even for five seconds, and with everything in parallel on a network, the blowing of one fuse usually means the blowing of many more. When a short circuit occurs, it will usually burn itself off. If it is caused by an arc across the high-tension transmission lines, which occurs when something is thrown across the lines, the voltage will usually be pulled down enough to quickly break the arc.

The throwing of stations in parallel is accomplished preferably at one of the generating stations, or it may be done at the sub-station in Salt Lake City. Both stations are started on independent bus-bars, the synchronizer is put between the bars, and with the aid of the telephone which connects all stations, the speed of the two plants can soon be brought near enough so that they can be thrown together. Once together, they stay so without the slightest difficulty.

Both air-blast and oil-cooled transformers have proven very satisfactory on the high-tension transmission work. On the 2300-volt network on the street, the oil-insulated transformers have shown themselves so far to be much more reliable than the dry. No oil-insulated 2300-volt transformers have been burned out in two years, save a couple which accidentally carried twice full-load for a time while two or three dry transformers usually go out each lightning storm on the 2300-volt circuits.

RELIABILITY OF HIGH-TENSION LINES.

The service over the 16,000-volt high-tension line, 36½ miles long, between Ogden and Salt Lake City, has been remarkably free from interruptions, the record from October, 1897, to December, 1900, being as follows: On one occasion a hurricane which tore up things generally through the valley broke down some telephone wires across the high-tension lines, but did not break poles or wires. On three occasions boys threw sticks or weeds across the lines, causing an arc between wires and a momentary short circuit. On one occasion an insulator was shot off. The Big Cottonwood and Utah lines have not been so free from interruption. The fact must be faced that wherever lines run through populated districts as they do in this case, there will be some trouble from the throwing of things across the lines and shooting at insulators. While this can be stopped to a great extent by offering rewards for offenders, and the emphasizing of the seriousness of the offense by the company, still such things will occasionally be done.

Mr. Hayward considers that building a transmission line without duplicate circuits so that repairs cannot be made on one dead line while the other is alive so that all will be dependent on the continuity of one line, is a practice that cannot be too strongly condemned. He believes that if a transmission line for supplying a large community will pay at all it will pay to put it in duplicate. Although repairs have been made on the Ogden 16,000-volt line while live, he does not consider it good practice.

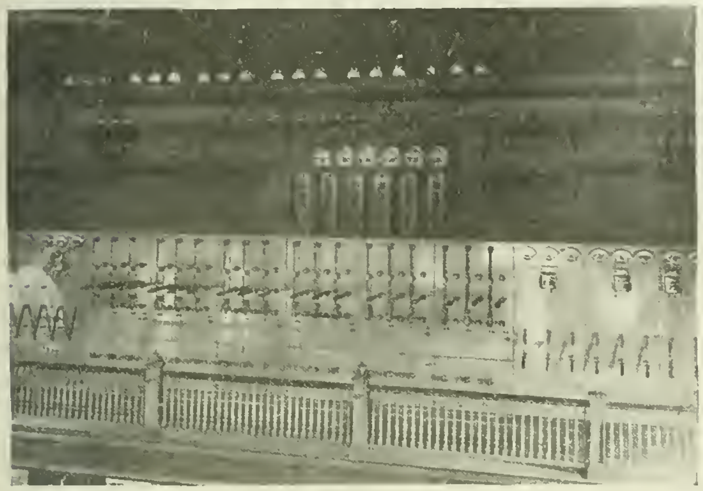


FIG. 6.—HIGH-TENSION SWITCHBOARD, OGDEN.

In building a long-distance line of this kind over mountainous country, it is considered that No. 5, or better, No. 4, is the smallest wire that should be put up, for reasons of mechanical strength, and the transmission voltage need not be higher than will transmit the power over this size line with 10 per cent drop, as it is thought that a scheme that will not stand this loss is not worth working out. When these things are considered the necessity for exceedingly high voltages in many plants is not apparent. This company has some solid aluminum wire on a 6-mile line from the Utah plant to some smelters south of Salt Lake City, consisting of three No. 2 aluminum wires. This wire was ordered specially soft and was not stretched very tight, and the results have been perfectly satisfactory. A neighboring transmission line (the Provo) has found it advisable to replace some solid aluminum conductors with stranded aluminum, owing to the brittle hard spots in the solid single conductor.

While it has been the practice with most transmission lines so far constructed to run them as straight as possible across the mountains to save distance, Mr. Hayward is decidedly of the opinion that this is a mistake where accessibility is sacrificed for straightness. A line upon which much is depending must be patroled and accessible for repair, and it is better to go a few extra miles if necessary to secure these things rather than put the pole line where it is a laborious task to get at it in summer, and next to an impossibility in winter.

COST OF POLE LINES.

The cost of a pole line suitable for a transmission of this kind is a matter of considerable interest. The cost of the Ogden transmission line is given as approximately $2,500 per mile. This has six No. 1 wires, on porcelain insulators, and is on poles set 50 to the mile. The poles are mostly 35 ft., except in Salt Lake City, where they are 50 ft. Attention is called to the fact that the pole line, independent of the copper, is such a large proportion of the expense that an increase in voltage to reduce the copper required would not proportionately reduce the total expense, and in many cases would put a practical limit to the desirability of increasing the voltage. For example, it is figured that the copper on the Ogden line did not cost more than $1,000 per mile, and that, therefore, if an increase in voltage could have halved the copper required, the cost of the line would have been reduced only to $2,000 per mile, provided there was no extra expense for insulators, etc., due to the increase in voltage.

POLES.

The poles on this company's lines come from Northern Idaho. They are straight and slightly tapering. None are used less than 8-inch diameter at the top. The 35-ft. pole makes the stiffest cross-country pole line, but it is found that in the Utah bench lands, consisting of sand and gravel, it does not take many years for the pole to rot away just below ground; and if 40-ft. poles are used they can be cut off close to the ground when rotten and the poles set 5 ft. lower. It may prove a good investment to put cement around poles in this soil. Experiments are being made with it. It has been put 14 inches thick for a depth of 2½ ft. around some poles in a specially bad spot at a cost of 80 cents per pole. Fifty poles to the mile is the minimum number that should be set, according to the experience in this country.

INSULATORS.

The insulators on the Big Cottonwood line were among the first high-tension insulators turned out and were made by the dry process. Fully one-third of them have had to be replaced. The insulators on the Ogden line were made by the Imperial Porcelain Works, and tested to 50,000 volts, as were those on the Utah line. Mr. Hayward reports no breakdowns of insulators on either of these lines. On the Cottonwood line it has never been found that a punctured insulator will cause a direct short circuit. If the insulator punctures, a small arc is formed from the porcelain into the pin, and the pin is gradually burned away until finally it breaks off if not attended to. It is the breaking of the pin and crossing of the wires that causes the trouble on the line, and not the original puncture. There is no instance of a pin being charred where the insulator was not punctured, which shows that up to 16,000 volts at least there is no burning of pins due to leakage over the surface of insulators, as has sometimes been supposed. As elsewhere, difficulty has been experienced with boys shooting at insulators with rifles, and, in fact, this is the most serious problem at the present time.

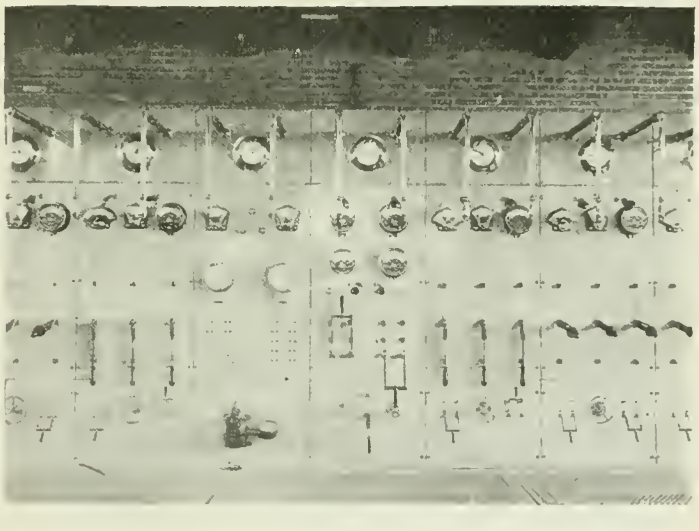


FIG. 7.—2300-VOLT SWITCHBOARD, OGDEN.

In one instance, where a boy threw a stick across the wires, a wire was burned off and fell to the ground. The power was interrupted while the wire was burning off, which lasted a few seconds, but after it fell to the ground things went on as if nothing had happened. Of course, this would not have been possible had any portion of the circuit been grounded permanently.

The wires on the Ogden circuit are transposed every half mile in a 50-ft. span, which is found to be a good plan, as it throws little side strain on the insulators, and it is not necessary to dead end the wires.

MISCELLANEOUS TRANSMISSION-LINE NOTES.

In making repairs on high-tension lines the circuit to be worked on is cut out, grounded and short circuited to prevent all danger from crosses with live lines while the men are working. The telephone is considered indispensable in the operation of a system of this kind, and indeed it is hard to see how it could be run at times without direct telephonic communication from one plant to another. The telephone wires on these lines are run on a short cross-arm always at least 6 ft. below the transmission lines. On the Ogden line the wires are transposed every five poles, and on the Big Cottonwood every pole. There is no difference in the working of the two lines. Men are sent out just as promptly to fix troubles on telephone circuits as on high-tension lines. On account of static discharges, the call bells only are kept continuously in circuit, and the transmitter and receiver circuit is thrown in for conversation by a double-pole baby knife switch. The sub-station in Salt Lake City is the "central office" for the system. Portable instruments are carried by inspectors so they can climb a pole anywhere along the line to talk to the power houses.

LIGHTNING PRECAUTIONS.

The experience with lightning in Utah is that while thunderstorms are not as frequent as in Colorado mountains they are severe when they do come. This company's experience has found satisfaction in the G. E. Wirt arresters. No static discharge wires are run along the transmission lines. The Wirt arresters are placed at generating and sub-stations. The plain metal cylinders of these arresters are placed with a 1-32-inch spark-gap between cylinders, and one of these gaps is allowed for every 600 volts line potential. In addition to this, there is in series with the arrester a graphite resistance of 80 ohms per 1000 volts on the line. During a thunderstorm small blue sparks frequently give evidence that there is a discharge over the arresters, but the line current does not follow across. Westinghouse-Wurts arresters are used at the Utah plant, and at the railway sub-station, also with good results. In one instance, a stroke of lightning came which splintered poles and jumped around among the power-station apparatus generally, but such things, of course, do not occur often, and probably no lightning arrester on earth could divert such strokes entirely.

LOAD.

The maximum winter evening load is now nearly 5500 horsepower, including all the stations. Besides electric lighting, which is very generally used in the city, there is a good load of motors in all sizes. There is about 2600 horse-power connected for service. There are a few direct-current 500-volt elevator motors driven from the railway station, but most of the motors are three-phase induction motors run off the regular three-phase distribution system. To keep down fluctuations due to starting of these motors, as far as possible the type having internal resistance in the armature is used. The resistance is cut out as the motor speeds up by means of a knob which protrudes out through one end of the hollow armature shaft. The drop-in voltage at starting is much less than with reactance coils. As to motor-circuit rates, a certain fixed rental is charged for power dependent on the indicated power taken by the motor in service, to which is added a certain sum per kilowatt-hour used. In effect, it is really a very low kilowatt-hour charge combined with a high minimum rate.

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The Metric System in Great Britain.

A report issued by the Decimal Association, of which Sir Samuel Montague is president and Lord Kelvin, Alexander Siemens, Sir Henry Roscoe, and other representatives of science and industry are members of the executive committee, has issued a report which shows that the metric system is steadily gaining strength in Great Britain. The British Education Department last year required that instructions in the principles of the metric system shall be given in the common schools. At the congress of the Chambers of Commerce of the British Empire held in London June last, a resolution was passed advocating the legalization of the metric system of weights and measures in all parts of the empire (excepting India) for all purposes, and that after a period of two years it be everywhere rendered compulsory. The report states that in Canada the Government is said to be seriously considering the adoption of metric weights and measures. In Russia there is a growing disposition on the part of the Government to adopt the method, and there are reasons for believing that an important step will be taken in that country shortly. Replies to a circular addressed by the British Government to its representatives in Europe showed that in all cases the change to the metric system was made without much difficulty, that there has never been any desire to return to the former system in use, and that the change to the metric system has assisted the trade of the countries which had adopted it. The report states that the representatives of the leading British trades unions continue to be warm supporters of the metric system, and are always ready and willing to give assistance in advocating its adoption. The names are given of 150 members of Parliament who have notified their approval of the compulsory adoption of metric weights and measures, and it is added that there are 20 more members known to be favorable, but authority to publish their names has not yet been received.

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Marconi Wireless Telegraph Patents Sustained.

Infringement suits against Mr. G. Marconi, the inventor, begun two years ago by Lyman C. Learned, of Boston, were dismissed on March 19 in the United States Circuit Court by Judge Coxe. Mr. Learned sued as the assignee of Professor A. E. Dolbear, of Tufts College, for damages to the amount of $200,000, and the issue of an injunction restraining Marconi from using apparatus for wireless telegraphy, said apparatus being alleged by the plaintiff to be covered by patents issued to Dolbear.

The original complaint in the case set forth that Dolbear was the original inventor of the system, that his patents were issued in December, 1882, and October, 1886, and assigned to Learned in July, 1899. The complaint further stated that the apparatus for wireless telegraphy exhibited in the diagrams of Marconi's patents was impractical, and that the defendant well knew this. It had, the complainant alleges, only commercial value when one terminal grounded was used for transmission and one for receiving, and hence that contracts entered into by the defendant for commercial purposes were carried out by recourse to the plaintiff's patented instruments or instruments similar. Therefore, application was made for the injunction and demand was made that Marconi be directed to pay over profits to the plaintiff.

The defendant, Marconi, applied similar criticism to the apparatus of Dolbear. It was useless, and not adapted for any commercial purposes, his defense alleged. For the rest, he set up a general denial that his apparatus or any part of it was an infringement of the plaintiff's.

Mr. Marconi's answer was supported by two expert witnesses called on his side, Dr. John Ambrose Fleming, of the University College, London, and Chas. R. Cross, Thayer professor of physics at the Massachusetts Institute of Technology. Dr. Fleming in his testimony, which was made in the form of a deposition, said that he had tried the Dolbear patent instructions and had failed to obtain any such signals or effects as were described therein. He also said: "The patentee (Dolbear) appears to be under the impression that he can raise and maintain the potential of the earth at one place by connecting that spot to the positive pole of an insulated battery. This, however, is absolutely incorrect and opposed to every-day experience. Hence both on theoretical grounds and as the result of my experiments I am of opinion that the arrangements described by Dolbear do not constitute any practical or useful art. I have tried and seen tried all the apparatus which is figured in the specifications of the Marconi patent. I am confident that, given suitable dimensions, signaling could be achieved by it over any distance, and I have not experienced any difficulty in obtaining transmission of signals through space by means of Hertz waves. There is no real similarity between the work of operation of the apparatus described by Marconi in his patent 586,193 and that described in the Dolbear patent 350,299. The apparatus employed by Marconi depends on the production of electric waves. The essential element is the spark gap. This spark gap is entirely absent in Dolbear's arrangement."

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Pan-American.

In a communication from Professor G. F. Sever, superintendent of electrical exhibits at the Pan-American Exposition, Buffalo, we are informed that there will be an extensive collective section in the Electricity Building in charge of a curator, Mr. W. J. Marland, of 132 Nassau Street, New York City. The plans are for a flat rate for individual exhibitors, covering the cost of space, attendance, light, platform and installation. A space 20 by 16 ft. has been set aside for this exhibit, and it can be enlarged if the demands become pressing. Already a large number of exhibitors have signified their desire for representation in this space.

Electric Lighting of the Thames Embankment.

A MOVEMENT for the electric lighting of the Thames embankment, which was inaugurated in 1884 (after the Jablochkoff candles, installed in 1878, had been abandoned), reached its conclusion Feb. 23, of the present year, when the plant erected was started with public ceremonies, in which the chairman and members of the London City Council and members of the Councils of the City and Westminster participated. As the plant consists of only four 70-hp units, the importance thus assigned to it is a commentary on the present state of arc-lighting development in London.

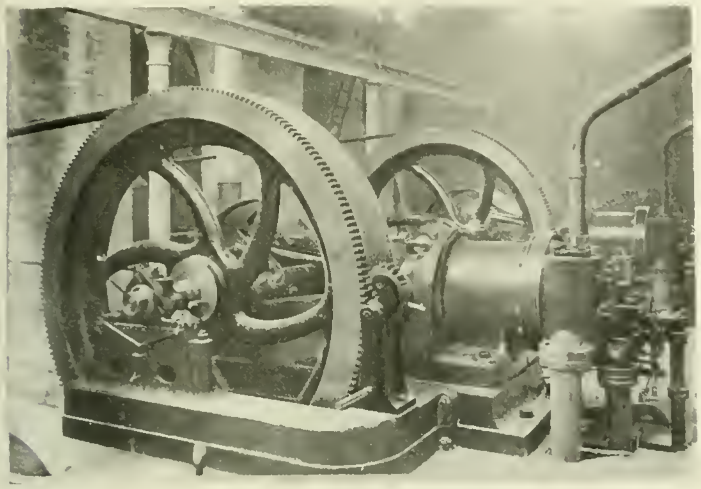

FIG. 1.—ONE OF THE GAS ENGINES.

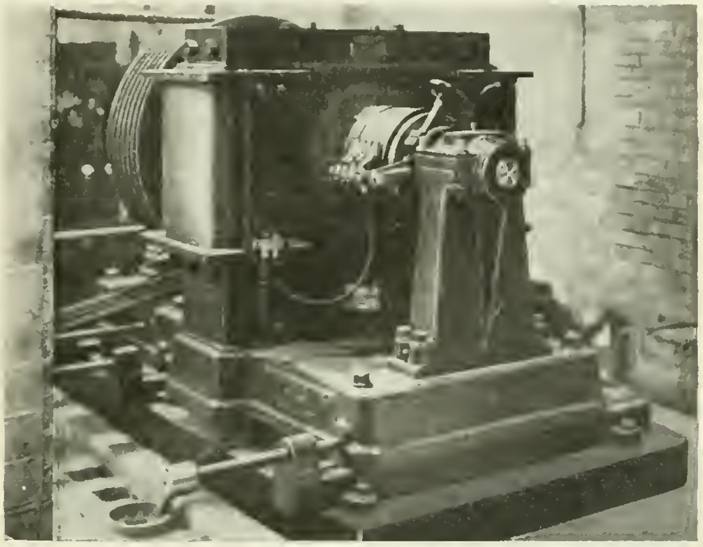

FIG. 2.—ONE OF THE DYNAMOS.

The station is a neat-looking building of Portland stone faced with bricks on the inside. The engine-room is in the basement, the dynamos being situated under the pavement; there are also offices, meter and lamp-testing rooms, and quarters for the resident foreman. The plant consists of four 70 b. h. p. gas engines, driving dynamos by means of six cotton ropes. The engines are of the "Stockport" type, fitted with self-starters and duplicate ignition, and run at 210 r. p. m. with a guaranteed consumption at full load of not less than 17 cubic ft. of gas per b. h. p. per hour. They are governed on the hit-and-miss principle, and the variation of speed is guaranteed to be not more than 1½ per cent above or below the normal. The dynamos are of the Manchester type, having an output of 70 amperes at 500 volts when running at 500 r. p. m. For lighting the building and meter testing a battery of 56 E. P. S. cells is shortly to be fixed, and these will be charged by means of a 20-kw motor generator built by the contractors for the switchboard, which runs the whole length of one end of the engine room. This board is made entirely of teak, each fuse and switch being separately mounted on enameled slate. The instruments are of the Kelvin type, and there are single-pole switches and circuit-breakers for each dynamo. The circuits are controlled by double-pole five-way lever switches with carbon break, enabling any group of circuits to be controlled by any dynamo; each circuit is protected by a double-pole fuse, and there is the usual complement of fixtures for controlling the motor generator and cells. The cables are taken from the switchboard to teak boards near the entrance to a subway 6 ft. high by 4 ft. broad, which passes under the roadway to the river side of the embankment. On these boards are fixed a number of copper links, each link being separately mounted on slate, by means of which the circuits can be disconnected for testing. The cables are composed of seven strands of No. 16 S. W. G., insulated with paper lead-covered, served, armored and again served. There are also several cables for common returns composed of seven strands of No. 14 S. W. G. These cables on the river side of the embankment are laid in the subway which was originally built to lighten the wall. On the land side the cables will be laid direct in the ground.

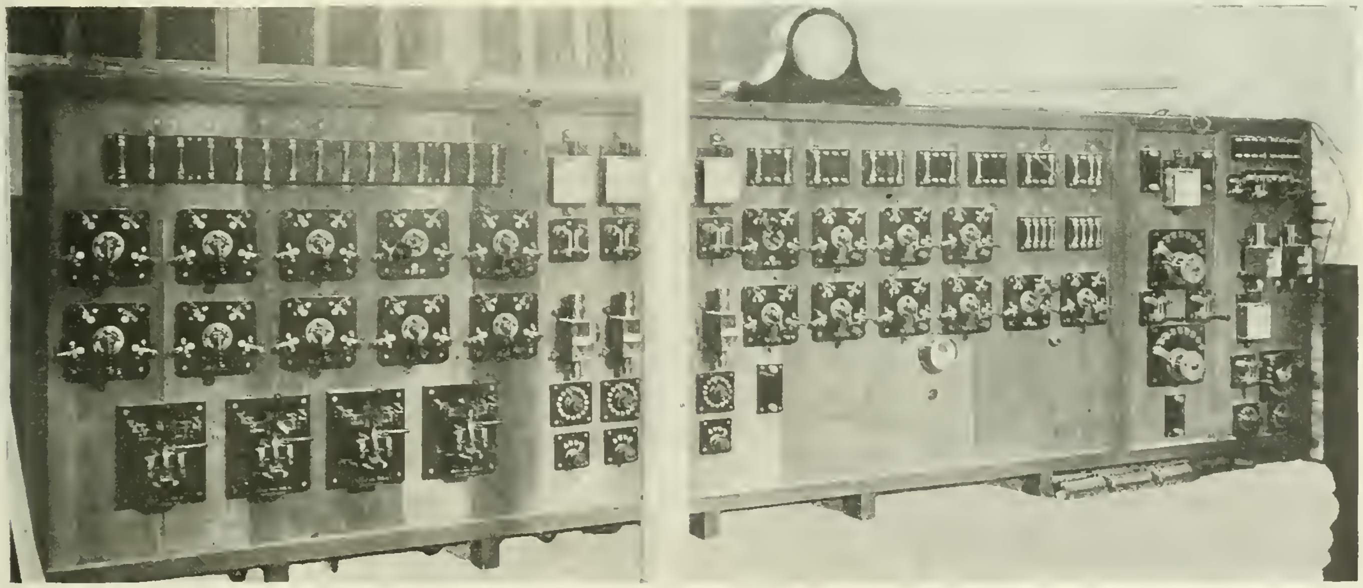

Fig. 3.—Switchboard, Thames Embankment Plant.

Several suggestions were considered by the Council with regard to the positions of the lamps, but it was finally decided to light the embankment from the footway kerbs, and utilize the old gas standards on the parapet of the Embankment and Westminster Bridge. At present only the lighting of the parapet lamps along the Embankment has been completed; the standards remain the same. New lanterns have, however, been fixed of almost exactly similar design to the old gas lanterns, except that holophane glass has been used for the bottom half. Opal glass has been used for the top half, and there is an opening through which the top of the lamp projects. The appearance of the post is shown in one of the illustrations. The addition of a cap at the top of the lantern is under consideration. There are 67 of these posts along the parapet, the posts being about 22 yards apart. The lamps take 6 amperes and are run on six circuits of 10 lamps and one of 7 lamps, and are alternately on separate circuits, so that every alternate lamp can be put out after midnight. The lamps are of the open, double-carbon, clutch type, and burn for 40 hours without retrimming. The chief feature of the lamp is the arrangement of the positive carbons, which slide in brass tubes which pass right up through the mechanism of the lamp, thus enabling the lamp to be very short considering the time it will burn without attention.

The only difficulty encountered was in drawing in the leads from the subway into the standards, owing to the arrangements only being suitable for gas, so considerable care had to be taken. As there is no provision for placing automatic cutouts in the pillar, these are to be placed in the subway, but they have not yet been so fixed. It is hoped that in another three months the rest of the lighting will be completed, when 79 more lamps will be placed along the curbs of the embankment and on Westminster Bridge. The standards for the embankment will be placed alternately on either side of the street, the lamps being separated by a distance of about 90 yards. The posts will stand about 32 feet, the center of the arc being about 25 ft. from the ground; they will be of a handsome design, with four baby dolphins where the base and pedestal join, to harmonize with the parapet standards. They will be fitted with wrought-iron brackets, with some artistic pretensions, differing from the usual cast-iron monstrosities that disfigure London. On Westminster Bridge the existing standards will be utilized, and the lamps will be fitted in the center branch of each of the three branch standards over the piers, the branch being, of course, suitably modified, and at the foot of Northumberland Avenue three arcs will be placed in the three existing gas lanterns. The lighting of Waterloo Bridge has been undertaken by the Charing Cross & Strand Supply Corporation free of cost, in consideration of concessions made by the Council as to the company's mains being allowed to cross over the bridge. The lamps will be of the same type as those on the parapets except that they will take 12 amperes and burn for 60 hours without retrimming, and along the embankment lowering gear will be employed.

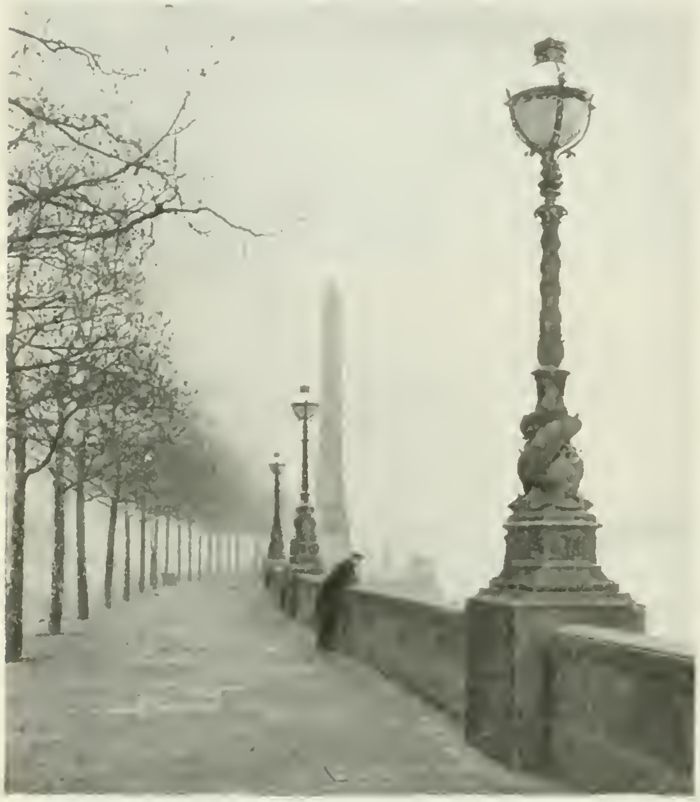

FIG. 4.—LAMPS ON THAMES EMBANKMENT.

The lighting, as far as it is at present carried out, is an unqualified success, the ground illumination being practically uniform, and the appearance of the standards excellent. Our contemporary, the *Electrician,* from which we borrow the above description and illustrations, considers that the Council would have been better advised to have procured powers to take current from one of the existing companies' stations; and even after it had settled to establish its own installation a compacter and more economical arrangement would have been to employ direct-driven steam dynamos.

The Long Distance Telegraph and Telephone Systems of Pupin, Thompson, and Reed—III.

(Concluded.)

By E. F. Roeber, Ph.D.

VII. THE REED SYSTEM.

In this system the whole line is divided into a number of equal parts connected together by mutual inductance. The current in each must satisfy the differential equation (1), of which (2) is the general integral. The problem is here also to fulfil the boundary equations at each point where two sections of the line are connected together by a transformer. These boundary equations can be written in a way which clearly shows the relation of the Reed system to the Pupin and the Thompson systems, and also the differences between these systems. It will be shown that the arrangement of the transformers shown in Fig. 9 is mathematically equivalent to the arrangement shown in Fig. 10, which is better adapted for formulating the boundary equations in our case. As this mathematical equivalence between the two arrangements in ordinary alternating-current practice is well known (see, for instance, the analytical proof of Mr. C. P. Steinmetz in his Alternating-Current Phenomena and Apparatus, second edition, pp. 182 to 185), I will restrict myself to a graphical explanation of the principle, as far as necessary for our purpose.

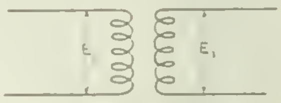

FIG. 6.—TRANSFORMER.

Let us consider any transformer connecting one section of the line with the adjacent section, as in Fig. 6. The number of turns in either primary or secondary winding is *n*, hence the ratio of transformation unity. Let *E* be the electromotive force induced in each turn, hence *n E* the electromotive force induced both in the primary and in the secondary winding. The internal resistance, reactance and impedance of the primary and also of the secondary winding may be represented by *r*, *x*, *z*, respectively. Here the reactance refers to the "true self-inductance" only, or to the cross flux interlinked with one coil only, while it does not relate to the mutual inductance. Let the electromotive force at the terminals of the primary and secondary windings equal E_0 and E_1, respectively. The diagram of the transformer is then given in Fig. 7. Φ represents the magnetic flux, $n\,i_\infty$ the total magnetomotive force, to which this flux is due. It is leading before the magnetic flux, on account of hysteresis and eddy-currents. $n\,i_\infty$ is the resultant of $n\,i_0$ and $n\,i_1$ the magnetomotive forces of the primary and secondary circuits. The e. m. f., E_0, impressed upon the terminals of the primary winding is the sum of the e. m. f. $i_0 z$, consumed by the internal impedance, and of the e. m. f. required to overcome the induced e. m. f. *n E*. The e. m. f. *n E*, induced in the secondary winding, is the sum of the e. m. f., $i_1 z$, consumed by the internal impedance, and of the e. m. f. E_1 at the terminals of the secondary winding.

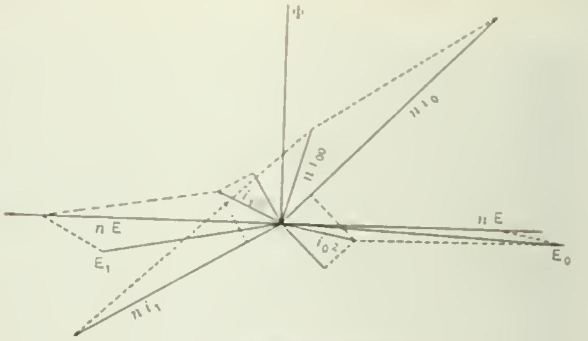

FIG. 7.—TRANSFORMER DIAGRAM.

Now, it is evident that the same Fig. 7 is also the diagram of the arrangement represented in Fig. 8. At point 1 the e. m. f. is E_0. In the coils inserted in the line between points 1 and 2, the e. m. f. $i_0 z$ is consumed, so that at point 2 the e. m. f. is *n E*. The same e. m. f. is at point 3. In the coils, inserted in the line between 3 and 4, the e. m. f. $i_1 z$ is consumed, so that at point 4 the e. m. f. is E_1. Between points 2 and 3 a shunt is arranged so that $i_0 + i_1 = i_\infty$. This corresponds to the combination of the magnetomotive forces $n\,i_0$ and $n\,i_1$ to the total flux $n\,i_\infty$ in Fig. 7.

We, therefore, see that to formulate the boundary conditions for the loaded conductor of the Reed type, as illustrated in Fig. 9, we can just as well formulate them for the arrangement represented in Fig. 10.

A long, uniform wire forms a loop *A B*. The whole length is $2\,l$, the distance between the transmitting end *A* and the receiving end *B* is therefore *l*. *R, L, C* represent the resistance, inductance and capacity, respectively, per unit length of the uniform wire (in ohms per mile, henrys per mile, and farads per mile, respectively). At equal distances, as shown in Fig. 10, Fig. 2*k* equal coils are inserted in series, each consisting of two halves, each half having the resistance R_1 (in ohms) and inductance L_1 (in henrys). There are, furthermore, *k* bridges across the line, each being a coil of the resistance R_0 (in ohms) and inductance L_0 (in henrys). Each of these bridges connects the middle points of two opposite series coils.

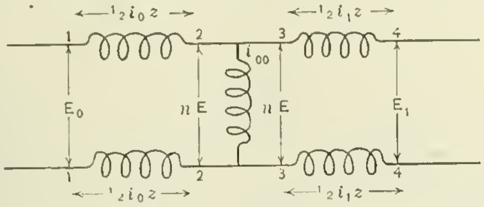

FIG. 8.—ARRANGEMENT EQUIVALENT TO THAT OF FIG. 6.

R_1, L_1, R_0, L_0 are related to the characteristic values of the transformers in the following way. R_1 is equal to one-half the internal resistance of either the primary or the secondary winding of each transformer. L_1 is equal to one-half the internal "true self-inductance" of either the primary or the secondary winding of each transformer. R_0 and L_0 are connected with the so-called "primary admittance" of the transformer, which is defined as the ratio of the exciting current to the primary counter e. m. f. If, in Steinmetz where *N* equals the frequency.

It therefore appears that the greater R_0 and L_0 the more is the loaded conductor of the Reed type equivalent to the loaded con-

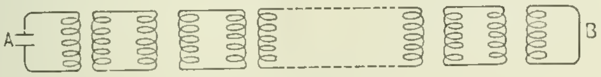

FIG. 9.—REED SYSTEM.

notation, this primary admittance is $g_0 + j\,b_0$ *we have*

$$R_0 = \frac{g_0}{g_0^2 + b_0^2}$$

and

$$L_0 = \frac{b_0}{2\,\pi\,N\,(g_0^2 + b_0^2)}$$

ductor of the Pupin type. On the other hand, the smaller R_1 and L_1, i. e., the smaller the internal resistance and the true self-inductance of the primary and of the secondary winding of the transformer, the more is the loaded conductor of the Reed type equivalent to the loaded conductor of the Thompson type. Considered from a purely mathematical point of view, the Reed system can, therefore, be regarded as the general case, comprising the Pupin system and the Thompson system as special cases.

It must, of course, be assumed that there is no distortion of the waves, due to hysteresis or eddy currents in the iron cores of the transformers. If the arrangement, shown in Fig. 10, is used in practice, with coils without iron, such an assumption is superfluous.

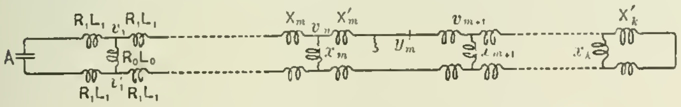

FIG. 10.—SYSTEM EQUIVALENT TO REED SYSTEM.

But in all cases when iron is used, either with the Pupin or Thompson or Reed system, special caution is necessary, as has been pointed out by Dr. Pupin.

VIII. CALCULATION OF THE REED SYSTEM.

Besides the values $R\ L\ R_0\ L_0\ R_1\ L_1$ defined in Section VII., the following notation may be introduced. Let be

$$Z_0 = R_0 + ip\,L_0$$

$$Z_1 = R_1 + ip\,L_1$$

The potentials at the terminals of the bridge *m* are v_m and $v^1{}_m$ and we have $v^1{}_m = -v_m$. At the transmitting end *A* an e. m. f. of the type $E\,e^{ipt}$ is impressed upon the line, so that the potentials at the terminals of the transmitting apparatus are $\frac{1}{2}\,E\,e^{ipt}$ and $-\frac{1}{2}\,E\,e^{ipt}$.

Let y_m be the current at any point between coils *m* and $m + 1$. Denote the distance of this point from the beginning of this uniform part of the line by ξ as shown in Fig. 10. The differential equation is the same as (1), the general integral the same as (2), namely

$$y_m = K_1 \cos M\,\xi + K_2 \sin M\,\xi \tag{21}$$

where

$$M^2 = -C\,(-p^2\,L + i\,p\,R)\,;$$

if $M = \alpha + i\,\beta$, α and β have the same values as in (4).

Let V_m be the potential at the same point; it is of the form

$$V_m = N_1 \cos M\,\xi + N_2 \sin M\,\xi \tag{22}$$

where, as before,

$$\frac{d\,N_1}{d\,t} = -\frac{M}{C}\,K_2$$

$$\frac{d\,N_2}{d\,t} = \frac{M}{C}\,K_1$$

Let X_m and $X^1{}_m$ be the currents in the coils between v_m and $(V_{m-1})_{\xi = \frac{l}{k}}$ and $(V_m)_{\xi = 0}$ respectively, and x_m the current in the bridge *m*, as indicated in Fig. 10.

We have, as in Section V.,

$$x_m = -\frac{2\,v_m}{z_0}$$

hence

$$X^1{}_m = X_m - \frac{2\,v_m}{z_0}$$

for $m = 1 \ .\ .\ k$. We then get

$$(y_m)_{\xi = 0} = X_m - \frac{2\,v_m}{z_0} = K_1$$

$$(y_m)_{\xi = \frac{l}{k}} = X_{m+1} = K_1 \cos\frac{M\,l}{k} + K_2 \sin\frac{M\,l}{k}$$

$$(V_m)_{\xi = 0} = \left(1 + 2\,\frac{z_1}{z_0}\right) v_m - z_1\,X_m = N_1$$

From $\frac{d\,N_1}{d\,t} = -\frac{M\,K_2}{C}$ we get

$$i\,p\left(1 + 2\,\frac{z_1}{z_0}\right) v_m - i\,p\,z_1\,X_m = -\frac{M}{C}\,K_2.$$

We have, therefore, three equations between K_1, K_2, X_{m_1}, X_{m+1}, v_m, and can determine K_1 and K_2 as functions of X_m and X_{m+1}. If we introduce the values, found in this way, into equation (21), and if we write for abbreviation

$$\operatorname{cotg} Ms = \frac{i\,p\,C}{2\,M}\,(z_0 + 2\,z_1)$$

we get

$$y_m = \frac{X_m\,\frac{i\,p\,C\,z_0}{2\,M} \sin M\left(\frac{l}{k} - \xi\right) \sin M\,s + X_{m+1} \sin M\,(\xi + s}{\sin M\left(\frac{l}{k} + s\right)} \tag{23a}$$

This equation is correct, for $m = 1, \ .\ .\ k - 1$, while we have the following equations for $m = O$ and $m = k$;

$$y_0 = \frac{X_1 \cos M\,\xi + \frac{i\,p\,C}{2\,M}\,E\,e^{ipt} \sin M\left(\frac{l}{2\,k} - \xi\right)}{\cos\frac{M\,l}{2\,k}} \tag{23b}$$

and

$$y_k = \frac{i\,p\,C\,z_0\,X_k \cos M\left(\frac{l}{2\,k} - \xi\right) \sin M\,s}{2\,M \cos M\left(\frac{l}{2\,k} + s\right)} \tag{23c}$$

We have further for $m = 1, 2 \ .\ .\ k - 1$.

$$v_m = \frac{z_0}{2}\,\frac{\sin M\,s}{\sin M\left(\frac{l}{k} + s\right)} \left\{ X_m \left(\cos\frac{M\,l}{k} + \frac{i\,p\,C\,z_1}{M} \sin\frac{M\,l}{k}\right) - X_{m+1} \right\}$$

and

$$v_k = \frac{z_0}{2}\cdot\frac{\sin Ms}{\cos M\left(\frac{l}{2k}+s\right)} X_k\left(\sin\frac{Ml}{2k} + \frac{ipCz_1}{M}\cos\frac{Ml}{2k}\right)$$

As

$$X^1_m = X_m - \frac{2v_m}{z_0}$$

we get for $m = 1, 2 \ldots k-1$,

$$(24a)\quad X^1_m = \frac{\sin Ms}{\sin M\left(\frac{l}{k}+s\right)}\left\{X_m\frac{ipCz_0}{2M}\sin\frac{Ml}{k} - X_{m-1}\right\}$$

and

$$(24b)\quad K^1_k = \frac{\sin Ms}{\cos M\left(\frac{l}{2k}-s\right)} X_k\frac{ipCz_0}{2M}\cos\frac{Ml}{k}$$

The k boundary equations for the determination of the k unknown values $X_1 \ldots X_k$ are for $m = 2 \ldots k$ of the form

$$\left(\frac{\delta y_{m-1}}{\delta\xi}\right)_{\xi=\frac{l}{k}} - \left(\frac{\delta y_m}{\delta\xi}\right)_{\xi=0} = -ipCz_1(X_m + X^1_m)$$

and for $m = 1$.

$$\left(\frac{\delta y_0}{\delta\xi}\right)_{\xi=\frac{l}{2k}} - \left(\frac{\delta y_1}{\delta\xi}\right)_{\xi=0} = -ipCz_1(X_1 + X^1_1)$$

If we introduce the values of $y_0 \ldots y_k$ from (23) and the values of $X^1_1 \ldots X^1_k$ from (24) into these equations, we get the following set of equations for the determination of

$$\left.\begin{array}{l} X_1 \ldots X_k,\ \text{where } m = 2 \ldots k-1: \\ (\sigma+1)X_1 - X_2 = D_0 - h_0X_1 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ (\sigma+2)X_m - X_{m-1} - X_{m+1} = 0 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ (\sigma+1)X_k - X_{k-1} = -h_1X_k \end{array}\right\}\quad(25)$$

In these equations h_0, h_1, D_0, and σ are functions of Z_0 and Z_1. As in the following we will only need the value of σ, I give only this, it is

$$\sigma + 2 = 2\left\{\left(1+\frac{2z_1}{z_0}\right)\cos\frac{Ml}{k} - \left[\frac{ipCz_1}{M}\,\frac{z_0+z_1}{z_0} - \frac{M}{ipCz_0}\right]\sin\frac{Ml}{k}\right\}$$

The set of equations (25) is again of the same form as equations (6) in Section II., Part II., of Dr. Pupin's 1900 paper. The solution is, therefore, given by his equation (7)

$$(26)\quad X_m = \frac{[2\sin\theta\cos(2k-2m+1)\theta - h_1\sin 2(k-m)\theta]D_0}{h_0h_1\sin 2(k-1)\theta - 4\sin^2\theta\sin 2k\theta - 2(h_0+h_1)\sin\theta\cos(2k-1)\theta}$$

where $\sigma = 2 - 2\cos 2\theta$

or $\sigma = -4\sin^2\theta$

This represents the general solution of the equations for a loaded conductor of the Reed type, and we are now ready to apply this solution for investigating under which conditions a loaded conductor of the Reed type becomes approximately equivalent to a uniform conductor.

IX. EQUIVALENCE OF A LOADED CONDUCTOR OF THE REED TYPE TO ITS CORRESPONDING UNIFORM CONDUCTOR.

We can proceed in the same way as in Section VI., and can apply directly the results obtained by Dr. Pupin in his 1900 paper, Part II., Section II., namely, that when $\sin\theta = \theta = \frac{1}{2}\frac{l}{k}(\alpha_1 + i\beta_1) = \frac{1}{2}\frac{l}{k}M_1$ nearly, this substitution transforms our equation (26) into the general equation of the current in a uniform conductor with impedances in the transmitting and receiving apparatus (equation (5), Part II., Section I., Pupin's 1900 paper).

The corresponding uniform conductor is, therefore, characterized in our case by the value of M_1, which is found as follows:

$$-4\sin^2\theta = \sigma = \sin\frac{Ml}{k}\left[\frac{2ipCz_1}{M}\left(1+\frac{z_1}{z_0}\right) - \frac{2M}{ipCz_0}\right]$$

$$-4\sin^2\frac{Ml}{2k}\left(1+\frac{2z_1}{z_0}\right) + \frac{4z_1}{z_0}$$

If $\frac{Ml}{k}$ very nearly $= \sin\frac{Ml}{k}$ we get[1]

$$-4\sin^2\theta = \frac{Ml}{k}\left[\frac{2ipCz_1}{M}\left(1+\frac{z_1}{z_0}\right) - \frac{2M}{ipCz_0}\right]$$

$$-\left(\frac{l}{k}\right)^2M^2\left(1+\frac{2z_1}{z_0}\right) - \frac{4z_1}{z_0}$$

Now, if we make

$$\sin\theta = \frac{1}{2}\frac{l}{k}M_1$$

we get[1]

$$-M_1^2 = -M^2 + 2ipCz_1\frac{k}{l}$$

$$+\frac{1}{z_0}\left[2ipCz_1^2\frac{k}{l} - \frac{2M^2}{ipC}\frac{k}{l} - 2M^2z_1 - \frac{4k^2}{l^2}z_1\right]$$

If we introduce the notation

$$\zeta_0 = R_0\frac{k}{l} \text{ and } \zeta_1 = R_1\frac{k}{l}$$

$$\lambda_0 = L_0\frac{k}{l} \text{ and } \lambda_1 = L_1\frac{k}{l},$$

where ζ_0 and ζ_1 have the same dimensions as R (ohms per mile) and λ_0 and λ_1 the same dimensions as L (henrys per mile), we get

$$(27)\quad -M_1^2 = ipC\{(R+2\zeta_1) + ip(L+2\lambda_1)\}$$

$$+\frac{2}{\zeta_0 + ip\lambda_0}\left\{ipC(\zeta_1 + ip\lambda_1)\{(R+\zeta_1) + ip(L+\lambda_1)\}\right.$$

$$\left.-\frac{k^2}{l^2}\left[(R+2\zeta_1) + ip(L+2\lambda_1)\right]\right\}$$

By this equation the "equivalent uniform conductor" is defined for the Reed system. To calculate the resistance and inductance of this equivalent uniform conductor separately, we must separate the real and the imaginary parts of the right side of equation (27). I will not give here the results of this calculation, as they are not necessary for the conclusions which I will draw from equation (27). First, I will show that this definition contains the definition of the equivalent uniform conductor of the Pupin type and Thompson type as special cases.

If $z_0 = \infty$, we get $-M_1^2 = ipC\{(R+2\zeta_1) + ip(L+2\lambda_1)\}$

i. e., in the Pupin system the equivalent uniform conductor has the same total resistance and inductance, as the loaded conductor.

If $Z_1 = O$, we get for the Thompson system

$$-M_1^2 = ipC(R+ipL)\left[1 + \frac{2k}{l}\,\frac{1}{ipC(\zeta_0 + ip\lambda_0)}\right]$$

This leads to the equations (16) and (17) in Section VI.

To simplify the equations, I will assume that L, the inductance per mile of the original unloaded conductor, is zero, which is approximately the case in ordinary telegraph and telephone lines. I will further assume the ideal case that the coils inserted in the line have the resistance zero, i. e., $\zeta_1 = \zeta_0 = 0$.

In this case, if the Pupin system is used the "equivalent uniform conductor" has the resistance per mile R and the inductance per mile $2\lambda_1$, i. e., the resistance has not been changed, while the inductance has been increased; the beneficial effect of the Pupin arrangement is due to this increase of inductance.

If the Thompson system is used, the "equivalent uniform conductor" has the inductance per mile zero and the resistance per mile $R - \frac{2}{C}\frac{k^2}{l^2}\frac{R}{p^2\lambda_0}$, i. e., the inductance has not been changed, while the resistance has been diminished; the beneficial effect of the Thompson arrangement is due to this decrease of resistance.

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[1] This supposition is necessary to get simpler formulas for the resistance and inductance per unit length of the "corresponding uniform conductor." In the case of the Pupin system it is fulfilled whenever Pupin's rule is fulfilled for the equivalence between the loaded conductor and a uniform conductor; if in Pupin's system the size of half the angular distance between two consecutive coils is nearly equal to half the angular distance itself, the angular distance relating to the wavelength in the "corresponding uniform conductor," the same is the case for the angular distance relating to the wavelength in the original unloaded conductor, because the wavelength is shorter in the loaded conductor of the Pupin type than in the original unloaded conductor. In the Thompson system the wavelength is greater in the loaded conductor than in the original unloaded conductor; in this case the above supposition to which this foot-note refers is a separate condition. Whether in the Reed case this supposition is a separate condition or not, depends upon the value of the wavelength in the loaded conductor of the Reed type, compared with the wavelength in the original unloaded conductor.

If the Reed system is used, we find from equation (27) that the inductance per mile of the equivalent uniform conductor is

$$2\lambda_1\left(1+\frac{\lambda_1}{\lambda_0}-\frac{2k^2}{l^2}\frac{1}{p^2C\lambda_0}\right)$$

and the resistance per mile

$$R\left(1+2\frac{\lambda_1}{\lambda_0}-\frac{2k^2}{l^2}\frac{1}{p^2C\lambda_0}\right)$$

Hence, the resistance becomes smaller than R and the inductance becomes positive, if

$$1+\frac{\lambda_1}{\lambda_0}>2\frac{k^2}{l^2}\frac{1}{p^2C\lambda_0}>2\frac{\lambda_1}{\lambda_0};$$

it is evident that λ_0 must be chosen greater than λ_1 or L_0 greater than L_1. It will be seen that with the Reed system it is possible to accomplish both purposes—increase of inductance and decrease of resistance of the transmission line.

I have considered the ideal case of $L = 0$, $\zeta_0 = 0$, $\zeta_1 = 0$, because the formulas become most simple and allow to show plainly the relations between the Pupin system, the Thompson system, and the Reed system. The principal purpose of this paper has thus been accomplished.

To sum up, the general theory of the Thompson system and the Reed system has been developed in a way analogous to that used by Dr. Pupin for the calculation of his own system. The formulation of the boundary conditions in the three cases of the Pupin, Thompson and Reed systems leads to analogous sets of equations, and this is the reason why the comparison of the loaded conductors of the Pupin, Thompson and Reed types with their "corresponding uniform conductors" can be made in the same way in the three cases and leads to analogous results; but the definition of the "corresponding uniform conductor" is essentially different in the three cases. While in the case of the Pupin system the total resistance and inductance of the corresponding uniform conductor, is equal to the total resistance and inductance of the loaded conductor, the definitions of the resistance and inductance per unit length of the corresponding uniform conductor for the Thompson system and the Reed system are given by the equations (16), (17) and (27).

The resistance and inductance per unit length being defined as functions of the frequency, I have restricted myself to the theory of the transmission of a single sine wave of given frequency. From the difference of the definition of the "corresponding uniform conductor" in the three cases, results the essential difference between the three systems. A loaded conductor of the Pupin type behaves like a uniform conductor with greater inductance per unit length than the original unloaded conductor; a loaded conductor of the Thompson type behaves like a uniform conductor with smaller resistance per unit length than the original unloaded conductor; in a loaded conductor of the Reed type both these beneficial effects may be combined.

As far as long-distance telegraphy with sine waves of a given frequency is concerned, the three systems discussed enable one to diminish the attenuation in the transmission of a given amount of energy over a line of given copper, or to save copper with the same attenuation. For telephony the question arises, How far the attenuation depends upon the frequency in the Thompson and the Reed systems? or, in other words, how far the circuit is distortionless for practical purposes? It would be interesting to investigate this in numerical examples, but the discussion of this question is beyond the principal purpose of this paper in which I wished to restrict myself to an exposition of the general principles of the problem.

Rotations from Electric Sparks.

By Alfred G. Dell.

In the following I will treat of the electric sparks coming from the secondary of an induction coil in producing rotations of a horizontal disk, the forces being frequently only discharges of the sparks. I will first give some experiments made with a mica disk coated with shellac and rotating in a horizontal plane, the forces being spark discharges, of a maximum length of ¾ inch, reduced to 9-16 inch, and passing under the disk on the one side.

I found the humidity of the atmosphere had an astonishing effect on the rotations of such disks, the moisture settling on the disks and about the electrodes, and also direct effect on the charges on the disks, and the discharges from the points under the disks. When a disk was made sensitive enough both as regards its freedom of rotation and balancing, and everything else made perfect, it always started, if left alone, from the + to the — direction; and if started from — to +, it rotated in that direction without reversal.

If the humidity of the atmosphere was, say, 48 per cent. the disk would rotate only in the one direction from + to —, but it was generally possible to obtain a rotation in the opposite direction with a starting velocity nearly equal to its final one, if the sensitiveness of the disk was increased, which is generally possible. As the humidity is decreased by putting the disk in a tight oiled and lacquered wooden box with glass sides and containing calcium chloride, the starting velocity required to obtain a rotation from — to + was diminished until, as far as I have gone in removing the humidity, it required only the slightest impulse to set it rotating — to +, while at the same time the rotation from + to — was increased. The final constant velocity of rotation was a little greater from + to — than from — to + in all cases. In my search for a cause of the above rotations, I had two theories, one of which was repulsion and attraction of charges on the disk between side discharges and direct ones from the points; and the other that small particles or atoms were torn off of the electrodes and propelled against the disk. Knowing that there would be charges on the disk, and that there would be repulsion and attraction between them and the discharges from the points, I accepted the former as the true theory, coupled with a shifting forward or backward of the charges on the disk by its rotation, the shifting depending in direction upon the direction of rotation.

I am quite sure that if nearly all moisture were removed from a box containing a disk, it would bring the two forces to an equalization; and if all were removed the minus would possibly predominate, and a very rapid rotation from rest from — to + would be obtained, I have a sensitive disk in a very tight box, which has contained calcium chloride for several weeks, and with it I am never quite sure in which direction it will to a certainty rotate from rest; the slighest inducement will send it from — to + direction. The smallest amount of moist air let into the box at once determines with more certainty the rotation from rest from + to —.

Right here some little light is thrown on the two discharges in a Geissler or Crookes tube. As the air with its moisture is being removed from the tube by a pump or otherwise, the cathode discharges begin to come into prominence, in the same manner as in the case of the disk when the moisture is being removed, which is an effect separate from that of the vacuum in the tube.

The question may be asked. Does not the disk sometimes, while moisture is present in the air, start to rotate? My answer is. there are sometimes, when the humidity of the atmosphere is high, indications of the forces being present by the disk very slowly rotating from + to —, providing there is no moisture on the disk or anywhere about it; these rotations become very erratic or cease entirely, and are only momentary impulses acting now and then, and produce no genuine constant rapid rotations. With moisture present I have found it impossible to make any experiments.

Sometimes the disk with ordinarily low humidity, will start from — to + and rotate, but I have always found it was from unnaturally tarnished points, produced by reversing the primary current, faults in the disk, a polarizing battery or a spark-gap in series somewhere, a broken wire for instance; with a spark-gap in series it nearly always, in fact, under certain conditions always, started from — to +, depending somewhat upon the length of the gap and degree of humidity. See a description of a Crookes tube requiring a spark-gap in series to produce Röntgen rays, printed in the *Electrical World*, Oct. 2, 1897.

It has been stated that the velocities of ions of the electric wind have the ratio of the — to the + of 1.31 for air in the same field. If that ratio is thought to hold in ordinarily dry air, I do not see how the disk could start to rotate from + to — unless the masses of the + ions were greater than those of the —, or unless the disk had to be started from + to — to make it rotate, which is not a fact, as it has to be started from — to +.

It has been stated, "It has been known for some time that a charged or electrified body resists having its motion varied, by reason of the magnetic disturbance which such variation effects, and which pulls upon the electric charge in such a manner as to oppose the change, etc." If that theory is to be applied to the rotating disks it would indicate something in the nature of a resistance to a change of the direction of the motion, but a resistance could not increase the velocity.

The changes of the rotation of the disk when in a tight box with calcium chloride are remarkable. I will describe in full the changes with a disk which I knew was sensitive enough to rotate well in either direction. I placed it in the box with calcium chloride, the humidity being about 60; it would not rotate, but after a few days I detected a slight rotation from + to —; and after some further time a rotation fairly well from + to —, and a long rotation from — to +, when started rapidly, but a final reversal; after a little while longer an increased rotation from + to — and a constant rotation from — to +, with a large starting velocity almost equal to its final velocity; after a little while longer a rapid rotation from + to —, and a rotation from — to + with a still smaller starting velocity, and so on, until finally a rapid rotation from + to —, and a rotation from — to + with but a slight impulsive force required in that direction; and now any slight imperfection (the forces being nearly balanced) in the disk began to make their appearances, such as a place from which, when the disk started of itself while at rest, is swung around to and fro as if undecided in which direction to go, the place acting as if it had springs at both sides, the space of oscillation in this case being about ½ inch on the circumference; it would generally finally rotate from + to —, but sometimes would obtain swing enough to send it the other way, and if it once passed one of the points of obstruction or faults in balancing, that determined the rotation, it having a start sufficient to send it on its rounds with an accelerating velocity to a final constant one. Its peculiarities can only be understood by following it up at intervals, as the moisture is taken up by the calcium chloride.

The "magnetic disturbance" and no other might be present, where in the above description, the disk rotates for a long time from — to +, and then reverses; but there is a driving force present also, which is shown by its subsequent action, which makes it impossible to distinguish the effects of one from the other, if the magnetic effect is really present, and retards the rotation. It may be asked, Cannot something be seen on the disk above the sparks? and my answer is, Yes, there appears a long line of flickering light moving to and fro on the disk right above the sparks; whether it is a visible true rapidly dissipating charges on the disk, or only the light which would be anticipated from the sparks, I am unable to state, and do not know as yet of any way to determine the point; it may be both. I believe the humidity in the air and collected on the disk very rapidly dissipates the charges on the disk, and also affects the discharges of the points in the same manner, but to a somewhat smaller extent.

Continued heat has some decided effects, but I have some doubts whether it has any direct effect on the discharges. The heat reduces the velocity of rotation, and to some extent increases the starting velocity required to send it in rotation from — to +. A disk rotated either way when the temperature in the room was 94 degs. F., but with a reduced velocity over that when it was cooler. I tried various means to determine whether there was any direct effect from heat, but as yet have not succeeded. Some effects connected with it are extremely difficult to account for, being so intermixed with other known effects, and thus in a manner covered up.

It may be asked, At what greatest distance from the points will the disk rotate? I will answer that by stating that I made an arrangement where the axle of the disk was magnetized and hung by magnetism from another piece of steel magnetized in the opposite sense. The arrangement was constructed so I could raise or lower the disk without disturbing it, even while in rotation. I found I could obtain rotation from the side discharges of 1½-inch sparks with the disk raised as much as ¾ inch from the points. This construction is very easy, and will rotate well. Those with jeweled bearings are more difficult to make, having to be well balanced to rotate well; but when perfect, they will furnish rapid rotation.

The following is one of the curious actions of a disk in a tight box with calcium chloride. I will first describe a part of the construction of the present arrangements. I have two of the disks in tight boxes. The one has the electrodes of a narrow brass plate with raised sharp points under the disk near the circumference. Both electrodes are placed on the outside of the disk, extending only slightly under the disk. They rest on cardboard covered with shellac, to keep out dampness when the box has to be opened, and there are two pieces of tinfoil at an opposite diameter of the disk. The cardboard is cut away between the sparker and elsewhere, so that if any dampness should collect in it the impulses from the one could not pass that way in going from one electrode to the other. The tinfoil is connected to the leading-in wires. Nothing except what has been described was noticed with this arrangement.

The other one is made the same way, but the electrodes are fastened direct to the leading-in wires. I fastened strips of thin mica on the pieces of cardboard with shellac covering the whole of the two pieces of cardboard, and extended the mica some little under the disk. With this arrangement I encountered an entirely new phenomenon. When I connected it up with the coil and started the current, the disk started to rotate from + to —, which is the direction it always started when not fast; it rotated rapidly for a while, but finally rapidly slowed up and stopped still, started over again, repeated it several times, and then suddenly started from — to +, and rotated in that direction, stopped and started again, reversed in direction, and finally came to a long stop. On pressing a piece of hollow rubber fastened on the end of the glass tube which passes through one side of the box containing the disk, with the other end of the tube above the disk I found I could budge the disk but little. It appeared to be nearly fixed as regards the air from the tube. On leaving the disk remain inactive for some time, at least a half an hour, trying it frequently, on pressing the rubber slightly the disk started to rotate, showing the tube acted properly. I found when the current had been turned off it would sometimes but not always start in that direction and rotate, if the current was turned on again, although the disk had been idle for some time, but still nearly unmovable. If when it stopped it had been rotating from + to —, it would often start in that direction, when the current was again turned on; and in both cases would go through something like the same motions that it did before the current had been turned off

The rotations are all rapid ones. When the disk is fast, by pressing the rubber on the end of the tube, it will start from — to + when the coil is started, providing the rubber is pressed hard and rapid; the wind assists the — side. While rotating from + to — the motion could not be reversed by the rubber. This is not due to the disk or electrodes, as I have used them frequently without the mica under the electrodes, and obtained the ordinary results

The blower acts well, as shown, when there has been no connection with the coil for some time. I again tried the arrangement with heat for some two hours, but it had not any perceptible effect. It is the mica under the disk that causes the strange phenomenon. It acts as if condensers were present. It is the first time I have obtained such peculiar results, and give the experiments for what they are worth. The parts under the disks have been thoroughly examined with a lens for any obstructions raised by the electrical discharges.

The perpendicular components of the repulsive forces are easily discovered from experiment. The top of the axle of a disk is always loose in its jewel, and when allowed very lightly to rest over the spark points, as soon as the first discharge takes place the disk straightens up and will rotate with but little falling over again towards the points, providing the disk is well constructed. I have been unable to discover from experiment anything relating to the attractive forces. It seems reasonable to suppose there must be some attractive forces present also, but not to the same extent as the repulsive.

For the disk to rotate well, it appears from experiments that the points must be exactly alike, but if there is slightly more metal on one side than the other, it makes no difference. When a disk is first arranged I always determine whether it will start and rotate, as near as I can distinguish, with the same velocity from + to —, whether the right or left hand-point is the positive one. I generally find that whenever there is a difference in the velocities, there is a difference in the points, which I could discover by the use of a lens. Any foreign matter on a point interfered with rotation.

I find that with the use of shifting cardboard pieces of large size covered with shellac and placed under the electrodes and disks, there is a slight condensation effect, such as is discovered to be of such great prominence with the use of mica or glass; it is so slight, however, that I would not have noticed it at all if I had not anticipated it and looked for it. The effect shows in a slight swinging backward and forward of the disk after it has been rotating for some time, and has come partly to rest; after the exciting influences of the coil have been removed it quickly disappears.

The after-excitations seem to come principally from the points discharging on the disk some of the accumulated charges on the material under the electrodes; and the electrostatic lines of force between the charges on the mica or glass under the electrodes and disk act like elastic rods standing erect perpendicular to the surfaces; they resist being bent by the forced rotations of the disk, and when bent return or attempt to return, and failing take hold of the disk in new places, the electrostatic lines extending from the mica or glass to the disk, and temporarily holding thereto.

There appears also at times to be a continuation of the rotations after the excitations of the coil have been stopped, although this is difficult to determine for a certainty; but I am almost positive that at times the disk rotated longer than it should from its ordinary momentum. The charges on the mica or glass last from ½ to 5 or 6 hours, depending upon the degree of humidity. The lower the humidity the longer they last, which is indicated by the resistance of the disks to the slight wind from the glass tube used to change its direction of rotation. To construct boxes that would keep out all moisture. they would have to have glass walls entirely.

When once the disks rotate well in both directions the boxes containing a small quantity of calcium chloride, they will rotate at all times when excited by the coil, and last for months; but there are always changes in their velocities of rotations from the effects of variations of moisture, heat, etc.

If there are any who repeat my experiments with the rotating disks I would suggest that they will, if convenient, allow the light from an electric arc to fall on a disk and its spark-gap, and note the results, if any, as to changes of velocities, etc. The light from a gas jet seems to increase the velocities.

In the *Electrical World* of Oct. 2, 1897, I described a Crookes tube which, when attached to the terminals of the secondary of an induction coil, required a spark-gap in series to produce Röntgen rays. Without the spark-gap there was no light in a fluoroscope. With the spark-gap in series, the brightness of the light obtained depended upon the length of the gap. The wider open the gap the greater the light, providing it was not too wide open to allow sparks to pass. I also described a peculiarily colored cloud of light around the anode with no gap in series, which gradually disappeared when the gap was being opened. It is well to compare experiments. I have found on numerous occasions—in fact, it is a natural effect, occurring always with one certain disk I have—that a spark-gap in series or even a poor connection, such as would hardly answer with a battery current, that the — side of the disk which is the more favorable side, will cause it to start from perfect rest and rotate from — to +. The effect of the gap is always in that direction, although sometimes with some disks it fails, its effect not being strong enough to reverse the starting direction. It would seem that the cloud of light around the anode of the X-ray tube mentioned above must have been anode spark discharges, which spark discharges must be suppressed to produce Röntgen rays; the anode discharges appearing in the tube as charges only, and not spark discharges across the tube or away from the anode, so as to meet the cathode discharges in space.

I will also refer to the activity of Röntgen rays often produced in Crookes tubes by the partial removal of the remaining humidity by absorbents, which is in agreement with the humidity effects on the rotating disks as described. In heating a Crookes tube, as is sometimes done, to make it more conducting, is it not likely that the heat frees the remaining moisture to some extent collected on the glass walls and electrodes, and thus raises its conducting conditions?

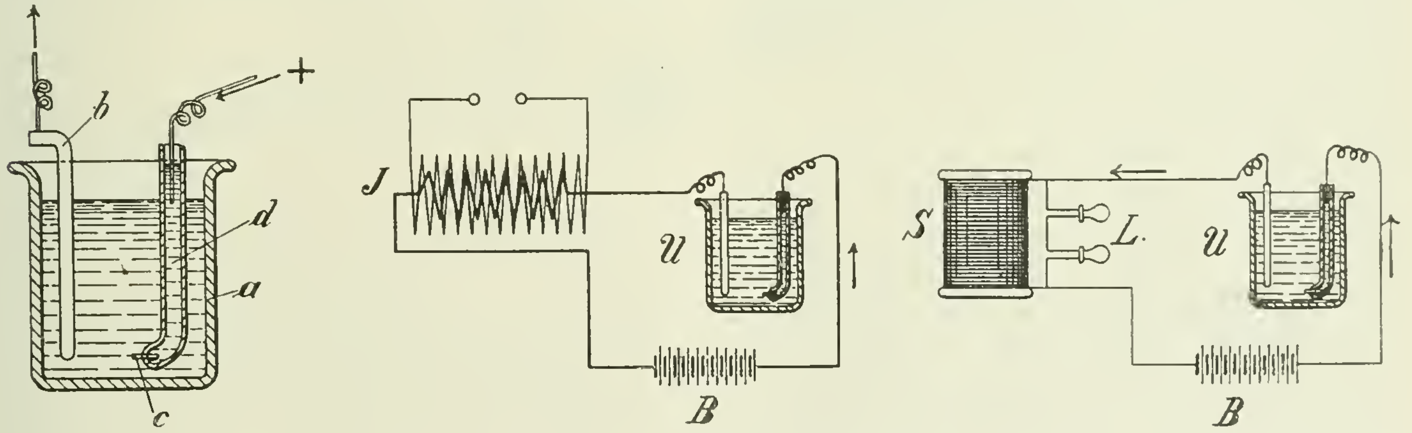
I do not think it will do to compare the phenomena of discharges in high-vacuum tubes with those that would take place in inter-stellar space, as the absence of all heat and humidity would have to be taken into account in celestial space. It must be remembered that disk arrangements can be constructed that will rotate, acording to my experiments. only from + to —, it making no difference on which side of the disk the + electrode is, or if for any rotation from — to + there will have to be a large starting velocity, no difference what the obtainable low humidity is. Such arrangements do not rotate with sufficient freedom to run well from — to +.

The Wehnelt Interrupter.

A United States patent was issued March 19 to Arthur Wehnelt on the electrolytic-current interrupter now well known by his name. A description of this interrupter first appeared in the *Elektrotechnische Zeitschrift* of Jan. 26, 1899, and led to a widespread interest in the device, which has scarcely been justified by the practical results obtained from it. The specification of the patent is so free of Patent Office jargon that we reprint it in full below:

When an electric current is sent through an electrolyte by means of two electrodes of unequal surface area under a voltage largely surpassing the polarization tension in opposite direction, the well-known phenomena of light and heat occur. Lagrange and Hoho, *Lum. él*, 1894, Vol. 52, page 113, and Vol. 51, page 165, based recently an electric-welding process upon this occurrence. They called the smaller electrode manifesting the generation of light and heat the "active" electrode. The following publications treat of this subject: Franz Richarz, *Wied. Annals* 39, pages 67 and 201, 1890; C. Fromme, *Wied. Annals* 29, page 187, 1886; Koch and Wüllner, *Wied, Annals* 45, pages 473 and 759, 1892. The latter gentlemen mention that they heard under the above-stated conditions when a telephone was inserted a purring sound and they deduce therefrom and also from the noise manifesting itself simultaneously with the phenomena of light and heat that the current passing the apparatus is not constant, but oscillating. Closer study by me into this phenomenon has resulted in the discovery that the current is not only oscillating, but completely interrupted, reaching as high a speed as 1700 breaks in a second.

For the experiments hereinafter described the apparatus represented in Fig. 1 was employed. Into a tumbler *a*, filled with diluted sulfuric acid (preferably of 20 to 25 degs. Baumé), a lead plate *b* and a platinum wire *c* are dipped or submerged, the latter being fused into a glass tube *d*. The glass tube is filled with mercury for the purpose of conducting the current to the platinum wire *c*. It proves to be the most advantageous to pass the current through the apparatus in the direction shown in the figure.



Figs. 1, 2 and 3.—Wehnelt Interrupter.

The efficiency of the interrupter was hitherto tested, as stated below:

First, on inductors of a length of spark of 2, 15, 30 and 50 cm the connection is represented in Fig. 2. *J* designates an inductor: *U* the electrolytical interrupter, Fig. 1, and *B* an accumulator battery or other source of energy (of at least 14 volts).

The discharge of the secondary coil of the induction coil has a peculiar character always more arc-like under normal current owing to the high number and the regularity of the interruptions or breaks. The length of sparks is the same as the same induction coil gives under equal current with the ordinary interrupters. By increasing the tension and the intensity of the current the effect of the induction coils can be materially enhanced without being injurious for the new interrupter—as, for instance, for platinum interrupters (in which the contacts will burn away). Whatever enhances the self-induction in the circuit increases the efficiency of the apparatus. The intensity of the current grows with the increase in the surface of the active electrode. The number of the interruptions grows with the increase in tension or voltage.

In order to obtain easy change in the surface of the active electrode, the arrangement represented in Fig. 4 is appropriately made. The platinum wire *c*, forming the active electrode, is passed through a porcelain plug *h* in this arrangement and fastened on a rod *e* of brass or similar material. The latter is adjustable in the box *g*, made of brass or similar material, said box being provided at its inner extremity with a sleeve *i*, of hard rubber or the like, which sleeve is screwed on and passes over the porcelain plug *h*. At its exterior extremity the box is provided with a check-nut *l*. The packing of this box against the wall of this vessel *a* takes place by means of the two rubber plates *k*, which are pressed together by the nut *l*. On the box *g* is fixed the terminal *f* for the positive pole. The rod *e* is provided at its rear extremity with a disk *m*, by means of which the platinum wire *c* can be pushed out from the porcelain plug *h* as far as may be desired, so as to increase thereby the surface of the active electrode at will.

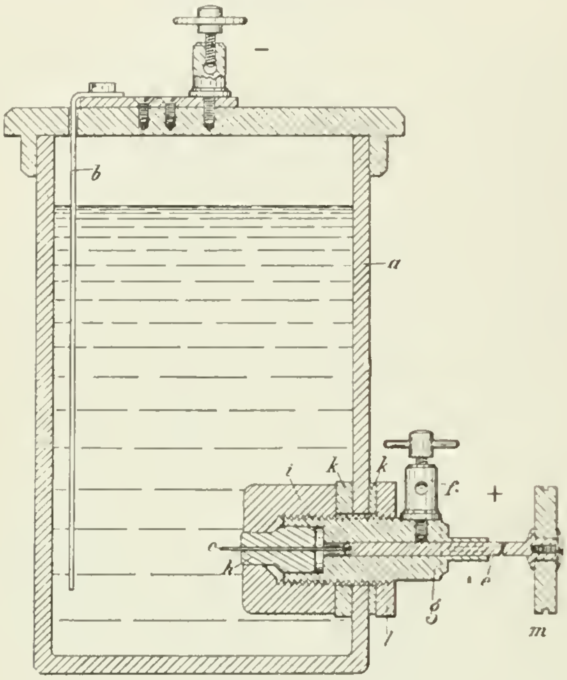


FIG. 4.—WEHNELT INTERRUPTER.

Second. When inserting incandescent lamps *L* parallel to the coil *S*, between *a* and *b*, Fig. 3, which was fed in rotation by the electrolytic interrupter *U*, by means of the battery *B*, with 12, 24, 48 and 96 volts, the following bright illuminations took place: When using 12 volts, a 30-volt lamp; when using 24 volts, a 63.5-volt lamp; when using 48 volts, a 120-volt lamp; when using 96 volts, two 120-volt lamps. Electrometrical measuring of the terminal voltage showed that it always amounted to more than double the battery voltage.

Third. For converting direct current into alternating current for optional up-and-down conversion of the latter two converters were used, 100 volts for primary and 1000 volts for secondary alternating current. These converters, fed by means of the new interrupter with a 100-volt direct current, do not yield secondarily 1000 volts of alternating current, but 2000 volts and over of alternating current. When converted down again, the low voltage or tension coil of the second converter yielded 200 volts. Many further tests with smaller converters proved the eminent usefulness and a good efficiency (up to 70 per cent) of the interrupter for converting purposes.

Two claims accompany the patent, as follows:

1. An electrolytical interrupter for direct currents comprising two electrodes, a vessel containing an electrolyte into which the electrodes dip, said electrodes being of a surface of unequal size, the anode serving as the active electrode and their terminal voltage being higher than the polarization tension.

2. In an electrical interrupter, the combination of the vessel containing an electrolyte, the two electrodes dipping therein, the active electrode being adjustable and means for adjusting the same consisting of the rod *e* connected with the electrode, the insulating block *h* through which the electrode extends, the box *g* through which the rod *e* extends, means for holding the insulating block to the box, means for holding the box to the vessel and means for electrical connection with the rod.

The Distribution and Conversion of Niagara Current at Buffalo, N. Y.*

By Henry Gordon Stott.

BEFORE proceeding to the subject proper of the paper a brief description was given of the apparatus and lines generating, transforming and conveying the current from Niagara Falls to the terminal house at the city limits of Buffalo, where the overhead lines terminate and the underground distributing system for the various purposes to be hereafter described, begins.

The power received in Buffalo originates at the well-known plant of the Niagara Falls Power Company at Niagara Falls, N. Y., in water-driven turbines direct connected to 5000-hp two-phase, 2200-volt, 25-cycle generators. Ten of these generators are now installed, and a new wheel pit is being excavated on the south side of the surface canal, parallel to the present power house, for 12 more generators of the same size, which will give an ultimate total capacity of 110,000-hp; and it is a very safe prophecy to say that every horsepower of it will be sold as fast as the turbines and generators can be installed, as the present installation of 50,000-hp is all contracted for, and already many customers find themselves in the position of Oliver Twist, and with no better results.

The 2200-volt, two-phase currents are conducted into the transformer house, where, after passing through time element overload circuit breakers, they enter two distinct banks of step-up transformers of the air-cooled type, of an aggregate capacity of 12,000 kilowatts, which are arranged in pairs for the two-phase, three-phase connection at the same time to change the pressure to 11,000 volts. Within a couple of months the secondaries, which are now in multiple, will be connected in series to give 22,000 volts as originally intended.

The 11,000-volt, three phase currents from the secondaries of the two banks of transformers are brought directly out in cables on large special porcelain insulators set in iron fixtures in the air chamber, and then on the regular helmet type porcelain insulators on timbers on the wall The lightning arresters are of the usual multi gap type, with reactive coils in series, and in a second type with an additional check to the current in the shape of carbon resistances to prevent the live current following the lightning discharge

The two three-phase, 11,000-volt circuits running on the same pole line to Buffalo, each consist of three bare stranded copper cables of 350,000-cm area, forming equilateral triangles on each side of the pole, the sides of the triangles being 3 ft. In the run of 23 miles to Buffalo, the lines are transposed five times in order to equalize and minimize the inductive drop on all phases, and at Tonawanda where a branch line is taken off for Tonawanda and Lockport, lightning arresters are installed of a type similar to those used at Niagara Falls and Buffalo. During the first two years' operation of this line, iron guard wires grounded at every alternate pole were used for protection from lightning, but so much trouble was caused by them falling on the lines that after striking a balance between the supposed protector and the known trouble, the result was so everwhelmingly against the former that the guard wires were taken down, and the interruptions due to line trouble very materially reduced The remaining trouble on this part of the system was almost exclusively due to the ever-present boy, who speedily discoverd that by a little dexterity in the manipulation of an old piece of iron wire or hoop he could produce brilliant Fourth-of-July effects at will. The cables were, at this time, only 18 inches apart, and an arc once established would travel backwards along the line with ease until the circuit breakers eventually opened at the Falls. This trouble was remedied very effectually by separating the cables 3 ft. apart, as at present, and at the same time arranging them so that they formed a triangle with the apex below instead of all being on the same plane as formerly.

At the terminal house situated at the city limits of Buffalo the lines now terminate in a common set of bus-bars, and to these bus-bars are connected the five three-conductor lead-covered cables which lead to the various sub-stations.

Simultaneously with the increase of line pressure to 22,000 volts there will be installed in the terminal house six 2250-kw step-down transformers of the oil and water-cooled type, reducing the pressure to 11,000 volts for distribution in the underground cables.

A third line is now being built from Niagara Falls to the terminal house, following a different route, in order to give greater security of service, but as the present pole line is built with very heavy poles 90 ft. apart, no great anxiety is felt as to the possibilities of even Lake Erie zephyrs combined with sleet affecting it.

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*Abstract of a paper read before the American Institute of Electrical Engineers, New York, March 22, 1901.

CONVERSION.

The 11,000-volt, 25-cycle, three-phase currents distributed to the seven sub-stations in Buffalo are manifestly unfit for use in the supply of power or light without transformation in the former and conversion in the latter case, as 25-cycle is much too low a frequency for arc lighting, which promises to displace incandescent lamps to a great extent in the near future.

In discussing the various means employed to make this power available to the customer, the paper begins with the simplest and then proceeds to the more complex. The simplest and most efficient method is evidently to reduce the pressure by means of static transformers of large capacity and high efficiency and deliver three-phase 2200-volt current to the various customers by means of a secondary network of cables. This is done in sub-stations Nos. 1, 2 and 3, where 2200-volt, three-phase currents are delivered by underground and overhead cables to customers for use in malt houses, grain elevators, machine shops, dry docks, bakeries, tanneries and all sorts of manufacturing establishments to the extent of about 4000 horse-power. This power is utilized in the above places chiefly by means of induction motors, some of which receive the current directly at 2200 volts, but in the majority of cases at a reduced pressure of 440 or 220, the reducing transformers being supplied by the customer. For grain elevators, in which a large amount of fine dust of an explosive nature is present, the induction motor presents an ideal solution of the power problem, as the safety and controlling devices can be located in a separate building, so that no spark can cause an explosion or fire. The efficiency of transformation with this system is evidently that of the transformers only, which in sizes of 250 kilowatts and upwards is from 97.5 to 98.3 per cent at full speed.

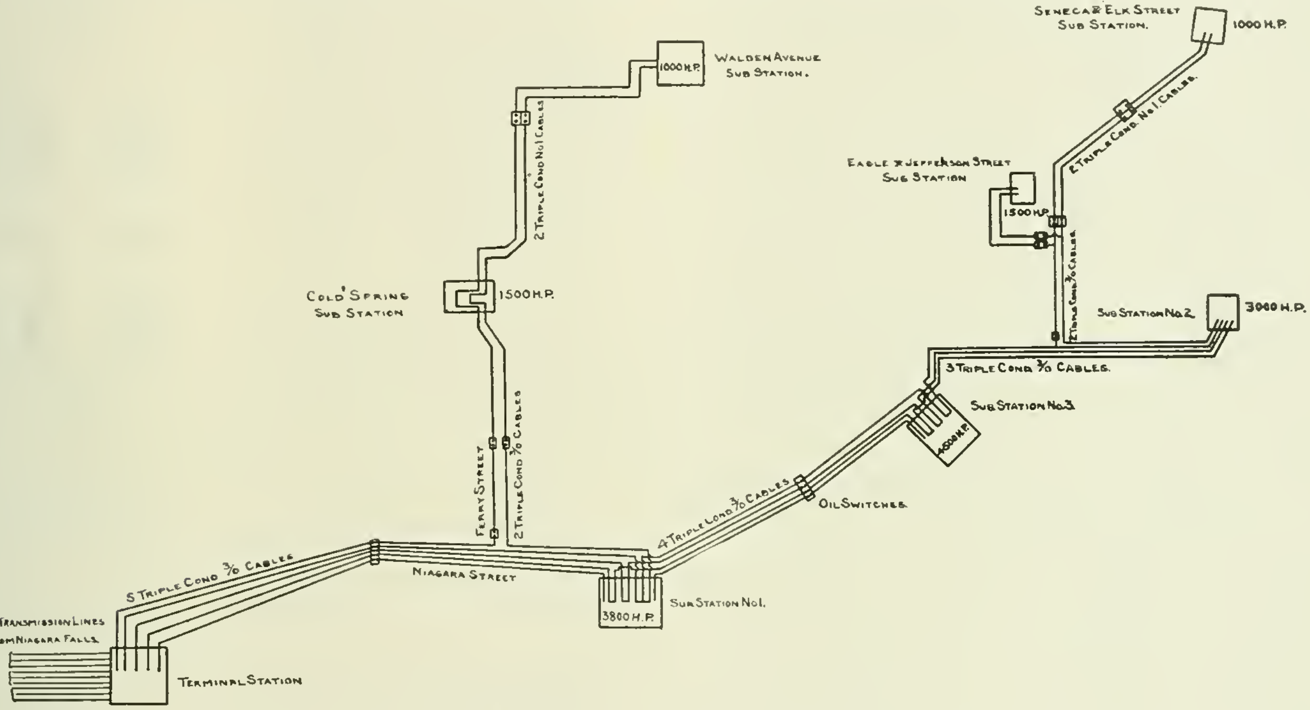

Fig. 1.—Arrangement of 10,000-Volt Circuits in Buffalo.

The largest user of power in Buffalo is the International Traction Company, which receives a total of 7000 horse-power in five substations—No. 1, Cold Springs, Walden Avenue, Eagle and Jefferson Streets, and Elk and Seneca streets—where the power is distributed to their 550-volt direct-current feeders after being transformed from 11,000 volts to 375 volts and converted in rotary converters to 600-volt direct current.

An interesting comparison is the relative efficiencies and cost of static transformers and rotary converters as against motor generators receiving the 11,000-volt current direct into the motor, and converting it into 600-volt direct current by means of a generator coupled to the same shaft, and is given in the above table.

EFFICIENCIES: 200-KW UNITS.

	Transformer.	Rotary.	Combined.	Motor.	Generator.	Combined.
Full load.	97.5	93.0	90.67	95	92	87.4
¾ load.	97.1	92.5	89.81	94	91	85.54
½ load.	96.0	90.0	86.40	92	88.5	81.42

From this table it will be seen that the transformer and rotary converter give 3.27 per cent at full load, 4.27 per cent at three-quarter load and 4.98 per cent at one-half load better efficiency than the motor generator set.

The investment shows a saving in favor of transformers and rotary converters of about 19 per cent, so that for purposes such as railroad work, where no great refinement of regulation is required, the rotary is beyond doubt the best and most economical.

At the sub-stations, the incoming current enters a three-pole oil switch, which is known as an emergency switch, and from there branches to several oil switches, each of which controls the primaries of three 150-kw static air-blast transformers connected in delta; the secondaries, also delta-connected, go direct to the collector-rings of a 400-kw rotary converter, so that the three static transformers and rotary converter form one unit, being, in fact, started from the direct-current end and synchronized by means of small potential transformers on the 11,000-volt primaries.

To provide for the emergency of a total shut down of the power circuits, those sub-stations which have no storage battery auxiliary from which direct current may be got for starting the rotaries, a small motor-generator set is installed, consisting of a 30-hp induction motor direct connected to a 20-kw, 600-volt direct-current generator. This set is supplied with alternating current by means of a three-phase oil-cooled transformer, reducing the pressure from 11,000 to 375 volts; as soon as the power is on the cables the induction motor is started, the small direct-current generator is connected to the bus-bars and one of the rotaries started and synchronized in the usual way, after which the motor generator set is shut down and the remaining rotaries started from the first. From the five sub-stations distributing power to the direct-current feeders great economy of distribution is obtained and an equality of pressure at practically every point of the system, which would be practically impossible with a single plant with 550-volt feeders covering the same distance. Storage batteries are installed at sub-stations No. 1, Cold Springs and Eagle and Jefferson, having a total capacity for 1½ hours of 2400 horse-power at 575 volts. They are used principally to help carry the peak load between 5 p. m. and 6.30 p. m., and to take up part of the extreme fluctuations of load through differentially wound boosters.

We now come to the last and most interesting plant connected to the transmission system in Buffalo, viz., that of the Buffalo General Electric Company, the transformer house of which is marked "Sub-station No. 3" in Fig. 1, and in which 4000 horse-power is received from the power company, and after being transformed to 360 volts is converted by means of motor-generator sets, rotaries, etc., into four different kinds of service—constant continuous current for street arc lighting, 60-cycle quarter-phase current for incandescent and arc lighting in the more remote districts, three-wire, 220-volt continuous current for the down-town district, and 550-volt continuous current for power to motors, elevators, etc.

The transformer house, built as an annex to the main tsation, has 12 250-kw transformers, reducing the three-phase, 11,000-volt currents to three-phase 360 volts. The transformers are arranged in two rows instead of three, as usually, in order to facilitate the rapid exchange of one in case of trouble. By arranging them in this way the transformer has only to be raised half an inch by the hand-crane and then run out of the way to make room for the spare one, an operation requiring only an extremely short period compared to that necessary to lift the transformer over the others. The transformers stand over a brick air chamber 30 by 9 by 7 ft. high, into which three 2-hp. induction motors direct connected to air-blowers force cool air, giving an even pressure of about half an ounce in all parts of the chamber. Access is had to the air-chamber through double air-tight doors, so that a man can work on the terminals or connect up a new group without interfering in any way with the air supply. Iron shelves on the outside of the brick walls of the air-chamber form supports for the primary cables leading to the switchboards on the one side and for the secondaries on the other, giving wide separation for safety.

The transformers are connected to the primary and secondary switchboard panels by rubber insulated and lead covered cables; each transformer is wired single-phase to the panels, the delta connection being made after passing through spring expulsion type aluminum fuses on the primary side, and ordinary long break aluminum fuses with barriers on the secondary side, so that in the event of a transformer burning out it will cut itself out of circuit without affecting the other two of the same group.

The secondary current after going through the usual recording and indicating instruments, terminates in three heavy copper bus-bars, extending the full length of the secondary board, to which are attached the cables bringing the current into the main building of the Buffalo General Electric Company.

In adopting the secondary voltage of 360, a number of points were taken into consideration, the principal one being that a large and healthy day load in 550-volt direct-current motors was being supplied at the same time steam was used for motive power, and could not well be discontinued, so that voltage was adopted which would permit of rotaries being run without any further transformation. This pressure besides being very safe for cables and motors, is a very economical one to build for, as it permits of the use of bar winding on all sizes, and as all motors are of the revolving field type, the question of carrying heavy current in the collector rings was left out. The only additional cost due to the low pressure was in the cables within the plant, and this was more than balanced by the saving in a further transformation for the 550-volt rotaries and in the additional safety of bar winding versus wire.

The power house is a building 91 by 91 ft., having a row of columns down the center, each half of the building being spanned by a crane traveling the full length with transfer points from one crane to the other.

In this building having 8281 square ft. of floor space are installed 6460 horse-power in motors, 6073 in generators, and 600 horse-power in rotaries, a total of 13,133 horse-power in electrical machinery, giving a floor space of 0.63 square ft. per horse-power, or 1.24 square ft. per horse-power of generating capacity, including all regulating apparatus, switchboard, etc.

APPARATUS FOR STREET ARC LIGHTING.

At the present day, if the problem of arc lighting for street purposes with 25-cycle three-phase current supplied, were to be placed before an engineer, several methods of solution would suggest themselves in the following order: First, rectifiers; second, motor generator sets, converting to 60 cycles constant potential, with some form of transformer or reactive coil to regulate for constant current; third, motor-generator set converting to constant continuous current; fourth, motor-generator set converting to constant-alternating current with series transformers and condensers.

The full-load efficiencies of the four systems with comparative investments and full-power factors are approximately as follows:

1 Rectifiers.	2 Motor Generators, 60 Cycles	3 Motor Generators, Constant D. C.	4 Motor Generators, Constant A. C.	
88	83.94	78.9	86.6%	Efficiency.
53	100	94	94	% Investment.
70	100	100	100	% Power Factor.

From the above table it will be seen that the rectifier leads in all respects save one, viz., power factor (the power factors given are those of the 25-cycle end, the receiver power factor being of small importance), but in a system where the arc lighting forms a considerable portion of the system this is a serious feature, especially with generators not having good inherent regulation.

Owing to existing contracts with the city, the company was forced to adopt the third plan, but after the expiration of the present contract it will probably adopt the fourth plan, installing enclosed alternating-current lamps.

The arc-lighting equipment at present consists of 14 motor generator sets, each set consisting of one 150-kw revolving field type three-phase synchronous motor direct-coupled to two 125-light 9.6 ampere Brush arc generators, the motor being in the center, with a generator on each end, coupled by means of a very simple but effective type of insulating coupling, consisting of four arms or spiders on the motor-shaft and a similar number on the generator, compressing spring rubber rolls 3½ inches in diameter by 4¾ inches long, and placed between the two sets of arms.

These motors are started in a very simple manner. The switchboard panel controlling each motor has mounted on it one ammeter, one double-pole field switch with discharge resistance, as shown in sketch, Fig. 2, three single-pole double-throw knife switches and a rheostat. The fuse base is mounted on the back. Fastened to the wall behind each panel are the reactive coils for starting the motor.

To start the motor the three single-pole switches are thrown down, thus connecting the motor armature to the bus-bars through the re-active coils; the motor come up to full speed in about 50 seconds, taking at the start about 150 per cent full-load current. The time of attaining synchronism is determined by touching the blades of the field switch connected to the revolving fields on the discharge resistance clips and noting if any spark occurs. In the absence of any, the field switch is closed, exciting the fields and the single-pole double-throw switches turned up one at a time (the motor running single-phase meanwhile).

The spark at the discharge resistance terminals is, of course, due to the speed of the motor. At the start this gives about 2200 volts, dying down in inverse ratio to the speed attained, to zero, at synchronism.

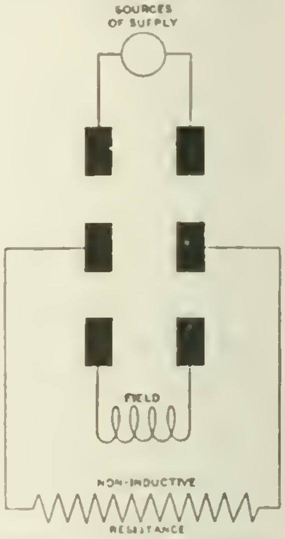

FIG. 2.—CIRCUITS OF SWITCH

The 550-volt power service is supplied from rotary converters in the usual way, calling for no comment beyond the method of starting form the A. C. end, which is done in exactly the same way as in the synchronous motors; the fields being stationary, a multiple blade switch is mounted on the frame of the machine to isolate each field winding, and thus break up the induced electromotive force at starting.

60-CYCLE SYSTEM.

Three 500-kw three-phase synchronous revolving field type motors direct connected to 500-kw revolving field 2200-volt quarter-phase generators, furnish the current for this system. The feeders are connected to double-throw oil switches, so that they can be thrown from one phase to the other to balance up the load, a further control of the voltage being obtained by means of regulators on each phase. Some rather unusual problems presented themselves in synchronizing these 60-cycle generators. The motors having eight poles and the generators 20, it is evident, that only every fifth pole of the motor will be the proper point to look at. At first it was supposed that by opening the field switch on the motor that it would slip a pole when the generator field was excited, and the whole iron losses acting as load, but the voltmeter showing the resultant voltage between the bus-bars and the ingoing generator refused to move. The synchronous motor was too good a hysteresis and reaction motor, but the solution was found in putting in a reversing field switch on the motor, thus causing it to slip a pole on each reversal. Another peculiar feature was that supposing the bus-bar voltage and that of the ingoing machine to be the same, and the machines apparently in phrase, if thrown together the ingoing machine would not take more than a small fraction of the load, and no change of field strength of either motor or generator had any effect, beyond making the generator carry idle current.

We have here the peculiar combination of double synchronism, with mechanical connection besides, so that either machine may act as motor or generator according to conditions. The explanation is as follows:

The motor carrying the load sags behind a few degrees of phase, carrying with it the generator, but the later having 2.5 times the number of poles of the motor, any sag of the motor is multiplied by 2.5, thus causing a difference of phase between the loaded generator and the unloaded one great enough to render division of load impossible. Increasing the field strength of the light generator merely results, under these conditions, in the unloaded generator supplying idle cross current out of phase with the bus-bar current, and therefore not putting load on its own motor. Manipulation of the motor field rheostats can evidently accomplish nothing to bring the generators into phase.

The solution is a rather startling one, and is found in the use of oscillatory currents. The in-going generator is excited to such a degree that the resultant voltage from it and the bus-bars is equal to the latter; this means at half load on one, and the other light, an increase of 4 per cent in voltage, indicating a phase angle difference of about 22.5 in the generators and 9 degs. sag in the motor. The motor fields are weakened and the unloaded generator thrown on the bus-bars. Owing to the difference of voltage and phase the sudden closing of the circuit establishes strong oscillatory currents between the generators; these are transmitted mechanically to the motors and repeated, the amplitude gradually decreasing from a maximum value of 100 per cent full-load current to zero as the equilibrium of the circuit is established. The whole time, from the moment of putting the unloaded generator into multiple to the disappearance of the oscillations, is usually about 45 seconds, during which the field strengths of the generators and motors are rapidly equalized, and the load will be found to be perfectly divided between the two generators, the mechanical oscillations having resulted in the only stable equilibrium possible under the conditions.

EXCITERS.

Before the installing of the storage battery it was necessary to have some quick means of getting continuous current, to determine the polarity of the rotary converters and energize the fields of the synchronous motors in case of a shut-down on the power circuits, and for this purpose two exciter sets consisting of 30-hp induction motors direct connected to 20-kw, 125-volt continuous-current generators were installed. Since the installation of the battery, all the exciting current is taken from it during the period of heavy load, for two reasons—first, to reduce the peak load; second, to automatically maintain an almost constant power factor of 98 per cent leading, on the total load of the plant, due to the Edison load increasing (and bus-bar pressure increasing correspondingly) simultaneously with the other station load and thus giving increased c. e. m. f. in the motors.

EDISON SYSTEM.

There are evidently two ways of converting three-phase, 25-cycle current into 120 to 150-volt continuous current, one being by means of tranformers with rotary converters and the other with motor generator sets.

A comparison of the net efficiency of both systems for 200-kw units is given in the following table, the rotary including in its circuit some form of regulators capable of varying the voltage 25 per cent.

	Motor Generator.	Transformers and Rotaries.	Difference.
Full load	87.40	89.87	2.47
Three-quarter load	85.54	88.70	3.16
Half load	81.42	84.90	3.48

Owing to the additional regulating apparatus necessary with the rotaries, the first cost in either case is practically the same.

From the above efficiencies, rotaries would seem to be indicated as the best choice, but in an extensive power transmission scheme, where nearly 50 per cent of the load is used for railway purposes, and the generators have a comparatively poor inherent regulation to enable them to withstand safely severe short circuits on the lines, rotaries have had to be abandoned for this service, every fluctuation of the line potential being reproduced on the direct-current side. Two 100-kw rotaries were installed, but additions have been made to the system only in motor generator sets, two of which are installed, the first of which is a direct-connected set, consisting of a 425-kw motor coupled to two 200-kw generators, having a very wide range of voltage to permit of changing the battery direct without the intermediary of a booster; the second, now being installed, is an 850-kw motor direct coupled to two 400-kw generators.

A 150-kw booster set consisting of a synchronous motor coupled to two direct-current boosters is used for charging purposes, and for carrying long feeders. The storage battery has a capacity for one and a half hours of 6000 amperes at 150 volts, there being 75 cells on each side of the system with two 20-point end-all switches, on each side to give control of the pressure under varying load.

A peculiar point observed is that a motor generator set and rotaries operating in multiple on the direct-current side, tend to regulate one another, with varying speed, for constant potential. The rotary being practically independent of speed, a fall of speed or frequency on a transmission system having a large amount of inductance reduces the reactance, and a rise in speed increases the latter so that but for changes in the impressed voltage the rotary should give the best results on a system driven from water power in which the governors must of necessity be sluggish. The motor generator, on the other hand, is independent of changes in impressed voltage, but sensitive, especially with under-saturated fields, to change of speed.

New York Meeting of the American Street Railway Association.

Plans for an unusually large and important street railway convention in this city are being actively pushed and developed. The twentieth annual meeting of the American Street Railway Association will be held in Madison Square Garden, New York City, Wednesday, Thursday and Friday, Oct. 9, 10 and 11, 1901. Papers will be presented on the following subjects: "Street Railways: A review of the Past and a Forecast of the Future"; "The Adoption of Electric Signals on Suburban and Interurban Railways, Single or Double Track, and Their Economy of Operation"; "The Value of Storage Batteries as Auxiliaries to Power Plants"; "The Public, the Operator and the Company"; "The Best Manner and Mode of Conducting the Return Circuit to the Power-house"; "The American Street Railway Association: The Purposes of its Organization and the Benefits Accruing to Investors in and Operators of Street Railway Properties by Membership Therein"; "The Economies Resulting from the Use of Four Motors Instead of Two on Double-motor Equipments"; "The Best Form of Car for City Service: A Consideration of the Various Types of Car as to Size of Car and Arrangement of Seats, Including Best Types of Brakes and Wheels"; "Practical Results Obtained from Three-Phase Transmission and Rotary Transformers or Motor Generators in Transmitting Power on Railway Lines"; "Relations of Interurban and City Railways"; "The Modern Power House, Including the Use of Cooling Towers for Condensing Purposes."

Friday, Oct. 11, has been set apart as a day for the examination of the exhibits. No session of the association will be held then, so that all may have time to view the exhibits. The annual banquet will be held Friday evening, when the officers-elect will be installed. The headquarters of the association will be at the Murray Hill Hotel. Regular rates will prevail, viz., $2 to $5 per day, European plan; $4 to $7 per day, American plan. No rooms will be assigned prior to April 15. The assignment will be made under the supervision of the local committee, preference to be given to members of the association.

National Electrical Trades Association.

Mr. R. E. Gallaher, who has just returned from Chicago, reports that a very harmonious and successful annual meeting of the National Electrical Trades Association was held there, accompanied by various festivities, including a dinner given at the Union League Club by the Chicago Association, and an evening at the theater. Officers were duly elected for the ensuing year, Messrs. W. M. Carpenter, of the Western Electric Company, as president, and Charles Price, of Pettingell & Andrews, as vice-president, with the old board of directors, Messrs. Gallaher, C. M. Wilkins, Price, W. M. Carpenter, chairman, and F. D. Lawrence. Mr. F. P. Vose was re-elected secretary and treasurer. The next meeting will be held in Philadelphia in March, 1902. The reports presented at this meeting were most encouraging as to the good accomplished by the association in behalf of its members. Not the least pleasant feature of the occasion was the hearty and liberal entertainment provided by the Chicago members.

Perils of Line Construction in Alaska.

The story of telegraph submarine cable and land line construction in Alaska promises to be an exciting and eventful one before the work is finished. The first details have just come to hand of the hardship and suffering endured by two corps of soldiers and engineers who attempted to construct a telegraph line between Dawson City and Fort St. Michael. A miscalculation was made and the two corps, working from opposite ends of the line, missed each other by 70 miles. It appears that it was necessary to send a relay expedition drawn by reindeer, to rescue the soldiers from death. A letter from Mr. Willard, dated at Eaton Reindeer Station, Dec. 31, 1900, says: "Lieutenant Offley left Unalalik as winter was setting in to build a line to Kaltag. At the same time Lieutenants Smith and Grimm set out from Kaltag to build across the portage, and the detachments were to meet half way between Kaltag and the coast. In the middle of the winter word was brought by travelers that Lieutenants Smith and Grimm, after building 18 miles of telegraph line, were in distress. They had several men with them, and, as there were no supplies at Kaltag and they had no communication with any other place, they were in danger of starvation. Their mule team had gone through the ice of a river and the load of provisions was lost.

"All the men were turned out to shovel snow in an effort to move forward. This proved useless, for the mules at every step left a track of blood. Their hoofs were torn and their legs were cut at every step. As soon as he heard of their condition, Lieutenant Offley took a dog team and started to find them. He found them in a frightful condition. They had leather shoes, which are of no use in this country, and their feet, hands, ears and faces were frozen. They were living on half rations.

"Their mules were suffering so much that two of them were shot. A request was sent to Dr. Francis H. Cambell, superintendent of the Government reindeer in Alaska, that some of the deer from the Eaton station be sent to rescue the party. Thirty reindeer hauling sleds, were sent to the rescue. They proved to be superior to dogs, as it costs nothing to fed them. By Dec. 20 the soldiers had reached Unalalik."

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The Quotation War in Chicago.

Official announcement was made in Chicago on March 23 that the controversy between the Chicago Board of Trade and the telegraph companies over the collection and dissemination of market quotations had been settled. The agreement was made at a meeting, at which were present President Warren, of the Board of Trade; Colonel Clowry, of the Western Union Telegraph Company, attorneys for all the parties interested, and several members of the Board of Trade Quotation Committee. The trouble started last July, and since that time the country has not had Chicago grain quotations, except as they were sent out over private wires from brokers, or in private messages, or in newspapers after the market closed. In making the announcement President Warren said: "The board and the telegraph companies have settled their differences in a way satisfactory to the board. I don't care to give out the details of the agreement until the formality of signing the contracts has been observed. The telegraph companies will be free to send out the quotations April 1." It is understood the agreement calls for the payment of an aggregate sum of $30,000 per annum by the telegraph companies to the board, the maintenance of rates in the local field so as not to crush out the Cleveland Telegraph Company, which has been handling the quotations in Chicago under the direction of the board, and which has a 20-year contract with the board, and the control by the board over applications for quotation service. The Board of Trade is to indemnify the telegraph companies against possible expense or damages obtained from the telegraph companies by reason of the disapproval of applications by the board.

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To Study American Electric Railways.

A London dispatch dated March 9 conveys the intelligence that the Midland Railway Company is sending two engineers, Messrs. Seeley and Woollinscroft, to the United States to study American railway methods, including the adaptation of electricity to railways.

CURRENT NEWS AND NOTES.

LONDON'S FIRE-ALARM SYSTEM includes 84 watch boxes, 675 fire alarm points, 7 bell-ringing fire alarm stations, 111 telephone lines between fire stations, 31 telephone lines between police stations and 110 telephone lines to police and other buildings.

MUNICIPAL ELECTRICIANS.—We have received from Mr. Morris W. Mead, of Pittsburg, Pa., president of the International Association of Municipal Electricians, a copy of the official report of the fifth annual convention of that association, which was held in Pittsburg last September. The book contains 202 pages and is substantially bound in maroon leather. It contains a historical sketch of the organization, portraits of the officers, past and present, and the papers read at the meeting and discussions thereon. Its contents will be valuable to the members and electricians in general. The latter will learn much about municipal electrical work and the problems which confront municipal electricians.

STREET CAR HEATERS IN GERMANY.—Under date of Feb. 11, 1901, Consul Warner, of Leipzig, reports that there is great need for electric heaters in the street cars of that city, the three electric street railways in and about Leipzig not having a single car which is heated either by electricity or coal on the coldest days in winter Formerly, when horse cars were in use, they were heatd by placing coals of fire in iron boxes: but, after several months' trial, the system was abandoned. Mr. Warner urges the introduction of American electric street car heaters, but adds that, in order to meet with success, it will be necessary, first of all, to convince the authorities of the fact that the health of the general public is greatly endangered by riding in unheated cars during the winter months.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—The third annual meeting of this association will be held at Houston, Tex., on April 19-22 The following is a list of the papers to be read at the meeting: "Municipal Ownership vs. Private Corporations," T. D Miller; "Association Between Meetings," C. A. Newning; "Station Work," Geo. Cushman; "Corporations and Its Employees," H. F. MacGregor; "Street Railways of Texas," F. E. Scovill; "Inspection," W. S. Rathell; "Electrical Potpouri," John G. Boyd; "What Are We Here For?" E. L. Wells: "Cheap Fuel and How to Use It Economically," L. T. Fuller; "Water Power for Small Plants," F. R. Starr. The railroads have granted one and one-third rates for the round trip. T. H. Stuart, of Waco, Tex., is the secretary of the association.

BUCKET SHOP TAXATION.—The Commissioner of Internal Revenue, in a decision published last week, states that it is the clear intent of the act of March 2, 1901, known as the Revenue Reduction act, that every person engaging in the business described in the third sub-division of Section 8 of that act (bucket shop brokers) shall pay special tax as regular brokers, and in addition shall pay a special tax as bucket shop brokers. The instructions of the Commissioner of Internal Revenue to collectors require the blank form of notice of intention to commence or continue the bucket shop business to be placed in the hands of these taxpayers at the earliest possible date, as this tax of $12.50 for the three months ending June 30, 1901, is payable April 1, in addition to the special tax as brokers, and after July 1, 1901, they must pay this tax, as well as that of broker, the two taxes aggregating $100 per annum. A keeper of a bucket shop who is caught doing business without filing a notice of intention and paying the tax is liable, in addition to the tax, to a fine of not less than $500, nor more than $5,000, or imprisonment for not less than three months nor more than two years, or both, at the discretion of the Court. The law also expressly declares that the payment of the tax and compliance with the law shall not be held to authorize the commencement or continuance of a bucket shop business contrary to the laws of any State.

SUBSTITUTE FOR RUBBER.—The State Department is in receipt of the following report from Consul Nelson, of Bergen, dated Feb. 6, 1901, relative to the discovery of a cheap substitute for rubber: "After having experimented for several years, a Copenhagen chemist has succeeded in producing a material called "solicum," which possesses qualities that will render it of the greatest importance to the caoutchouc industry. It is produced, it seems, from asphalt, and can be used for the manufacture of linoleum, rubbers, insulators, etc. It is also claimed that the material can be used as a paint, in all colors, and that it is absolutely waterproot.

BUCKET SHOPS.—The Court of Appeals, in Illinois, has sustained the decision of the lower court that bucket shops are not entitled to exchange quotations.

RUSSIAN PIONEERS IN ELECTRICITY.—The Imperial Technical Society, of Russia, has issued a pamphlet giving an account of the pioneer work of Russians in the branch of electricity and its applications during the century ending with 1900. The pamphlet was originally issued as an explanatory catalogue of the exhibits of the Society at the Paris Exposition. The pamphlet includes a large number of illustrations of the pioneer apparatus, and a number of portraits, including those of Baron Shilling De Kannstedt, Jacobi, Lenz, Jablochkoff, Lodyguine and Dolivo-Dobrowolsky. The well-illustrated notices of the early Russian work in electricity gives a considerable historical value to this pamphlet.

POLITICS ON THE PACIFIC COAST.—The last Congress was quite liberal in providing for electrical improvements on the Pacific Coast. An appropriation was secured for making a beginning of a cable from Alaska to Puget Sound, and the War Department has authorized the laying of the section extending from Skagway to Juneau. For a cable extending from the mainland of the State of Washington to Tatoosh Island, at the entrance of the Straits of Fuca, $20,000 was appropriated. The appropriations made at the last two sessions of Congress for electrical and other improvements at the naval station at Bremerton, Puget Sound, aggregate over $600,000.

TECHNICAL ABSTRACTS.—Nos. 6 and 7 of the second volume of our esteemed contemporary, *Le Mois Scientifique et Industriel,* contains more than 200 pages and two or three times that number of abstracts of important articles selected from the periodical technical literature of the world. A new feature appears in this number consisting of a list of all the French patents issued during the months of October and November, accompanied by a concise statement of the subject of each patent. The value of many of the digests, particularly in the engineering department, is much enhanced by the inclusion of illustrations. The value of this very useful publication increased progressively, and we commend it to such of our readers as are conversant with the French language.

GASOLENE FOR INTERIOR ILLUMINATION.—The inspectors of oils for the first and second districts of Ohio have issued a circular calling attention to certain statutes relating to the use of gasolene, and which concludes as follows: "Gasolene is not intended for illuminating purposes and will not meet the required legal test; and any person who sells or offers gasolene for sale for such purpose, or any person who uses gasolene in lamps or other devices for illuminating purposes, except as stored in underground reservoirs outside the building to be lighted, violates the law, and is liable to the penalty prescribed for such violation; and persons are hereby notified that any violation of the foregoing sections of the revised statutes will be prosecuted by the officers of this department."

ELECTRIC POWER IN THE GOVERNMENT PRINTING OFFICE.—In a discussion at a recent meeting of the Franklin Institute, on the subject of electrical distribution of power in workshops, Mr. W. H. Tapley stated that the Government Printing Office at Washington has now a motor equipment of 854 horse-power distributed among 200 motors. Of these 145 motors are geared to presses, aggregating a horse-power of 375. For lighting there are the equivalent of 5000 16-cp lamps and an average of 70 amperes of current is used in heating 10 press heads. Although the power used in 1899 was more than double that used in 1894, and the boilers were called upon to heat 1,000,000 cubic ft. more of space, the total cost of coal and gas for 1899 was only $5,614.75, as against $27,812.13 in 1894.

ENGINEERING LECTURES AT THE UNIVERSITY OF ILLINOIS.—The following course of lectures, under the auspices of the Mechanical and Electrical Engineering Society of the University of Illinois, will be delivered by non-resident engineers during the current spring semester: Mr. J. V. Schaefer, of the Link Belt Manufacturing Company, Chicago, Ills., on "The Handling of Materials by Means of Endless Elevators and Conveyors." Mr. John Birkinbine, consulting and expert mining engineer, Philadelphia, Pa., on "From Mine to Furnace." Mr. William Kent, associate editor *Engineering News,* New York City, on "Steam Boiler Efficiency." Mr. W. L. Abbott, chief operating engineer, Chicago Edison Company, Chicago, Ills., on "Recent Development in Central Station Electrical Supplies." Mr. W. A. Layman, electrical engineer, Wagner Electric Manufacturing Company, St. Louis, Mo., on "Some Important Considerations of the Design, Manufacture and Use of Transformers." Mr. T. P. Gaylord, electrical engineer, Westinghouse Electric Manufacturing Company, Chicago, Ills., on "Alternating-Current Power Works." Mr. Bion J. Arnold, consulting engineering, Chicago, Ills., on "Central Power Station Design." Professor L. P. Breckenridge, Ph.B., Professor Mechanical Engineering University of Illinois, on "Locomotives at the Paris Exposition."

SUMMER SCHOOL OF APPRENTICES AND ARTISANS.—The University of Wisconsin will conduct a summer school for apprentices and artisans, the session beginning July 1 and ending Aug. 9. The school is for the benefit of machinists, carpenters or sheet-metal workers; stationary, marine or locomotive engineers; shop foremen and superintendents; superintendents of water works, electric light plants, power stations, factories, large office and store buildings in cities; and for the young men who wish to qualify themselves for such positions. For these employments the full four-years' professional courses in engineering are not required, and yet to satisfy the present demands upon this class of men it is necessary for them to obtain considerable theoretical and practical knowledge not commonly taught in any of our schools. One of the leading purposes of the school is to supplement the work of the Correspondence Schools. Persons coming with a fair knowledge of the theory of a certain line of practice can spend their entire time in the shops or laboratories if they choose, and so put into practice, or prove experimentally, the scientific principles learned from books, or in the correspondence courses. There are no correspondence courses given in this University, but persons applying to the University for correspondence instruction will be referred to the regular correspondence schools, some of which are giving very good and thoroughly sound instruction along many lines of engineering and mechanical practice. If the interest shown in the school and its purposes should be considered sufficient to justify the institution of a regular artisans' course extending throughout the year, the University will endeavor to establish the same.

TROLLEY CAR BARNS.—It is stated that the interest of companies in the approaching rating of the risks under the United Railway & Electric Company's schedule in Baltimore has been increased by the loss reported under the International Traction Company's schedule, Buffalo, concerning which so much discussion as to the proper rating recently arose. In commenting on the general subject of rates on electric railway property, the New England special agent of a prominent company says: "It is the opinion of an electrical expert that the recent loss at Providence, R. I., on the Elmwood car barns of the Union Railroad Company was caused by an overheated 'heater,' or by defective insulation of the wire by which current was supplied to the same. I find it is the custom of many street railways, especially those using large pattern cars, some 40 ft. in length, to leave the trolley on the wire after the car is run into the car house, so that the whole current is continuously supplied to the heaters. It is fair to assume that the continuous radiation of heat so generated would in time carbonize to a dangerous extent the wood near the heaters. I have it as the opinion of the superintendent of one of the roads in New England that passengers often endanger the insulation of the supply wire by hitting the heater with their feet, and, in consequence, the danger of short circuiting is great. Some railway companies now protect their heaters by a wood slat frame placed over same. I believe that companies and rating committees should give special consideration to the great hazard pertaining particularly to car barns and should compel arrangements to have the trolley removed from the wire as soon as cars are placed in the barns. If this cannot be done, or some electrical expert cannot invent a resistance device to care, after the motors are cut out, for currents of electricity in excess of that required to keep the car at normal heat while standing in the barn, companies should insist on higher rates."

THE EADS BRIDGE TUNNEL in St. Louis will, a St. Louis correspondent informs us, be freed from gases and other objectionable conditions by the substitution of electric or compressed-air motors for steam, or eleminated altogether as a factor in the passenger traffic, in time for the World's Fair.

TO CONNECT ODESSA AND BERLIN BY TELEGRAPH.—United States Consul-General Guenther, of Frankfort, has notified the Department of State that the Russian Government, in order to facilitate the telegraphic business between Odessa and Berlin, will construct a long direct line across Russia between these two cities.

ELECTRIC RAILWAYS IN HAVANA.—Mr. Edwin Hanson, president of the Havana Electric Railway, has just returned to Montreal from Havana. He reports satisfactory progress in the work of constructing the railway. The system, which is being built by Canadian and American capital, will comprise some 40 miles of track. About one-half of it will be in operation about the end of March. Half of the line will be double track, and the double overhead trolley system will be used. The company is contemplating the extension of the railway to other parts of the city and its environments.

A PLUG CUT-OUT AMMETER.—An interesting form of ammeter is the subject of a patent issued March 19 to Gustave Grabosch, of Berlin, Germany. The ammeter is adapted for introduction into an Edison plug cut-out socket, and externally resembles an Edison plug cut-out very closely. The instrument consists essentially of a hollow spool, the lower part of which is provided with a metal-sheathed screw thread, and the upper part with a winding which is connected in circuit when the socket is screwed home. The cylindrical bore of the spool contains a spindle carrying a metal strip and provided with a pointer and a spiral spring. In order to protect the pointer and internal parts of the device, the top has a cap of transparent material, such as mica or glass. If the apparatus is plugged in the circuit the latter is closed, the current passes through the coil and acts on the metal strip mounted on the spindle and carries the pointer along a scale, the amount of deflection being the measure of the current strength.

ACTIVE MATERIAL FOR ACCUMULATOR PLATES.—It is well known that the oxides of zinc and magnesium form with the chlorides of these metals, basic insoluble compounds. This is also the case with cadmium oxides, and a patent issued March 19 to E. W. Jungner, of Stockholm, Sweden, deals with this property of cadium oxide, and its use to form active material for storage battery plates. A suitable grid indifferent to the electrolyte to be used, such as copper, is coated with cadium oxide that has been stirred up with water containing a small quantity of ammonium chloride. As soon as dry the electrode is placed in a solution of ammonium chloride for from two to fifty hours, whereby a solid mass is formed. The electrodes are then placed in an alkali bath to reduce the metal to a metallic state by removing the oxygen and chlorine from the basic salt. In this manner the cadium is deposited on the grid in a chemically divided state that partly retains the solidity of the basic solid mass. The electrode is then ready for use in a storage battery in connection with a silver oxide element.

AMERICAN INSTITUTE ELECTRICAL ENGINEERS.——At the last meeting of the Council of the Institute the board acting upon the preliminary balloting as to officers for the ensuing year selected the following ticket: President, Charles P. Steinmetz; vice-presidents, Samuel Sheldon, George F. Sever, M. I. Pupin; managers, J. W. Lieb, Jr., Samuel Reber, Charles F. Scott, W. E. Goldsborough; treasurer, George A. Hamilton; secretary, Ralph W. Pope. In the nominations for president Mr. L. B. Stillwell and Dr. M. I. Pupin occupied respectively second and third places. Mr. Steinmetz received 76 votes from members, Mr. L. B. Stillwell 65 and Dr. Pupin 44. The salary of the secretary was raised from $2,500 to $3,000. The committee of the Institute having in charge the plans for the conversazione at Columbia University on April 12, has issued a circular letter of information to intending exhibitors, copies of which can be obtained from Secretary Pope. The current available at the University is 115, 220, 440 and 500 volts direct; 115 volts two-phase, 60-cycle alternating, and 115 volts single-phase, 130-cycle alternating. Requests for space should be filed this week.

AUTOMATIC ELECTROLYTIC LAMP.—A patent issued March 19 to Professor R. A. Fessenden describes an automatic method of cutting off the current through the heater of an electrolytic lamp as soon as the glower becomes conductive, the arrangement also serving as an automatic regulator for the glower current. A small transformer has its primary connected to the line, and is supplied with two secondaries, one of which is in series with the heater and the other in series with the glower. The heater secondary has a relatively large effective impedance while the glower secondary has a relatively small effective impedance. When the switch of the primary is closed, a small voltage will be produced in the heater secondary, say, 5 volts. At the same time a large voltage will be produced in the glower secondary coil, say, 500 volts, and which may be, say, 10 times greater than that required to normally operate the glower; as a consequence, the current will be established through the glower much sooner than if the latter were merely subjected to the working voltage As soon as the current begins to flow through the glower it will exert a demagnetizing effect on the core of the transformer, and the magnetic flux will gradually drop until a normal current is flowing through the glower, the voltage then at the extremities of the pencil being, say, 50. The flux being thus reduced in the transformer, the voltage on the heater secondary will be reduced to but one-tenth, and consequently the current in the same will be reduced in the same proportion and only about one per cent approximately of the total energy will be consumed therein. This small waste, which may be made as small as desired by proper proportioning, can be neglected. The reduction of the magnetic lines in the core, as above stated, will also react on the primary coil, and as a consequence the lamp is to a very considerable degree self-regulating, any excessive current in the glower automatically reducing the magnetic flux and consequently the current through the glower. Means are provided for automatically short circuiting the glower circuit in case of breakage of the glower, thus preventing a high voltage being impressed on the heater circuit.

LETTER TO THE EDITORS.

The Invention of the Telephone.

To the Editors of Electrical World and Engineer:

Sirs:—In reply to your suggestion, I submit the following comments on Mr. Skinkle's claim to the invention of the speaking telephone. I speak of the matter with reluctance, because I do not care to revive controversies long since settled, but feel constrained to state my understanding of the facts.

Mr. Skinkle was employed by my firm in 1875, as he states, as a draughtsman. He knew nothing whatever of electricity when he came to us. In 1875 and 1876, as well as later, he made numerous drawings of Gray's inventions, and became thoroughly familiar with them. Gray spent practically most of his time in January and February, 1876, in our office in Washington, preparing numerous applications. The idea of the possibility of the invention of a speaking telephone was then in the air, so to speak, and was freely discussed in the office. My impression is that Mr. Skinkle derived everything he knew on the subject from conversations with Gray and others in our office at that time. I remember experimenting with the "lover's telegraph" at that time (in January, 1876) with Professor Henry in my office, where Gray explained his inventions to him.

The applications of Gray's patent, No. 173,460, of Feb. 15, 1876, for "Automatic Circuit Breakers for Electro-Harmonic Telegraphs," was filed Jan. 8, 1876, and prepared, of course, some time prior to that date. The drawings of that patent, made by Mr. Skinkle, will show whence he derived his knowledge of the mechanism shown in his sketches. The combination of the diaphragm and magnet was also old and well-known at that time, and shown in some of Gray's earlier patents or applications. My impression is that the drawing shown me by Mr. Skinkle consisted of two of Gray's organ-pipe transmitters in circuit. I have no recollection of the description accompanying his drawings.

In addition to other suggestions made by me, I called Mr. Skinkle's attention to the impropriety of a confidential employee attempting to avail himself to the detriment of a client of information incident to his employment. Whatever question of originality there may be between Skinkle and Gray is unimportant, to my mind, in view of the fact that the application of Bell's telephone patent of March 7, 1876, was prepared at least as early as December, 1875, and the crude drawings and descriptions of untried devices could have no standing, in view of Bell's prior invention and prompt reduction to practice.

I fought earnestly for Gray's rights, and only desisted when convinced that he was not legally or morally entitled to the invention of the telephone. Mr. Skinkle was fully aware of Bell's invention and claims, but never, to my knowledge, claimed to be prior in date to him, whatever may have been his contentions in regard to Gray; and, of course, as to the latter, he was estopped by his acquiescence in Gray's claims. He made and witnessed the drawings of Gray's caveat filed Feb. 14, 1876. The subject is capable of indefinite expansion, but I refrain from further comment.

Washington, D. C. W. D. Baldwin.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Modified Induction Motor.—Grob.—An article giving the theory of a three-phase induction motor, in which stator and rotor are connected in series. The two rotary fields must have the same speed in space; for that reason the rotor must have double the speed of the stator field and the rotor field must rotate in the opposite direction. He gives briefly the theory of such a machine and shows that it exerts a torque. It is a synchronous motor and not self-starting. He compares the properties of the same motor, in the one case connected as an ordinary induction motor, in the second case as a synchronous motor, and assumes that the utilization of the copper and iron are the same in both cases. This condition requires the double voltage for the synchronous motor; the speed is doubled for the synchronous motor, the no-load current is reduced to one-half, the maximum torque is doubled, the angle of phase is reduced to one-half; the efficiency is nearly the same. He also gives a comparison of both motors at equal speed. The voltage and the no-load current are the same; the overload capacity is about doubled with the new connections; the power factor has slightly increased; the efficiency is about the same. Rotor and stator may also be connected in parallel, but the two circuits must then be well balanced. A set of two such motors, coupled together, can be run at four different speeds; both motors in parallel, each with stator and motor in parallel; both motors in parallel, each used as ordinary induction motor; the rotor of the one motor, used as ordinary induction motor, supplies the current to the second motor, in which stator and rotor are in parallel; both motors run as ordinary induction motors, the secondary of one supplying current to the primary of the other. The four speeds have the proportion 2 : 1 : ⅔ : ½. He remarks that the same method can also be used for two-phase motors, but not for single-phase motors. He has not yet confirmed all of his theory experimentally, but a first experiment shows that a motor, connected by his method, runs and gives the maximum torque according to the theory.—*Elek. Zeit.*, March 7.

REFERENCES.

Rotary Magnetic Field.—A didactic article, with diagrams, showing the relation of the magnetic fluxes in a rotary magnetic field and methods of calculating the fluxes by means of vectors.—*Am. Elec.*, March.

Repair Shop Notes.—Weeks.—An illustrated article on the tearing apart, repairing and replacing of a commutator, with some practical suggestions.—*Am. Elec.*, March

Surface-Wound and Slot-Wound Armatures.—Heldt.—A comparison of surface-wound and slot-wound armatures in which the author shows that slot-wound machines are cheaper and more efficient than surface-wound machines.—*Am. Elec.*, March.

Lights and Lighting.

Blue Island.—An illustrated description of the alternating current lighting plant of Blue Island, Ill. Series arc lamps and series incandescent lamps of 50 candle power for street lighting, and ordinary multiple incandescent lamps of 16 and 8 candle-power for store and residence lighting, are operated from one machine, a 120-kw, 1100-volt inductor alternator. For street lighting the 1100-volt current is carried to two 15-kw step-up transformers, which raise the voltage to 2000; the 2000-volt current is sent through two 25-light regulators, and on each circuit 17 arcs and 40 incandescent lamps of 50 candle-power are operated. The commercial incandescent lighting is operated at 1100 volts primary, and by the use of transformers the current is stepped down to the secondary voltage of 110 volts, the transformers being placed at the points of distribution.—*West. Elec.*, March 16.

REFERENCES.

Consumption of Carbons in Arc Lamps.—An anonymous illustrated account of experiments made to compare the carbon consumption of high voltage and low voltage arc lamps.—*Elek. Anz.*, Feb. 10, 17.

Light Prints.—An illustrated description of different methods of making light prints with electric arc lamps.—*Elek. Anz.*, Jan. 17.

Power.

REFERENCES.

Drilling Machine.—An illustrated description of an electrically driven portable drilling machine. It is entirely self-contained, the motor developing 2 horse-power at 800 revolutions.—Lond. *Elec. Rev., Elec. Eng.*, March 8.

Recent Types of American and European Engines.—Illustrated articles describing in detail the 5000-hp compound Westinghouse Corliss engine for the Bay Ridge station of the Brooklyn Edison plant, and a triple expansion engine for electric light service, built by Bromley Bros., of Moscow, Russia.—*Am. Elec.*, March.

Driving of Centrifugal Machines.—Simon.—An illustrated serial on the theory and practice of electric driving of centrifugal machines.—*Elek. Anz.*, Jan. 20, 24, 27.

Snoqualmie Falls.—Baker and Doble.—A very long and well-illustrated article on the power transmission plant of Snoqualmie Falls.—*Jour. of Elec.*, Jan.

Traction.

Automobile Charging Station.—An illustrated description of the new charging station of the New York Electric Vehicle Transportation Company. There are six synchronous converters, each of 250 horse-power, which receive alternating current from the Edison mains and convert it into direct current of six voltages, differing from each other by about 3 volts. Each battery is charged first on the lowest voltage and successively on those higher, so that at no time does it get an excessive current. By using six different voltages no rheostats are required.—*The Automobile*, March.

Protection Against Shocks from Trolley Wires.—An illustrated description of the Quin patent safety device for protection against either a trolley wire breaking or against falling telephone wires. The same issue contains an illustrated abstract of an old German article by Ulbricht, in which an arrangement is described for guarding against accidents due to the falling of telephone or other wires across trolley lines; it is based on the principle of a momentary connection between the trolley wire and earth, causing a direct connection between the same, which remains until the apparatus is reset by one of the tramway officials; the efficiency of the system is largely dependent on the use of an automatic earthing device of very simple construction, which may serve to protect simultaneously several points crossed by telephone or other wires.—Lond. *Elec. Eng.*, March 8.

REFERENCES.

Car Building in England.—The first part of an illustrated description of the new car building works of Milnes & Co., in Hadley, Shropshire.—Lond. *Elec. Rev.*, March 8.

New Zealand.—An illustrated description of the trolley road of the city of Dunedin, which is the first electric tramway in New Zealand. —Lond. *Elec.*, March 8.

Interurban Line.—A brief illustrated description of the Cleveland and Eastern trolley line—*St. R'y Rev.*, March.

New England.—Fairchild.—A brief illustrated description of the street railways of Portsmouth, N. H., and Kittery, Maine.—*St. R'y Rev.*, March.

Automobiles—De Contades.—An article on the electric automobiles exhibited in the Salon du Cycle.—*Cosmos*, March 9.

An Unusual Condition.—Parham.—An article with diagram showing why a car ran faster with its motors in series than it did when its motors were in parallel, owing to the excessive drop in voltage on the line.—*Am. Elec.*, March.

Installations, Systems and Appliances.

Chicago.—A long abstract of the annual report of the Dept. of El'ty of Chicago for 1900. The average number of arc lamps for street lighting was 3867; the net cash operating cost per lamp was $58.25, the total number of lamp-hours 15,121,612, the average cost per lamp per hour 1.55 cents. Other parts of the report deal with the fire-alarm system, the police telegraph, the removal of overhead wires, etc.—*West. Elec.*, March 16.

Great Britain.—Summerfield.—An article on recent central station practice. The plant of a typical English central station of the present day is said to consist of either Lancashire or water-tube boilers, high-speed vertical enclosed compound engines, direct coupled to multipolar dynamos, which generate direct current at from 400 to 500 volts and supply a three-wire system, with storage batteries and boosters to balance and steady the load.—Lond. *Elec.*, March 8.

REFERENCES.

Russia.—Perkins.—An article on polyphase power plants in Russia. Brief notes on the stations of St. Petersburg, Tanboy, the Port of Noworosisk, the water works plant of Moscow and the Prochoroff mill in Moscow, are given.—*El'ty*, March 20.

Lowestoft.—A long illustrated description of this new British electric lighting plant. The direct-current three-wire system is used. There are one 150-kw and one 75-kw dynamo and a battery of 270 cells, the normal discharge rate being 100 amperes for four hours.—Lond. *Elec. Eng.*, March 1.

Central Stations with Sub-Station.—Ehlert.—Continuation and conclusion of the serial on the calculation of electric central stations with sub-stations and on the choice of the best system for installations of up to 10,000 lamps and distances of up to 5000 meters.—*Elek. Anz.*, Jan. 10, 20, 31, Feb. 7.

Portland General Electric Company.—A descriptive article on some of the special features of the Portland General Electric Co., at Oregon City, Ore. Each generator is connected to two turbines, one for low heads and one for high, because of the great difference of head at various seasons. A home-made type of inductive regulator is used, which may be used to either boost or lower the voltage.—*Am. Elec.*, March.

Switchboard.—An illustrated description of a new feeder switchboard at the Newington (London) electric supply works.—Lond. *Elec.*, March 8.

British Power Bills.—Madgen.—A paper, read before the Brit. I. E. E. on "The electrical power bills of 1900; before and after"; also the discussion that followed.—Lond. *Elec.*, March 1, 8. A long abstract of the paper in Lond. *Elec. Rev.*, March 1, 8.

Wires, Wiring and Conduits.

High-Tension Cables.—E. K. Scott.—An article in which he recommends the Brooks semi-solid system for high-tension cables. The cables are covered with jute braiding, and are then drawn into an oil-tight conduit into which the oil is poured at about 300 degs. F. When cold, the oil is of the consistency of india rubber solution, and should a fault occur the temporary current warms up the oil locally, making it run readily, and so automatically seals the fault. Boiled resin oil is used, and as it is heavier than water, any moisture which remains in the tube rises to the surface, the cable of course sinking to the bottom. Experience at Chatham, Rochester, Hong Kong, Glasgow, etc. has shown that this method gives practically constant insulation. The cable may be struck by lightning and yet the self-healing property is so effective that immediately afterward it is impossible to detect any fault or weakness; this has actually occurred at Chatham and New Jersey. The cables can be carried in iron pipes, but stoneware pipes, ⅝ in. thick, are also good.—Lond. *Elec. Rev.*, March 8.

Current Density in Small Conductors.—Whitcher.—An article on "The economical current density in small conductors." He says that Kelvin's law should be taken into consideration in the design of the average house wiring system. He claims that there is no real call for nicety in regulation. He has formerly investigated the economical current density for electric light mains and found that the true economical current density is not varied by the load factor to anything like the extent usually supposed, because of the way in which the cost of the wasted energy also is influenced by the same factor; he arrived at the practical conclusion that the economical density in the mains is 600 to 700 amperes per square inch, under widely diverse conditions. He then treats mathematically the case of house wiring. He develops two formulas for the economical current density in ampere hours per square inch. For the smaller conductors in high-class wiring systems it becomes 4000 times the square root of 15 divided by the number of hours per year; for the large mains it is 20,000 times the square root of 1, divided by double the number of hours per year. If the number of hours per year is 200, these formulas give 1,095 and 1000 amperes per square inch, respectively. For 1000 hours per year the formula gives 490 and 450 amperes per square inch, respectively.—Lond. *Elec. Rev.*, March 1, 8.

Three-Phase System.—Latour.—A brief mathematical article "On the non-existence of the alleged superiority of three-phase currents in power transmission." He says that the usual comparison of different systems under the supposition of equal tension between the line wires is not justified. The comparison should be made under the supposition that the insulators and the thickness of the insulating material of the wires are the same in both cases; in other words, he considers the tension between any conductor and earth. He calculates an economy of 20 to 25 per cent of copper in favor of the single-phase system over the three-phase system. "As far as the economy in the installation of the line is concerned, there is no superiority of the three-phase currents, and if lighting is the only purpose of the transmission, it is a real technical mistake to use them. The expenses for the insulation of the line are thereby increased. The single-phase alternating current and still more the direct current are the most advantageous currents from the point of view of expenses."—*L'Eclairage Elec.*, Feb. 16.

Storage Batteries for Power Transmission.—Latour.—A brief article on the saving of copper in transmission lines of short length with the use of storage batteries. He shows first in a general way, and then in a numerical example, the advantages of an arrangement in which a storage battery is placed at the consumers' end of a transmission line. This enables one to save considerable copper in the line, without increasing the expenses for insulation.—*L'Eclairage Elec.*, Feb. 23.

REFERENCES.

Ocean Cables.—Marsh.—A long article of a general nature on "Ocean Cable-making and laying." After some remarks on American types of cables, he describes the manufacture and the laying of transoceanic cables. He urges that the trans-Pacific cable could be made in the United States, and gives some statistical data on ocean telegraphy.—*Jour. of Elec.*, Jan.

Pole Lines.—Knox.—An illustrated article on pole line construction. The dimensions are given for wooden and iron poles, and rules are given about some details of the construction.—*St. R'y Rev.*, March.

Interior Wiring.—Knox.—An article giving wiring plans and methods of lighting a department store by electricity.—*Am. Elec.*, March.

Electro-Physics and Magnetism.

Transparency of Bodies for X-Rays.—Benoist.—An investigation of the relation between the absorption of X-rays by matter and its density. He defines the X-ray transparency of a body as the mass in grammes of a prism of the body 1 square cm in base, which produces upon X-rays passing along its axis an absorption equal to that produced by a layer of paraffin 7.5 cm thick. From a large number of measurements he concludes that the specific transparency of a body is independent of its physical state. Thus water and ice of equal density would show the same X-ray transparency. It is also independent of chemical combination, the atom exerting the same absorption whatever its grouping with other atoms. A more or less strict proportionality between atomic weight and absorptivity is only observed when the X-rays are of the most penetrating kind. Otherwise the curve of absorption resembles an equilateral hyperbola. On entering the atomic weights as abscissas and transparencies as ordinates, a curve is obtained which fairly follows the hyperbola laid through lithium, but shows a maximum divergence for the atomic weights between 40 and 50.—*Comptes Rendus,* Feb. 11; abstracted in Lond. *Elec.,* March 8.

Röntgen Rays.—Rollins.—A continuation of his very long illustrated serial. He describes a Röntgen-light examination table, discusses the precautions which ought to be taken against diffused Röntgen light, and describes cathodes for powerful surges. The greatest problem in Röntgen-light tubes is said to be to find the best way of curing tubes suffering from terminal exhaustion. One direction in which to work is to try to find the new gases which he thinks are the cause of the "pristine" brilliancy of an X-light tube. Another possible direction appears to be to look for substances, not gases, in the metals of the terminals, which have the properties attributed to radium of giving off minute particles, the supposition being that if a cathode could be allowed with them, the great stress which can be produced in a vacuum tube might cause them to be driven against the target with sufficient force to produce "X-light."—*Elec. Rev.,* March 9.

Thermo-Luminescence Due to Radium Rays.—Wiedemann.—A description of an easy method of producing an intense thermo-luminescence by radium rays. The radium preparation was contained in a hole 8 mm wide, sunk into a glass plate 3 mm thick. A piece of aluminum foil was pasted over the hole, thus keeping the substance safe against moisture. The detective substance used for thermo-luminescence was the solid solution of manganese sulphate in calcium sulphate. This was spread in a thin layer on a piece of aluminum foil 6 cm square, and covered with a sheet of mica. The radium preparation was laid upon it, and left so for several hours. The aluminum foil was then placed upon a heated copper plate. At the place where the radium preparation had lain a green circle showed out, visible at some distance. That the solid solution named is only feebly incited to phosphorescence, but strongly by thermo-luminescence by radium rays, is paralleled by its behavior under the influence of discharge rays, and shows that both kinds of rays exert an influence upon the structure of the substance.—*Phys. Zeit.,* Feb. 2; abstracted in Lond. *Elec.,* March 1.

Condenser with Adjustable Capacity.—Ercolini.—An improvement of Brigg's adjustable condensers, made of flexible mica plates subjected to varying pressures, which gives a wide range of capacities, but is open to the objection that the variation of capacity with pressure, follows an unknown law, and is not always a certainty. The improvement consists in substituting glass plates for the flexible plates. The glass plates are mounted one above the other on metallic rails laid into an ebonite scaffolding. The scaffolding can be sheared like a parallel ruler, so that the glass plates can be made to approach each other to any extent desired. Sheets of tinfoil stuck on both surfaces serve as the metal plates. The capacity varies with the cosine of the angle of inclination of the guiding rod. The condenser can, of course, be used as an air-condenser, or immersed in a liquid.—*Nuovo Cimento,* Nov., Dec.; abstracted in Lond. *Elec.,* March 8.

Current Strength of Lightning Flashes.—Pockels.—He has shown that the remanent magnetism produced in basalt by a magnetic field only depends upon the maximum intensity of the latter, however short the time during which that maximum intensity might prevail. This fact can be used for determining the current strength of lightning flashes by placing a rod of basalt near a lightning conductor in such a position that the circular lines of magnetic force produced by a discharge, approximately pass through the length of the rod. Some basalt rods were successfully exposed by Chistoni in the Monte Cimone Observatory in the Appennines, and the resulting magnetizations indicated currents of 10,000 to 20,000 amperes.—*Phys. Zeit.,* Feb. 16: abstracted in Lond. *Elec.,* Mar. 1.

Magnetic Expansion of Iron and Nickel.—Shaw and Laws.—The conclusion of the article, the first part of which was noticed in the Digest March 16. The results are as follows: The curves for iron and nickel can now be plotted nearer to the origin than in any previous research, yielding evidence of a retraction of iron when the curve leaves the origin. The electric micrometer is capable of more minute work than any other form of optical lever hitherto produced, while every other measuring arrangement appears to be "out of the running." The smallest readings taken were about 0.00000005 cm. By using three specimens of one length, but of different diameters, they find that there is a general law as to the relation of diameter to slope of the curve, both for iron and nickel. This law leads to the idea of producing a curve for an ideal wire, which they call the attenuant. This curve has interest in being the lower limiting one, but it also gives a case in which the simple law for obtaining the field in a solenoid coil is accurately true.—Lond. *Elec.,* March 8.

Magnetic Induction.—Buchanan.—A theoretical paper, giving "A contribution to the theory of magnetic induction in iron and other metals." He shows that solutions of an equation of the same form as Fourier's partial differential equation (stating that the first differential quotient of a function, to the time, is proportional to the second differential quotient of the same function, to the length) are capable of expressing the complex results obtained in the numerous experiments which have been made on magnetic induction in iron and other metals. He discusses the following two cases: Induction by continuous increase of field intensity, and periodic variation of field-intensity and residual magnetism.—*Phil. Mag.,* March.

Magnetic Properties of Alloys.—Richardson and Laws.—A brief paper giving the results of their investigation "On some interesting changes in the magnetic condition of an alloy of nearly pure iron and aluminum (2.42 per cent) due to successive heatings and coolings." The effect of temperature on the magnetic behavior of impure alloys of iron and aluminum is very different from that on the behavior of iron itself. The curves conecting the permeability and temperature for a constant field have at least two maxima, which is explained by assuming that the specimens investigated consist of two distinct constituents. Subsequent microscopic examinations have shown the presence of crystals. In another curve three maxima were observed, which would indicate three distinct magnetic substances.—*Phil. Mag.,* March.

Magnetic Effect of Electric Charge.—Cremieu.—An account of a continuation of his former researches which have aroused considerable interest, as they appeared to be in strict disagreement with Maxwell's theory. He has repeated his experiments on the magnetic effect of a moving electric charge, with a view to meeting the objections raised by Rowland, Himstedt and Fitzgerald. He acknowledges that the action of the armatures which are used to discover the magnetic effect looked for, is difficult to determine. He therefore devised a new experiment in which no metallic layer was interposed between the needle and the turning disk. But, as before, the revolving charge disk produced no magnetic effect whatever. It was easy, however, to obtain an effect showing the same reversibility as the magnetic effect looked for, and even agreeing with it in order of magnitude. This pseudo-magnetic effect of electric connection is due to sparks or brushes, and is in any case of electrostatic origin. It is always observed when the suspended system has not been very carefully diselectrified, or when it is not protected by a good conductor. A tube of paper covered with graphite, which constitutes a perfect electric screen for bodies at rest, ceases to be so when they are in motion. The conditions of experiments are generally so difficult that it is impossible to take a satisfactory set of readings. But he still considers himself justified in denying the existence of a magnetic effect of electric convection.—*Comptes Rendus,* Feb. 11; abstracted in Lond. *Elec.,* March 8.

ELECTRO-CHEMISTRY AND BATTERIES.

Capacity of Storage Batteries.—A long article on the characteristic curves of lead storage batteries and their dependence on the construction of the plates. He first discusses briefly the processes in a battery during discharge. If a capacity curve is plotted, the time of discharge being the abscissa, the ampere-hour capacity the ordinate, the capacity first increases rapidly with increasing duration of discharge, the capacity depending mainly upon the quantity of acid which can enter from the electrolyte into the active mass during the discharge. The greater the duration of discharge becomes, the greater is the influence of the exhaustion of the active mass, until for very small current strength the capacity is dependent only on the quantity of active mass; the curve becomes approximately parallel to the abscissas axis. If for a given battery a set of such curves is plotted, each for a discharge down to a certain voltage (for instance, 1.8, 1.85, 1.9, 1.92, 1.95 volt), the abscissas being always the time of discharge, the ordinate the capacity, this set of curves gives out not only the capacity for any discharge, but also at once the curve of discharge itself. Any straight line through the zero point of the system of co-ordinates, represents a discharge with constant current as capacity divided by time gives the current strength. The point in which this straight line intersects any of the capacity curves, gives the time of discharge and capacity of discharge with the constant current down to the special voltage to which the capacity curve refers. The points of intersection of the straight line with the set of, say, five capacity curves, give sufficient data for plotting the curve of discharge for that special current strength, if the voltage at the beginning of the discharge is also known. He gives such curves for three batteries, differing in the construction of the plates, and discusses the influence of this construction. The curves show that for proportioning the amount of acid for portable cells it is necessary to take into consideration whether the cells are for rapid or slow discharges.—*Centralblatt f. Accum.*, Feb. 1, 15.

Law of Dissociation.—Sackur.—A summary of some recent articles of Jahn and Arrhenius. It has been a subject of some annoyance for the followers of the dissociation theory that Ostwald's law of the relations between dissociations and concentration or between electric conductivity and concentration, is not in agreement with the measurement of the conductivity of K Cl, Na Cl, H Cl for different concentrations. Jahn has endeavored to find the cause of this disagreement. He shows that it can be explained if the supposition is dropped that the migration velocity of ions are independent of the concentration. He shows that this supposition can be proven to be wrong by experiments, if Nernst's formula for the e. m. f. of concentration cells is assumed to be strictly correct. The final result of Jahn's investigation is that the conductivity measurements of K, Cl, Na Cl H. Cl can be brought into agreement with Ostwald's law, if the migration velocities are assumed to decrease with decreasing concentration; from the conductivity, therefore, the degree of dissociation cannot be strictly determined; the only strict way of determining it is Nernst's formula. Against this result Arrhenius has made the criticism that Nernst's formula is not strictly correct from a theoretical point of view; he gives a more exact formula.—*Zeit. fuer Elektrochemie,* Feb. 21.

Solubility of Metallic Deposits.—Immerwahr.—An account of an experimental investigation of the potentials of mercury, copper, lead, cadmuim and zinc electrodes in saturated solutions of their salts. From the value of the e. m. f. between eectrode and electrolyte he calculates with the aid of Nernst's formula the concentration of the metallic ions. He made experiments with chromates, phosphates, carbonates, cyanides, sulphides, also with chlorides, bromides, iodides. His results, given in tables, show distinct regularities, from which he concludes that the maximum concentration of the ions, and therefore also the solubility, is an additive property, *i. e.*, the solubility is mainly the result of a property of the two ions; this property is the "electro-affinity."—*Zeit. f. Elektrochemie,* Feb. 28.

REFERENCES.

Electro-Chemistry and Electrometallurgy.—Crocker.—The first theoretical part of what promises to become a long serial. He discusses Faraday's law at some length, gives Ohm's law and its application to electro-chemistry, discusses the specific resistance of electrolytes, the temperature coefficient of electrolytes, the conductivity of non-aqueous solutions and of fused electrolytes. He also shows how to calculate the e. m. f. of a cell from the energy changes and develops the general formula of Helmholtz.—*Sch. Mines Quart.*

Electrolytic Production of Soda and Chlorine.—Franke.—An article on the electrolytic production of pure soda and chlorine, from a solution of common salt. A spray of mercury is used as a negative electrode, and the sodium forms an amalgam with the mercury, from which it is afterward reclaimed. Chlorine is liberated at the insoluble positive electrode.—*Am. Elec.*, March.

Oxidation Cells.—Schaum.—A brief preliminary account of measurements of the e. m. f. of concentration cells with unattackable electrodes, in which he found peculiar differences between measured and calculated values.—*Zeit. f. Elektrochemie,* Feb. 28.

Old Storage Batteries—Levermann.—An article in which he discusses how to use spongy lead and old plates commercially, and what to do with them.—*Centralblatt f. Accum.*, Feb. 15.

Stationary Storage Batteries.—Schindler.—An article on the weight of stationary storage batteries and on the methods of placing them in buildings.—*Elek. Anz.*, Jan. 31, Feb. 3.

Acid for Storage Batteries.—Heinz.—An article in which he discusses the great importance of using very pure sulphuric acid for storage batteries; the degree of impurities which may be allowed is briefly discussed.—*Centralblatt f. Accum.*, Feb. 1.

Cupron Cells.—Jordis.—An article on the treatment of cells with zinc and cuprous oxide electrodes and lye of sodium or potassium as electrolyte without diaphragm. He recommends them and shows how to use them in private electro-chemical laboratories.—*Zeit. fuer Elektrochemie,* Feb. 21.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electric Anemometer.—Legrand.—A description of a simple device which overcomes all the difficulties experienced in transmitting the indications of an ordinary centrifugal anemometer, to a distance. The shaft of the cup anemometer carries a small Gramme ring, which revolves between the pole-pieces of a strong permanent magnet. The e. m. f. produced in the ring is proportional to the speed of rotation. The apparatus is connected with a voltmeter formed by providing a Deprez galvanometer with a suitable damping device and a low resistance. To avoid errors due to temperature the circuit is made of manganin wire. The apparatus is graduated empirically.—*Comptes Rendus,* Feb. 11; abstracted in Lond. *Elec.*, March 8.

Electric Brake Dynamometer.—Rieter.—An illustrated description of an electric brake dynamometer of precision. It consists of a two or multipolar magnetic field system which can rotate around an axle by a few degrees and which is excited from any source of current. Around the magnetic field there is a ring of iron or steel which can be revolved. This ring forms the brake. The mechanical work, supplied by the dynamometer, is changed into electrical energy and this into heat by means of eddy currents. There is no mechanical friction.—*Elek. Zeit.*, Feb. 28.

Thermo-Elements for the Measurement of High Temperatures.—Lindeck and Rothe.—A description in detail of the methods of testing thermo-electric apparatus for the measurement of high temperatures as carried out at the German Reichsanstalt. The first part of the paper is a description of the furnaces used and the arrangement of the junctions on them. In later experiments the thermo-elements of Le Chatelier's form were compared in electrically heated furnaces, which consist of several concentric tubes, the inner tube containing the thermo-electric junction and the one next to it the wire whose rise of temperature on the passage of a current causes the heating of the furnace. These tubes are formed of a highly infusible sort of porcelain. For temperatures up to 1400 degs. the material used for the heating wire is nickel. For higher temperatures up to 1600 and 1700 degs. platinum irridium is used. In the second part of the paper full particulars are given of the method of measurement of the e. m. f. by a compensation arrangement.—*Zeit. f. Instrumentenk.*, Oct., 1900; abstracted in *Science Abstracts,* Feb.

REFERENCES.

Induction Coil and Interrupter.—An illustrated description of a new "unipolar" induction coil of Guerre and two new mercury interrupters of Guerre, to be used for Roentgen rays experiments.—*La Nature,* March 9.

Use of the Electro-Dynamometer.—Woodbury.—A note on the use of the electro-dynamometer in which the slide rule is used for computing the current.—*Am. Elec.*, March.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Photophones.—Rubmer.—An illustrated article, in which he says that an electric arc is not absolutely essential for the transmission of speech by light. It may be accomplished by means of a simple Bunsen flame surmounted by a piece of platinum foil serving as an electrode, while the burner itself serves as the other. The flame is inserted in the secondary circuit of a transformer and a battery and microphone receiver in the primary circuit. The effect is, however, much feebler than in the case of the arc. In using the arc care must be taken to have the proper transformation ratio, the best ratio being that in which the number of turns in the two coils are in the proportion of the square roots of the resistances of the microphone and the arc respectively; the ratio comes out as something like 1 to 2.2. To attain this ratio empirically and to vary it in accordance with the pitch of the note transmitted, he proposes to use a single coil transformer with variable contact. At the receiving station low-resistance selenium cells should be used. Under favorable conditions they may be made to work the recording magnet of a Poulsen telegraphone.—*Phys. Zeit.*, Feb. 23; abstracted in Lond. *Elec.*, March 8.

REFERENCES.

Small Telephone Exchanges.—Dobbs.—The fourth article of his serial on "The construction of small telephone exchanges." He discusses the hanging of cable spans, and the placing of the anchors and guys.—*Elec. Rev.*, March 16.

Independent Telephone Exchanges.—Burlingame.—An illustrated description of the branch exchange of the Cuyahoga Telephone Co. at East Cleveland, Ohio. The exchange is provided with lamp signals and a thoroughly modern equipment for 600 subscribers, with provisions for 1400 more.—*Am. Elec.*, March. (See E. W. & E., March 9.)

Intercommunicating Telephone Set.—A descriptive article with working drawings on the construction of an intercommunicating telephone set, together with plans for connecting up the instruments and wiring for four stations.—*Am. Elec.*, March.

Common Battery Telephone Switchboard Systems.—Henry.—An illustrated article describing various methods of connecting common batteries to telephone switchboard systems.—*Am. Elec.*, March.

Statistical.—A long statistical article on telegraphy and telephony in Germany in 1899; also the conclusion of the statistical article on telegraphy and telephony in British India in 1898-99.—*Jour. Tel.*, Feb. 25.

MISCELLANEOUS.

REFERENCES.

Electric Shock Accidents.—Cottrell.—A summary of "Precautionary instruction in relation to the avoidance of, and for the treatment of sufferers by, accidental shock from electrical current."—Lond. *Elec. Rev.*, March 8.

General Electric Co.—The first part of an illustrated description of the Schenectady works of the General Electric Co.—*Elec. Rev.*, March 16.

Paris Exposition.—An illustrated description of the induction coils exhibited.—*Elek. Anz.*, Feb. 10, 21.

New Books.

BOOKS RECEIVED.

Impianti di Illuminazione Elettrica. Quinta edizione, rifatta. Di Emilio Piazzoli (Hoepli Manual). Milan: Ulrico Hoepli. 605 pages, 263 pages. Price, 6.50 lire.

American Engineering Competition. Being a series of articles resulting from an investigation made by the *Times*, London. New York: Harper & Brothers. 139 pages. Price, $1.

Recenti Progressi Nelle Applicazioni Dell Elettricita. Di Rinaldo Ferrini. 3a edizione, completemente rifatta. Milan: Ulrico Roepli. 283 pages, 109 illustrations. Price, 7.50 lire.

Electric Lighting. A Practical Exposition of the Art for the Use of Engineers, Students and Others Interested in the Installations or Operation of Electrical Plants. By Francis B. Crocker, E. M., Ph.D. Volume II. New York: D. Van Nostrand Company. 505 pages, 391 illustrations. Price, $3.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 9, 10 and 11, 1901.

Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

Canadian Electrical Association. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

National Electric Light Association. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

New York State Street Railway Association. Next meeting, Rochester, N. Y., September, 1901.

Ohio Electric Light Association. Next meeting, Put-in-Bay, Ohio.

Pennsylvania State Street Railway Association. Next meeting, York, Pa., Sept. 4, 1901.

Southwestern Gas, Electric & Street Railway Association. Next meeting, Houston, Tex., April 19-22, 1901.

Northwestern Electrical Association. Next meeting, Sheboygan, Wis., last week in June, 1901.

Automobile Notes.

At the Automobile Club of America headquarters in this city on March 26, Mr. A. L. Riker delivered an extemporaneous address on the subject of the practical handling of electric automobiles, a subject with which no one in this country has greater expert familiarity. The address was followed by a discussion. The annual dinner of the club has been fixed for Thursday, April 18, at the Waldorf-Astoria.

An automobile show began on Saturday last at the Coliseum, Chicago, under the auspices of the *Motor Age*. There are about 50 exhibitors, and the show will remain open this week. Among the exhibitors who had their displays in position last week were: Electric Vehicle Company, New York; Mobile Company of America, New York; Hewitt-Lindstrom Motor Vehicle Company, Chicago; De Dion-Bouton Motorette Company; National Automobile & Electric Company, Indianapolis; Woods Motor Vehicle Company, Chicago; Milwaukee Automobile Company; Ralph Temple Automobile Company, Chicago.

Ohio Independent Telephone Association.

Mr. H. D. Critchfield, secretary of the Independent Telephone Association of Ohio, has issued a notice of the annual meeting of the association to be held at the Chittenden Hotel, Columbus, on April 5. There are about 180 independent companies in Ohio, nearly all of which are identified with the State Association. It is announced that the business of the meeting will be to consider matters tending to promote more harmonious relations among the companies.

A New California Transmission.

The Keswick Electric Power Company is putting in a power house on Mill Seat Creek in Shasta County, Calif., for the supply of electric power to mines and towns in the copper mine district. Redding and Keswick will be supplied with light and the De Lamar and other copper mines furnished with light and power. The water power is to be taken in a ditch 6000 ft. long to a point where a fall of 1171 ft. to the power house will be obtained. The pipe line is to be 30-inch steel pipe. The machinery contracted for consists of two Pelton waterwheels, to run 400 r. p. m. direct connected to two 750-kw Westinghouse generators. The transmission system will be at 20,000 volts, three-phase, the longest transmission being 45 miles. There will be two circuits on one pole line. H. H. Noble, of San Francisco, is president of the company, and Hunt, Meredith & Corey, of San Francisco, are the consulting engineers.

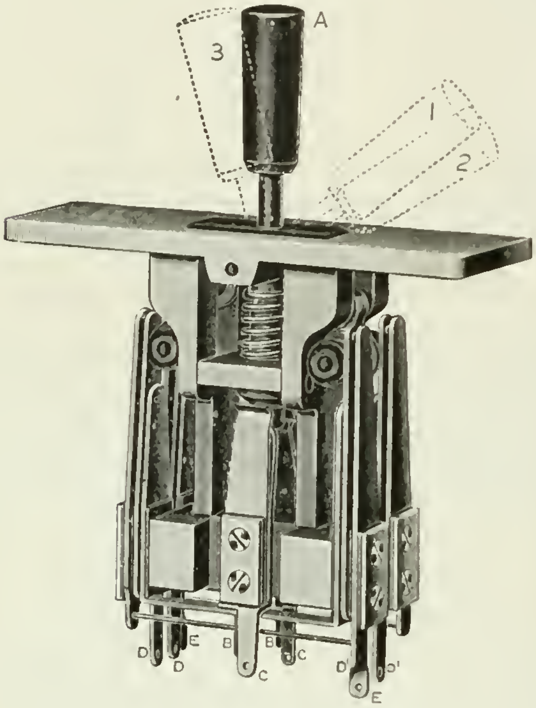
Utica Street Railways.

The Utica Belt Line street railroad, of Utica, N. Y., has passed into the hands of a syndicate represented by Horace E. Andrews, of Cleveland. The transfer was made by John W. Boyle, the president of the road, who represents a controlling interest of the stock. The purchase price was about $500,000. The Belt Line Road consists of four suburban lines, and six different lines running throughout the city. The company also has franchises for extending its New Hartford line about five miles, connecting with prosperous villages south of Utica. The company operates about 75 cars. The Andrews syndicate recently purchased the Bleecker Street Railroad. Its intention is to build an electric line from Rome to Little Falls, a distance of 37 miles, running parallel with the New York Central tracks. Engineering corps are now at work, and active work on the extensions will be begun within a few weeks. Among those interested with Mr. Andrews are the Westinghouse Electric Company, Mr. Archbald, a son of John D. Archbald, of New York; Paul T. Brady, of Syracuse, and others. It is understood that Mr. Andrews will take personal charge of the road.

Combined Telephone Ringing and Listening Key.

An ingenious union of several functions in one lever is illustrated in the accompanying cut, which shows a combined ringing and listening key, just brought out by Couch & Seeley, the telephone manufacturers, of Boston, Mass. As our telephonic readers are aware, considerable ingenuity has been employed in this direction, and the present device is regarded as a distinct advance, the three important "tricks," if so simple a word may be used, being concentrated into the easy capacity of the one lever—listening in, calling and ringing back.

Referring to the cut, *A* indicates the lever in normal position. When a call comes in the operator throws the lever forward to position 1. At the same time the same forward motion inserts the answering plug into the jack of the subscriber, calling "Number, please," "1105 Main." She picks up the calling plug, inserts it into 1105, carries the lever forward to position 2, and then throws the generator direct to line. On removing the hand from the lever it flies back to "listening," and a slight touch restores it to normal. The operator rings back by bringing the lever toward her. The only place where the lever will stay is at normal and listening in.



COMBINATION TELEPHONE KEY.

It is said that no mechanism gets harder work than the ringing and listening key on a telephone switchboard, and this has been built to stand the racket of the most severe use. It has been tested and examined on several of the largest exchange boards in the United States, and the comments of their experts have been uniformly very favorable, in regard to operation, workmanship, etc. All the contacts are platinum, and the phosphor bronze springs are shaped and mounted in such a way as to insure permanent adjustment, resulting in a device of superior merit and endurance.

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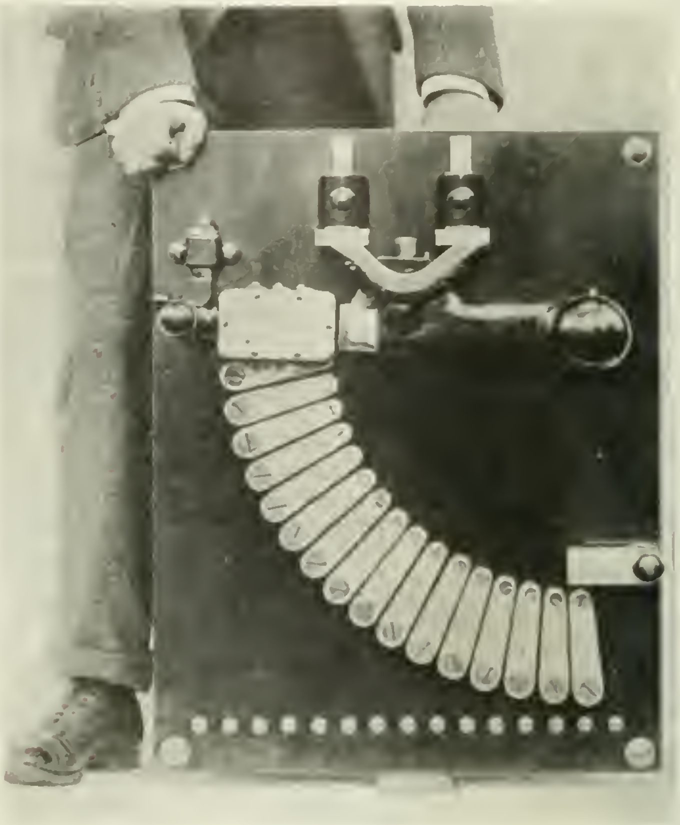
A 150-H. P. Motor Starter.

We illustrate herewith a 150-hp motor starter manufactured by the Ward Leonard Electric Company, of Bronxville, N. Y. This motor starter is very compact for a starter of such large size, and is extremely substantial, being entirely enclosed in a solid iron case excepting the slate front which carries the switch parts. The company has sent a large number of these starters to foreign customers. The illustration shows one of a lot, which is to be used in practical operation in connection with the exhibit of D. Bruce Peebles & Co., at the Glasgow Exhibition in May. In series with each of these starters will be a Ward Leonard circuit breaker, which will automatically open the circuit when the supply voltage is cut off and also whenever the current exceeds a predetermined maximum.

The illustration shows the height and width of this starter as compared with a man of ordinary size. The depth over all is only about 1 ft., so that the total space occupied is extremely small when compared with the open coil type. The resistance is in the form of a thin ribbon made of nickel-copper alloy, the ribbon being 4 inches wide. This ribbon is embedded in a mass of pure white quartz sand, which entirely fills the cast-iron box. These starters are guaranteed to stand for one minute a current which is 50 per cent greater than the full-load current of the motor. The double-pole circuit breakers are of the usual Ward Leonard type, making it impossible to close the circuit when an excessive overload or short circuit exists.

This combination of starter and circuit breaker makes a highly desirable one for use with large motors, as the combination is perfectly fireproof and also perfectly "fool-proof," and the extremely large overload capacity makes the starter practicaly indestructible. The contacts are also extremely large, and are renewable. There are three entirely independent contact shoes, and when the starter is in its operating position the contact lever is automatically short circuited by means of a large switch of the "laminated leaf" type.



150-HP MOTOR STARTER.

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Electrically Locked Letter Boxes.

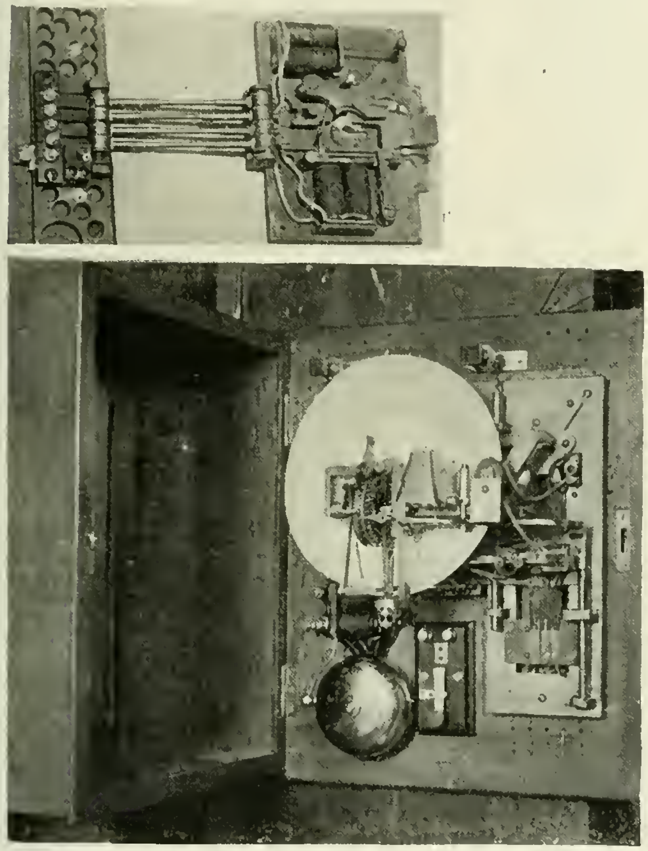
A number of new electric letter boxes have recently been put up on Pennsylvania Avenue, Washington, D. C. These boxes are provided with comparatively simple duplicate locks. The lock is operated by the joint use of an electro-magnet and the mail collector's key. The boxes along the mail route are numbered. Each box on the route is connected electrically with a clock-like apparatus at the post office, in charge of the electric mail route operator. All the electric cables used are in the ducts of the local electric light company, which supplies the small amount of current required for operating the letter-box system. The central station apparatus controls the operation of the first letter box on each route. After that box has been opened, it automatically closes the circuit between it and the second box, setting it so that the collector's key will unlock it.

The operator at the post office having allowed the collector the specified time to reach the first box on his collecting route, presses an electric button and causes the electro-magnet in the box lock to draw back an obstructing metal bar and permit the lock bolt to slide back when the mail collector's key is turned in the lock. Both the opening and closing of the letter-box door registers the number of the box on the time card of the clock. The route is now independent of "central," since the opening of this box has set the electric lock in the next box. No other box but No. 2 can be opened. The box just closed is barred against the key. It is compulsory, therefore, for the collector to visit the letter boxes in the prescribed order.

It is impossible to skip collecting from any box or boxes on the route to make up any wasted time. The registration on the clock records the time taken to reach the route, the time each box remained open, the time occupied covering the distance between boxes and the total time spent on the route. It is claimed that this system effectively checks loitering, and careless collecting. It is practically a guarantee to business men that their important letters can be deposited in letters boxes and be collected at the proper time without delay.

The electric-locking device permits the collector to ring an electric bell in the clock, the number of rings according to code transmits one of a few important messages. The duplicate lock affords a protection against thieves.

This apparatus of the Williams Electric Dead Lock Company was installed by Mr. Frederick Williams, its inventor. This system is working satisfactorily in the post offices at Boston, New York and Philadelphia. It can be easily installed in hotels having annunciator and call-bell wiring. Its use will prevent the unlocking of rooms by hotel thieves, as the lock will be under control of the clerk, who will set the locks for the guests' keys when requested by them.



FIGS. 1 AND 2.—LETTER-BOX LOCK AND AUTOMATIC ELECTRIC LOCK AND TIME REGISTER.

The robbery of stores by employees having duplicate keys can be prevented by the use of this lock. In penal institutions its application will prevent doors being unlocked out of prescribed hours, as the control of the locks will be directed from the superintendent's office.

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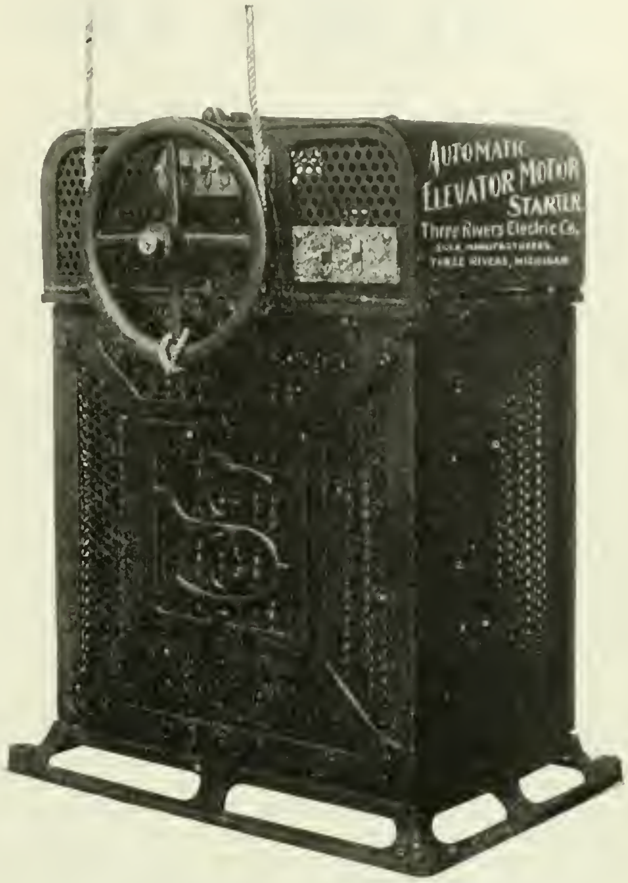
Automatic Motor Starter.

The automatic motor starter shown in the accompanying illustration is designed for starting non-reversing motors for elevators of the double-belt type. The circuit-closing switch of the starter is made up of four blades having parallel action and carbon break tips. The starter is operated by a rope fastened to the sheave wheel, as shown in the cut, which passes up the hatchway and can be manipulated from any floor. When pulled in one direction the motor starts, and when pulled in the other direction the circuit is completely opened. The two binding blocks at the right of the wheel are terminals for a lamp circuit to each floor, and so connected at the starter that no currents flows when the motor is at rest; the lamps burn only when the motor has reached full speed, and thus indicate to the operator that the elevator can be started. Everything about the starter is interchangeable.



AUTOMATIC ELEVATOR MOTOR STARTER.

The motor starter described is made by the Three Rivers Electric Company, Three Rivers, Mich.

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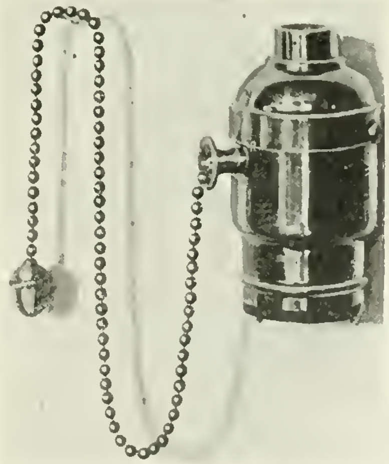
Pendant Chain Pull Socket.

The device illustrated herewith is intended for use in situations where the ordinary key socket is not within reach. From the side of the socket is a pendant chain which, on being pulled, turns the current on and off, as the case may be, and another pull produces the opposite result. The mechanism of the device is simple. One pull of the chain turns the switch one-half a revolution, and either closes or opens the circuit, and the next pull completes the revolution with the reverse effect. The contact points are frictional, and are kept smooth and bright. These sockets are fitted with Edison, T. H. and Westinghouse bases, and are made by Mr. Harvey Hubbell, Bridgeport, Conn.



CHAIN-PULL SOCKET.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The money market was nominal, call money closing at 2@2½ per cent. Time money closed at 3¼ per cent for 60 days to 90 days, 3½ for 4, 5 and 6 months. There was a moderate supply of mercantile paper and a fair demand; the closing quotations being 3½@4 per cent for 60 to 90 days' indorsements, 4@4½ for choice 4 to 6 months single names and 5 for others. In the stock market prices advanced and speculation broadened, and there was large buying of securities for investment. The assured success of the United States Steel Corporation caused great activity and marked advance in steel stocks, while other industrials received bullish attention. The leading railroad stocks and specialties closed with further advances. There was considerable activity in electric tractions. During the week these stocks were affected by reports of the Vanderbilt interests buying Brooklyn Rapid Transit stock, also by rumors of the buying of Manhattan Railway and Brooklyn Rapid Transit stock by Metropolitan Street Railway interests. The sales of Metropolitan aggregated 67,031, which is the largest number recorded for several weeks; the highest point reached was 168¾, and the lowest 162¾, closing at 163⅝. There was heavy buying also in Brooklyn Rapid Transit, the total number of shares sold being 269,700. The movement of prices of this stock was on a higher level than those of the previous week, the closing price being ⅜ points greater than that of the week previous. Among the electric stocks General Electric scored a net advance of 4½ points on rather narrow trading. There was some extraordinary activity in Western Union, which closed with a net increase of 1⅛ points, 28,150 shares having changed hands during the week. The week's market in outside securities was the most active in the history of trading on the "curb." sales of the United States Steel securities alone footing up between 500,000 and 1,000,000 shares. The prices fluctuated after the first rapid advance, the net gain for the week on the common stock being 3½ points, and preferred 8¼. Less interest was shown in the traction and electric list. Following are the closing prices at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Mar. 16.	Mar. 23.		Mar. 16.	Mar. 23.
General Electric	211½	215	Electric Vehicle	15	15
Brooklyn Rapid Transit	82⅜	82¾	Electric Vehicle, pfd	25	25
Metropolitan Street Ry	167⅜	163⅝	General Car	2	2
American Tel. & Cable	—	97	Illinois Elec. Veh. Tran.	1	1
Western Union Tel	88½	88⅜	Hudson River Tel	120	—
American Dist. Tel	36½	36	N. E. Elec. Veh. Tran.	2⅞	2⅞
Commercial Cable	—	160	N. Y. Elec. Veh. Tran.	4	4
Electric Boat	24	24	Tel. & Tel. Co. of Am.	6	7
Electric Boat, pfd	50	51	N. Y. & N. J. Tel	178	—
Electric Lead Reduc'n	5⅛	5			

BOSTON.

	Mar. 16.	Mar. 23.		Mar. 16.	Mar. 23.
New England Telephone	—	139	Erie Telephone	53½	50¾
Mexican Telephone	3¼	—	General Electric, pfd	—	192
Westinghouse Electric	62	62	Am. Tel. & Tel	160	169
Westinghouse Elec., pfd.	71	71	Boston Electric Light	—	—

PHILADELPHIA.

	Mar. 16.	Mar. 23.		Mar. 16.	Mar. 23.
Electric Storage Battery.	72	72	Philadelphia Elec	6	6⅛
Elec. Storage Bat., pfd.	76	74	Pa. Electric Vehicle	*1	½
Elec. Co. of America	8⅜	8⅝	Pa. Elec. Veh., pfd	*¾	½
General Electric Auto	—	—	Am. Railways	38½	38

CHICAGO,

	Mar. 16.	Mar. 23.		Mar. 16.	Mar. 23.
Chicago Edison	154½	154½	Chicago Telep. Co	260	265
Chicago City Ry	270	260	Union Traction	16	15
National Carbon	15¾	15¾	Union Traction, pfd	56½	56½
National Carbon, pfd	82½	82	Northwest. Elev. Com.	39	39

*Asked.

A DEAL AT ELMIRA, N. Y.—It is stated that the Mutual Life Insurance Company has disposed of its interests at Elmira, N. Y., to a syndicate composed of New York and Elmira capitalists. The amount involved is supposed to be above $4,000,000. The syndicate will now own all the franchises and all of the public utilities in Elmira, with the exception of the telephone and telegraph franchises. The property which has been disposed of consists of the Elmira Water Works, the Maple Avenue Street Railroad, the West Water Street Railroad, the Elmira & Horseheads Street Railroad. the Elmira Gas Company, the Elmira Illuminating Company, an electric light concern, the old Interstate Fair Grounds, now known as the Maple Avenue Driving Park. and Rorick's Glen Park. These street railways and the water works system will be consolidated with the West Side Railroad system and the Elmira Heights Water Company, already owned by the local Elmira capitalists interested in the deal. Extensions and improvements are to be made at once as a result of the consolidation.

DIVIDENDS.—The New York Metropolitan Street Railway directors have declared the regular quarterly dividend of 1¾ per cent, payable April 15. United Gas Improvement Company has declared a quarterly dividend of 2 per cent, $1 per share. The Union Traction & Electric Company, of New Jersey, has declared a dividend of 1 per cent. The Boston Electric Light Company directors have declared a regular quarterly dividend of $2 and an extra dividend of $1, payable April 15 to stockholders of record April 1. Directors of the Newton, Mass., Street Railway have declared a quarterly dividend of 1½ per cent, payable April 1. This is a reduction of ½ per cent. The company has paid quarterly dividends of 2 per cent for the past eight years. Directors of the American Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable April 15.

ELECTRIC STORAGE BATTERY.—At the annual meeting of the Electric Storage Battery Company old directors were re-elected. Of 160,000 shares 140,665 were voted. The earnings for 1900 are about 7 per cent on the present outstanding stock of $16,875,000. The annual report for year ended Dec. 31, as already forecast in these pages, shows:

	1900.	1899.	Changes.	
Gross	$3,309,443	$2,122,079	Inc.	$1,186,764
Mfg. purchase and instal. charges	1,861,023	1,186,813	Inc.	675,110
Gross profits	$1,477,519	$935,866	Inc.	$541,653
Fixed charges, etc.	297,779	326,781	Dec.	29,002
Net profits	$1,149,759	$609,185	Inc.	$540,574
Other inc.	168,105	315,438	Dec.	147,333
Net inc.	$1,317,865	$924,523	Inc.	$393,342

Other figures compare:

	1900.	1899.
Orders booked	$3,500,002	$3,500,996
Orders unfilled Dec. 31	1,230,047	1,378,316
Plates mfd—pounds	15,301,000	10,796,427
Plates shipped—pounds	11,088,151	8,336,739
Plates ordered—pounds	11,017,579	14,062,137

CANADIAN GENERAL ELECTRIC STOCK.—Application has been made to list the stocks of the Canadian General Electric Company on the Montreal Stock Exchange. The capitalization of the company is $1,500,000, of which $300,000 is preferred, paying 6 per cent interest. The common stock pays 10 per cent per annum, and the closing quotation in Toronto a few days ago, and where the stock has been active for some time, was 210¼. The capitalization will be increased to $2,000,000. Last year the company paid out in dividends $127,623. The Royal Electric Company, of Montreal, holds 3000 shares of Canadian General stock, which it received in payment for its manufacturing plant a short time ago. The Royal got this stock at 160, which would make its original value to the company $480,000, but since that time the value of the stock has risen until it is now worth about $630,000.

BELL TELEPHONE OUTPUT.—The net output of instruments of the American Telephone & Telegraph Company indicates a rapid development in the telephone business. The net gain of subscribers for the month of February throughout the country is not far from 22,000, as against 16,000 for the same period last year. The net gain of subscribers for the months of January and February is estimated at 43,000, as against 35,000 for the same period last year. Nearly every Bell subsidiary company in the country has recently increased its capital stock or authorized bond issues, and this year promises to be one of great development.

ELECTRIC COMPANY OF AMERICA.—Notices are issued for the annual meeting of the Electric Company of America to be held April 23. The profits of the year show about $410,000. The year's dividend, $1 per share, is on nearly 400,000 shares outstanding, and the surplus over the dividend in 1900 is understood to be about $20,000.

WORCESTER TRACTION.—The stockholders of the Worcester Traction Company ratified the action of the directors in selling the stock, franchise and plant of the company to Vermilye & Co., of New York. The company is capitalized for $5,000,000, of which $3,000,000 is common stock and $2,000,000 preferred.

PHILADELPHIA BELL TELEPHONE will vote May 21 to increase from $6,000,000 to $8,000,000.

GENERAL ELECTRIC at 216 leads the "risers" in the stock market, with a gain of $74 since election and $45 since Jan 1.

BROOKLYN RAPID TRANSIT.—The Brooklyn Rapid Transit Railroad reports gross earnings for February of $843,394, an increase of $26,112 as compared with the same month of last year, and net $258,933, an increase of $41,917. For the eight months ending Feb. 28 the gross earnings were $7,899,100, an increase of $254,048, as compared with the corresponding period of last year, and net $2,748,694, an increase of $462,836.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the commercial agencies during the week indicate a continuance of the healthful conditions in trade and business in general. In the iron and steel lines, manufacturers make very favorable reports, with orders on hand to carry them well into the midsummer and with an outlook for fall business, which is highly satisfactory. Export business is quiet, but enterprising American concerns are still securing fair orders for finished material, notably rails, bridges and structural work. There is a rapidly increasing demand in structural steel and building hardware, and there is every indication that with the opening of spring, building operations throughout the country will be on an extensive scale. The only line of trade in which no improvement is noticed is the textile industry. The metals are fairly steady, except tin, which is slightly lower. Copper is unchanged, and manufacturers in this country, though they are busy, have not been buying much. Lake is quoted at 16⅞@17c.; electrolytic in cakes, wire bars or ingots, at 16.35@16.45c.; in cathodes at 16.10@16.20c.; casting copper, 16⅜c. The gross railway earnings for the second week in March show a gain of 8 per cent over the same period last year. The failures during the week, as reported by *Bradstreet's*, number 231, as against 207 the week previous and 192 the same week a year ago.

TELEPHONE, TELEGRAPH & CABLE COMPANY.—The Telephone, Telegraph & Cable Company of America, at a special meeting in Jersey City on March 26, approved the resolution of the board of directors providing for a decrease of the capital stock from $30,000,000 to $9,000,000. The decrease is to be effected by reducing the par value of a share from $50 to $15. Two hundred and nineteen thousand four hundred shares were represented, and the vote in favor of decreasing the capital stock was unanimous. William J. Latta, organizer of the company, was not present, and nothing regarding the company's plans for the future was divulged. The Telephone, Telegraph & Cable Company of America was organized about 16 months ago, and $5 a share was paid, and later $7.50 additional became payable. After the company gave up control of the Erie Telegraph & Telephone Company it has not done much to widen its field.

CUBA AND MEXICO.—The Compania de Ferrocarriles del Distrito Federal de Mexico (the City of Mexico Tramways Company) and the Havana Electric Company continue to be among the largest purchasers of equipment and supplies. Last week's shipments include 400,000 lbs. of copper trolley and feeder wire for the Mexican road. The trolley wire was manufactured by W. A. Clark, of Bayway, N. J., while the feeder order was executed by the Holmes, Booth & Haydens Company, of this city. The shipment, which was made through the Morris Electric Company, of New York City, was valued at some $80,000. Pending shipments to Havana comprise an $18,000 lot of miscellaneous supplies. The International Coal Company, of Philadelphia, has just shipped two cargoes of bituminous coal for the Cuban road, amounting to 6200 tons.

THE PIESA LESA ELECTRIC LIGHTING STATION at Lima, Peru, which at present is operated by hydraulic power, is to be equipped with a steam plant, as under existing conditions the frequent scarcity of water does not permit of running regularly. Westinghouse, Church, Kerr & Co., of New York City, have been awarded the contract. There will be a 200-hp boiler built by the Babcock & Wilcox Company. The heating apparatus will be manufactured by the National Pipe Bending Company, of Bridgeport, Conn. The pumps are to come from the Deane shops of the International Pump Company, while the condensers will be of Worthington make. The contract also calls for a 16-inch Westinghouse compound engine, together with the requisite piping and fixtures to make a complete plant. The Lima concern is equipped with four 150-kw generators manufactured by the General Electric Company.

THE NIAGARA RAILWAY SUPPLY COMPANY has been incorporated with a capital of $500,000 to manufacture the McPherson safety frog and switch. The incorporators are De Lancy Rankine, of Niagara Falls; Charles R. Huntley and Robert W. Pomeroy, of Buffalo. The company will locate its factory on the lands of the Niagara Falls Power Company, having selected a site at the foot of Iroquois Street. The plant is expected to be an extensive one. for the company will also make other railway supplies outside of the frog and switch above referred to. New York and Canadian capitalists are interested in the company, and it is stated that other names will be added to the list of directors. Ground will be broken for the factory as soon as the frost is out of the ground, the hope being to get the plant in operation by July or thereabouts.

THE CHICAGO PNEUMATIC TOOL COMPANY, of New York, has secured an order through Takata & Co., of 10 Wall Street, for supplying a number of riveting, caulking, chipping, drilling and other pneumatic tools, which are to be installed in Japanese dockyards. The order also requisitions for a large air compressor, which will be built by the New York Air Compressor Company, of New York City. The equipment is to be driven by a 45-hp electric motor manufactured by the Westinghouse Electric & Manufacturing Company. The Chicago Company is about to ship two complete plants consisting of various pneumatic tools, air compressors and motors, to Brazil. The motors will be 15-hp each. They are being furnished by the General Electric Company.

AUTOMOBILES FOR THE TRANSVAAL.—Mr. A. W. K. Peirce of the General Electric Power Company, Limited, Germiston, Transvaal, South Africa, writes us that he would be glad to receive particulars from the manufacturers of electric automobiles in America, as to the vehicles they make. He states that at the present time a horse in Africa eats about $45 worth of provender a month, with every probability of an increase rather than a decrease in the cost. It appears to him, therefore, that under the conditions prevailing at his power station, there is a good field for the "auto," and he would like to hear from our manufacturers on the subject as soon as possible.

THE CASE MANUFACTURING COMPANY, Columbus, Ohio, report that they have just closed contracts with the following parties: James Leffel & Co., Springfield, Ohio, for one 15-ton 50-ft. span electric traveling crane; Henry D. Perky, Niagara Falls, N. Y., for two one-ton electric traveling cranes; United States Cast Iron Pipe & Foundry Company, Addyston, Ohio, one 25-ton electric traveling crane; William R. Trigg Company, Richmond, Va., one 3-ton 3-motor electric traveling crane.

THE MORRIS ELECTRIC COMPANY, of New York City, states that work begins on its new East Orange factory within the next few days. Elmer P. Morris says that he hopes to commence the execution of orders there inside of six weeks. There is to be a brass foundry plant. A number of molding machines are about to be ordered as well as ten furnaces. The steam power plant has been ordered of the Atlas Engine Works, of Indianapolis, through the Edward P. Hampson Company, of New York City.

THE NATIONAL GAS & CONSTRUCTION COMPANY, of Philadelphia, is about to place contracts for the equipment of the new city lighting station at Norfolk, Va. The equipment will consist of two engines of 310-hp, each direct connected to 250-kw alternating-current generators. There will also be a complete steam plant of 620 horse-power. These contracts will entail an expenditure of some $30,000.

THE CHAPARRA SUGAR COMPANY, of 109 Wall Street, New York City, which is placing several important contracts for machinery, equipment, etc., for its plantation in Cuba, has given an order to the General Electric Company for the furnishing of generating apparatus to supply electric light in the factory buildings. The engine end of the order will be undertaken by the Harrisburg Foundry & Machine Company.

MACHINE TOOLS.—The Cincinnati department of the Marshall-Huschart Company, is now located in new quarters. Among the machine tools purchased were two from the Cincinnati Milling Machine Company, two from the Bickford Drill & Tool Company, and a lathe, some drill presses and planers from the Bradford Machine Tool Company.

AMERICAN JESSOP STEEL.—A cable dispatch from Sheffield, England, of March 12, says: At the annual meeting of William Jessop & Sons to-day it was announced that the directors are about to establish works for certain branches of their business in the United States.

THE GALENA OIL COMPANY, of Galena, Pa., is at present making some substantial purchases of machinery, equipment, etc., in view of an extension to its plant. Westinghouse, Church, Kerr & Co., of New York City, have received an order for a 200-hp gas engine for electrical purposes.

THE SHELBY STEEL TUBE COMPANY, with a capital of $15,000,000 and operating more than half a dozen plants in the States of Connecticut, Pennsylvania, Indiana and Ohio, will soon, according to report, make its principal headquarters in this city.

BRADFORD MACHINE TOOL COMPANY.—The Bradford Machine Tool Company, Cincinnati, Ohio, reports a foreign demand for its machines, principally from Portugal.

NIAGARA POWER.—If a bill now before the New York Legislature becomes law, it will give Niagara Falls a new power company, the name selected for which is the Lower River Power & Water Supply Company. The capital is $5,000,000. The incorporators are Commodore P. Vedder, Tunis G. Bergen, William Williams, Charles E. Hotchkiss and DeWitt V. D. Riely, of New York; George W. Knox, Patrick F. King and James S. Simmons, of Niagara Falls. The company under the provisions of the bill is authorized to construct and maintain pipes or tunnels through or under the city of Niagara Falls and the town of Lewiston, and the streets and highways thereof, extending from such point or points outside of the lands of the New York State Reservation, on the easterly side of the river. In other words, this new power company seeks the right and a franchise to construct a tunnel from a point below the lower steel arch or railway bridge, at the whirlpool rapids, through the point of land at the whirlpool on the New York side. This tunnel would begin just below the railway bridges and have its outlet near the Devil's Hole, the drop of level being about 80 ft., it is understood. The power station would be at the Devil's Hole, and the power developed would be used in the northern section of the city in all probability. The press dispatches announce that the company seeks to be a rival of the company that has rights on the Erie canal, but the company has no such intention or aspiration. The company feels that the cost of constructing the tunnel would be greatly reduced by the fact that electrically operated dump cars could be run right into the tunnel from the line of the Gorge road. The excavated rock could be easily disposed of in strengthening the roadbed of the Niagara Gorge road, and it would not have to be carried far beyond the upper entrance to the tunnel; in fact, such a supply of rock would be valuable to the Gorge road, it is believed.

ENGINES AND GENERATORS FOR ST. LOUIS.—The Supply Commissioner, March 15, opened bids for furnishing the water department with generators and engines for installation at the Baden plant to manufacture electricity for lighting the several buildings there, and at Bissell's Point, and also for furnishing power to operate an electric railway between the two stations. He also received proposals for furnishing a double motor equipment. The bids received were based upon several propositions. On furnishing one 20-kw alternating-current generator and Pelton waterwheel, direct connected, there were three bids—Westinghouse Electric & Manufacturing Company, $1,785; General Electric Company, $2,040, and Stanley Electric Manufacturing Company, $2,205. Three firms submitted bids for furnishing one 100-kw alternating-current generator and engine, direct connected, as follows: Westinghouse Electric & Manufacturing Company, $5,840; General Electric Company, $6,007, and Stanley Electric Manufacturing Company, $6,325. The third proposition on which bids were received was for furnishing one 100-kw direct-current generator and engine, direct connected. There were four bids for this contract, two firms presenting two bids, based on different propositions. The bids were as follows: General Electric Company, $4,655; Crocker-Wheeler Company, $5,500; Westinghouse Electric & Manufacturing Company, $4,476 and $4,687, and the Northern Electric Manufacturing Company, $4,568 and $4,679. For furnishing the motor-car equipment there were but two bidders—the General Electric Company, $1,600, and the Westinghouse Electric & Manufacturing Company, $1,787.

THE CASTNER ELECTROLYTIC COMPANY has made a contract with the Niagara Falls Power Company for an additional block of 5000 electrical horse-power. It will be recalled that the Castner Electrolytic Company is an English syndicate that bought out the Mathieson Alkali Works located on the lands of the Niagara Falls Company. The power just contracted for is to supply very extensive additions to be made to the output capacity of the works. Several new buildings will be erected on the east side of the plant, the style of architecture and general appearance to be similar to the buildings of the present works. The company is now using 2000 electrical horse-power, and the output is about 300 tons of caustic soda and bleaching powder a week. When the extensions have been completed and the installation is in full operation, the output of the plant will be about 1000 tons a week, or more than treble what it now is. A portion of the new block of power is to be furnished in November next, while the balance must be ready by January next. It is evident from this that the new buildings are to be erected with all possible speed. The number of hands employed at present is 240, but the payroll will have 700 names on it when the works are extended. In their finished state the buildings will cover over 10 acres of land and the expenditure on the additions will be about $500,000.

NIAGARA PLATING INDUSTRY.—A consolidation of the business interests of the Niagara Silver Company, of Niagara Falls, and William A. Rogers, of New York, has been effected, the new firm taking the name of William A. Rogers, Limited, and being incorporated under the Ontario Companies' Act, with a capital stock of $1,350,000. Both parties to the consolidation are interested in the manufacture and sale of silver-plated ware, the Niagara Silver Company being a tenant of the Niagara Falls Hydraulic Power & Manufacturing Company, and a consumer of electric power. The directors are S. J. Moore, of Toronto; A. E. Ames, of A. E. Ames & Co., bankers, of Toronto; Hon. W. Caryl Ely, president of the International Traction Company, of Buffalo; Robert Kilgour, vice-president of the Canadian Bank of Commerce of Toronto; James L. Morrison, president of the Niagara Silver Company, of Toronto; Hon. Charles H. Duell, ex-Commissioner of Patents, Washington, D. C., and Wm. A. Rogers, of New York. The officers are: President, S. J. Moore; vice-president, A. E. Ames; general manager, William A. Rogers. There will be a considerable extension of the business.

THE NATURAL FOOD COMPANY, of Niagara Falls, has made a contract with the Niagara Falls Power Company for 2500 electrical horse-power for the operation of the new factory building now in course of erection on Buffalo Avenue in that city. The Natural Food Company are the makers of shredded wheat biscuit, and the plant now in building at the Falls is destined to be one of the most wonderful factory structures in the country. In length it will be 542 ft., width 66½ ft., and height six stories. The skeleton will be of steel and the walls of brick. It is expected that it will demonstrate the perfection of factory construction in every department Henry D Perky is the head of the company, and the day that he journeyed to the Falls is marked by a white stone. A very large force of men is at work rushing the plant to completion.

POWER EQUIPMENTS.—The Triumph Electric Company, Cincinnati, Ohio, is now booking orders for power equipment for next August and September deliveries. A recent contract secured is for the equipment of the Newport Rolling Mills, a 100-kw generator and four motors, aggregating 40 horse-power. Other orders are for one 21-kw direct-connected machine for Tampa, Fla.; one 50-kw for Grand Forks, Minn.; one 17½-kw direct connected, and a 3½-hp motor for the University of Cincinnati; one 200-kw direct connected and one 5-hp crane motor and one 2½ for the Globe-Wernicke Company, Cincinnati; four motors for the Bradley & Sorin Company, equipment for two new Ohio River steamers; two 100-kw belted machines for the Union Hill, N. J. lighting plant, and one 20-kw direct-connected machine for the Conshohoken, Pa., lighting plant.

THE LEHIGH VALLEY RAILROAD is making a number of improvements. One of the most expensive of these is the installation of the automatic electric block-signal system along its entire main line. This system will be finished by June 1. When it is completed the Lehigh Valley will be operated under the automatic electric block-signal system from New York to Buffalo, and will be the first of the trunk lines to have established this costly but valuable improvement along its entire main line.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., manufacturers of the chloride accumulator, announces that a sales office has been established at Cleveland, Ohio, and Mr. E. V. Stebbins, formerly of the Philadelphia staff, has been placed in charge as manager. The office will be located in the New England Building and all business from that territory will be handled by Mr. Stebbins.

ELECTRIC POWER IN BREWERY.—Contracts for changing the power of the Anheuser-Busch Brewing Company from steam to electricity have been let to a St. Louis firm, and work on the new equipment will be commenced at once. A new power building is to be erected near the present lighting plant. It is estimated the change will cost between $200,000 and $300,000.

MR. C. LORENZ, S. O. 26 Elisabeth Ufer, Berlin, Germany, would like to undertake for Germany and Russia the handling of American specialties and novelties in the line of telephony, telegraphy, railway signals, stock tickers, etc. For some 20 years past he has sold such apparatus to the German railways, post office, military authorities, etc., and is therefore in a good position to introduce articles of merit.

PROPOSALS FOR ELECTRIC LIGHT PLANT.—Mr. E. M. Dawson, chief clerk of the Department of the Interior, Washington, is preparing to invite proposals for an electric light plant, for which an appropriation of $74,000 was made by the last Congress. The plant will supply light to the Patent Office Building, the old Post Office Department Building and the Pension Building.

RAILWAY MATERIAL.—Manager McCallum, of the Electric Railway Equipment Company, Cincinnati, Ohio, reports an excellent inquiry for electric railway material, both domestic and foreign. Some heavy shipments have just been made to England. There is some inquiry from South America, also Japan and China.

THE DIEHL MANUFACTURING COMPANY, of Elizabethport, N. J., has just filled a very large order for ceiling fans and electroliers of unique and magnificent design, to be installed in the Imperial Palace at Formosa.

General News.

THE TELEPHONE.

LONDON, KY.—A. W. Huggins is organizing a telephone company here.

CARLISLE, ARK.—E. A. Wilson and others have organized an independent telephone company.

ANSONIA, CONN.—The Ansonia Telephone Company has increased its capital stock to $25,000.

MIDDLEBOURNE, W. VA.—The Inland Telephone Company contemplates making some improvements.

DRY RUN, MD. The Dry Run Telephone Company has been organized. It will build to Williamsport.

CARLISLE, ARK.—Mr. E. H. Wilson desires prices and catalogues of telephone equipment and supplies.

CHARLOTTE, N. C.—Negotiations are said to be under way for the construction of a telephone line between Clinton and Whitmore, S. C.

NEW YORK CITY.—The general offices of the Knickerbocker Telephone & Telegraph Company have been removed from 418 Broome Street to 100 Broadway.

INDIANAPOLIS, IND.—The Star Telephone Company of French Lick has been incorporated; capital, $2,000; directors: L. Ellis, Harry Roland, and J. L. Sutton.

KNOXVILLE, TENN.—The Southern Telephone Construction Company has been incorporated by W. O. Rhode, W. S. Roberts and J. W. Sneed. Capital, $10,000.

KNIGHTSTOWN, IND.—The Henry County Telephone Company, organized at this place, has disorganized on account of the low rural rates offered by the Bell Company.

TRENTON, N. J.—The Southern Telegraph Association has been incorporated; capital, $100,000. Incorporators: Sanford Duncan, John T. Lands and George H. B. Martin.

ALBANY, N. Y.—The Livonia Telephone Company of Livonia has been incorporated; capital, $1,000; directors: E. A. Bronson, C. E. Hartson, and W. B. Thurston, Livonia.

PORTAGE, WIS.—The People's Telephone Company, which owns exchanges at Rio, Wyocena, Cambria, Randolph and Fox Lake, contemplates establishing exchanges at Beaver Dam and Juneau.

INDIANAPOLIS, IND.—Articles of incorporation have been filed with the Secretary of State by the Star Telephone Company, of Shoals, and the Warrington Telephone Company. A system will be established in each town.

LONDON, KY.—A. W. Huggins, of this place, has secured right of way for a telephone line to Manchester. A stock company is being organized. As soon as completed to Manchester the line will be extended to Hyden and on to Hazard.

HARTFORD CITY, IND.—The Central Union Telephone Company, which is asking for a new franchise, has announced that it will furnish telephones at 90 cents a month. The rate of the independent company is $2 and $1 a month.

SCOTTSBURG, IND.—The town board has granted a telephone franchise to each of four applicants, viz: Hoosier Telephone Company, Scott County Telephone Company, C. E. Gregory, of Sheridan, and E. E. Dougherty, of Brownstown.

DELTA, OHIO.—The Delta Telephone Company has increased its capital stock from $10,000 to $20,000. The owners of the company are Y. J. Platt, F. W. Zerman, George A. Everett, G. R. Whitehouse, C. P. Waltz and G. B. Whitehouse.

BALTIMORE, MD.—The Suburban Telephone Company has been incorporated by C. Ross Mace, John H. Sheridan, John W. Crouch, Robert C. McClintock, Joseph Dryer, Edward C. Carrington, Jr., and R. Vincent, Jr. Capital, $10,000.

BLOOMDALE, OHIO.—The Oil Belt Telephone Company is preparing to install a local exchange which will also cover the surrounding country. Long-distance service will be secured through the lines of the United States Telephone Company.

AUGUSTA, GA.—H. W. Buxton, formerly manager of the exchange of the Southern Bell Telephone Company at Augusta, Ga., has assumed charge of the local exchange in Atlanta, Ga., succeeding R. L. West, promoted to the office of division superintendent.

WHEELING, W. VA.—A telephone war between the Bell Company and the National Company is imminent. The Bell people are charging $100 a year for business telephones and $50 a year for residences. The National has placed its rates at $35 and $18 a year.

CHARLOTTE, N. C.—The telephone exchange at Ducktown, Tenn., has been purchased by the Cumberland Telephone Company and will be connected with Knoxville, Tenn. The company is also said to be negotiating for several other exchanges in East Tennessee.

COMER, GA.—The Danielsville & Homer Telephone Company expects to increase its exchange capacity from 40 drops to 100 drops. Its business outlook is encouraging. The company now has twenty-seven subscribers and began business in August, 1899 with one line.

SEYMOUR, TEXAS.—The Proffitt Telegraph and Telephone Company of Seymour, Baylor County, Texas, has been incorporated with a capital stock of $10,000. The incorporators are J. W. Proffitt, of Proffitt, Texas; J. H. Glasgow and G. G. Garrett, of Seymour, Texas.

DES MOINES, IA.—The Iowa, Minnesota & South Dakota Telephone Company, of Sioux Falls, has been incorporated with a capital stock of $100,000. The company will establish a branch office at Britt, Ia. The Iowa members of the board are T. A. Way, T. A. Potter, E. P. Healy and B. C. Way, of Britt.

HILO, HAWAII.—The Hilo & Hawaii Telephone and Telegraph Company now has 260 subscribers. The company's prospects are good. It has a switchboard capacity of 500 drops and is looking forward to additional subscribers in the immediate future. Mr. E. E. Richards is manager of the company.

GREENFORK, IND.—The Home Telephone Company, of this place, is completing a plant that will afford service to the town and to a wide section of surrounding country. The telephones are furnished at 40 cents a month, and that price includes service of the long-distance lines within a prescribed territory.

ZANESVILLE, OHIO.—All the $200,000 capital stock has been subscribed for the Zanesville Telephone & Telegraph Company, $40,000 being allotted to local investors. The larger portion of the balance is held by the Federal Telephone Company, of Cleveland. Sherman M. Granger is president of the company.

SUMPTER, S. C.—A telephone fight of interest is in progress here, where Peter Blow, of Nashville, Tenn., is seeking a franchise for a new company, and the Sumpter Telephone Company is endeavoring to hold an exclusive franchise. The City Council has considered the matter but has postponed action until some future date.

SPARTANSBURG, S. C.—A warm fight is in progress here between the Citizens' Telephone Company and the Bell Telephone Company for supremacy. The market men of the city, heretofore using the Citizens Company's telephones by agreement, have agreed to install the Bell telephones. They are now threatened with the removal of the Citizens' telephones.

BARABOO, WIS.—A company has been formed here for the purpose of building a telephone line from Lacrosse to Milwaukee via Baraboo, with a capital of $100,000. It will be known as the Badger Long-Distance Telephone Company. The officers are A. C. Gray, president; Frank T. Brewster, secretary. It is the intention to eventually extend the line to Minneapolis.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has connected up its new Broadway exchange which will take care of 600 subscribers in the Newburgh district of the city. The exchange has an ultimate capacity of 2000 subscribers. The new Shore exchange at Nottingham is to be enlarged to take care of a large territory along the lake shore outside of the city.

TORONTO, ONT.—The corporation of the city of Toronto has petitioned the Dominion government to enforce the clause in the act of 1892, providing that existing rates should not be increased by the Bell Telephone Company without the consent of the government; also, that the company be obliged to supply telephones to all persons who require and are willing to pay for the same.

CHARLOTTE, N. C.—The plant of the Queen City Telephone Company, at Charlotte, was sold at a receiver's sale March 18, the purchaser being the Curtis syndicate, of Newark, N. J. The price paid was $23,000. The plant is said to have cost over $40,000. Improvements and enlargements are contemplated. The rumor that the purchase was made for the Bell Company was denied by all parties concerned.

NORFOLK, VA.—The Southern States Telephone Company, a Maryland corporation, operating exchanges in Norfolk, Portsmouth, and Berkeley, has filed a mortgage here to the Fidelity and Deposit Company of Baltimore to secure a bond issue of $150,000, the money to be used in retiring $50,000 of a previous bond issue and $100,000 in improving and extending the company's lines hereabouts.

ERIE.—The Erie Telephone system reports its wire mileage construction in 1900 as follows: Exchange, 625 pole miles, 73,027 wire miles; long distance, 2,585 pole miles, 25,907 wire miles. Of the 98,934 miles of wire constructed during the year, 45,957 miles were put underground. On Dec. 31, 1900, the system had in operation: Exchange, 3,915 pole miles, 198,470 wire miles; long distance, 17,207 pole miles, 95,574 wire miles. Of the 294,044 wire miles, 95,906 are working underground.

RICHMOND, IND.—The Telephone, Telegraph and Cable Company of New York which owned an interest in the National Telephone and Telegraph Company, operating exchanges in 700 towns in Northern Indiana, Southern Michigan, and Northwestern Ohio, has sold its interest to H. C. Paul and C. S. Bash of Fort Wayne, Ind. The Bell Company made an effort, it is said, to get the property, but failed. The stock owned by the New York company brought $120,000.

MANSFIELD, OHIO.—The Mansfield Telephone Company, which is backed by the Federal Telephone Company, of Cleveland, has bought out the Richland County interests, including the local franchise, of the Star Telephone Company. The price paid is said to have been $18,000. The property includes 149 miles of toll lines. A new system will be installed in Mansfield. The money derived from the sale will be utilized by the Star Company in improving its exchange at Ashland, where a new system will be installed.

MILWAUKEE, WIS.—There is talk of establishing a telephone company to compete with the Wisconsin Telephone Company in this city. Mr. Kurtz, of the National Telephone Company, of St. Louis, is promoting the plan. Mr. Kurtz is the inventor of a new system, called the new multiple contact transmitter and receiver, which is said to eliminate the metallic sounds of the Blake transmitter and to make the voice more distinct and natural in tone. The company also controls a single wire underground system.

BALTIMORE, MD.—There is great activity in the extension of telephone lines in Baltimore County. The Maryland Telephone Company is extending its line to Catonsville. The County Commissioners have granted permission to the Suburban Telephone Company to build lines on the Philadelphia road, from the Baltimore City limits to the Harford County line, and on Eastern Avenue, from the City limits to Chase station; Bow Lane, from the Philadelphia road to the Belair road; on the road between Kingsville and the Belair road and the road from Franklinville to Upper Falls.

GRAND RAPIDS, WIS.—The telephone and toll lines between this city and Marshfield and Pittsville, and owned by the local company, have already proved a success, and the company has started to extend its connections. The toll line is operated in connection with the Twin City Telephone Company and will be extended to Babcock and Bethel at once, and in the spring a branch will be built to Progress and Veedum. The company has purchased the line between this city and Vesper, and in the spring this will be rebuilt. The line between Hansen and Pittsville has also been purchased, which will probably be changed to a farmers' line.

FRANKFORT, IND.—Serious telephone trouble has broken out here. The Stromberg-Carlson Telephone Manufacturing Company has filed suit here against the Central Energy Telephone Company of this city, J. H. Murphy, of Indiapolis, general manager, and the Marion Trust Company, trustee. The action is based on a promissory note to foreclose a mechanics lien and to have a receiver appointed for the property and business. The amount alleged to be due and unpaid is $7,000. It is also alleged that the defendants are insolvent and are involved to the extent of more than $25,000. The company has just completed a fine plant and system.

CLEVELAND, OHIO.—The February report of the Contract Department of the Federal Telephone Company shows that $20,000 worth of new business has been added to the properties controlled by the company outside of Cleveland, Columbus and the United States Telephone Company, during the month of February. In January the figures were $16,600. The Federal Company has the controlling interest in the independent companies at Cleveland, Columbus, Youngstown, Zanesville, Portsmouth, Massillon, Columbiana County, Fostoria, Findlay, Lancaster, Galion, Shelby and other places. It is expected that the next few months will show a 25 per cent increase in the total number of subscribers.

ELECTRIC LIGHT AND POWER.

BURNSIDE, KY.—An electric light plant is being established here.

MIDWAY, KY. The city contemplates establishing an electric light plant.

STATESBORO, GA.—There is some talk of establishing an electric light plant in this place.

KALISPELL, MONT.—The Big Fork Electric Light & Power Company has been incorporated with a capital stock of $100,000.

PENDLETON, IND.—The town board has decided on putting in an electric light plant, and petitions asking for franchises are being filed.

DUNN, N. C.—The Legislature has authorized the issuance of $35,000 of bonds by this city for an electric light plant and water works.

BLOOMINGTON, IND.—The new light and power company of this city has let the contract for improvements to its plant aggregating $25,000.

TOLEDO, OHIO.—The Home Heating & Lighting Company, recently organized, will erect a $70,000 lighting and heating plant on Monroe Street.

ST. CHARLES, MO.—The city's electric light system is being extended and a new 30-light power dynamo is being place in position at the power house.

GASTONIA, N. C.—An election will be held on May 6 to vote on a proposition to issue $25,000 bonds for an electric light plant and water works.

WAUSEON, OHIO.—H. H. Williams & Company have been given a contract to furnish light for three years. About 100 arc lamps will be required.

PENSACOLA, FLA.—The Escambia County Electric Light & Power Company will add new dynamos and increase its present lighting capacity one-third.

TIPTON, IND.—The City Council has decided to put in a municipal electric light plant. Plans for its construction are being submitted to contractors.

KNIGHTSTOWN, IND.—Work is well under way on a new electric light plant at this place. It will be run in connection with the water works plant.

KENOSHA, WIS.—If local capital can be interested in the plan, a new electric light and power company will be started as a rival of the present company.

RICHMOND, VA.—The General Assembly has passed an act authorizing the town of Abingdon, Va., to supply the inhabitants with water, gas and electric light.

FRANKFORT, KY.—The People's Water & Electric Light Company has been incorporated with a capital stock of $20,000 by L. I. Crawford, H. M. Stegenan and C. W. Evans.

COLUMBUS, OHIO.—The municipal electric light plant of this city is shut down and will not resume operations until an ordinance is passed by the City Council providing the necessary funds.

GRAND RAPIDS, WIS.—The Electric & Water Company, composed of citizens using electric lights and city water, has requested the city to issue municipal bonds for the building of a new system.

CITY OF MEXICO, MEX.—The inauguration of the new electric light plant of Linares, State of Tamaulipas, Mex., will take place on May 5. The event will be celebrated as a holiday by the people of that place.

TRENTON, N. J.—The Cataract Light, Heat and Power Company, capital $100,000, has been incorporated; incorporators: Harry F. Bell, Leonard J. Tyman, Ralph Turner, Leonard J. Tyman, all of Paterson, N. J.

NEWARK, N. J.—The Union Township Electric Company, principal office, Township of Union, Union County, N. J., has been incorporated; capital, $2,000. incorporators: John Kean, Hamilton, F. Kean, Julian H. Kean, John W. Whelan.

REDFORD, VA.—The Redford Water Power Company, of Redford, has been chartered, with a capital of $50,000, to furnish water and electric power. G. M. Miles, of Redford, Va., J. H. Carper, of Pulaski, Va., and others are the incorporators.

COLLINWOOD, OHIO. The local municipal lighting plant which was installed four months ago at an expense of $30,000 has proved such a pronounced success that the village will issue $22,000 additional bonds and will double the capacity of the plant.

TOLEDO, OHIO.—The East Side Iron Elevator Company is planning to double the capacity of its large elevator. A new engine will be put in and an electric plant installed so that any portion of the elevator may be operated by independent motors.

BUCYRUS, OHIO.—The Bucyrus Gas & Electric Light Company, which was recently incorporated with $150,000, has organized with the following officers: I. C. Baxter, president; J. G. Gormley, vice-president; Peter Young, secretary treasurer; John Gwynn, general manager.

LYONS, N. Y.—The electric department of the Clyde Gas and Electric plant was ruined by fire on March 21. The plant was formerly owned by the Clyde Gas and Electric Company, which failed several years ago, but is now owned by Edward M. Moir of Marcellus. The loss is $10,000, fully insured.

ALLIANCE, OHIO.—The City Council has voted against the acceptance of the city lighting ordinance proposed by the Alliance Gas & Electric Company. A proposition to issue $40,000 worth of bonds for the purpose of erecting a municipal lighting plant has also failed to pass. Just what will be done is not known.

JAMESTOWN, N. Y.—In his annual report to the common council, Charles G. Sunderland, superintendent of the Jamestown, N. Y., municipal electric light plant, claims that the 300 arc lights of that city had cost only $36.36 each during the past year, on an all-night every night schedule. This is claimed to be the cheapest light secured by any city in the State.

CINCINNATI, OHIO.—The Union Light, Heat & Power Company has been incorporated at Covington, Ky., with a capital stock of $1,500,000. It will acquire and operate the gas and electric light plants of the Kentucky cities opposite Cincinnati. The incorporators are Jas. C. Ernst, Chas. E. Prior, J. Theo. Van Horne and E. W. Wetmore. Jas. C. Ernst is president.

ALBANY, N. Y.—The following companies have been incorporated: Power Installation Company of Buffalo, capital, $5,000; directors: G. F. Westcott, Wm. E. Westcott, Buffalo; Max Mauran, Niagara Falls. Lux Electric Light, Heat & Power Company of Clyde, Wayne County, capital, $50,000; directors: Chas. A. Lux, D. E. Lux and C. F. Lux, Clyde. The Gloversville Citizens' Electric Company, to supply electricity to Gloversville, Johnstown, Northville and Broad Albin, Fulton County; capital, $40,000; directors: John Begley, F. S. Sexton and Ervin Klein, Gloversville.

TORONTO, ONT.—The Canadian General Electric Company has acquired a tract of land in this city for the extension of the Canada Foundry Company's works that are now owned and controlled by the former company. Electric cranes will be installed for the handling of materials up to fifty tons weight. All machines will be operated by electricity supplied from the Canada General Electric works. The Peterboro branch of the General Electric works has been considerably extended of late, the main shop being 600 feet in length. About forty acres of ground are occupied in that city by the company.

THE ELECTRIC RAILWAY.

HOPKINSVILLE, KY.—E. B. Bassett is in the market for electric railway material.

CIRCLEVILLE, OHIO.—The village council has granted a franchise to the Columbus & Southern Railway Company.

PORTSMOUTH, VA.—All the union employees on the Portsmouth Street Railway went out on a strike on March 17.

CANTON, OHIO.—The Canton Massillon Electric Railway is negotiating for the purchase of Myer's Lake, near this place.

FOND DU LAC, WIS.—The Fond du Lac Street Railway & Light Company is making extensive improvements in its system.

PINE BLUFF, ARK.—The Citizens' Light & Transit Company has been granted a franchise. It is capitalized at $200,000.

PENSACOLA, FLA.—The Pensacola Electric Street Railway Company will expend $15,000 for improvements and betterments.

HASTINGS, NEB.—The Hastings Automobile & Rapid Transit Company has been incorporated with a capital stock of $60,000.

BRYAN, OHIO.—A franchise has been granted to William D. Sherwood as trustee for the Northern Ohio Electric Railway Company.

COLUMBUS, OHIO.—The Grove City & Green Lawn Electric Railway has been reorganized. A. G. Grant, of Grove City, is president.

TOLEDO, OHIO.—It is stated that the Toledo, Bowling Green & Fremont Railway Company will extend its line from Jerry City to Fremont.

MILWAUKEE, WIS.—The Milwaukee & Lake Geneva Electric Railway Company has asked for a franchise to enter the city on the south side.

CLEVELAND, OHIO.—The owners of the Chagrin Falls & Eastern Railway are contemplating building a road from Chagrin Falls to Willoughby.

CLEVELAND, OHIO.—The Cleveland, Chagrin Falls & Eastern Railway Company is considering the advisability of extending its line to Warren.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company is planning an extension of its Lowellville line to Mahoningtown and Newcastle.

TOLEDO, OHIO.—The officials of the Toledo & Western Railway Company are considering the advisability of building a branch line through Ogden, Mich.

CLEVELAND, OHIO.—Ordinances authorizing various extensions of the lines of the Cleveland City Railway Company have been approved by the board of control.

CINCINNATI, OHIO.—The formal absorption of the Covington, Newport & Cincinnati Railway lines by the Cincinnati Traction Company is now a question of but a few days.

ZANESVILLE, OHIO.—T. H. Wheeler and E. G. Abott, representing the Zanesville, Adamsville & Coshocton Electric Railway Company, have asked a franchise for that road.

CANAAN, CONN.—A company is being organized for the construction of an electric road from the Massachusetts State line, north of here, to Bridgeport, a distance of 70 miles.

SMITHVILLE, VA.—The Charlotte & Prince Edward Electric Railway, with $100,000 capital, has been chartered. J. R. Martin, W. G. Williams and others are the incorporators.

CINCINNATI, OHIO.—The village Council of Reading has been asked for franchises by the Cleveland & Cincinnati Railway Company and the Millcreek Valley Railway Company.

WILMINGTON, DEL.—Peter J. Ford and other local capitalists are interested in a project to build a trolley road from Wilmington to Elkton, Md., by way of Newport, Stanton and Newark.

LIMA, OHIO.—The Western Ohio Electric Railway Company, which is building a line from Lima to Wapakoneta and St. Marys, is working on a right of way to extend the line to Celina.

ALBANY, N. Y.—The Scotia Traction Company has been incorporated; capital, $30,000. Directors—G. W. Lynch and William H. Delaney, New York City; H. V. Mynderse, Schenectady.

CINCINNATI, OHIO.—Thos. H. Fordyce, of Detroit, has been granted a contract authorizing the construction of an electric system for the propulsion of canal boats between Cincinnati and Toledo.

DAYTON, OHIO.—It is reported here that the deal for the consolidation of the Dayton & Xenia Traction Company and the Dayton & Xenia Rapid Transit Company will be closed within a few days.

CHARLOTTE, N. C.—A corps of civil engineers of the Cape Fear Electric Power Company has left for Buckhorn Falls. The survey necessary to the construction of the proposed dam will be made.

DAYTON, OHIO.—The Dayton & Northern Traction Company has filed a mortgage for $450,000 to the Central Trust Company of New York. The money derived will be utilized in completing the road.

CINCINNATI, OHIO.—Right of way has been granted the Cincinnati & Northwestern Railway. This will open up direct connection with the roads coming into the city through the Millcreek Valley.

TOLEDO, OHIO.—The Southern Railway Company has been asked to consider a lease on the 14-mile railroad connecting Georgetown, Midway and Versailles. The projectors want to utilize the right of way for an electric road.

KAUKAUNA, WIS.—The Fox River Valley Electric Interurban Railway Company has decided to build its line to Kaukauna city limits during the coming summer, without waiting for any further action of the City Council.

CHARLOTTE, N. C.—The directors of the Durham,(N. C.) Traction Company have approved plans for their new power house. The work of laying the tracks will be started as soon as the material ordered can be supplied.

TORONTO, OHIO.—E. E. Francye and Samuel McAdoo, of this place, and W. M. Miller, of Steubenville, representing the Toronto Traction Company, have applied for a franchise for a line from Steubenville to Toronto, and in Toronto.

BUCYRUS, OHIO.—The county commissioners have granted F. D. Carpenter and S. N. Coe, of Cleveland, an electric railway franchise from Galion to Crestline. The road will be an extension of the Ohio Central Traction Company's line.

CLEVELAND, OHIO.—M. J. Mandelbaum & Company have sold $100,000 worth of treasury bonds of the Cleveland, Elyria & Western Railway to a local syndicate. The money obtained will be used in the construction of the new Norwalk branch.

CHIHUAHUA, MEX.—The street railway lines in Chihuahua are to be converted into electric lines. A handsome new bridge has just been built across the Rio Concho to connect the two parts of the city. The new electric railway will cross this bridge.

HUNTINGTON, IND.—A $500,000 mortgage has been filed here on the Fort Wayne & Southwestern Traction Company's property by the Merchants Loan & Trust Company and Leon T. Loehr, Chicago. It is to run thirty years and bears 5% interest.

WAUSAU, WIS.—Articles of incorporation for the Wisconsin River Valley Electric Railway Company have been filed. The incorporators are Thomas F. Frawley, C. T. Bundy and Roy P. Wilcox, of Eau Claire, who are acting for Eastern capitalists.

ELWOOD, IND.—Prominent business men of this city and of Richmond, are taking steps toward organizing a stock company to construct an electric railway to connect with the Union Traction Company's system at Anderson, and to run through to Richmond.

RICHMOND, IND.—Representatives of the Dayton & Northwestern Traction Company have reached an agreement with the county commissioners of this place on a franchise asked. The company is incorporated in Ohio, and will also be incorporated in Indiana.

RICHMOND, VA.—The Westhampton Park Railway Company, with an authorized capital of $300,000, has been chartered by R. A. Patterson, W. T. Armstead and others to operate an electric line in Richmond, Manchester and the County of Hampton.

BUCYRUS, OHIO.—The Buckeye Traction Company, which is projecting a line from Bucyrus to Norwalk, has secured a franchise in Crawford County and for much of the way through Huron and Ashland Counties. Construction work will start from here at once.

ALBANY, N. Y.—The Albany Common Council has authorized the sale of a franchise allowing the Schenectady Electric Railroad Company to lay tracks in Albany. The franchise is to be sold for not less than $2,500 cash and 1 per cent per annum of the gross receipts.

URBANA, OHIO.—The Dayton, Springfield & Urbana Railway Company has announced its intention of extending its line from this city north to Bellefontaine and Kenton during the coming summer. It is stated that eventually the road will be extended to Toledo.

CLEVELAND, OHIO.—It is reported in electric railway circles here that the Adams Express Company is backing the Everett Mahler syndicate in its efforts to make through traffic arrangements to Toledo and Detroit for the newly organized Lake Shore Electric Railway.

FOSTORIA, OHIO.—The Ohio Northwestern Railway Company has been incorporated by William D. Clark, J. M. Bever, Levi Harbaugh, John A. Bradner, W. B. Marks and H. E. Bradner. Temporary capital stock, $2,000. It will build a road from Fostoria to Mungen.

STEUBENVILLE, OHIO.—The county commissioners and the village council of Brilliant have granted franchises for the extension of the Steubenville, Mingo & Ohio Valley Traction Company's line from Mingo to Brilliant. A lighting franchise has also been granted in Brilliant.

WASHINGTON, D. C.—The Fairfax, Potomac & Washington Railway Company has been chartered with $25,000 capital and principal office at Fairfax, Va., to construct an electric railway from Fairfax to Washington, D. C. J. F. King, of Washington, D. C., and others are interested.

CLEVELAND, OHIO.—The directors of the Cleveland & Eastern Railway Company are planning to build an extension east from the present terminus at Middlefield. It is probable that the extension will go to Meadville, Pa. An appropriation of $500,000 has been made for the work.

CINCINNATI, OHIO.—The Cincinnati & Lebanon Traction Company has secured a perpetual double track franchise over the Reading Turnpike for its route to Lebanon, Ohio. This will connect by electric railway the towns of Sharon, Mason, South Lebanon, and Lebanon with Cincinnati.

LANSING, MICH.—Gov. Bliss has signed the bill amending the law permitting the consolidation of electric light, street railway and gas companies, and immediately articles of association of the Muskegon Street Railway, Electric Light & Gas Companies were filed with the secretary of State. Capital, $600,000.

THOROLD, ONT.—The Niagara District, Wellandport & Dunnsville Electric Railway Company is seeking incorporation to construct a line of electric railway from Niagara Falls through Thorold, Port Maitland and the townships of Pelham, Clinton, etc. Jos. Battle and W. M. German, M.P., are interested.

OTTAWA, ONT.—The Ottawa Electric Railway Company has purchased the necessary plant at a cost of $5,000, and will commence work early next month to cast and weld the joints on its various lines. The work will be carried on at night, about 100 joints being cast welded each night at an average cost of about $5 per joint.

CLEVELAND, OHIO.—The Cleveland City Railway Company and the Cleveland Electric Railway Company have paid their license fees of $10 for each car operated this year. The former company paid on 250 cars and the latter reported 85 combination cars, 243 closed cars, 178 open cars, a funeral car and a special car; total, 508.

INDIANAPOLIS, IND.—Benson Bidwell, who claimed to be the inventor of the overhead trolley system, and brought injunction proceedings against the Indianapolis Street Railway Company for infringement and for an accounting of the profits, failed to make good his claim and the suit has been dismissed by the Federal Court.

YOUNGSTOWN, OHIO.—The Girard & Lowellville Belt Line Railway Company, of Youngstown, capital stock $15,000; the Girard, Thorn Hill & Haselton Belt Line Railway Company, of Youngstown, capital stock $10,000, and the Manufacturers' Belt Line Railroad Company, of Youngstown, capital stock $10,000, have been incorporated.

STEUBENVILLE, OHIO.—The Steubenville & Pleasant Heights Traction Company, which was incorporated recently with $150,000, has organized with the following officers: C. H. Strubel, president; George N. Henry, vice-president; George Canfield, secretary; Emmett McKee, treasurer. The above, with J. H. McKee and J. H. Maxwell, are directors.

FINDLAY, OHIO.—R. Rosenstock, of Cleveland, promoter of the Findlay & Southeastern Electric Railway, which will run from Findlay to Delaware, states that all of the private right of way has been secured and that surveyors will commence their work at once. The road will be double track the entire distance and will be constructed with the most modern equipment.

CITY OF MEXICO, MEX.—The Federal District Railway Company, which operates the electric and mule car street railway lines in the City of Mexico and Puebla, Mex., has been reorganized in London and its name changed to the Electric Tramways, Ltd. Hon. C. S. Stanhope, now in London, has been elected president of the company, and Charles Clegg manager.

TOLEDO, OHIO.—The lines of the Toledo Traction Company narrowly escaped being tied up recently by the overflow of the Maumee River. Water reached almost to the boilers of the power house, and the fuel supply became exhausted. A shutdown was avoided by the city authorities permitting the company to violate a city ordinance and switch a car of coal over the city streets during the daytime.

FOSTORIA, OHIO.—W. D. Marks, president of the City Heat & Light Company, has made a proposition to the Pennsylvania Railway Company for the purchase of an abandoned right of way between this place and Mungen. It is the intention to build an electric railway, power for which will be furnished from the local plant. A new company will be incorporated under the title of the Ohio & Northwestern Electric Railway Company. Mr. Marks is backed by Eastern capitalists.

HAMILTON, OHIO.—W. G. Wagenhals, general manager of the Mill Creek Valley Railway Company, acting for the Elkins-Widener syndicate, which has recently leased the Cincinnati lines, has made a cash proposition for the purchase of the lines of the Hamilton & Lindenwald Electric Transit Company. The property is valued at about $200,000 and it is proposed to consolidate it with the new Mill Creek Valley road, now building into Cincinnati. The proposition will probably be accepted.

WHEELING, W. VA.—The stockholders of the Wheeling & Elm Grove Railway Company have presented a plan to amalgamate the Wheeling & Elm Grove Railway Company, the Suburban Electric Company, the Suburban Light & Water Company and the Wheeling Park Association, and to issue $1,250,000 in bonds, of which $500,000 is to be a reserve fund and $750,000 to be used to retire the stock and bonds of the several companies amalgamated. Consolidation and a bond issue have been authorized.

COLUMBUS, OHIO.—The Columbus, Grove City & Southwestern Railway Company has been incorporated with $250,000, and officers have been elected, as follows: A. C. Grant, president; A. E. Appleyard, vice-president; Emmett Tompkins, secretary; John G. Webb, treasurer, and H. A. Fisher, general manager. The above, with J. S. Harshman and G. B. Darnell, constitute the board of directors. The company is the reorganization of the Columbus & Grove City Railway Company and the absorption of several other projects. The line will be extended to Morgan Station, Mt. Sterling and Washington Court House.

THE AUTOMOBILE.

THE MOBILE COMPANY OF AMERICA has opened its San Francisco agency at 316 Post Street, where a large stock of vehicles is displayed.

AUTOMOBILES IN SAN FRANCISCO.—The season is opening very favorably for the owners of automobiles in San Francisco. Several Sunday "runs" have been made by members of the California Automobile Club, on one of which they invaded Golden Gate Park. The Park Commissioners have since made additional concessions and the vehicles are now admitted to certain portions of the inclosure. It is considered only a matter of a little time when all classes of automobiles will be admitted to all parts of the parks.

NEW YORK CITY.—Plans are well under way for an automobile stage line to run acros New York City via Sixty-sixth Street. It is intended to connect the Sixty-sixth Street station of the Ninth Avenue elevated line with the Sixty-seventh Street station of the Third Avenue line. The vehicles will run through Central Park on the Converse road, connecting Sixty-sixth Street east and west. It is proposed to run five stages, each holding nine persons, and driven by gasoline power. One of the regular calling stations of the line will be the new riding academy in Sixty-sixth Street, near Central Park West. The stages are now being built at Tarrytown, and, it is believed, will be in operation early in April. A five-cent fare across town is to be charged.

NEW INDUSTRIAL COMPANIES.

ALBANY, N. Y.—The Ravena Electric Company of Coeymans has been incorporated; capital, $10,000. Directors: Aldine Nodine and S. W. Mosber, Coeymans; Nathaniel Niles, Albany.

ALBANY, N. Y.—The Electro-Chemical Engraving Company of New York, capital $17,000, has been incorporated; directors: F. E. Switzer, Benjamin Woodruff and G. V. W. Switzer, New York City.

THE AMERICAN TRANSFORMER COMPANY, with principal office at 44 Elm Street, Newark, N. J., has been incorporated; capital, $25,000. Incorporators: W. L. Kimball, Edw. B. Hawkins and Alfred G. Brown.

AUGUSTA, GA.—A. Brill, J. K. Hair, Chas. F. McKenzie, H. C. Morrison and L. J. Schaul have incorporated the Brill Electric Company, with a capital stock of $10,000. It will carry on a general electric construction business.

DOVER, DEL.—The Magneto Electric Company of New York has been incorporated; capital $1,000,000. Incorporators: Louis E. Niles, Springfield, Ill.; William S. Van Brocklin, Amsterdam, N. Y.; William H. Rower, Jr., Troy, N. Y.

THE SECURITY CONDUIT COMPANY, capital $250,000, to manufacture conduits and electrical supplies, has been incorporated in New Jersey. Incorporators: George B. McGown, George W. McGown and Charles A. Boynton, all of Jersey City.

THE COLONIAL SUPPLY COMPANY has been organized at Portland, Maine, for the purpose of manufacturing electrical appliances, with $10,000 capital stock. The officers are: President, Walter E. Nichols of Portland, treasurer, A. Glendon Dyar of Portland.

THE STANDARD ELECTRICAL COMPANY, of Danville, Va., has been chartered with a capital stock of $5,000. The incorporators are James G. Penn, president; R. L. Dibrell, vice-president, and James M. Williams, secretary and treasurer. The company will conduct a general electrical engineering and contracting business.

LEGAL.

EDISON PHONOGRAPH.—The application for a receiver for the Edison United Phonograph Company, which was made by the United States Phonograph Company, has been dismissed by Vice-Chancellor Stevens, of New Jersey, upon payment of the judgment held by the applicants and the costs of the application. The dismissal of the application was resisted by the Edison Phonograph Works, which will file an independent bill.

OBITUARY.

MR. EMILE M. SHAPE, for many years chief operator of the Western Union Telegraph Company in Milwaukee, died suddenly last week from pneumonia. He was one of the oldest and best-known telegraphers in the United States, having been attached to Gen. Grant's staff during the Civil War.

MR. LEANDER D. PARKER, for 18 years general superintendent of the Postal Telegraph Company of Chicago, died at his home in Evanston, Ill., last week. He resigned his position with the Postal Telegraph Company the first of the year owing to ill-health. He entered the telegraph service in 1855, and for the first three years of the Civil War served as a military operator. He was born in Canada in 1837.

PERSONAL.

MR. CONWAY ROBINSON is no longer connected with the Lea Electric Manufacturing Company.

MR. HANS W. BEATTIE has ceased to be treasurer of the Metropolitan Street Railway Company of New York.

MR. C. H. DUELL has resigned as United States Commissioner of Patents and will resume patent practice, it is said.

MR. R. I. TODD, formerly in charge of the Pittsburg Traction lines, has assumed the management of the operating department of the Cincinnati Traction Company.

MR. E. S. MANSFIELD, of the Edison Electric Illuminating Company of Boston, was a visitor in New York this week in connection with affairs of that progressive corporation.

MR. EDWARD WESTON, who recently caught a burgular in his room at the Waldorf, has now succeeded in trapping a blackmail confidence man there, who is now in the hands of the police.

MR. AUGUST H. KRUESI announces the approaching marriage of his sister, Miss Emily Margaret Kruesi, to Mr. Wayne Ramsay Brown, on April 9, at the First Reformed Church, Schenectady, N. Y.

MR. WARD BARNUM, formerly with the Arnold Electric Power Station Company of Chicago, has been appointed superintendent of the new Union Heat, Light and Power Company of Covington, Ky. They have under consideration an entirely new plant.

MR. F. H. NALDER, the English electrical instrument manufacturer, and Mr. P. A. Ransom, a gearing manufacturer, have arrived here and will spend two or three weeks making a tour around Canada and the United States, where they have many friends.

MR. JACOB L. GREATSINGER, a western railroad man, has been elected president of the Brooklyn Rapid Transit system in the place of Mr. C. L. Rossiter, resigned, and handsomely remembered by the board of directors. The new incumbent has a favorable record.

PROF. GEO. F. SEVER, superintendent of electrical exhibits at the Pan-American Exposition, Buffalo, has issued an admirably illustrated brochure in regard to his part of the work on that great enterprise. The pamphlet is in fact a summary of recent electrical development.

MR. A. A. KNUDSON has issued in pamphlet form his very interesting paper upon the "Cause and Effect of Electrolytic Action Upon Underground Piping Systems," read and discussed before the New England Water Works Association last December. It is quite freely illustrated.

MR. EDWARD K. GILLETTE has assumed charge of the Cincinnati office of the Stirling Company of Chicago, vice Mr. Isidor Raub, resigned. Mr. Gillette was for eleven years identified with the General Electric Company, but has been more recently the Pittsburg sales agent of the Stirling Company.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company of New York, has a striking article on the opportunities for young men in the new business order, in the *Saturday Evening Post*. While he does not decry college education, Mr. Vreeland insists that it is by no means all. It is the man's own work and high aim that count.

MR. JOHN KILGOUR, president of the Cincinnati Street Railway Company, has been elected president and general manager of the City & Suburban Telegraph Association, which operates exchanges in Cincinnati and Hamilton. He succeeds the late George N. Stone. W. A. Blanchard succeeds Mr. Stone as director, and Mr. Kilgour as treasurer.

MR. N. C. COTABISH, the sales manager of the National Carbon Company, Cleveland, Ohio, informs us that the recent reports of the fire at their works were greatly exaggerated by the daily papers. The fire has not in any way interfered with the filling of orders, and the works were not shut down for a single hour.

PROF. S. W. STRATTON, of the physics department of the University of Chicago, returned to that city and announced that in view of the fact that he had been appointed director of the new Standardizing Bureau at Washington he would resign his professorship. His resignation will take effect either in April or July. He will go to Europe, where he will study systems of weights and measures in France, Germany, England and Austria.

MR. NIKOLA TESLA has, it is stated, ordered from the Westinghouse Company some apparatus to be used in his Atlantic Ocean wireless telegraph. Mr. Tesla states that the success of his latest enterprise is more assured now than ever before, and within the next six months his invention will be given a practical test. He hopes to prove that it is not beyond the range of possibility to establish communication across the ocean without the aid of wires.

MR. G. W. ALDRIDGE.—An announcement is made that George W. Aldridge has closed a contract with the Citizens Light and Power Company of Rochester, N. Y., and taken a considerable financial interest in the corporation, and the understanding is that he will act as general manager, not only of the Rochester concern, but of a number of other lighting corporations under the control of the Young-Brady syndicate. It is understood that the salary to be received by Mr. Aldridge will be $10,000 a year. The syndicate is headed by A. M. Young, of New York, and Anthony M. Brady, of Albany. Mr. Aldridge is well known in State politics and in canal work.

Mr. FRED J. ALLEN, of Auburn, N. Y., has been appointed by President McKinley United States Commissioner of Patents, to succeed Mr. Duell, resigned. A dispatch from Indianapolis of March 26 says: "About 20 of the dependent telephone companies of Indiana were represented at a meeting here to-day when a formal protest was adopted against the appointment of Fred. J. Allen, of Auburn, N. Y., as Commissioner of Patents. They claim he is interested in the Bell Company patents and is a director in one of the New York Bell companies. S. P. Sherin, of the Indianapolis company, presided over to-day's meeting. He stated that $75,000,000 is invested in independent plants, which must not be jeopardized in numerous patent cases arising before an interested Commissioner."

EDUCATIONAL.

PURDUE UNIVERSITY.—The annual inspection trip of the electrical engineering department of Purdue University, Lafayette, Ind., is scheduled to take place during the present week. The class will inspect the principal electrical plants in Chicago, the work covering four days from March 25 to March 28. The trip is being conducted by Prof. W. E. Goldsborough.

Trade Notes.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, has installed at different time nine Cross oil filters for the Republic Iron & Steel Company, Chicago.

THE ELECTRIC APPLIANCE COMPANY is selling agent for Richmondt electro-galvanized wire conduit tubing, and is now sending out advertising matter giving full information regarding it.

MR. A. R. SCHMIDT has opened a business of electrical contracting and repairing at 461 Broadway, Milwaukee, Wis. He was formerly superintendent of the Milwaukee Electric Railway & Light Company.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., reported the re-election of its officers, as follows: F. R. Bacon, president; F. L. Pierce, vice-president; H. H. Cutler, general manager; J. G. Hickcox, secretary and treasurer.

REMOVAL.—Messrs. Garrett, Miller & Company, electrical supply dealers and engineers and contractors, Wilmington, Del., announce the removal of their office, shops and warehouse to larger quarters at the corner of Fourth and Orange Streets, Wilmington.

THE FALK COMPANY, Milwaukee, Wis., reports a heavy increase of business. The company is planning to erect a large addition to its plant at once. The company's business abroad is showing a gratifying increase, the orders from England, France and Germany being large.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is sending out a circular showing various cuts of its apparatus which it is prepared to furnish to its customers who may desire to advertise these goods. The cuts are of desk, bracket and ceiling fans of all styles.

THE MECHANICAL APPLIANCE COMPANY, of Milwaukee, Wis., has been incorporated with a capital of $20,000. The company will engage in the manufacture of small power motors, heat regulating devices and special tools. It is probable that the motor business will receive the greatest attention.

"HIGH VOLT" LAMPS.—The Columbia Incandescent Lamp Company, St. Louis, Mo., is making lamps of 200 to 250 volts, for which some specially interesting claims are made. These lamps are called "high volt" by the company. The company will be glad to answer any inquiries regarding its product.

THE INSPECTORS IN AN ARC LAMP FACTORY.—With this title the General Electric Company has printed a neat and well-illustrated pamphlet in which the manufacture of an arc lamp is followed from inception to the finished and tested product. Every arc lamp user will find the little brochure both interesting and instructive.

THE ELKHART ELECTRIC COMPANY, Elkhart, Ind., was recently incorporated with a capital stock of $100,000. The incorporators are: Martin V. Beiger, Chas. H. Tenney, J. S. Dodge, Chas. Hewitt and James Dushane. The former announcement of this company's incorporation gave its headquarters as Goshen, Ind., which was an error.

THE AMERICAN BRIDGE COMPANY has secured the contract for the bridge over the South Shrewsbury River at Seabright, N. J. This contract includes furnishing cylinder piers and abutments, four deck plate girder spans, and one draw span 220 feet long. The bridge will have a thirty-foot roadway and two seven-foot sidewalks. The contract is with Monmouth County, N. J.

MACHINERY PAINTS.—Messrs. Chas. H. Besly & Company, Chicago, Ill., are the Western representatives of the Pecora machinery paints, and carry a complete stock of these goods. Attention is called to Pecora blow hole cement, which is stated to be something new. This cement will stand under the planer, lathe, file and other finishing operations. It stands 200 degs. of heat and is gas and air tight. Samples will be sent on application.

BANQUETTING FIREMEN.—In appreciation of their services in saving the plant of the Lea Electric Manufacturing Company, of Elwood, Ind., from destruction by fire on March 15, Jacob Loomis, president of the company, gave the firemen an elaborate banquet on March 18. The affair came in the nature of a surprise, the department being summoned to the café expecting to find a fire. Instead, an elaborate menu was in readiness to occupy their attention.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, Newark, N. J., has just issued three new bulletins descriptive of the different types of lamps made by it. Bulletin 114 C relates to the company's series alternating-current enclosed arc lamp; bulletin 15 A describes its multiple direct-current lamp, and bulletin 13 A the multiple alternating-current enclosed arc lamp. The different styles of these lamps are illustrated, together with views of the constituent parts.

NEW YORK CENTRAL BRIDGES.—According to F. L. Chase, bridge engineer for the New York Central Railroad, that road expended last year nearly $2,000,000 for bridge work, and this year will expend an equal amount. A few days ago the company asked for bids on 28,000 tons of steel work, comprising several hundred spans. This is the largest single contract for bridge material ever let by any railroad company in the United States, and the contract for the whole lot was awarded to the American Bridge Company.

WATER TUBE BOILERS.—The Cincinnati office of the Stirling Company has just closed a contract with the Wellman-Seaver Engineering Company of Cleveland, for 1500-hp. water tube boilers, to be installed in the plant of the Lake Superior Power Company at Sault Ste. Marie. Another contract was for a 600-hp. water tube, to be installed in the plant of the Iroquois Portland Cement Company, at Caledonia, N. Y. The Champion Coated Paper Company of Hamilton has just purchased of the Stirling Company 3200-hp. water tube boilers.

MOTORS FOR AUTOMOBILES.—The De Dion-Bouton Motorette Company, Brooklyn, N. Y., announces that its 1¾-hp. De Dion air-cooled motor is particularly adapted to the requirements of motor bicycle manufacturers. It weighs only 45 lbs., and its average speed is 1,800 to 2,200 r. p. m. The 2½-hp. motor is suitable for tricycles, quadricycles, racing bicycles or motor tandems. When fitted to any one of these types of machines, it does not overheat under full load or speed. The average speed of this motor is from 1500 to 1800 r. p. m.

HYLO BABY FILAMENT LAMPS.—The Central Electric Company, of Chicago, is sales agent for the new incandescent lamp called the "Hylo Baby Filament Lamp." It has two distinct filaments, one giving 1 candle-power and the other 16 candle-power. Changing the light from 1 to 16 candle-power, or vice versa, is done by slightly turning the lamp in the socket. This does not introduce a resistance, but the changing mechanism is a part of the lamp and does not require a special socket. They are made in Edison, T. H. and S. M. base, and for from 50 to 125 volts.

"ABOUT A STREET RAILWAY COMPANY."—The foregoing is the title of a little pamphlet issued by the Garton-Daniels Company, Keokuk, Ia. The story, in brief, gives the experience of a certain street railway company in Chicago with Garton lightning arresters. The Garton Company reports that its February business in arresters was double that of any previous February in the history of the concern, and that the March business gives indications of the same rate of increase. Many of the orders are coming from Central America for large electric railways being built there.

AUTOMATIC LUBRICATION.—Mr. H. H. Humphreys, of St. Louis, consulting engineer for the Anheuser-Busch Brewing Association, has specified the "Siegrist System" of automatic lubrication for its new electric light plant. The Memphis Light and Power Co., of Memphis, Tenn., has also specified the "Siegrist system" for its entire station. On account of its increasing business, the Siegrist Lubricator Company has purchased the property at the northeast corner of Second and Vine Streets. A four-story brick structure to cover the entire lot is to be erected, and will be used as a factory for the manufacture of lubricators.

ELECTRIC LOCOMOTIVES FOR MINE HAULAGE.—A recent publication of the Westinghouse Electric & Manufacturing Company is a handsome pamphlet descriptive of electric locomotives for mine haulage. The illustrations consist of excellent half tones showing many styles of mining locomotives, in every case engraved from photographs of equipments supplied to mining companies. The type of motor used with the locomotives is illustrated in complete detail. An instructive feature of the catalogue consists of some pages of engravings showing every part of a locomotive, both mechanical and electrical, and including the slightest details.

PIERSON GAS PRODUCER.—We have received from J. & O. G. Pierson, 54 Faubourg Montmartre, Paris, several pamphlets relating to the Pierson method of gas production for power purposes. One of the pamphlets consists of a report of the well-known authority, Prof. Aime Witz, on a gas engine plant installed to operate a street railway line at Cassell, near Dunkerque, France. A test showed that the consumption of coal per kilowatt-hour was but a little over a kilogramme, or about two and one quarter pounds. The Pierson "Gazogene" system is for the production of poor gas, or what is known here as "water gas." A motto carried on the pamphlets is, "Poor gas enriches those who use it."

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 19, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

669,999. ELECTRIC SIGNALING APPARATUS; A. Mensing, Berlin, Germany. App. filed May 25, 1900. A circuit closer comprising an air and water-tight casing and a movable circuit terminal adapted to be moved to close the circuit by a jar or blow on the outside of the casing.

670,006. ELECTRIC EXERCISING MACHINE; N. H. Raymond, Buffalo, N. Y. App. filed Aug. 14, 1900. An elastic cord fitted with handles passes over the pulley on the armature shaft of a magnetic machine; the current generated in the exercising movement passes through the body.

670,022. INTERCOMMUNICATING TELEPHONE SYSTEM; N. H. Holland, Brookline, Mass. App. filed Nov. 12, 1900. In an intercommunicating telephone system, a signal sending circuit at each instrument provided with a selective controlling device; a signal receiving circuit at each instrument independent of said signal sending circuit; and means independent of said selective controlling device for closing either of said circuits.

670,024. PROCESS OF MAKING ACTIVE MATERIAL FOR ACCUMULATOR-PLATES; E. W. Junger, Stockholm, Sweden. App. filed May 12, 1900. (See current News and Notes.)

670,026. ELECTRIC CIGAR LIGHTER; A. B. Kittson, Boston, Mass. App. filed Oct. 24, 1900. A flattened coil of fine platinum wire is protected by a sheet of mica, through which the heat is transmitted to the cigar.

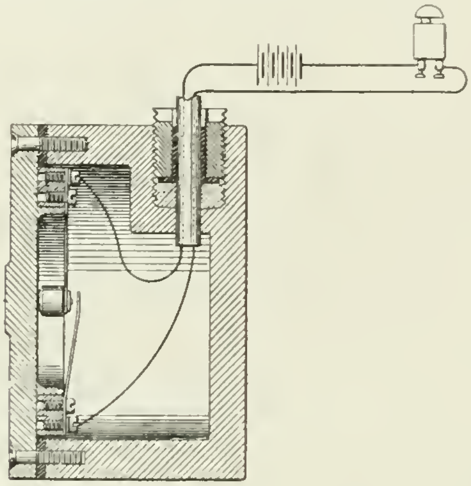
670,059. COMMUTATOR BRUSH HOLDER; W. D. Pomeroy, Akron, Ohio. App. filed Sept. 22, 1900. Details.

670,119. BRUSH HOLDER FOR ELECTRIC MACHINES; J. Trier, Chicago, Ill. App. filed April 26. 1900. A construction whereby the inspection of the brushes is rendered easy.

670,142. ELECTROLYTIC CURRENT INTERRUPTER; Arthur Wehnelt, of Charlottenburg, Germany. App. filed May 16, 1899. (See page 515 of this issue.)

670,145. ELECTRIC SWITCH; W. F. Bossert, Utica, N. Y. App. filed June 7, 1900. The switch blade consists of two plates spaced apart which are adapted to pass over the outside of a spring clip.

670,149. TIME SWITCH FOR ELECTRIC CIRCUITS; E. I. Dodds, Avalon, Pa. App. filed Sept. 9, 1899. This switch is made on the principle of the hour glass; the moving material being mercury instead of sand, and the circuits being complete as long as the mercury is flowing.



669,999. -Electric Signaling Apparatus.

670,172. ELECTRIC WATER HEATER; W. F. Follett, New Haven, Conn. App. filed Dec. 10, 1900. An arrangement of pipes for circulation of the water, the heating resistance being disposed around the pipes in a manner to protect them.

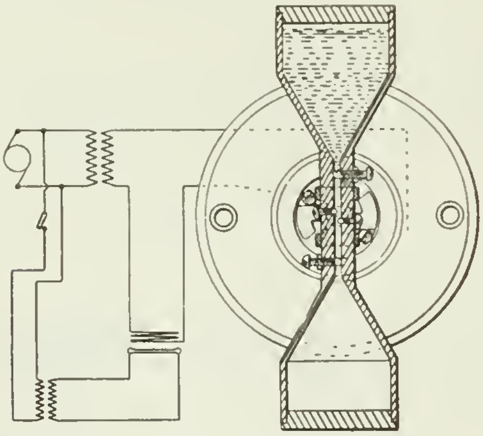
670,174. AMMETER; G. Grabosch, Berlin, Germany. App. filed Oct. 12, 1900. (See Current News and Notes.)

670,201. PROCESS OF PRODUCING ZINC OXID AND NITRITES; Edwin D. Kendall, Brooklyn, N. Y. App. filed Oct. 11, 1900. An electrolyte consisting of an aqueous solution of a nitrite or nitrites is subjected to the action of an electrolytic current passing between an anode formed of zinc and a cathode of carbon, or a suitable metal which sufficiently resists the destructive action of the electrolyte.

670,202. APPARATUS FOR CONTROLLING THE MOTION OF ELECTRIC SWITCHES; W. Kingsland, London, Eng. App. filed Aug. 9, 1900. A brake device to prevent the over movement of a switch element whose stroke is produced by a tappet.

670,203. APPARATUS FOR CONTROLLING THE MOTION OF ELECTRICAL SWITCHES; W. Kingsland, London, Eng. App. filed Aug. 9, 1900. A modification of the preceding.

670,204. APPARATUS FOR CONTROLLING THE MOTION OF ELECTRICAL SWITCHES; W. Kingsland, London, Eng. App. filed Aug. 9, 1900. A still further modification.



670,149.—Time Switch for Electric Circuits.

670,252. IGNITING DEVICE; E. Schmidt, Wilmersdorf, Germany. App. filed Jan. 19, 1900. A form of gas lighter in which a weight is employed to assist in turning on the gas.

670,274. SWITCH FOR SUSPENDED ELECTRIC CONDUCTORS; J. Floyd, Washington, D. C. App. filed Feb. 2, 1900. The switch is for an over running trolley, and is formed by branching and looping the wires themselves in a peculiar way.

670,278. REVERSING APPARATUS FOR ELECTRICAL DEVICES; R. J. Hughes & A. B. Shaw, Duquesne, Pa. App. filed Oct. 13, 1900. An electromagnetic device for automatically reversing a dynamo by changing the direction of current in the leads to its field magnet or armature.

670,316. INCANDESCENT LAMP; R. A. Fessenden, Allegheny, Pa. App. filed Nov. 27, 1900. (See Current News and Notes.)

670,319. UNDERGROUND CURRENT SUPPLY FOR ELECTRIC RAILWAYS; H. T. Hillischer, Vienna, Austria-Hungary. App. filed Oct. 26, 1900. Details for the ready removal of the cover of the contact box.

670,350. ELECTRO-ENDOSMOTICALLY FREEING MATERIALS FROM FLUIDS; Botho Schwerin, Munich, Germany. App. filed July 26, 1900. The process is based upon the fact that when an electric current passes through a liquid the molecules of the latter are caused to travel from the positive electrode to the negative one, where the liquid accumulates. The material to be treated is brought into contact with the positive and negative electrodes by placing it between the same; electric current is passed through the mass by means of the electrodes and the fluid is allowed to discharge at the negative electrode. The material is preferably operated upon in the state of a pulp, sludge, mud or slime.

670,351. APPARATUS FOR ELECTRO-ENDOSMOTICALLY FREEING MATERIALS FROM FLUIDS; Botho Schwerin, Munich, Germany. App. filed July 26, 1900. There are two cylinders one within the other, the inner one constituting the positive and the outer the negative electrode. The outer cylinder is constructed of wire and gauze with an external covering of canvas. Materials such as peat pulp to be freed of moisture, are fed between the two cylindrical electrodes by means of a rotating spiral working in the annular space, which causes the material during its passage through the apparatus to pass repeatedly from the outer to the inner electrode, thus preventing too dry a layer of material from forming in front of the positive electrode.

670,363. ELECTRICAL COUPLING OR TERMINAL; W. Walker, Jr., Birmingham, Eng. App. filed Sept. 15, 1900. The end of the conductor goes into the split end of a plug, the plug being conical and screw threaded externally, and adapted to receive a cup which screws over to bind the end of the wire.

670,375. CONTACT SHOE LIFTING APPARATUS FOR ELECTRIC CARS; J. S. Morrison, Richmond Hill, N. Y. App. filed April 20, 1900. Mechanical devices whereby the shoe can be lifted from the car platform by means of a lever.

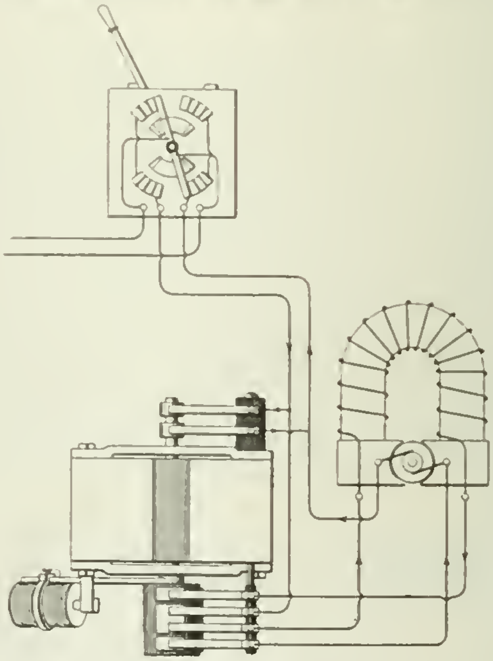
670,376. EXTENSION PLUG; P. H. Quinn, Pasadena, Cal. App. filed June 11, 1900. The plug is arranged so that when it is screwed into the socket the wire is not twisted.

670,380. CURRENT INTERRUPTER IN CONDUCTING RAIL CONTACT SYSTEMS; J. F. Bjurland, Richmond Hill, N. Y. App. filed Sept. 26, 1900. Mechanical apparatus for lifting the shoe out of contact with the third rail.

670,382. TROLLEY WHEEL; J. Caldwell, Providence, R. I. App. filed June 9, 1899. Inside of the hub and around the axle are placed two reversely wound coil springs, which feed the lubricant along the axle.

670,384. TROLLEY ROPE HOLDER; J. W. Clayton, Denver Colo. App. filed Nov. 1, 1900. A spring catch placed upon the hood of the car for holding the rope.

670,408. SIGNALING APPARATUS FOR TELEPHONE STATIONS; T. W. Loaring, Cleveland, Ohio. App. filed Oct. 27, 1900. Details.



670,278.—Reversing Apparatus for Electrical Devices.

The following patents, issued March 5, were delayed in being forwarded by the Patent Office:

669,233. ELECTRIC IGNITER FOR EXPLOSIVE ENGINES; Wm. F. Davis, Milwaukee, Wis. App. filed Jan. 2, 1900. Relates to mechanism for suddenly separating sparking electrodes within the gas chamber.

669,429. COIN-CONTROLLED ELECTRIC CIRCUIT CLOSER; Wm. Howard Paine, Providence, R. I. App. filed March 14, 1900. A normally open circuit including a motor, means for closing the circuit governed by a mechanism in connection with the motor, and a coin-controlled mechanism for primarily releasing a member of the circuit closer. The circuit may be closed for a period of time and automatically opened when the work of the automatically operated mechanism is completed.

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American Export Trade.

The figures revealed by the reports of trade for the two-thirds of the fiscal year up to the end of February, show that the excess of exports over imports continues upon the same remarkable scale that has characterized our international commerce of the past two or three years. For the eight months of 1900-1 the exports reached a total of slightly over $1,000,000,000, giving an excess over imports of $491,000,000. In the corresponding period of 1899-1900 the exports were slightly over $900,000,000, showing an excess over imports of $364,000,000. It will be admitted that these are extraordinary figures, for large as our export trade was, it again shows an increase, and disproportionate as the relation between exports and imports appears to be, it is seen that the exports are nearly one-third greater as to excess than they were in the previous period. It is hard to find fault with such figures, but at the same time it would have been more satisfactory had the increase consisted in manufactures rather than, as they do, in products of agriculture. As a matter of fact, manufactures have declined slightly from a percentage of 29.68 per cent to 27.03 per cent. Still, this might have been expected in view of the troubled relations in China, where our trade has sadly shriveled up, and also to the continued industrial weakness in such disturbed regions as South Africa, Cuba and the Philippines.

In another column this week a somewhat closer analysis will be found of the figures which relate more specifically to manufactures of iron and steel and metals in general. It is there that the statistics of electrical and mechanical export will be found, and it will be noted that the appreciation of electrical apparatus of American make throughout the world shows no signs of falling off. On the contrary, it must be said to be growing in an encouraging manner, to which perhaps the efforts of this journal and the activity manifested by progressive electrical manufacturers, are contributing in some degree. In this connection we can only repeat our regrets that owing to a dispute over the sugar tariff, this country should have got into a commercial deadlock with Russia so that the hopeful prospects of electrical exports to that great section of the globe are seriously overloaded. The increases in duty are apparently enormous, the rise being, it would seem according to the copy of the new tariff recently forwarded, from 72.01 cents per pood to $1.313 and 30 per cent, on motors, engines and dynamos. Having ourselves in this country inflicted heavy duties of corresponding amount on the poor foreigner, we begin to see how it feels when the tables are turned. In respect to this dispute, as in regard to other branches of the trade, readjustment seems to be required, and it can only be once more pointed out that the most prosperous trade is that which rests on the broadest reciprocal basis.

The Edison Storage Battery.

In view of the deep effect that previous inventions and improvements made by Mr. Edison have had on the arts, the excitement aroused by the report that he is about to launch a new storage battery of lesser weight for equipment work and of minimized depreciation, is quite justified. We are glad, therefore, to be able to present our readers with an account that they are likely to find very interesting, of some of his latest work in this field. The patents that Mr. Edison has taken out abroad indicate the lines along which he has been working, in the production of a copper-cadmium cell, although it may be stated that the mere description in the patent does not wholly describe the most recent developments, Mr. Edison having been busy on improvements up to the very moment at which this note is written. It is understood that Dr. Kennelly is to give the Institute a paper on the subject, and in the meantime Mr. Edison expects to have the battery at the Institute conversazione next week. Considering the need of further modifications in the modern storage battery for purposes not yet brought within its range, it is to be devoutly hoped that Mr. Edison has now added another to his long list of triumphs, by success in a field which he himself has chosen for a long time deliberately to neglect.

THE INSTITUTE CONVERSAZIONE.

The plans which are now ripening fast for the conversazione of the Institute of Electrical Engineers, to be held at Columbia University on April 12, promise an affair of unusual interest and importance, as may be seen from the still incomplete list of important exhibits, given in our pages this week. Such an affair is rather novel here, but tempted by the brilliant example in this direction noted by them in England, France and elsewhere in Europe last year, the officers of the Institute believe that they can make it a grand success, stimulating alike to the science and the society. We commend the effort most heartily to the support of all the members, and advise them by active participation to make it an occasion long to be remembered for the pleasure and instruction enjoyed. Columbia itself is alone well worth the visit, with its fine electrical, mechanical and chemical laboratories and museums, while the special exhibits will represent the very last results in investigation and application.

IRRIGATION PUMPING IN CALIFORNIA.

The use of electric transmission and distribution for supplying power to irrigating well pumps in California is believed by many acquainted with the conditions to be one of the most important of the coming electrical developments in that State. The amount of electric power so used at the present time is by no means small, yet but a meagre portion of the available territory is being supplied with power for electric irrigation. A large number of small steam and gasoline engine pumping plants are now in use and the farmers are by no means loath to part with them if cheap electric power is available. There is also considerable territory that has not been irrigated at all, but which has a good underground water supply that can be reached by wells of moderate depth. Elsewhere in this issue one of the most notable applications of this kind, that at Bakersfield, Calif., is described. In this case both the farming and pumping are under the control of large corporations, and the best opportunity has therefore been afforded for testing of different types of apparatus and reducing all to a uniform, efficient standard. In other places power has been sold by the power companies to private farmers who put in any kind of pumping apparatus they chose. In some cases inefficient machinery has been used and the bills rendered from the meter readings have been so large that the power companies are wisely beginning to consider that unless they look after the machinery their customers install there is danger that the use of electricity for irrigation will get a black eye among farmers.

The centrifugal pump for use with the electric motor has reached a high state of perfection in California, a matter which should be a source of satisfaction to electrical engineers, for no other pump adapts itself so readily to use with the electric motor. It is in its present state efficient, noiseless, requires a minimum of repairs and can be direct connected to the motor shaft. The centrifugal pump was known of old as a low-head machine, but single pumps are now made for 100 ft. lift, while quadruple pumps for 400 ft. lift are now running, the four pumps being "connected in series" in the latter case. The efficiency of a centrifugal pump of the type used at Bakersfield when placed at water level was found to be 67 per cent. This is probably as high as any type of electrically-driven pump. It has the drawback that to secure maximum efficiency it must be placed at the water level so that there is no suction lift. In some cases this would not be practicable, but the use of a vertical shaft motor and pump makes it easy at Bakersfield. Besides irrigation there is another class of pumping work toward which electric power companies are looking, and that is in reclaiming marsh land along the Sacramento River. There are many square miles of such land along the Sacramento, and it is being surrounded by dykes and pumped dry to make farm land. Electric power has not been used in this work yet, but the large transmission plants that are now within reach of it are not likely to overlook it unless a better market for their complete output be found elsewhere.

Pumping of this kind makes a very desirable load, as it is constant night and day during the irrigating season. As a consequence, the companies' supplying electric power can and do make very low rates. In the neighborhood of Los Angeles, where there is the greatest amount of electric irrigation pumping, the rates are about 2 cents per kilowatt-hour. The main drawback to this work from the standpoint of the power companies is that it comes at a time of year when the water is lowest in the mountain streams and when they can get the minimum amount of power from their water-power plants.

ARC LIGHTING IN LONDON.

An article, which we reprinted in last week's issue, on the lighting of the Thames Embankment in London, has an interest rather from the insight which it gives of the radical difference between British and American methods in dealing with electrical development, than from bringing out any engineering details of importance. In the early history of electric lighting, the Thames Embankment figures prominently as having been the scene of the first extensive attempt at outdoor lighting, 20 Jablochkoff candles having been there installed as early as December, 1878. Eight years later the Government authorities came to the conclusion that the lighting was unsatisfactory, and gas lighting was resumed at a date when the arc light for street illumination was becoming firmly established in this country and was rapidly driving out the gas light. Though tenders for the continuation of electric lighting were applied for in 1884, nothing had been accomplished up to 1892, when another branch of the Government stepped in and took up the problem. The following year authority was obtained to erect a plant, which, however, was not finally put in operation until February of this year.

After all these years expended in considering the simple question of lighting a relatively small extent of river front, one would expect as a result the installation of a model plant in every respect. In point of fact, the plant just installed is of a type that would appear antiquated in this country. Though the enclosed arc lamp is rendering the open arc an anachronism with us, the latter is employed in the London plant. The arc machines are rope-driven, and are only of about half the capacity of standard American arc lighters. A combination of series and parallel lighting is used, in which the intrinsic merits of either system appear to be sacrificed. Altogether the installation is of a kind that might have been made in this country fifteen or more years ago, but certainly would not be considered at the present time.

MAGNETIC DISTURBANCES ACCOMPANYING THE TOTAL SOLAR ECLIPSE OF MAY 28, 1900.

In the December, 1900 (No. 4, Vol. V.), issue of *Terrestrial Magnetism and Atmospheric Electricity,* appears an interesting paper by Mr. L. A. Bauer, in charge of the Magnetic Department, United States Coast and Geodetic Survey. It seems that in advance of last year's total eclipse, arrangements were made by the Coast Survey to observe the horizontal component of the earth's magnetism, the magnetic declination, and also the temperature of the air, at three stations distributed along the belt of totality in Alabama, North Carolina and Virginia, as well as at three stations situated at some distance from the belt of totality. The instruments employed differed at the different locations, but the general method of observing was prescribed in advance.

On plotting the observations it was observed that there was a depression in temperature at each station accompanying the eclipse, but lagging somewhat behind it in time. This local fall of air temperature was, of course, to have been expected. Accompanying the temperature variation, however, it was found that there was at each station a small magnetic disturbance occurring not at the same moment of standard time, but associated at each station with the time of maximum obscuration of the sun's disk by the moon. The duration of the magnetic disturbance was apparently about the same as that of the eclipse, or about 2½ hours. The total range of the variation in declination was about one minute of arc, and the total range of the disturbance in horizontal intensity was about the one-three-thousandth part of the whole. The analysis of the disturbance seemed to show that the disturbing causes were external and not internal to the earth's crust, or were such as might be due to magnetic forces residing in the atmosphere, and the presumption seems to be that the origin of the disturbance was owing to the abstraction of the sun's rays from the atmosphere by the moon. The effect upon the needles of the observers seems in each case to have been such as might have been produced by a long, thin, straight, weak bar-magnet approximately coincident with the axis of the moon's shadow, and moving along with that axis over the surface of the earth, the lower end of this imaginery moving magnet being a south-seeking pole, or attracting the north-seeking poles of the observer's needles. It is stated that traces of this feeble magnetic disturbance accompanying the eclipse were felt as far from the line of totality as Toronto, Canada. The observations themselves are to be published in the appendix of the forthcoming Annual Report of the Coast and Geodetic Survey for 1899-1900.

The deduction is incidentally made from the observations that in order to render apparent variations of the order here considered, the automatically photographic recording magnetometers ought to be more sensitive and register over a wider scale. If the observations here considered had been made by standard magnetometers, instead of having been made by indicating instruments of considerable sensibility and recorded by skilled observers, the results here in question would have probably escaped observation. It is to be hoped that the next total solar eclipse which makes itself visible in the United States will be followed with many more magnetic instruments and observers than that of May 28, 1900. Fortunately, such observations do not entirely depend on fine weather for their conduction. If it is really true that the solar eclipse is accompanied by a feeble local magnetic disturbance of the earth the fact is of great importance in throwing light upon the nature of the earth's magnetism. Assuming that Prof. Bauer is right in his conclusions—and they certainly seem to be supported by many individual observations—then the general conclusion is suggested that the daily variation of the earth's magnetism is due to the effect of the sun's rays upon the atmosphere. This, indeed, has been the most recently prevailing theory; in fact, if the sun's rays incident upon the northern hemisphere seem to repel the north poles of suspended needles, as in the daily variation, then a shadow cone in these rays should appear to attract the said north poles as in these observations.

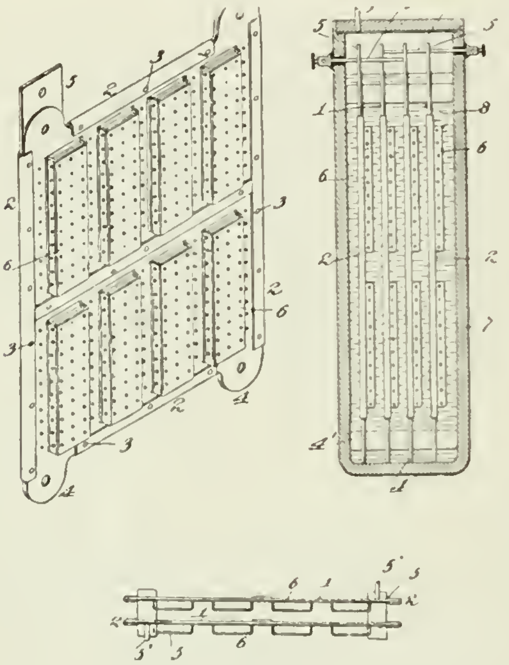
Bearing upon this general question is a paper by A. Nippoldt, in the September number of *Terrestrial Magnetism and Atmospheric Electricity,* on "The Present Status of the Theory of the Earth's Magnetism." A very interesting means due originally to Gauss is described, whereby such portion of the earth's magnetism over a given area as depends upon a potential, and upon the magnetization of the earth in the ordinary sense of the word, can be separated from whatever residuum must be due to electric currents, and which would be, therefore, devoid of a potential. If an area of country be mapped out following a contour along which the magnetic elements have been carefully observed and recorded, then in completing an imaginery circuitation, the line integral is computed of the magnetic force coincident with and around the closed contour. If this summation gives the result zero, then all of the magnetism within the contour is assignable to such causes as are accompanied by a magnetic potential; but if the summation leaves a positive or negative residuum, this indicates either an error in the process, or else a source of magnetism such as is not accompanied by a magnetic potential in the distribution, and such as a distribution of electric currents would effect. It seems that from the results of observations and calculations by this "curling" process, that the magnetic behavior of the earth is practically all attributable to a magnetic potential, if the variations or disturbances be eliminated. In other words, the permanent magnetism is such as is possessed by a permanent magnet. Superposed upon this permanent magnetism are the variations due to solar influences, and perhaps to other influences as yet untraced.

The permanent magnetism of the earth is, as we all know, far from being that of a homogeneously magnetized sphere of iron. If such a sphere were uniformly magnetized with respect to the axis of rotation, the magnetic potential at the surface should increase in proportion to the sine of the latitude; or, expressed in another way, it should increase with the distance from the earth's center of the perpendicular projection of the point of observation upon the magnetic axis. If the earth were so magnetized, the lines of equal intensity and equal dip would all be circles of latitude, and the agonic lines would all be meridians. An attempt has, however, been made to set up the hypothesis that the earth was uniformly magnetized with respect to a particular axis, and that upon this uniform magnetization there was superposed a separate distribution capable of bringing the total up to the observed distribution. Up to the present time, however, no very marked success seems to have been made in these calculations.

Edison's Work in Storage Batteries.

Considerable interest has been manifested in the announcement that Edison has been working on a new type of storage battery, but no definite information has been obtainable concerning the same. While the American patents have not yet been issued, an English patent has, however, been recently granted, an abstract of which has just appeared in a German paper. We, therefore, give below a nearly literal translation of this abstract, it being the only information which, up to the present time, is available in this country. We assume that the accumulator described therein is the one—or one among others—on which Mr. Edison is now working, as it answers to the description that it is not a lead accumulator, and that the chemical actions in it are quite different from those in the ordinary storage battery.

In some respects the German abstract is not very clear, but the general principles of the battery can be understood from the article. It seems to be fundamentally a modification of the familiar copper oxide alkaline accumulator, for which such great claims were made a dozen or more years ago, and one form of which was known in this country as the Waddell-Entz battery. One change seems to consist in having the copper more finely divided, and in the use of cadmium instead of zinc. The battery seems, apparently, to be identical with an accumulator described in a Swedish patent to Schmidt and Junger. There appears to be a misprint concerning the voltage, which is given as 44, but this is probably a misprint for 0.44, which would be a little more than a fifth of the voltage of the ordinary accumulator. This voltage corresponds approximately to that required by theory. If this is correct, it would, therefore, have to have five times the ampere-hour capacity per pound of cell to be the equivalent of the lead accumulator as to weight. Mr. Edison is understood to have said that he cuts the weight of the cell in two for equivalent work. Judging from the extract from the patent, great care is necessary to have the copper extremely finely divided, or otherwise it is claimed the copper will dissolve.



FIGS. 1, 2 AND 3.—EDISON'S STORAGE BATTERY.

The abstract, of which the following is a translation, is from the *Centralblatt fuer Accumulatoren und Elementenkunde.* The translation is as follows: The present accumulators are too heavy, because much solution is required. In this new storage battery the electrolyte remains unchanged, so that only a small quantity of it is required. As depolarizer, the lower oxide of copper is used; that is, the red oxide. In the older cells of this general type (referring presumably to the alkaline copper accumulator) soluble copper salt is said to be formed, which transfers copper to the zinc and thus produces rapid deterioration by local action. Efforts were made to prevent the circulation of this salt by surrounding the positive electrode with a porous material, but these experiments were unsuccessful because this material did not prevent the circulation entirely, and was destroyed gradually by the strong alkali; moreover, much liquid was required and the resistance of the cell was greatly increased. Edison has found that very finely divided copper forms copper oxide free from water and insoluble in alkaline lyes, whereas with the smallest particle of solid copper present or upon the pressing together of the finely divided copper, soluble hydroxide of copper is formed. Finely divided copper is artificially prepared, preferably by the reduction of the carbonate with hydrogen. As negative electrode, finely divided cadmium is used. This and the copper are in a tank of nickel or other metal, such as nickel plated iron.

Fig. 1 gives a perspective view of a plate, Fig. 2 a horizontal cross-section of a pair of plates, and Fig. 3 a vertical cross-section of a cell with two pairs of plates. The plate marked 1 is made of relatively thin sheet nickel. The lower parts of the plates are connected by insulating rods, 4, passed through the holes, 4. The pins, 5, in the holes, 5, in the upper parts of the plates are used for the electrical connection. On one side of the plates there are reservoirs or "pockets" marked, 6, for the electrode metals. These pockets are best made of perforated nickel sheets or nickel-plated sheets. The best method of cleaning the plates is to heat them in a closed compartmnt to a red heat, and then reduce the oxide by hydrogen. Cadmium in very finely divided, fibrous and very pure condition, is obtained by electrolysis of a week solution of cadmium sulphate between a thin platinum wire as cathode and a cadmium sheet as anode, using a strong current. The deposit of cadmium is removed from the cathode from time to time, and freed of the sulphate by washing with water. It is then filled into the "pockets."

Finely divided copper is obtained by the reduction of fine carbonate with hydrogen. The temperature must be kept as low as the completeness of the reduction allows, as otherwise the density of the copper is increased too much. The finely divided copper thus obtained is poured under slight pressure into thin blocks which fit the "pockets" accurately. To avoid an increase of the density of the copper in parts, the molds must not scratch or otherwise injure the plates. The plates are then heated in a closed compartment for 6 or 7 hours, to not more than 260 degs. (probably centigrade), until the copper is changed into the black cupric oxide. At higher temperatures the density is increased too much. The cupric oxide blocks are next reduced to metal electrolytically, and are then changed into the red cuprous oxide by charging. It would be possible to fill the finely divided copper first obtained, directly into the pockets; but as it is not fibrous like the cadmium, the connection between the particles is not close enough, so that it is not as good for the purpose as when treated in the way just described.

After the pockets have been filled and the plates of equal sign have been connected together, they are placed in a case, 7, which contains as electrolyte a 10 per cent solution of pure hydroxide of sodium. During the charging of the cell, cuprous oxide is formed and water is decomposed. During the discharge, cadmium oxide is formed and water is regenerated. As only a very small amount of liquid is required, it is sufficient to place thin sheets of asbestos or another light, powerful material which is not attacked by alkalies, between the plates and to moisten with the electrolyte. The internal resistance is very small. The materials are not attacked, and there is no local action between the cadmium and the nickel. The case, 7, may be made of nickel or other metal, for instance iron, the interior of which is nickel plated. The case may be sealed for liquids, the opening, 9, being required only for the gases which are formed when the cell is overcharged.

It may be added that not only has Mr. Edison stated that he would reduce the weight of the modern storage battery by one-half, but that he would reduce the depreciation to a tenth—to virtually nothing.

Automobile Show at Chicago Coliseum.

An automobile exhibition was held last week (March 23 to 30) in Chicago, as already noted, under the auspices of the *Motor Age.* The main floor of the Coliseum was well filled with the exhibits of automobile and cycle manufacturers, and a short track, gave opportunity for the exercise of vehicles. The largest electric exhibitors were the Woods Motor Vehicle Company, Chicago; Hewitt-Lindstrom Motor Company, Chicago; Electric Vehicle Company, New York; National Automobile & Electric Company, Indianapolis (Ralph Temple, Chicago, agent), and Sipe & Sigler, makers of the Willard Storage Battery Company, Cleveland. A. B. Holson, of Chicago, also had a two-wheel experimental rig and the Bachelle electric automobile was also present.

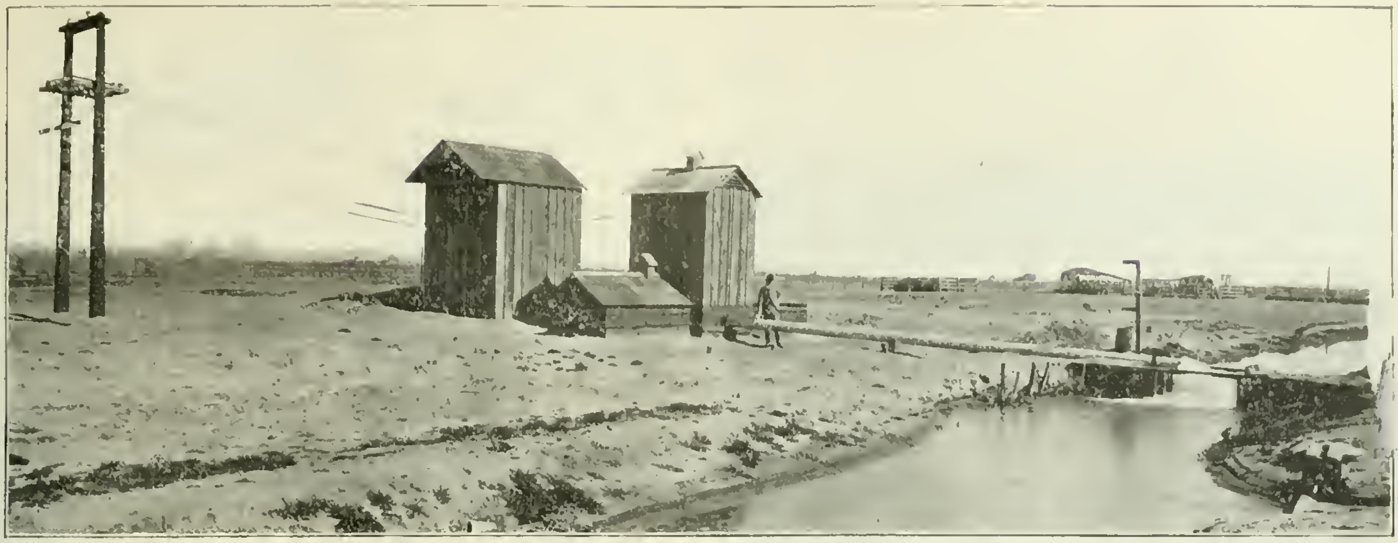


Fig. 1.—One of the Pumping Stations.

Electric Power for Irrigation Pumping at Bakersfield, California.

To many perhaps the most interesting electrical installation in the State of California is the one at Bakersfield for irrigation pumping because it is believed that this plant is the forerunner of a very great development along that line in California and elsewhere. Indeed, the Bakersfield plant, though the pioneer in its field, is not now alone, for other electric power companies in the State have followed its example in a limited way. The Bakersfield installation, however, is of the most interest, because the details have been more systematically and thoroughly worked out than in any other plant.

Bakersfield is located in the valley of the Kern River in Southern California. The climate is too dry to make farming practicable without irrigation. A great portion of the year there is no surface water flowing in the Kern River or its branches, as it is all taken off for irrigation soon after it comes down out of the mountains. This leaves the most of the valley without any water except what can be pumped. The valley is very broad and level, with mountain ranges on each side. The soil is fertile and only needs water to make it productive. It was found that while there was no water on the surface in the Kern River Valley there was a plentiful underground current which could be reached by wells 60 ft. deep. This is a condition that also prevails in many other places in California. By sinking wells so as to tap this underground flow a considerable area of country can be irrigated. The only problem is a cheap method of pumping. It is here that electric transmission and distribution steps in. At Bakersfield a company known as the Kern County Land Company owns a very large tract of land in the vicinity. The Power Development Company, of Bakersfield, of which C. N. Beal is secretary and the active spirit, and F. T. Whorff, superintendent, was organized by interests friendly to the land company for the purpose of developing the water-power of the Kern River in the mountains and transmitting it over the valley for pumping purposes and for light and power in Bakersfield. The Power Development Company sells power to the Kern County Land Company for pumping for irrigation.

The water-power plant in the cañon of the Kern River is 13 miles from the sub-station in Bakersfield. It has at present writing two 450-kw, three-phase, 500-volt, 60-cycle General Electric generators. One more unit is being put in. These are direct connected to Knight waterwheels, operating under a 200-ft. head. The efficiency of these wheels, as shown by a very careful set of weir measurements made by the company before the wheels were accepted, showed their efficiency to be 77.6 per cent at full load. While this is lower than waterwheel efficiency is generally supposed to be, it is well to mention in this connection that this figure is above the specifications drawn up by the company and that some impulse wheels previously installed failed to come up to the specifications. The governors on these waterwheels are the design of C. N. Beal, the secretary, and work on a new principle. Their working depends not only on the speed, but also on the load. That is, there is a dynamometer on the shaft between the water wheel and the generator. As the load comes on and the pull on the dynamometer increases the governor acts to turn on the water, thereby anticipating the decrease in speed which would follow the increase in load before an ordinary governor would act. In addition to the dynamometer feature of the governor there is also the usual method of governing dependent on the speed.

A new tunnel has just been finished to replace an old pipe line. With the completion of this tunnel there will be no more trouble from falling rocks, a common form of interruption with many water power plants. This tunnel is 8425 ft. long. It is smooth cement finish on bottom and sides, and has a capacity of 300 cubic feet of water per second, with a height of 5 ft. of water in the flume. Figs. 5, 6, 7 and 8 show the details of the concrete work. Fig. 10 shows the details of the sand-settling box at the end of the tunnel.

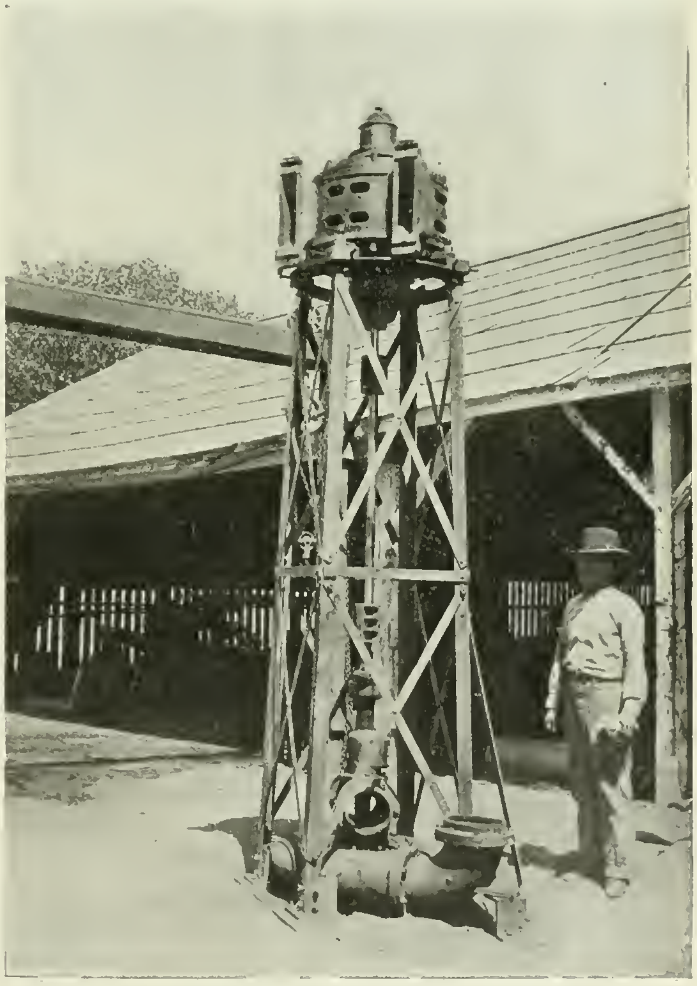


Fig. 2.—Motor and Pump Before Installation.

The power is all transmitted over two three-phase lines at 10,000 volts to the sub-station in Bakersfield, where part of it is transformed down for local lighting distribution in Bakersfield, and the rest is sent on at the original voltage for the use of the Kern County Land Company. No fuses are used at the power house or anywhere along the line until the sub-station is reached.

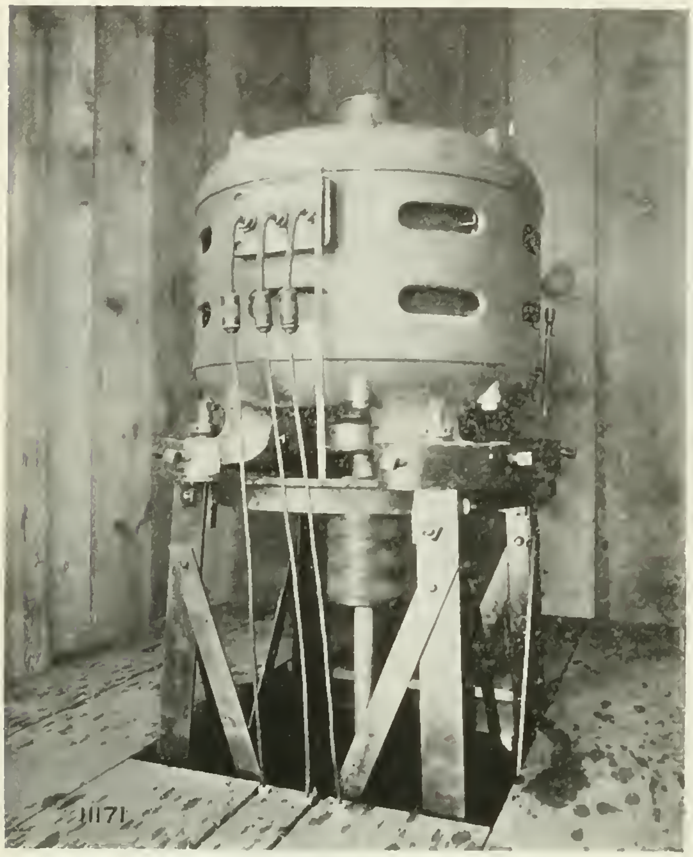


FIG. 3.—MOTOR IN PUMP HOUSE.

Fig. 11 is a diagram of a new transformer panel recently put in for the alternating-current side of a rotary converter, which runs a new electric road operating between Kern City and Bakersfield. Fig. 12 shows the construction of a generator panel now being installed. Fig. 9 is the main switchboard panel at the power house.

In addition to the local lighting and railway load the Power Development Company supplies current for pumping city water. This is done with centrifugal pumps, which pump directly from wells into the mains at 35 lbs. pressure, and lift water about 12 ft. with the suction. This kind of service is an eye opener to those not familiar with the development of the centrifugal pump. There are four pumping stations of this kind for city water at the present time, and two more are to be put in.

THE PUMPING AND IRRIGATION SYSTEM.

The transmission lines and pumping stations of the Kern County Land Company, to which the Power Development Company supplies power, are shown by the map (Fig. 4). These pumping stations are under the charge of A. J. Bowie, engineer of that department of the work. The transmission lines are only shown from the sub-station at Bakersfield, where the Land Company's jurisdiction begins. From the power house to the Bakersfield sub-station, 13 miles, the lines belong to the Power Development Company. The distribution for pumping is all at 10,000 volts. The numbered stations are the standard type of pumping station such as is described and illustrated hereafter. The others are some special applications as explained on the map. The regular type of irrigation pumping station consists of two step-down transformers, usually 15 kilowatts, reducing from 10,000 to 500 volts, an outdoor switch for cutting off the 10,000-volt supply and a 30 or 40-hp General Electric three-phase induction motor direct connected by a vertical shaft to a Byron Jackson centrifugal pump, 15 to 20 ft. below the surface of the ground.

The exterior appearance of one of these pumping stations is shown in Fig. 1. The outdoor switch for breaking the 10,000-volt circuit is shown at the extreme left in this picture. It is a double break affair, with the movable part pivoted in the middle, so that one end swings up and the other down. The moving part carries a 36-inch fuse of No. 28 copper wire enclosed in a hard-rubber tube. The switch is operated by ropes from the transformer house, so that it cannot be tampered with. The transformer house, which is the building at the left, the interior of which is shown in Fig. 11, has the two transformers, the motor starting compensator and the fuses and switch in the motor circuit. The secondary switches are being equipped with an automatic device, not shown, for cutting off current in case the suction should fail, due to the temporary stoppage of the pump by interruption of the current supply. These devices will work by virtue of the water pressure,

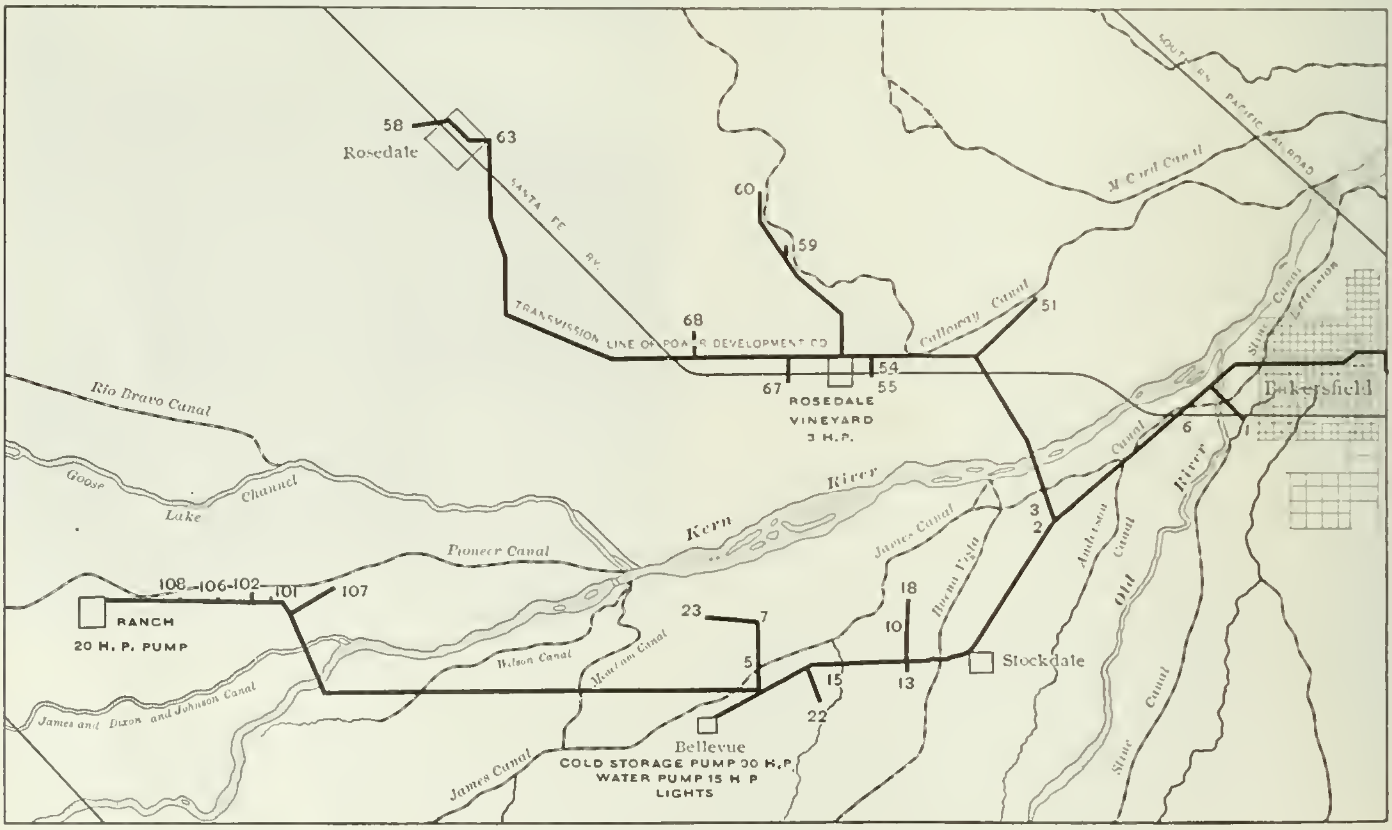
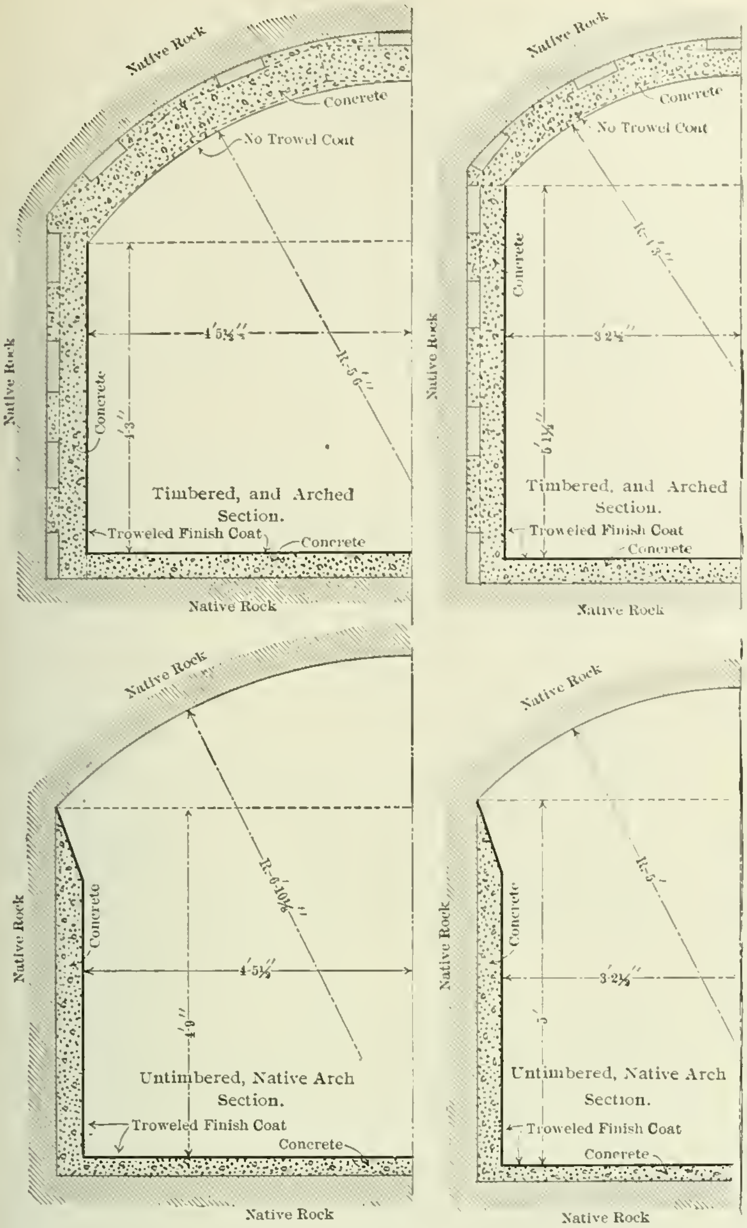


FIG. 4.—MAP OF PUMPING AND IRRIGATING SYSTEM.



FIGS. 5, 6, 7 AND 8.

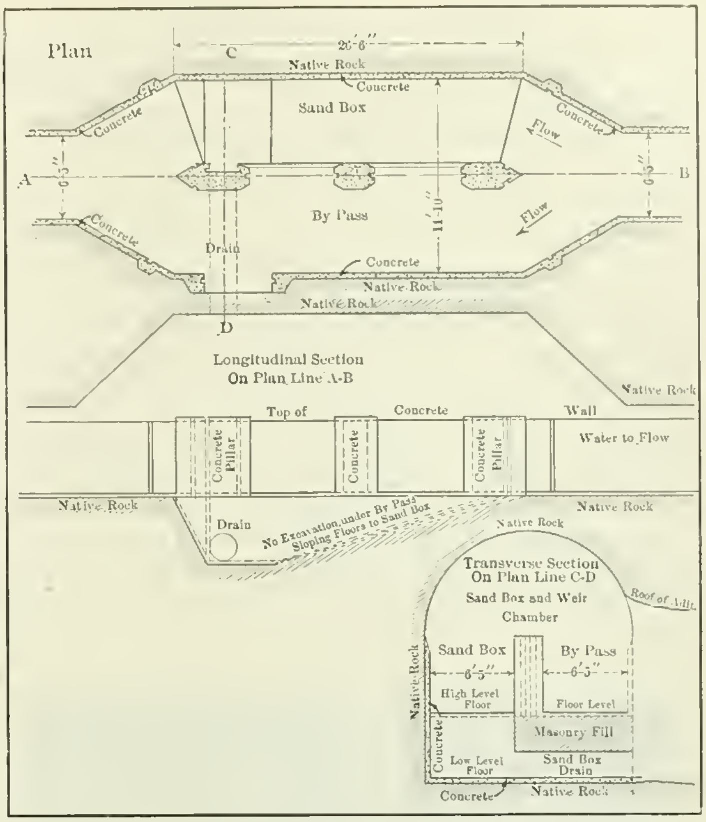


FIG. 10.

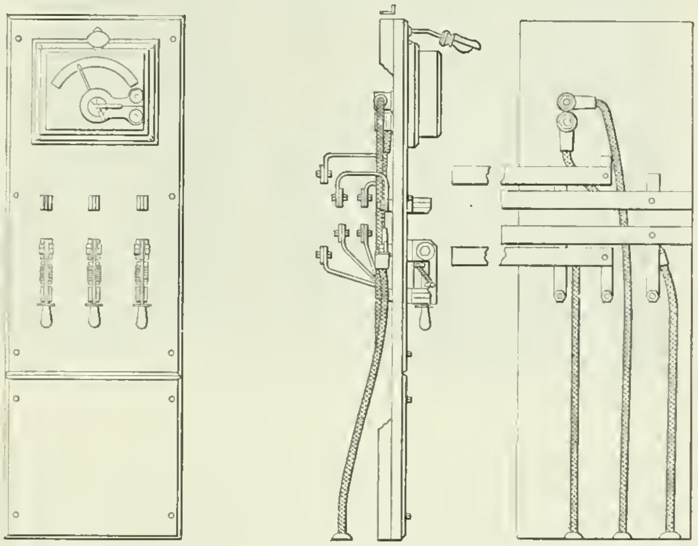


FIG. 11.

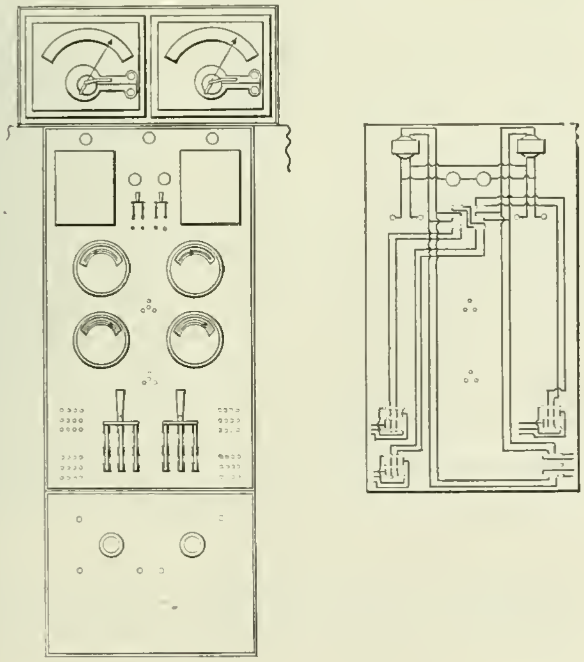


FIG. 9.

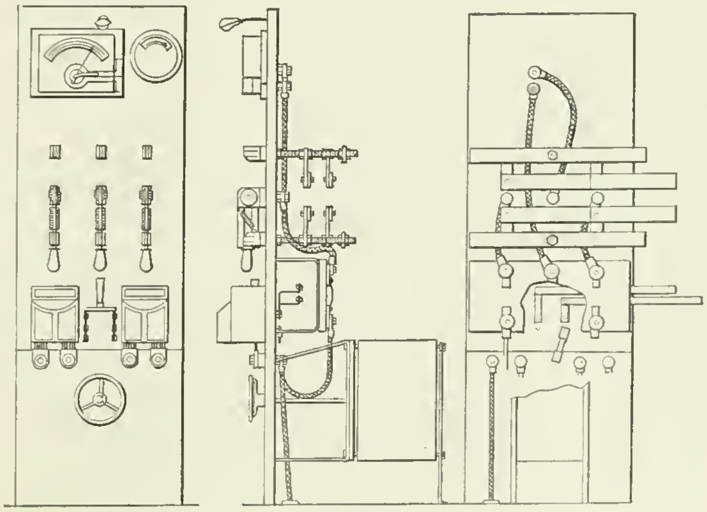


FIG. 12.

Figs. 5 to 12.—Details of Construction Work and of Switchboard Panels and Connections.

and if the water pressure supplied by the pump fails the switch will open. These pumps run many hours without attention, and while it is not desired that they run when the priming of the pump has failed, it is desired that they should not stop every time the voltage is dropped by a short circuit on the line as would be the case were a switch-opening device dependent on the current supply used.

The building at the right (Fig. 1) contains the motor and covers the pump pits. Four wells, about 60 ft. deep and 12 inches diameter, are sunk in a row about 12 ft. apart. A pit from 10 to 20 ft. deep is dug, so as to bring the pumps down as near to the water level as possible, because centrifugal pumps work much more efficiently when so placed. Fig. 2 illustrates the bottom of a pump showing the 8-inch galvanized steel suction pipe which connects the four wells to the pump, and the pump, framework and pressure pipe. The pump located in the pumphouse just above the pit is shown in Fig. 3, and a motor and pump mounted on an iron framework ready to be installed is shown in Fig. 2. The Kern County Land Company has done considerable testing and experimenting on the best form of pump for its purpose, and with the co-operation of the Byron Jackson Machine Works, of San Francisco, has settled upon the vertical shaft type illustrated as the best suited to its needs. As before noted, it is important to have a centrifugal pump down as near the water line as possible, for by so doing the best efficiency is obtained. With a direct-connected horizontal shaft pump the pump and motor must necessarily be placed above the high-water line when the pump is not running. As the water always falls a number of feet in the wells as soon as the pump starts, this means that a horizontal shaft pump must always work with considerable suction, and hence inefficiently. By using a vertical shaft pump so that the motor can be kept up out of the water the pump can be put right down to water level or even below, and can be worked at nearly its maximum efficiency. The tests made by engineers of this company some time ago showed the efficiency of a vertical shaft centrifugal pump under the most favorable conditions to be 67 per cent. The efficiency of the horizontal shaft pump under the most favorable conditions under which they could be worked in practice was 57 per cent. This type of vertical shaft pump has a number of very interesting and important points. The runner or wheel of the pump is a solid casting with ports instead of a wheel with vanes. The suction pipe enters at the top and the runner is so close to the bottom of the pump and so close fitting in the chamber in which it runs (although it does not touch) that when the pump is running the suction and pressure act to entirely take the weight of the shaft, runner and armature so that practically no weight comes on the thrust bearing. The thrust bearing is at the top of the shaft on the motor. The oiling devices for the bearings are very ingenious. The motor has a hollow shaft, and as the oil runs through the bearing into a receptacle below the motor, it is picked up by a scoop on the shaft and forced by virtue of the speed of the scoop up through the shaft and into the bearing again. The iron frame work of the motor-pump combination is braced firmly by timbers in the pit, and the pumps run with practically no vibration.

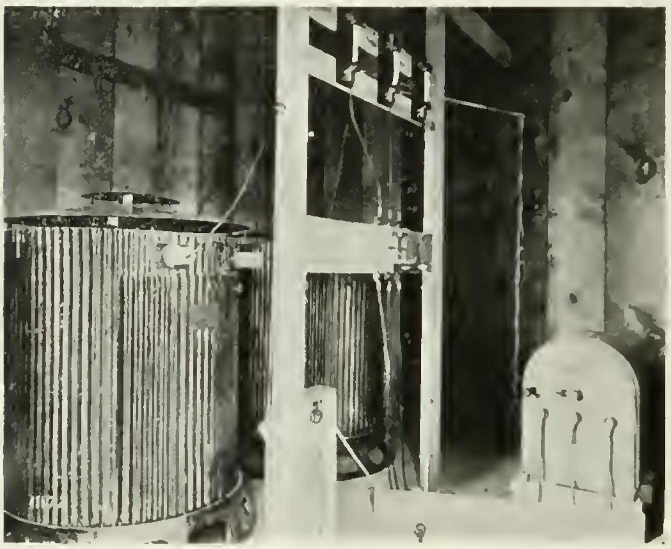


FIG. 13.—INTERIOR OF TRANSFORMER HOUSE.

It is found that a 30-hp motor will pump enough water to irrigate about 1 square mile of land. The average total lift of water from the well to the surface is about 25 ft. The pumps raise from 3½ to 5 cubic feet of water per second, depending on the lift. The discharge pipe is 10-inch galvanized steel. In each pump pit is a small piston pump, which can be belted to the motor shaft for priming the centrifugal pump when it is necessary. In operation one man looks after 10 wells, and two other men attend to 8 each. The pumps are run continuously, except when some of them have to be stopped on account of shortage of power. Each pump is visited by an attendant twice a day. A telephone circuit is run to each pumphouse on the transmission line poles. On account of the great number of instruments the telephones at the pumping stations are cut out by a double-pole baby knife switch (except when a man is at a pumphouse), to prevent having so many bells bridged across the line.

At present writing, the power load in pumping and other ranch uses is about full load for two 750-kw generators during the day, and some pumps have to be cut off in the evening to accommodate the lighting. The power factor in the middle of the day when the load is almost entirely induction motors, is said to be about 75 per cent. With the introduction of synchronous motors and a rotary connector this will, of course, be increased.

The Artificial Production of Graphite.

By Clinton Paul Townsend.

THE temperature of the electric arc itself has never been determined, but careful measurements of the temperature of the carbon terminals have been undertaken from time to time. Violle,[1] in 1893, having convinced himself by photometric methods that the temperature of the positive crater is the same whether produced by an arc of 10 or 400 amperes, determined the temperature of the positive terminal at the latter amperage to be 3500 degs. C. This estimate was based upon a direct calorimetric measurement of the heat given out by the detached tip of the electrode, and is subject only to the error in the value assumed for the specific heat of carbon.

Violle assumes, by reason of the peculiar constancy of the light emanating from the crater, that carbon is here at its point of vaporization, and has later,[2] employing a slightly different factor as representing the specific heat of carbon, determined this point of vaporization to be 3600 degs. C.

There does not lack evidence that the temperature of the arc itself is somewhat higher than that indicated for the terminal, but it is clear that the figure represents a near approach to the limiting temperature of the "arc" type of electric furnace, employing carbon electrodes and operating at atmospheric pressures.

Considering now furnaces of the "resistance" type, wherein the heat is developed by the resistance opposed to the current by a carbon rod or a mass of carbon granules, it is clear that the point of vaporization of carbon again sets a limit to attainable temperatures. Whether or not this limiting temperature is necessarily identical for arc and for resistance furnaces will be considered later.

At this limiting temperature we find a new chemistry. Compounds formerly considered unalterable by heat and elements regarded as infusible are melted and vaporized. Elements which at low temperatures are inert, display a varied activity, and others which at ordinary temperatures constitute our most active agents of chemical change, become relatively inert. Even the electro-chemical relations of the elements appear to undergo profound modifications.

The new field thus presented to the chemist has been carefully explored, with the result that no solid substance, element or compound, has been found to be both physically and chemically stable at the highest temperature attainable by means of the arc. It is the purpose of this paper to give some account of the modifications undergone by carbon, and of the conditions governing them, together with such inferences as may properly be drawn from the data at hand.

Since the original observation by Scheele in 1778 of the solvent power of molten iron for carbon, and the fact that a portion of the carbon so dissolved separates as graphite from the cooling mass, the conditions of the separation and its effect upon the physical properties of the metal, have been a part of the technology of the iron industries. For the present purpose it is necessary only to recall the observations by Moissan[3] that the purity of this graphite is proportional to the temperature to which the solvent metal has been heated, and to the pressure exerted by the iron in cooling. Graphite from this source, and, indeed, from all sources, contains hydrogen as an invariable constituent,[4] but not, it would seem, in chemical combination, for long heating in a vacuum suffices nearly or quite to eliminate it.

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[1] *Comptes Rendus*, Vol. 115, p. 1273.

[2] *Comptes Rendus*, Vol. 120, p. 868.

A method of forming graphite described by De Ville in 1847[5] consisted in passing a current of carbon tetrachlorid over molten iron, whereupon the iron volatilized as chlorid, while the separated carbon dissolved in the remaining metal. Owing to the elimination of iron the saturation point of the molten bath was quickly reached and graphite separated. Reference may also be made in passing to the production of graphite by a current of carbon monoxid over ferric oxid heated to 400 to 500 degs., and by the decomposition of carbon disulfid at high temperatures by metallic iron.

Despretz,[6] in 1849, undertook a careful study of the changes undergone by carbon at high temperatures, employing for the purpose a closed cast-iron vessel into which projected through leather stuffing boxes, two carbon electrodes. Pipes for the induction and eduction of gases were provided, and the effects of reduced and increased pressures were noted. In this miniature electric furnace, carbon, in its various forms, was interposed as a resistance in the form of rods, or was subjected to the arc. As a source of current Despretz employed 600 Bunsen cells, in series of 25, 50 or 100, as the exigencies of the work required—truly an expensive generator, but most efficient. He studied the behavior of retort carbon, of carbon derived from sugar and from turpentine, of anthracite coal, graphite and the diamond. His conclusions are thus summarized:

1. Carbon in a vacuum volatilizes at temperatures produced by 500 to 600 Bunsen cells. Under pressure of nitrogen at 2½ atmospheres volatilization occurs more slowly.
2. Carbon at these temperatures may be bent, welded, fused.
3. Carbon from all sources becomes progressively softer, finally turning to graphite.
4. Graphite volatilizes slowly.
5. Diamond is converted to graphite.

All of the varieties of carbon experimented with contained some ash, varying from 2 per cent in the retort carbon to .014 per cent in carbon derived from large, colorless crystals of sugar. Despretz recognizes no influence due to this admixture, but in the course of his article the following statement occurs:

"I have enveloped, I have impregnated, acicular rods of carbon with more fusible materials, silica, alumina, magnesia, to determine whether the presence of a more fusible body would render the fusion of the carbon more easy. The silica, magnesia and alumina escaped as vapors, and the carbon *remained unmodified*." (est resté avec ses propriétés.) This is a clear and succinct statement of the modern method for the commercial manufacture of graphite, and that it should have failed utterly in Despretz's hands is extraordinary.

Despretz's treatment of anthracite coal was more successful, for he records its conversion to "well characterized graphite." This seems to have been effected by placing a lump of anthracite in a crucible and striking an arc to it.

The next systematic study of the direct combination and conversion of carbon was published in 1870 by Berthelot,[7] who had previously effected the synthesis of acetylene by means of an arc between carbon terminals in an atmosphere of hydrogen—a reaction which he accomplished not only with several varieties of amorphous carbon, but with graphite also.

Berthelot was unable to convert amorphous carbon to graphite by the action of heat other than that of the arc, nor could he accomplish the reverse reaction. The presence of chlorin or iodin did not determine either conversion.

Berthelot noted that the negative terminal of the arc, which has become thickened by the transport of carbon, yields much graphitic oxid, whereas but little can be obtained from the positive electrode—an effect not attributable, however, to the transport of carbon, since capsules of sugar carbon constituting the negative pole of an arc from 600 Bunsen elements, in an atmosphere of hydrogen, were largely converted into graphite.

Berthelot's observations on the form taken by carbon liberated from its compounds under various conditions and by various agents, are of great interest. Hydrocarbons, subjected to heat, deposit amorphous carbon; decomposed by the electric spark, they yield amorphous carbon mixed with a small amount of graphite. Cyanogen gives precisely similar results. Berthelot remarks, referring to this admixture of graphite in the deposit by the spark: "I think that the amorphous carbon results from the decomposing action of the heat proper, and the graphite from that of the electricity." Recently Wilson and Fitzgerald[8] have published an observation curiously confirmatory of this, although not so recognized by them. Striking an arc between carbon terminals in an atmosphere of hydrogen containing hydrocarbons, they noted that "trees of soot and a deposit of hard graphitic carbon formed on this positive carbon, as if there were electrolysis of the hydrocarbon, and carbon were electronegative compared with hydrogen."

Chlorin, iodin and hydriodic acid were found by Berthelot to decompose methane without yielding graphite. Chlorid of carbon and carbon disulfid deposit, on the other hand, at redness, amorphous carbon together with considerable graphite.

It is to Berthelot that we owe the discovery that graphite may be obtained by the decomposition of a carbid. He heated the so-called carbid of boron—the "bore adamantin" of De Ville—with dry chlorin gas, and found that at a temperature below the softening point of glass carbon separates as amorphous graphite, and at the fusing point of porcelain as hexagonal crystals. This method uses a reagent capable of combining with the non-carbon constituent of the carbid, and seems in this respect more rational than the commercial process, in which a carbid is directly heated to a temperature at which the non-carbon element is volatilized. It is interesting to note that an analogous procedure has been recently developed by Bergmann[9] for the production of graphite from calcium carbid, the carbid, together with hydrogen peroxid, being gently heated under five atmospheres pressure; in the reaction which follows graphitic carbon separates. Acetylene reacts similarly with hydrogen peroxid. The method is not, however, of general applicability; aluminum carbid, for instance, heated with chlorin to dull redness, yields aluminum chlorid and a residue of amorphous carbon.[10]

Girard and Street in Paris have since 1893[11] practiced a method of superficially graphitizing carbon electrodes and other articles by causing an arc or a series of arcs to traverse the entire surface of the article, the operation being preferably conducted in a closed chamber, in an atmosphere of carbon monoxid, nitrogen or other neutral gas, or in a vacuum. The process is a commercial one, and the carbon to be converted is, of course, not free from ash.

Moissan, in 1896,[12] noted the production of graphite from a diamond heated in the arc, from the similar treatment of sugar charcoal preliminarily purified by chlorin, and of purified wood charcoal. He also noted the presence of graphite upon the tips of electric light carbons—all practical repetitions of the earlier observations of Despretz and others. Moissan also studied the solution of carbon in many metals—aluminum, silver, manganese, nickel, chromium, tungsten, molybedenum, uranium, zirconium, vanadium, titanium and silicon—and its separation therefrom, and in this connection made his classic observations on the formation of diamonds by the sudden cooling, in mercury or lead, of molten iron saturated with carbon. By this solution method also were reproduced the natural dilating graphites—"graphites foisonnants"—and it was noted that whereas, as a rule, graphite derived from carbon dissolved in fused metal dilates when heated in the presence of small amounts of nitric acid, that formed by the direct heating of carbon does not. The phenomenon was shown to be due to a brisk evolution of gas, probably derived from small quantities of unconverted carbon between the graphite laminæ.

Moissan[13] exposed to the direct action of an arc of 2000 amperes at 80 volts a carbon tube of 1 cm internal diameter, and thereby most beautifully demonstrated the volatilization and condensation of carbon. The interior of the tube became filled with carbon vapors which condensed upon its sides as a light deposit of graphite of great purity. Crystallized silicon placed at the lower portion of the tube fused and volatilized, and its ascending vapors, meeting the descending vapors of carbon, united with them to form a network of transparent needle-like crystals of carbid of silicon. Reference will be again made to this experiment. Condensed vapors of carbon collected upon the furnace walls, or upon a water-cooled tube traversing the furnace likewise consisted entirely of graphite. This was also found to be true of the coating which forms slowly on the walls of incandescent light bulbs, and of that which is rapidly formed by the rupture of the filament.

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[3] *Annales de Chimie et de Physique*, 7th Series, Vol. 8 (1896), p. 340.

[4] Ibid.

[5] Ibid. 3d Series, Vol. 49, p. 72.

[6] *Comptes Rendus*, Vol. 29, pp. 709-724.

[7] *Annales de Chimie et de Physique*, 4th Series, XIX., p. 392.

[8] *Proc. Royal Society*, LX. (1896-7), p. 379.

[9] German Patent, 96,427.

[10] *Comptes Rendus*, Vol. 119, p. 16.

[11] German Patent, 78,926. *L'Eclairage Electrique*, 1895. 4, 454.

[12] *Annales de Chimie et de Ph.* 7th Series, VIII., pp. 306-347.

[13] *Comptes Rendus*, Vol. 119, p. 776.

All attempts to weld two pieces of carbon failed, even at temperatures at which it vaporizes freely; at normal pressures there is no intermediate liquid state.

Very recently Moissan[14] has directed attention to the production of graphite by solution of carbon in the carbids of neodymium and praseoymium. These carbids dissolve carbon freely at high temperatures, yielding graphite on cooling.

Moissan's conclusions from his varied researches relating to graphite have been thus stated by him:[15]

1. Whatever the variety of carbon, elevations of temperature always suffices to convert it to graphite. This graphite may be amorphous or crystallized, has a specific gravity of 2.10 to 2.25, and a temperature of combustion in oxygen of 660 degs. C.

2. There are several varieties of graphite, just as there are several varieties of amorphous carbon and of the diamond.

3. The stability of graphite (its resistance to oxidation), increases in proportion to the temperature to which it has been subjected.

4. This fact is clearly shown by the resistance opposed by different graphites to transformation to graphitic oxid. The difficulty of this oxidation increases in proportion to the fusing point of the metal from solution in which the graphite has been derived. Similarly, a readily oxidizable graphite like that of Ceylon becomes much more resistant after heating.

In connection with his well-known experiments upon the phosphorescence exhibited by diamonds when exposed to "molecular bombardment" in the vacuum tubes which bear his name, Sir William Crookes long ago observed that there occurs a discoloration or blackening of the surface of the gem; this he has more recently found[16] to be due to a superficial coating of graphite—a conclusion which has been confirmed by Moissan.[17] This graphite is so very resistant to oxidizing agents as to recall those specimens which have been subjected to the temperature of the arc. Crookes likewise calls attention to the fact that diamonds rendered phosphorescent by other means, as by exposure to the direct rays of the sun, to an electrical discharge in air, or to the Röntgen rays, are superficially darkened; possibly there occurs under these conditions also a minute transformation to graphite.

Acheson, in whose hands the manufacture of carborundum—carbid of silicon—has become an established industry, experimented in 1895[18] with a process for the purification of coke by direct heating by the electric current, volatilizing the impurities, and leaving the carbon thereby "in a practically pure state and with largely increased electrical conductivity"; probably a conversion, at least partial, to the graphitic state. Later in the same year he applied for a patent[19] for the conversion of carborundum into graphite by subjecting it to heat sufficient to volatilize the silicon.

The conversion is a striking one, the graphite often appearing as pseudomorphs of the familiar hexagonal plates of carborundum, and reproducing even the details of their striated surfaces. In this process the regular carborundum charge of coke, sand, salt and sawdust, the coke constituting about 50 per cent of the mass, was packed around a carbon core, and the current through the core so regulated as to first form, then decompose the crystalline carbid of silicon. Alumina, lime, iron oxid or clay may replace the silica, the corresponding carbids being successively formed and dissociated. It is stated also that magnesia gives similar results, but this may be questioned in view of the fact that magnesium forms no carbid by reaction with carbon at electric furnace temperatures. A confirmation of the reaction as regards lime has been since furnished by Moissan,[20] who produced graphite directly from calcium carbid by heating the latter substance in an arc of 1200 amperes at 60 volts.

An important forward step in the process is marked by the later observation of Acheson[21] that under proper conditions the action may become progressive, or pseudo-catalytic in character. If any form of carbon be mixed with silica, iron filings, or the oxids or oxy-salts of iron, the latter constituting not more than 3 per cent of the mass, there occurs a progressive formation and decomposition of carbid, and the vapors of silicon or of iron traverse the entire charge, combining with each molecule of amorphous carbon, and then abandoning it in the graphitic state for the next. The final escape of the iron, etc., from the furnace may be observed with the spectroscope.

It would seem that when the percentage of carbid-forming impurities is low the completeness of the conversion is conditioned upon their distribution throughout the carbon. In any mechanical mixture this necessarily fails of absolute uniformity, but Acheson finds[22] that certain natural carbonaceous substances, as anthracite and other non-caking coals, and certain carbonaceous products as willow charcoal, possess mineral constituents proper in kind, quantity and distribution to permit complete conversion of the carbon to graphite. At the close of the operation such mineral constituents are found to have been almost completely volatilized; for instance, an anthracite having 5.783 per cent of ash yielded graphite with an ash content of only 0.033 per cent. Reference has already been made to the conversion of anthracite coal to graphite by means of the arc, by Despretz a half century earlier.

Early in 1897[23] a series of observations were published by Borchers upon the weakening or bending of carbon resistance rods. The experiments were conducted in a closed electric furnace with water-cooled terminals and under high gas pressures. Under these conditions the carbon assumed a hard crystalline state, and the effect of impurities upon the crystallization was strongly marked. Borchers summarizes his observations as follows:

1. The more impure the carbon, the lower the temperature at which weakening occurs.

2. The harder and more crystalline the rod after cooling.

3. Broken edges of some carbon rods which have been used for heating charges composed of mixed carbon and oxids of metals, scratch quartz easily.

4. All materials which form "alloys" (legierungen), or more or less easily decomposable compounds with carbon, assist its crystallization.

As elements of this character he mentions boron, silicon, titanium, zirconium, vanadium, aluminum, the cerite metals, chromium, molybdenum, tungsten, uranium, manganese, iron and nickel, and refers to the probable efficacy of gaseous compounds of carbon with oxygen, hydrogen and sulphur. The distinction between this work and that of Acheson is stated to be that Acheson operated at atmospheric pressure, thereby requiring so high a temperature that "only graphite, not diamond," was obtained.

In 1899[24] Acheson published certain observations on the yield of graphite and his conclusions therefrom:

1. Comparatively pure petroleum coke produces practically no graphite.

2. Impure bituminous coal coke produces large quantities of graphite.

3. The larger the percentage of impurities in the bituminous coal core, the greater the yield of graphite.

4. Only part of the carbon core of carborundum furnaces is converted into graphite (that part which carries an admixture of slate or a high ash content). This conversion is not increased even by repeated use of the same grains in successive furnaces.

Acheson's conclusions follow:

1. *Graphite* is the form carbon assumes when freed from chemical associations under conditions of low pressure and protection from chemical influence.

2. *Diamond* is the form carbon assumes when freed from chemical associations under the conditions of high pressure and protection from chemical influence. And "by inference"

3. *Amorphous carbon* is the form carbon assumes when freed from chemical associations under conditions of high or low pressure and exposure to chemical influence.

The precise meaning of the expression "chemical influence" as employed above with reference to a substance separating out in elemental state is not clear, even from the context, and the invalidity of the inference as a logical deduction is patent.

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[14] *Comptes Rendus*, Vol. 131, p. 595 (1900).

[15] *Comptes Rendus*, Vol. 119, p. 980.

[16] Chemical News, Vol. 74, p. 39.

[17] *Comptes Rendus*, Vol. 124, p. 653.

[18] U. S. Patent, 542,982.

[19] U. S. Patent, 568,323.

[20] *Comptes Rendus*, Vol. 126, p. 302.

[21] U. S. Patent, 617,979.

[22] U. S. Patent, 645,285.

[23] *Zeitschrift für Elektrochemie*, III., p. 393.

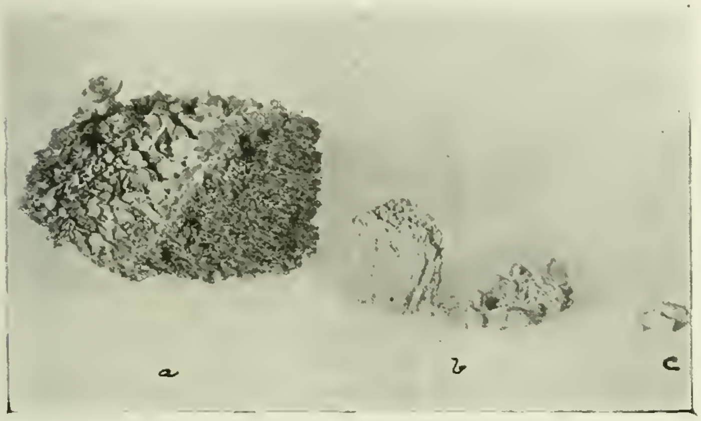
[24] *Journal of the Franklin Institute*, Vol. 147, p. 475.

It would seem that no adequate theory regarding the several modifications of carbon, and particularly with reference to the relation between the so-called allotropic forms, amorphous carbon and graphite, has been offered.

Graphite and amorphous carbon present a relationship for which we find no close analogy in other elements. Not only do they differ in their specific heat and in their heat of combination with oxygen, but graphite is capable of yielding by oxidation a solid compound, graphitic oxide, which is eminently characteristic. Furthermore, and perhaps most important, the two modifications cannot be considered as phases in equilibrium at a fixed temperature, for although amorphous carbon is readily convertible to graphite, the reverse transformation does not occur.

As regards the artificial production of graphite, it will be noted that there is at least an apparent conflict between the results of different experimenters, and there is a real conflict between their expressed conclusions. Moissan states definitely: "Whatever the variety of carbon, elevation of temperature always suffices to convert it to graphite." Acheson finds it impossible to effect the conversion with relatively ash-free petroleum coke, notes that those coke granules which escape conversion in the first carborundum furnace, remain unchanged in succeeding furnaces, and believes that the formation and decomposition of a carbid is an essential part of the process. The conclusions of Despretz agree with those of Moissan, as do also the results of Berthelot. Borchers appears to be in close agreement with Acheson.

It should be borne in mind that both amorphous carbon and graphite are very highly polymerized bodies, and that the polymerization of either depends upon the temperature to which it has been subjected. Moissan[25] found that lampblack was attacked by an oxidizing mixture—sulfuric acid and potassium bichromate—at 60 degs. C., and took fire in oxygen at 371 degs.; after five minutes calcination at 910 degs. the corresponding figures were 90 degs. and 440 degs. Three hours heating gave a new product, oxidized by the mixture at 95 degs. and burning at 476 degs., and after six hours heating the data obtained were 99 degs. and 506 degs., respectively. The similar results with graphite, showing the effect of temperature upon its oxidizability have been already quoted. That the difference between the two forms is more than one of *degree* of polymerization, is indicated by the absence of intermediate states and by the sharp distinction in properties, both chemical and physical.



A.—Crystallized Carborundum. B.—Graphite pseudomorphs of Carborundum Crystals. C.—Grapbite Granules from Coke Coal of Carborundum Furnace.

THE MANUFACTURE OF GRAPHITE.

Referring again to that experiment by which Moissan demonstrated the volatility of carbon in the arc, it will be recalled that the vapors so produced were caused to mingle with vapors of silicon, and that a bridge, consisting of a network of crystals of carbid of silicon, formed between the carbon and the molten silicon. Since this reaction could occur, the temperature of these vapors was below that at which carbid of silicon is decomposed; that is to say, below that of the Acheson graphite furnace. But inasmuch as the temperature of both arc and incandescent furnaces is limited by the point of vaporization of carbon, we can only conclude that this point of vaporization is lower in the arc than when the carbon is directly heated by inclusion as a resistance in the circuit. This effect is to be ascribed to the action of the arc in reducing the complexity of the carbon molecule, and thereby increasing its volatility. It would perhaps be accurate to define the limiting temperature of the arc between carbon electrodes as that temperature at which the complex carbon molecule breaks down, and that of the carbon resistance furnace as the true point of vaporization of carbon, the former temperature being distinctly lower than the latter.

There is evidence that the carbon of the arc terminals is not only depolymerized, but is *ionized*. For if the vapors from the two poles be separately withdrawn, they are found to be oppositely charged, those from the positive pole carrying a negative charge and vice versa. This is considered by Chéneveau[26] to indicate that the ions proceed from the electrodes themselves. Merritt and Stewart[27] have found that these vapors retain their charges for the relatively long period of 10 seconds after withdrawal from the arc.

I am inclined to believe that the preliminary ionization of the carbon is essential to the production of graphite. For it will be noted that when Moissan speaks of "elevation of temperature" he means the heat of the electric arc, whereas Acheson and Borchers refer to heat developed in a carbon resistance. In the former case conditions favorable to the ionization of the carbon are present, while in the latter such effects are, so far as we know, definitely excluded. Acheson's failure to effect the conversion of pure carbon cannot, as we have seen, be ascribed to the employment by him of too low a temperature, for in Acheson's furnace carbid of silicon is decomposed, whereas Moissan *formed* this compound by the union of silicon with carbon vapors—vapors which, when condensed, yielded "graphite of great purity." Moissan's production of graphite was therefore effected at a temperature lower than that at which Acheson found carbon to be unchanged.

Other of the observations before referred to tend to confirm the view that the production of graphite is due to more than the simple heat effect of the current; Berthelot's supposition that the mixture of the two forms of carbon which results from the passage of an electric discharge through hydrocarbons and cyanogen is due to the joint action of heat and electricity, appears eminently probable, and finds confirmation in the work of Wilson and Fitzgerald. If we re-examine the work of Despretz we find that whenever the arc was used the transformation to graphite was readily accomplished, even though the ash content of the carbon were only one part in 7000; but when the carbon, as a filament, was directly included in the circuit, the results are less positive, and the production of graphite seems to follow either the presence of a large admixture of ash, or the rupture of the filament.

The essential condition for the formation of graphite, then, may be considered to be the presence of carbon in the ionized state and its separation therefrom. This, so far as we know, may be accomplished by any one of four methods:

1. By solution in metals or carbids.
2. By the direct ionizing action of the electric discharge, and notably the arc, upon carbon.
3. By the action of the electric discharge upon gaseous carbon compounds.
4. By the dissociation by heat of certain carbon compounds, notably the carbids.

These four general methods embrace all of the special cases heretofore described.

Is it possible that carbon may be separated from the ionized state in an unpolymerized non-graphitic form? Coehn[28] has recently stated that he has succeeded in dissolving carbon, and separating it as cation from its solutions. Starting from the observation of Bartoli and Papasogli that a carbon anode in surfuric acid yields a yellow or brown liquid, with evolution of oxygen, carbon monoxid and carbon dioxid, Coehn found that by properly choosing the concentration and temperature of the acid and the current density he was able nearly to suppress the evolution of oxygen, producing the yellow solutions referred to, and a mixture of anode gases, consisting of about 70 per cent carbon dioxid, 30 per cent carbon monoxid, and not over 1 per cent of oxygen. From this solution there separated upon the cathode a dense and adherent coating, having the appearance of carbon, and giving its reactions in the flame and with oxidizing agents. Analyses of the precipitate have not been published, but are stated to show the presence of both hydrogen and oxygen, indicating, according to Coehn, either the presence with the carbon of a solid conducting carbohydrate, or of a "kind of water of crystallization." Coehn's results appear too fragmentary to serve as a basis for definite conclusions, or to support his contention that we have in his solution carbon as an ion, or in his deposit, the element itself as a simple cation.

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[25] *Annales de Chimie et de Physique.* 7th Series VIII., p. 294.

[26] *L'Eclairage Electrique XX.* (1899), p. 401.

[27] *Physical Review,* VII. (1898), p. 129.

[28] Coehn, *Zeit für Elektrochemie,* II., p. 541; III., 424. Vogel, Ibid., II., 581.

Concerning the properties of the simple element carbon we can only speculate. Berthelot[29] having in mind not only the progressive polymerization of carbon, but also the constant presence of hydrogen, said that carbon, as known to us, seems to present less the characteristics of an element than of the extreme condensation product of the hydrocarbons: "Indeed, carbon is not comparable to a true simple body, but rather to a hydrocarbon, extremely condensed, extremely poor in hydrogen, and of extremely high equivalent (à équivalent extrêmement élevé). Pure carbon is in a way a limiting condition, which can scarcely be realized under the influence of the highest temperatures which we are able to produce. As it is known to us in the free state, it represents the extreme term of molecular condensations, that is to say, a state as far removed as possible from that of the element carbon, brought to the condition of a perfect gas and comparable to hydrogen."

However this may be, it is highly probable that non-polymerized carbon, whether or not a gas, would present new characteristics, entering into reaction at ordinary temperatures, affording by its combinations a ready source of electrical energy, and giving us an insight not otherwise attainable into the chemical processes of living organisms.

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Storage Battery Maintenance.

By Thos. J. Fay.

In the maintenance of storage batteries there are a number of important considerations, but none more important than the preservation of the purity and strength of the electrolyte; that is, provided the materials furnished for the installation are originally pure. This may not always be the case, for even the most scrupulous manufacturer will have little mishaps, and 100th of 1 per cent of nitrate can easily find its way into the finished product where, unless it is discovered by the battery operator and promptly removed, it will soon put the positive plates out of commission owing to the "formation" continuing; as a consequence the plates will "grow" and finally disintegration will set in through the plates lacking in "backbone."

As a further illustration of a possible cause of deterioration, take, for example, a "chloride" battery. The process involved in the manufacture of this type of battery is as follows: Finely powdered metallic lead is dissolved in nitric acid, from which it is precipitated in the form of lead chloride by the addition of hydrochloric acid. The precipitate is removed, washed and fused with zinc chloride, and in the molten state is run into molds, thus forming pastilles, 5-16 by ¾ by ¾ inches, or thereabouts. The pastilles are set up in molds, and the metal for supporting grid poured into the same under pressure, thereby increasing the density of the metal, which is a lead-antimony alloy. The plates are then packed between zinc plates in a bath of zinc chloride solution and short-circuited, with the result that the chloride is extracted for the most part, the remaining chloride being removed by washing the plates in running water. It is perfectly obvious that any lack of attention on the part of the workmen who have the work in hand will result in chloride being present in the finished product; indeed, this often occurs, and unless the presence of chloride is noted by the operating force the ill effects of chloride will soon be manifest, and the life of the battery, so contaminated, will be put in jeopardy.

On the other hand, take a battery of the Planté type involving the electro-chemical process of formation. In this type of battery the plates are first cast or spun, thus increasing the surface in the ratio of, say, 20 to 1. That is to say, a plate having one square foot of superficial area is so spun, scored or grooved as to increase the surface, say, to 20 square feet, or the plate may be cast and a similar result obtained. The plates are then placed between dummies in a nitrate bath and a current of electricity sent through them as positives for a sufficient length of time to "grow" the active material out of the plates themselves, almost to any desired thickness. The result is a supporting grid of pure metallic lead, with the spaces between the leaves completely filled with active material (lead peroxide), the object of the nitrate being to hasten the formation. The plates so formed are removed from the nitrate bath and washed thoroughly in running water. They are then set up in a dilute sulphuric acid bath and formed as negatives, under which condition all remaining impurities are cast off. The plates are again removed, washed, and plates intended for positives are reformed in a dilute sulphuric acid electrolyte between dummy negatives. After this process is completed, the plates are removed, trimmed, the necks burned on and the elements are set up into jars or tanks, the cross-bars and interconnecting straps burned on, and the jars or straps filled with electrolyte of the proper strength, when the process is completed, and the plates are ready for the initial charge and discharge of the completed battery.

It is possible that by careless workmen, or in the rush to fill orders, the process may be slighted; or to economize, the electrolyte may be kept in service too long—all resulting in the presence of nitrate in the completed battery. It is important that battery operators shall guard against this contingency, and to do so, a test for nitrate be applied to every element promptly upon receipt of a battery, and if the nitrates be present to reject the battery or remove the nitrates, otherwise the forming process will go on, the plates will "grow," the supporting grids will be reduced and the life of the battery will be but short. It is a fallacy to assume that "only a trace of nitrate is present, and it can be of no great consequence." As a matter of fact, the regular nitrate forming bath carries but a small percentage of nitric acid, and as the primary reduction takes place in from 20 to 40 hours, 100th part of 1 per cent in the working electrolyte will be felt in but a short time.

It might be asked, if the nitrate formation and the chloride process are so fraught with dangers, why not use some other process? The writer fails to observe that the horse would be of any other color, if through careless workmen or a press of business a taint of the forming solution is present in the finished product. There could be but one result, and that is a continuation of the "forming" process, always to the detriment of the supporting grid and leading to the final destruction of the battery. Now it happens to be the case that batteries, under normal conditions free from any "forming" ingredient, last none too long; in fact, no one ever heard of a centenarian battery, and so it would seem as if all who have the care of batteries in hand should not only be capable of making tests for contaminating ingredients, but should be provided with suitable instruments and reagents. This alone, however, is not enough, for they should take the time necessary and systematically and frequently test for iron, copper, chlorine, nitrates, mercury and such other ingredients as have no rightful place in the make-up of a battery.

The writer, who spends his entire time in and about the various establishments using storage batteries and especially automobile stations has never come across a place wherein this problem is properly met, while he can name a dozen places wherein tests for impurities are never made, where the equipment for making tests is conspicuous by its absence, and where skill in the matter of tests of this sort is as yet undeveloped.

It is with the hope that the soul of the artist may be awakened in the many battery men who now go blindly on ruining good batteries because "they know not what they do," that the writer raises this question, and here submits some simple tests. There are, no doubt, more simple methods, and it may be others will contribute their quota, thus giving "battery men" the option of choice as between methods. The following tests for undesirable ingredients will be found simple and inexpensive, as respects the equipment required.

TESTS FOR CHLORINE.

The presence of chlorine in the electrolyte may be noted from the fact that a few drops of a solution of nitrate of silver in a test tube of the electrolyte to be tested will produce a curdy white precipitate of silver chloride which is solvable in ammonia and precipitated by nitric acid. Silver chloride melts to a horny mass and on exposure to light turns violet.

TEST FOR IRON.

Iron salts are known by the proto salts being green, and their solutions giving a dark blue precipitate with red prussiate of potassium. The per salts are foxy red, and their solutions yield a dark prussian blue with yellow prussiate of potassium. A few drops of each of the prussiate solution in separate test tubes of electrolyte will disclose the presence of iron salts, *proto* or *per*, as the case may be.

TEST FOR COPPER.

The copper salts are known by their solutions yielding, with liquor potassæ, a blue precipitate which turns black on boiling, and with a solution of ammonia, a bluish-white precipitate which is dissolved and forms a beautiful sapphire blue solution with excess of ammoniacal solution. They also give a chocolate precipitate with ferrocyanide of potassium.

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[29] *Annales de Chimie et de Physique*, 4 Series, IX., p. 475.

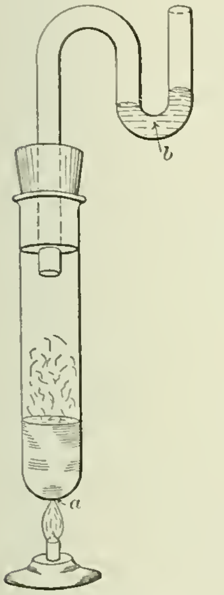
A few drops of liquor potassæ in a test tube of electrolyte will first show the bluish precipitate, if copper be present. The proof of this lies in the fact that the precipitate will blacken on boiling. The ammonia test can be made in a separate tube at the same time, using another quantity of the same sample of electrolyte, although the potassæ test will be conclusive in itself.

TEST FOR MERCURY.

The mercurous salts are known by giving a black precipitate with lime water, and an olive green precipitate with iodide of potassium solution. The mercuric salts give a yellow precipitate with lime water and a scarlet precipitate with iodide of potassium. Users of hydrometers having a mercury bulb are nearly sure to have mercury in the batteries. Thermometers are, of course, open to the same criticism, but to a less marked degree, because thermometers are somewhat less fragile.

TEST FOR NITRATES.

(a) In a test tube holding 25 cms of electrolyte add 10 grams of proto-sulphate of iron solution, add carefully 10 cm of concentrated, chemically pure, sulphuric acid. The presence of nitric acid may be known from the fact that a brown stratum will appear between the electrolyte and the concentrated sulphuric acid. The intensity of the color will denote the quantity of the nitrate present.



NITRATE TEST TUBE.

(b) A more satisfactory test can be made as follows: Referring to the accompanying illustration, place the electrolyte to be tested with some chemically pure copper filings in the test tube *a* and a few drops of proto-sulphate of iron solution in the bent glass tube *b*. Apply heat to the tube *a* when, if nitrates be present in the electrolyte, the color will change to a blackish brown. If, however, much chlorine be present, this test fails, in which event proceed as follows:

(c) Add a small amount of gold leaf and somewhat more of concentrated hydrochloric acid to the electrolyte, then boil the mixture. If gold is dissolved the presence of a nitrate is indicated, the smallest amount of gold dissolved may be discovered upon adding to the liquid a few drops of proto-chloride of tin, which develops the purple of cassius.

The best way is to test the electrolyte for chlorine first, and if the same is found to be present, then proceed with the "gold" test for nitrates; but if no chlorine is found, the proto-sulphate of iron test can be substituted, if the operator so desires.

There are other objectionable ingredients which, if found in a lead-sulphuric acid battery, would lead to complication. They do not predominate, however, excepting in rare instances, and their effect is not so marked as that produced by the compounds above listed; therefore, no space will be taken here in a further discussion of possible impurities.

It might be well to add, however, that contamination may be due to impurities in the plates, in the acid or in the water. More often, however, impurities are due to the surroundings; that is to say, a battery is put into a vehicle, for instance, in which bolt heads are exposed; it is but a question of a few days when the corroding effect of the acid fumes will be noticed and the iron salt, cast loose, will fall into the battery. The practice of using water from the city mains also leads to a goodly supply of iron and whatnot.

The safe rule, in view of all these possible sources of trouble, is to proceed as follows:

(a) Test the battery when first received for the given list of impurities. If the battery comes "knocked down" or "dry," test the plates.

(b) Test every carboy of electrolyte received before any of it is used, and, above all, do not purchase electrolyte made from iron pyrites. The only suitable electrolyte is made from sulphur for the acid and distilled water for diluting.

(c) Do not have concentrated sulphuric acid around, as some careless person may put it into the battery either to bring up the strength of the electrolyte or by mistake.

(d) Use only distilled water from carboys, not from barrels, and test every carboy of water received before using.

(e) Keep the electrolyte up to strength in the batteries by the following process:

1. Add distilled water to reduce the strength.
2. Add 1400 specific gravity electrolyte to increase the strength.
3. Test for acid strength always with a fully charged battery.

(f) Temperature has a marked effect on battery output and acid strength, hence observe the temperature at which all equalizing of electrolyte is done, and either compensate for temperature or wait until the temperature is at some predetermined point, say, 75 degs. F.

In conclusion, it may not be out of place to give a list of re-agents used in qualitative analyses, and a statement as to their mode of preparation. This list is far from complete, but will be all that is required for every-day practice in the battery room. It is worth while to add, however, that if impurities are discovered, they must be eradicated, else tests will be *"pour passer le temps."*

RE-AGENTS.		To Make Solution, Proceed as Below.
Formula.	Name.	
$Ag\ N\ O_3$	Nitrate of silver.	1 part salt, 20 parts water, in orange colored bottle.
$K_3\ Fe\ Cy_6$	Potassium ferricyanide, Red prussiate of Potassium.	1 part salt, 12 parts water.
$K_4\ Fe\ Cy_6$	Potassium ferrocyanide, Yellow ferrocyanide.	1 part salt, 12 parts water.
$N\ H_3$	Aqua ammonia, Ammonia water.	Purchase 16 degs. B., in glass-stoppered bottle.
$K\ O\ H$	Liquor potassæ.	Purchase ready for use, green glass bottle.
$Ca\ H_2\ O_2$	Hydrate of calcium and water, Lime water.	½ grain of lime to 1 oz. of water.
$K\ I$	Iodide of patassium.	1 part salt to 20 parts water.
$H_2\ S\ O_4$	Concentrated sulphuric acid.	Purchase 66 degs. B. sulphuric acid.
Cu	Copper filings.	Purchase test copper.
$Fe\ S\ O_4\ 7\ Aq$	Green vitriol, Proto-sulphate of iron.	1 part salt, 8 parts water.
Au	Gold leaf.	Purchase as required.
$H\ Cl$	Muriatic acid, Hydrochloric acid.	Purchase concentrated acid in glass-stoppered bottle.
$Sn\ Cl_2$	Proto-chloride of tin.	1 part salt, 10 parts water.

Dowered Telegraphers.

A question put in the British House of Commons elicited the fact that the Postmaster-General encourages matrimony among women employees of his department by giving them marriage portions. As much as $50,000 has been given away in this manner in a single year. Women enter the Government Postal Service as telegraph operators at an average age of 16. By the terms of the Treasury minute regulating the compassionate allowance scheme, as it is officially called, a woman is entitled to the allowance after six years of service. That is to say, she has reached the marriageable age of 22, when she is first entitled to her dowry from the State. For each year of service she can ask one month's pay. At the end of a woman's sixth year of service, when she is at her best as a telegrapher, she receives no more than $25 a month, so that if she should marry forthwith her compassionate allowance would amount to just $150. If she should wait until 28, she would then be entitled to 12 months' pay, or the maximum amount of allowance, whichever worked out to the smaller sum, the official maximum being $400. As a matter of fact, the average amount paid has been found in practice to be about $200.

The Institute Membership.

American Institute of Electrical Engineers has 1240 members, of whom 690 live in the States of New York, New Jersey, Pennsylvania and Massachusetts. New York has 416, California has no fewer than 51. There are 38 in England, 28 in Mexico, 7 in Hawaii, 7 in Australia, 6 in South Africa, 3 in Brazil, 3 in Austria, 3 in Holland, 10 in Japan, 2 in the Philippines and 2 in New Zealand.

Firemen and Electric Shocks in Italy.

By Guido Semenza.

During recent years cases have been reported of firemen receiving shocks from electric lighting conductors while engaged in extinguishing a fire. Such shocks have been attributed to the conductivity of the stream of water from the hose coming into contact with the wires, and as a result firemen have come to view electric conductors as a source of real danger from this cause. To those who are aware of the small conductivity of pure water, a shock from the cause attributed does not seem very probable for the reason that a column of water of the size which comes from a nozzle must have a notably high resistance. It might, however, be asserted that some phenomenon due to electric capacity may account for the shocks which have been received, and in order to determine this question the writer performed some experiments with the aid of the Milan Edison Company, which kindly offered the use of its laboratory for this purpose.

In this laboratory there are available direct current at voltages varying from 2 to 550, and alternating current at 42 cycles and 4 voltages varying from 10 to 3000 volts; besides a connection can be made with an electric railway circuit and with a three-phase, 3600-volt network. The trials made were of two kinds—with direct current and with alternating current. The experiments took place in a large yard quite close to the laboratory, in which a plate of metal about a yard square was placed in a slightly inclined position on porcelain multiple petticoat insulators. This sheet was connected to one of the conductors, the other of which was well earthed. The experiment was performed in the following manner:

A fireman, with his boots and bottom part of his trousers wetted, placed himself near the spot where the wire was grounded, and directed a jet of water from a nozzle against the metal plate, holding with bare hands the metallic nozzle. The water was supplied by a steam pump at a pressure which could be made as high as 180 lbs. to the square inch. The voltage was measured in the laboratory with the necessary instruments, and at intervals the voltage between the metal plate and the earth was determined so as to be sure that a good earth connection was being maintained.

Before passing to a description of the experiments it should be said that though the results of the trial have a great practical value from giving a sure measure of the dangers to which firemen may be subjected, on the other hand, they cannot be considered exact from the scientific point of view for the reason that one of the testing instruments was necessarily human organism. As is well known, a large difference as to sensibility exists between different persons with respect to electric shocks. It was found, for example, that the length of water jet at which different firemen began to feel the current, varied as much as 50 per cent. and the length of the jet at which shocks could be supported, varied considerably with different men. Besides, it was found that the sensibility of the same person varied within certain limits from day to day, and that those accustomed to receive shocks have a lesser sensibility to them. As the results obtained were thus affected by the human element, the experiments consequently cannot be claimed to be of a scientific order, though sufficiently decisive for practical purposes.

Direct current was supplied from a storage battery of 250 cells, and the voltage varied by connecting up the cells in different ways. Sensations were not felt up to 200 volts. At 200 volts a slight pricking in the hands was experienced when the pipe was approached to within about an inch of the metallic plate; indeed, in order to render the sensation surely perceptible, the nozzle had to be moved so that the jet touched the plate intermittently. A shock was then felt owing to the resulting opening and closing of the circuit.

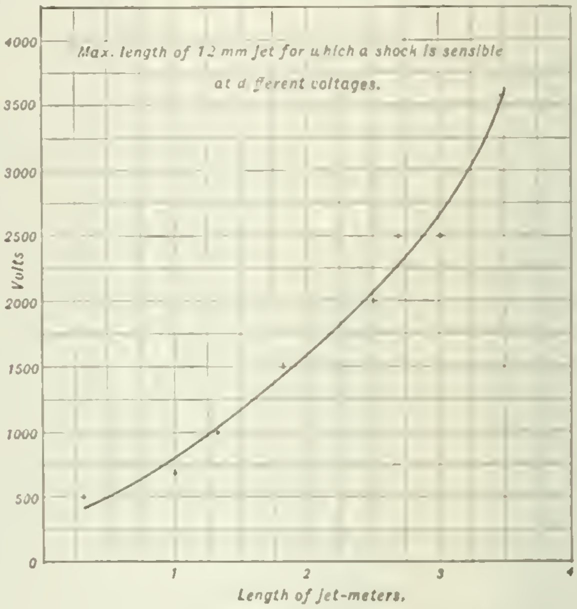
Upon raising the voltage gradually to 500 volts, the distance at which one began to feel slight shocks rose to 2½ to 3 inches. Nozzles of various diameter were then tried, and with a jet from a nozzle 2 inches in diameter shocks began to be perceptible with a length of jet slightly over 3 ft.

As these experiments partook of a laboratory character, to remove any doubt that could arise as to the influence of the self-inductance of the machines or the capacity of the lines, the experiment was repeated by directing the water jet on a trolley wire in service. The fireman climbed a wooden structure, with one hand grasped a wire having a good connection to the track rail, and with the other hand held a nozzle which directed a jet on the trolley wire. The results were identical with those obtained in the laboratory.

During the experiments with alternating currents, the current was obtained from a transformer with a ratio varying from 1-1 to 1-4, the upper limit of the voltage being 400. Above 400 volts an alternator was used. Experiments could thus be made at any voltages from 40 up to 3600, the frequency in every case being 42. Trials were made with nozzles of different diameter and with jets under different pressures.

With a jet from a ½-inch nozzle under such a pressure that the column of water reached its destination without breaking, the first sensation was at 40 volts with the nozzle at about 1 inch from the plate. With the increase of voltage the distance gradually increased and at 500 volts it was about 7½ inches. The shocks from alternating current are therefore perceptible sooner than with direct current, as was to be foreseen; and the sensation is also different, the direct current giving an instantaneous shock upon opening and closing the circuit, while the shock from the alternating current is continuous and gives a sensation of strong pricking.

The accompanying diagram shows the curve relating to the length of the water jet at which the shock becomes perceptible with the voltage, and referring to a ½-inch nozzle. Though the curve, for reasons above pointed out, is lacking in mathematical precision, still it gives a sufficiently clear idea of the case, and from it can be noted that the effect is smaller for a given percentage increase of length of water jet than it is for the similar increase of the voltage.



CURVE SHOWING RELATION OF WATER JETS AND VOLTAGE.

The maximum value of the voltage used was 3600 volts, and at this tension a sensation was perceptible at a distance of about 10 ft. A person of average sensibility can endure the sensation from this voltage without great inconvenience up to a length of jet of about 3 ft. The section of the jet, however, notably changes these distances. Thus, with a 2-inch jet the shock is perceptible for 500 volts at 8 ft., and with 3600 volts it is quite strong at 24 ft.; at 13 ft. it becomes quite intense and nearly reaches the limit at which it may be supported by a person of average sensibility. The form of jet has a great influence, which can be easily understood. A continuous jet must offer very much smaller resistance to the current than one which breaks or scatters. This was quite clearly shown by experiments. With equal lengths of water jet the sensation is stronger the smaller the velocity, as with the smaller velocity the stream is much more compact. This explains why the shock increased less rapidly than the voltage; in fact, the greater the distance the less easy it is to maintain a compact jet.

After having finished the experiments in the manner above described, tests were made to see if the effects of the capacity of a system of high-tension cables, transformers and motors, such as may form part of a city distribution, might introduce any changes. For this purpose one of the conductors of the three-phase distribution of Milan was put into communication at 3600 volts with a metal plate and a water jet directly against the latter. The difference of potential with respect to the earth was about 2000 volts. No notable divergence was observed from the experiments that had been made with 2000 volts in the laboratory.

The conclusions of a practical order that may be drawn from these trials are quite important. Above all, they showed that it is practically impossible for a fireman to receive a shock from a wire at a low potential without approaching a nozzle to within about an inch of the conductor, and only in this case when the fireman holds the nozzle with one hand and an earthed conductor with the other, and is well soaked with water. As a consequence, firemen can be assured that they may throw water on live conductors without danger of shock. The shocks felt by firemen in throwing water on electric light wires of 220 volts cannot be explained except by admitting a direct contact between the pipe and the wires. The results of these experiments are consequently reassuring with respect to the supposed dangers to firemen from electric conductors, such as may be encountered in extinguishing fires.

Elements of Illumination—XXIII.

By Dr. Louis Bell.

To determine the real illumination produced at any distance by a particular radiant, it is necessary to take the assumed height and the distribution curve to the radiant, and then to compute the illumination of that distance, using the real candle-power corresponding to the direction of the ray considered. To save labor it is convenient to plot the illumination at various distances in the form of a curve, thus enabling the illumination in candle-feet to be read directly. Fig. 1 shows a set of curves thus computed from the four types of arc lamps, of which distribution curves were shown in Fig. 3 of the last paper. The first important lesson to be drawn from them is that none of the lamps shown gives really useful illumination at a distance of more than 150 ft., and that lamps *A* and *B* should not be spaced more than 250 ft. apart if the minimum illumination is to be about 0.03 candle-foot. Lamps *C* and *D* might be spaced at 300 ft., but not much further without producing a conspicuous dark belt. *A* and *D*, the enclosed arcs, give relatively better illumination at considerable distances than the open arcs. It should be noted that the height of all lamps is assumed to be 25 ft. and that the curves begin at 50 ft. from the lamp, the space within that distance being relatively well lighted.

Comparing the several types of lamps it at once appears that for street lighting the 6.6-ampere enclosed continuous current arc is fully equal to the 9.6-ampere open arc (so-called 2000-cp), while the 6.6-ampere alternating arc is rather better than the 6.6 ampere continuous-current open arc (so-called 1200-cp), but materially less effective than the other two. In the author's opinion, it would correspond to a nominal 1500 cp as respects the open arcs rated in the old-fashioned way.

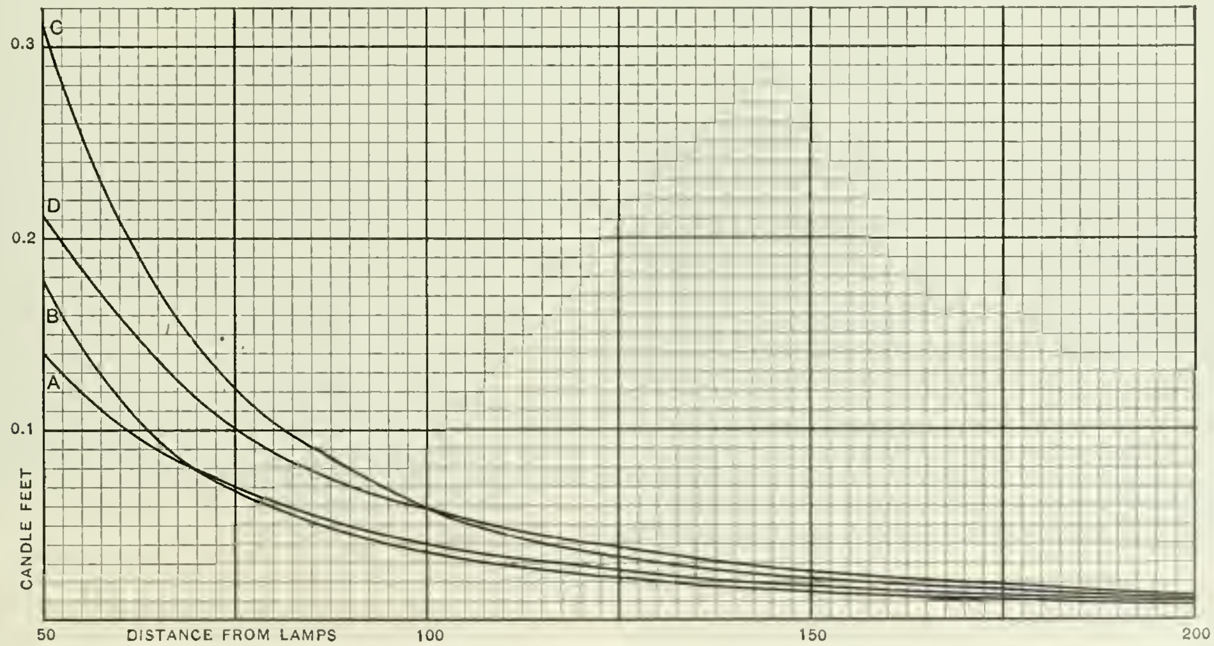


Fig. 1.—Illumination Curves of Four Types of Arc Lamps.

But theory and experience unite in indicating that effective illumination on streets is not measured exactly by the process just explained, useful though it may be. There is a physiological as well as a physical factor in illumination, for in the presence of lights of great intrinsic brilliancy the iris closes and the image on the retina grows faint, like the image in a camera when the lens is stopped down. Thus it is difficult to see beyond a brilliant light, and when the eye is exposed to the intense glare of an open arc it does not recover promptly enough in passing on to get the full value of the relatively feeble light at a distance from the lamp. This effect and the more uniform distribution of light account for the well-established fact that enclosed arcs, both for alternating and continuous currents give more satisfactory illumination than would seem to be warranted by the computed intensity of the illumination. Besides the enclosed arcs are generally steadier, which tends to improve matters.

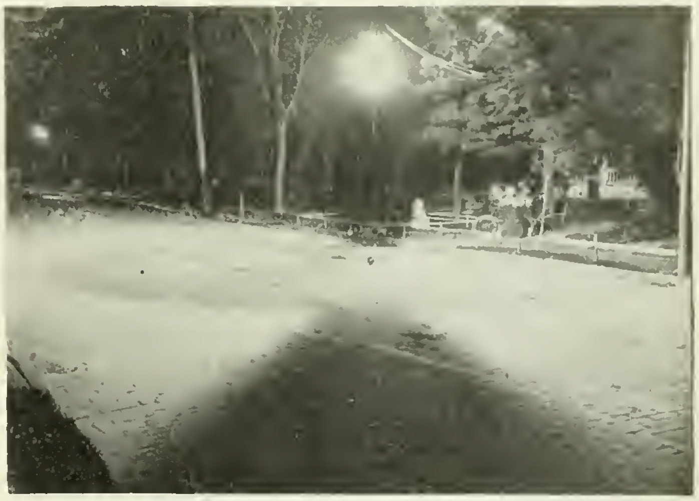


FIG. 2.—ILLUMINATION FROM AN OPEN-ARC LAMP.

The same advantages would be secured by using open arcs with properly designed diffusing globes, but these last really require the employment of a focusing lamp in which both carbons are fed into the arc at rates proportional to their rates of consumption so as to hold the arc in a fixed position. Such lamps are more complicated and less fitted to out-door use than ordinary lamps, and have not come into use for this purpose in this country.

The advantages in uniformity of distribution and in absence of shadowed areas, gained by the use of enclosed arcs, are very conspicuous. Fig. 2 shows the illumination from an ordinary open arc, aided by a globe ground below to diffuse the light and lessen the shadows beneath the arc. In spite of this the illumination is far from uniform and the side rods of the lamp, on account of the small luminous area of the arc, throw dense lateral shadows. Fig. 3 shows the result of replacing this particular lamp by an enclosed arc. The shadows completely disappear and the more powerful rays near the horizontal are shown both by the better illumination along the street and by the glare that evidently entered the camera. These results are very striking, and amply justify the present tendency to replace open by enclosed arcs, quite irrespective of the lessened cost of carbons and of trimming in the latter case.

Enclosed continuous-current arcs can be operated about 100 hours with one pair of carbons; in other words, they have to be trimmed only about once a week in all-night street lighting, while the ordinary open arcs require trimming daily under like circumstances. The resulting saving in labor and in carbons is variously estimated, and changes somewhat with local conditions, but the weight of evidence indicates a net saving of about $10 per year per lamp, the same energy being used in each case.

Of late a strong inclination has developed toward the use of alternating-current lamps, worked in series like the others through the aid of constant-current transformers or automatic regulators, which take the alternating current at constant voltage and deliver a current constant in amount, but varying in voltage according to the load to be carried. To discuss these interesting mechanisms in detail is without the purpose of this paper. Suffice it to say, that they do their work extremely well, although at the cost of certain inconveniences, less on the whole than those attending the use of ordinary arc generators. As already has been noted the alternating arcs demand a little more energy relatively than continuous-current arcs, but, as a rule, this loss is fully compensated by the more economical distribution of current rendered possible. The enclosed alternating arcs require slightly more expensive carbons, and rather more frequent trimming than the enclosed continuous-current arcs. As a rule, one pair of carbons will last 75 or 80 hours, and the street lamps must be trimmed once in five or six days, but a considerable saving in carbons and labor is still effected. It probably amounts in average cases to about $8 per year per lamp.

The smaller intrinsic brilliancy of enclosed arcs enables some gain to be made by placing them lower than 25 ft., perhaps no more than 18 or 20 ft., which means a still further gain in effective lighting. As between continuous current and alternating-current arcs taking the same current the former are distinctly more powerful but either at 6.6 amperes can replace the open arcs either of 1200 or 2000 nominal candle-power, lamp for lamp, and give equally satisfactory illumination. In new installations the alternating lamps may advantageously be spaced a little closer than the continuous-current enclosed arcs, as the curves of Fig. 1 indicate.

There is no question that where plenty of light is wanted in a street comparatively clear of trees, well distributed arc lights give by far the best results yet attained. But where, as in many residence streets in the smaller cities the whole roadway is well shaded by trees, arc lamps as ordinarily installed, find their usefulness greatly limited by shadows. If the foliage does not come too low good results can be obtained by putting the arcs on cross suspensions over the center of the street at a height of not over 18 to 20 ft. In this case the enclosed or otherwise shaded arcs have an immense advantage, as they can thus be swung low without seriously dazzling the eyes, and throw shadows less intense than the open arcs.

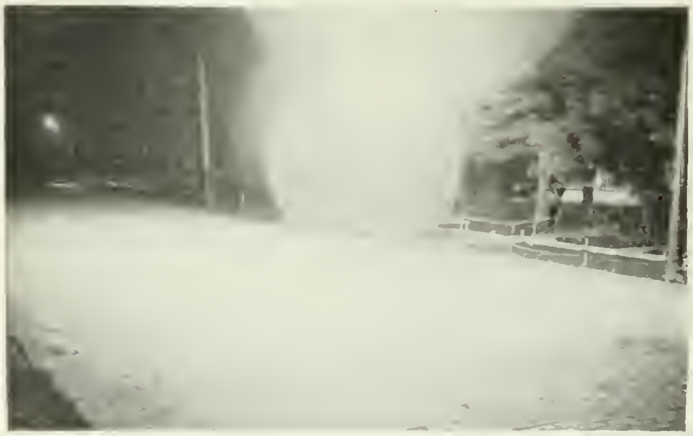


FIG. 3.—ILLUMINATION FROM AN ENCLOSED-ARC LAMP.

But there are streets so well shaded that even arcs so placed are at a disadvantage, and there are also many cases in which there is no real need of a brilliant illumination, but merely enough light is desired to make the way fairly clear. Economy also sometimes dictates caution in the expenditures for street lighting, and in such cases incandescent electric lamps or gas lamps are capable of doing good service at comparatively moderate cost. The incandescent lamps used for such service are nearly always operated in series, either on the same circuits as arc lamps or on separate series circuits by themselves. In the former case the lamps are generally 50, 65 or 100 candle-power, made to take a constant current corresponding to that used for arcs. In the latter case the incandescents are generally of 16, 25 or 32 candle-power, worked in series upon an alternating-current circuit of 1000 or 2000 volts, taking 2 to 4 amperes. The running conditions in either case are rather severe, owing to the likelihood of fluctuations in current, and incandescent lamps intended for such service are rarely of higher efficiency than 3.5 to 4 watts per candle.

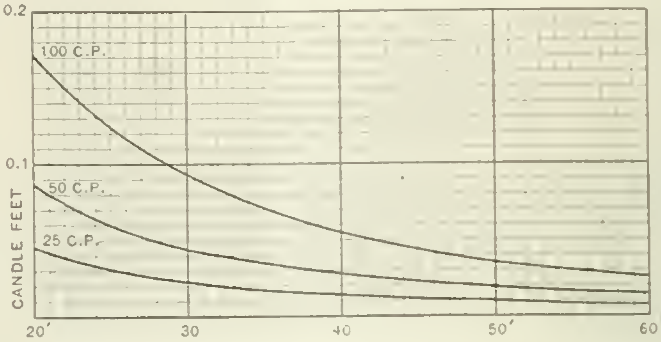


FIG. 4.—ILLUMINATION CURVES OF INCANDESCENT LAMPS.

In the case of gas lighting, the present tendency is to use mantle burners giving initially 50 to 100 candle-power. Their color is comparatively inoffensive in street lighting, and they can be run at very low cost, but outdoor conditions seem to tend to rapid deterioration of the mantles, so that in practice it is difficult to find a street in which most of the mantles have not long outlived their usefulness. Incandescent electric lamps deteriorate fast enough, but in street service even they hold their brilliancy much better than the mantle burners. The moral is that in using either of these illuminants a very liberal allowance should be made for falling off in candle-power.

As in the case of arcs, the illumination should be computed from the distance, height and light-distribution curve of the radiant. For incandescent lamps of 25, 50 and 100 candle-power the resulting illumination curves are shown in Fig. 4, which may be compared with Fig. 1. It is clearly evident therefrom that such lights should hardly be spaced much over 120 ft apart, even when of 100 candle-power, while those of 50 and 25 candle-power should be spaced somewhat nearer. If they held their brilliancy well, one might space them further, but, in fact, it is undesirable. In using the above curves for mantle burners it should be noted that one such burner corresponds approximately to a 50-cp incandescent electric lamp, being somewhat better in the early stages of its life, but losing brilliancy rather rapidly.

In heavily shaded streets incandescents and mantle-burners may best be used bracketed out a few feet from the curb, with alternate lamps on opposite sides of the street. One hundred-candle-power lamps spaced in this way with 250 ft. between consecutive lamps on the same side, or even 300 ft. under favorable conditions will produce a fairly lighted street, and 50-cp lamps spaced a little closer, say, at 175 to 200 ft. on each side, will do even better, but except for use in shaded streets arcs are much to be preferred.

When close economy is an object, 25-cp lamps spaced at 150 ft. between lamps on the same curb, or mantle-burners similarly placed will give tolerable lighting, but when in suburban districts lights must be economized it is better to trust to arcs spaced even so widely as to leave regions of comparative darkness between them.

Whenever possible, lights should be so located at street corners as to shine effectively in all four directions. They should be placed preferably on long mast arms on on cross-suspensions, unless in a fairly clear street, where pole taps or short brackets are effective. One small but useful point in locating lights is as follows: Never locate a lamp, particularly an arc at the curb squarely opposite a crossing, for the shadow of one walking on the crossing plunges his way into inky blackness as soon as he has passed the light.

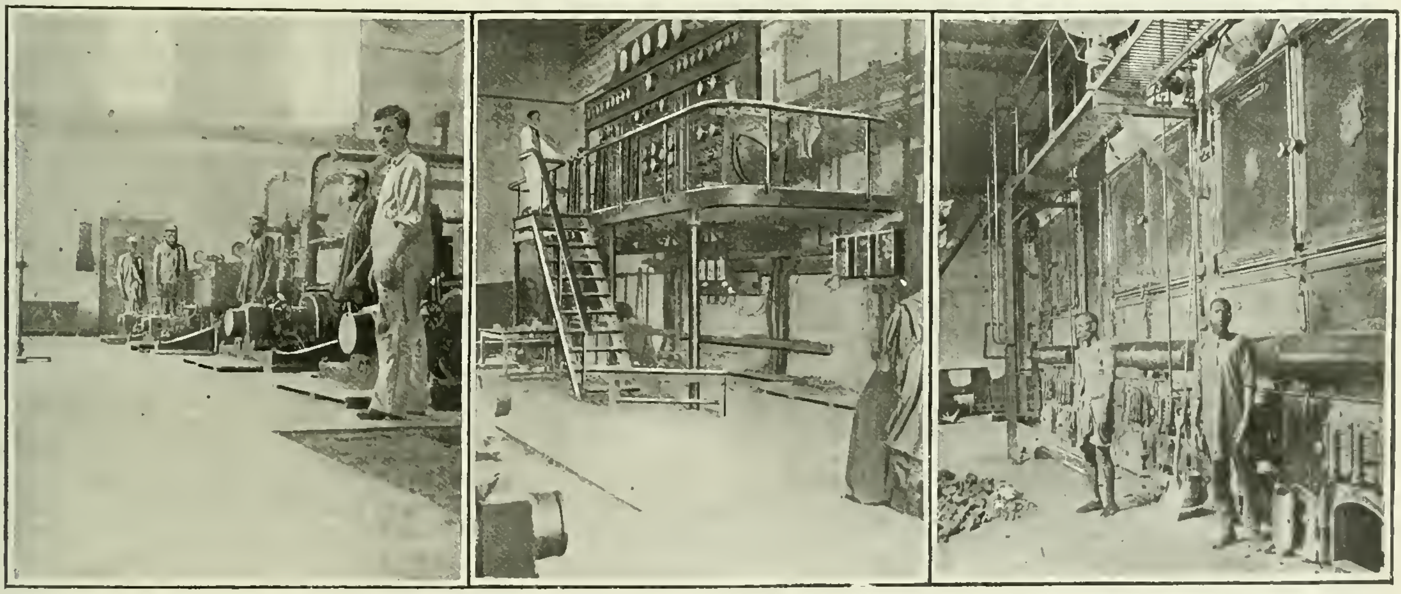
Squares and open spaces should be treated somewhat in the same manner as streets, but if the spaces are clear the lights may well be placed higher than in street lighting, 30 to 40 ft. being advantageous. In well shaded spaces one may use lights of small intensity to considerable advantage, but ordinarily arcs do the best work. As to intensity, the lighting depends on the character of the space, but it should never be less than in a well-lighted street. Now and then such lighting drifts naturally into a species of scenic illumination, the object being to bring some fine square into brilliant relief. Occasionally in such work incandescent lamps can be massed with admirable results, although in general it is not advisable to mix arc and incandescent lighting.

The arrangement of public lights should be more or less influenced by the general illumination of the private premises along the streets. In large cities it often happens that through the evening hours when the citizens are much abroad the sidewalks are fully lighted by the stray illumination from windows. In such instances the public lighting can be well directed toward special points where it will do the most good, care being always taken to see that the illumination does not fall below minimum requirements when the batches of private lights are out. In small cities there is comparatively little aid of this sort. The most troublesome problems are those connected with the environs of such cities where miles of sparsely settled streets must be dealt with.

Electrical Development in India.

Considerable attention has been devoted of late to the subject of electrical development in India, and the plans now adopted for such work as the long distance transmission in Mysore, are likely to set an example for other portions of the British Empire. The larger Indian cities are taking up questions of local lighting and trolley traction, and a good market bids fair to spring up. The fact that American apparatus has been ordered for the Mysore transmission is said to be only an indication of readiness to buy apparatus here. United States Consul-General Patterson, of Calcutta, has recently made an interesting report on the subject, which is supplemented and confirmed by advies from our own correspondent.

He states that the past year has been marked by a great development of electrical enterprise in India. The largest scheme is, as noted, that at Mysore, where the waters of the Cauvery Falls are being harnessed for the benefit of the gold mines. In Calcutta, the tramways company will shortly adopt electrical traction, and will require dynamos of the same size as those ordered for Mysore; but there is no water power available in Calcutta, no one as yet having essayed to chain the mighty Hooghly. But the largest dynamos yet ordered for India are those for the Calcutta Electric Supply Corporation, whose engineer, Scott Moncrieff, has just returned from England, having arranged for the delivery of two sets of engines and dynamos, each of 1100 horse-power. The present somewhat limited plant is illustrated in the accompanying views.



Glimpses of the Central Station, Calcutta, India.

As already noted by our correspondent some months ago, the electric fan, driven by current from the corporation's mains, has already acquired great popularity in Calcutta. These fans are in most cases placed 15 ft. apart. In the cathedral, which is pronounced the coolest place in Calcutta in the hot weather, they are placed ten feet apart. The central telegraph office and the high court have adopted the fifteen-foot standard, and private installations vary in their number of fans according to the ideas and pecuniary resources of the householders. The Electric Supply Corporation has introduced a system of hiring out fans at a charge of four rupees ($1.28) per month for each fan, which is likely to prove popular. The electric light is also particularly useful in India, and its widespread use in Calcutta shows how well it is appreciated.

In addition to the above instances of the use of electricity, it is announced the workshops of the East Indian Railway and of the Bengal-Nagpore Railway will shortly be driven by electricity, the shafting, belts and pulleys giving place to electric motors.

Preparations for the Institute Conversazione.

Few recent events in electrical circles have excited so much general interest as the approaching conversazione of the American Institute of Electrical Engineers at Columbia University on April 12. A large committee is busily at work, applications are coming in briskly from members for tickets for themselves and guests, and a most interesting programme of exhibits has already been provided, although at this writing the list is not complete in all its details. Secretary Pope requests us to ask members who desire to attend to send in their requests for tickets immediately in order that due provision may be made, and that the work of the various sub-committees may be facilitated. The following members and scientists will be present and describe new and novel inventions and apparatus, perform experiments, etc. The Engineering Building of Columbia University, its museums and laboratories, will be open for inspection: Andrews, W. S., Revolving High Frequency Spark: Aluminum Cell; Baillard, E. V., Faradmeter and Bridge; Clark, C. L., Phase Indicator; Clift, A. F., Telpherage System; Crocker, F. B., Magnetic Liquids; Geyer, Wm. E., Incandescent Lamp Experiments; Donaldson, W. W., Gould Storage Battery; Hammer, W. J., Langley's Bolometer. Collection of Balloon Photographs. Nernst Lamps in Operation; Hewitt, Cooper, Vacuum Tube Lighting in Operation; Hutchison, M. R., Micro-Telephonic Apparatus for Deafness; Laws, F. A., Radiographs of A. C. Wave Forms; Louis, Otto T., Electric Furnace. Holtz Machine and Ohmmeter; Palmer, H. R., Telautograph, working between Columbia and Chicago Universities; Perret, Barrett and Meadowcroft, Storage Battery; Pupin, M. I., Original apparatus used in developing recent invention for improvement in Long-Distance Telephony; Reber, Captain Samuel, Wireless Telegraph. Army Telephone Outfit; Robinson, Wave Form Indicator and Frequency Indicator; Rice, M. P., New X-Ray Apparatus; Ryan, H. J., Radiographs of A. C. Waves; Sanville, H. F., Copper Splicing Machine; Scott, Charles F., Alternation Meter, Phase Shifting Transformer, Power Factor Indicator, etc.; Thomson, Elihu, Dynamo Static Machine, Electric Gyroscope and Bohnenberger Sphere; Townsend, Fitzhugh, Wave Tracer.

Losses of Heat from Underground Pipes.

By Alton D. Adams.

So rapid is the loss of heat from bare pipes containing hot water or steam, that their use in any extended system of underground distribution for general warming is entirely impracticable. Trials by several experimenters have shown the loss of heat from bare steam pipes to be five to six times as great per square foot as the loss from pipes of equal temperature covered with the best kinds of heat insulation to a thickness of one inch. Dry, still air is one of the poorest conductors of heat, and the best materials for insulating hot pipes owe most of their effectiveness for the purpose to the fact that they consist mostly of air confined among their fibers. This is illustrated by coverings of loose wool, feathers and mineral wool, each of which has solid matter to only about 5 per cent of its bulk. All of the heavy materials that are used for pipe insulation are comparatively ineffective, in nearly the same proportion that their weight increases. Animal and vegetable fibres, while desirable as to their insulating properties, are not generally suitable for the insulation of steam and hot-water pipes, because their structure is changed and even destroyed, together with most of their insulating properties, by long exposure to high temperatures. As the thickness of the best insulating materials on hot pipes is made greater the loss of heat is not reduced as fast as the radial depth of the coverings is increased, and a point is soon reached where the cost for additional covering is enough to offset its advantage.

A radial depth of one inch is much used for pipe coverings, but this is a smaller amount than the possible saving in heat warrants. Thus it has been found for covering of hair felt with a thickness of four inches, the loss of heat is about four-tenths, and with two inches six-tenths of the escaping heat where a covering only one inch thick is used. The less effective substances for heat insulation, show much smaller gains for an increase of thickness, as in the case of sand, which allows the escape of nearly seven-tenths as much heat when six inches as where only one inch thick. Still poorer heat insulators, such as dry clay, show a nearly constant loss of heat from pipes, whatever the radial depth from one-half inch up to six, while for solid carbon, nearly twice as much heat escapes where it is applied to a depth of six inches, as where it is only one-inch thick. Wood is a rather poor insulator of heat, and allows a comparatively large loss when it is used as a covering in contact with the pipes, its use in this way is also open to the objection that heat changes its structure and may lead to combustion. Loose calcined magnesia and mineral wool are among the best non-combustible materials for the insulation of hot pipes. A method of insulation that has been employed in a number of cases for underground heating pipes includes for each pipe a box or bored log of white pine, with an opening large enough to allow about one inch of air between the surface of the pipe and the wood all around. While it is claimed that this method of pipe insulation is very effective, there are no reports of accurate tests at hand to show just what has been accomplished with it. Quite a number of careful tests have been made to determine the losses from hot pipes with coverings of a mineral nature, of which loose calcined magnesia, light carbonate of magnesia and mineral wool are among the best examples. These coverings are usually placed in contact with the pipe surface and with a radial thickness of about one inch.

Whatever the covering used on heated pipes, it is highly important that it be kept dry, since water largely increases the heat-conducting power of any substance employed for insulation. It is especially important that water be kept away from the outside surfaces of steam and other pipes that are at or above a temperature of 212 degs. F., because the steam formed at this temperature and atmospheric pressure absorbs heat very rapidly. The losses of heat per unit of time, from a steam or hot-water pipe, whether insulated or not, depends on the difference in temperature between the pipe itself and the air or other substance outside of a bare pipe, or outside the insulation of a covered pipe. To determine the loss from any particular pipe it is therefore necessary to know the temperature of the air in the trench and that of the steam or water in the pipe. The temperature of the trench in which the pipe is laid can be only approximately determined for the average practical case, but that of the circulating steam or water is easily found at the station and on the premises of consumers. From the temperatures found for the steam or water at the last mentioned places, an average may be fairly taken for the temperature of the underground pipes. A thermometer may well be introduced at points in conduits for underground pipes, and the temperatures thus taken, but such results are subject to variations with changes in the weather, the amount of water in the soil and the degree to which the circulating water is heated or the pressure of the steam employed.

In heat distribution by water in underground pipes, the average temperature of the pipes may be as low as 150 degs. in mild weather or at some hours of the day in cold weather, while as much or more than 187 degs. when the demand for heat is at its greatest. If steam is distributed at 10-lbs. gauge pressure its temperature is 240 degs.; at 20 lbs., 259 degs.; at 50 lbs., 297 degs., and at 100-lbs. gauge, 338 degs. F. The temperature of distributed steam is much more nearly constant than that of hot water, because water falls in contained heat at the same rate that it cools, while nearly all of the heat that steam gives up is latent. Thus steam, in falling from 20-lbs. gauge pressure to that of the atmosphere, yields 15 heat units per pound, and drops in temperature from 259 to 212 degs., but on the change from steam at 212 to water at 212 degs., 966 heat units are given off per pound. A certain amount of pipe surface in an underground system of heat distribution will, therefore, usually suffer a greater loss where steam than where water is used.

It has been found that heating pipes covered to a thickness of one inch with the best insulating materials of a mineral nature, such as mineral wool and loose calcined magnesia, give off approximately 0.5 heat unit per square foot of pipe surface hourly per degree difference in temperature between the pipe and the surrounding air. For bare steam or hot-water pipes the loss of heat may easily be 2.5 units hourly per degree difference of temperature between the pipes and air, for each square foot of their surface. These figures indicate that about five times as much heat is lost from steam and hot-water pipes when bare, as when insulated with a first-class covering one inch thick. Where the quality of pipe insulation, and the temperature of the conduit in which pipes are laid, is known, the rate of loss of heat per square foot of pipe surface can be readily predicted, for any temperature of the circulating medium. Thus, with steam at 20-lbs. gauge pressure, corresponding to a temperature of 259 degs. and a temperature of 100 degs. in the pipe conduit, the loss of heat per hour from each square foot of outside surface of the pipe, when covered with one inch of first-class insulation, is $(259 - 100)\ .5 = 79.5$ units. At a steam pressure of 50 lbs., corresponding to 297 degs., the hourly loss of heat is $(297 - 100)\ .5 = 98.5$ units, and at a pressure of 100 lbs. and 338 degs. of temperature $(338 - 100)\ .5 = 119$ units per square foot. With the same assumption as to temperature of conduits, hot-water pipes with an average temperature of 187 degs. corresponding to conditions in very cold weather have a loss of $(187 - 100)\ .5 = 43.5$ heat units hourly per square foot. In comparatively mild weather, and during a part of each 24 hours, in very cold weather, the average temperature of hot-water pipes may readily be as low as 150 degs., so that the hourly loss of heat per square foot of pipe surface is only $(150 - 100)\ .5 = 25$ units. It should be clearly understood that the figures here given for loss of heat from pipes are based on the outside surfaces of the pipes themselves, for both bare and insulated pipes, and do not refer in any case to the surface areas of coverings. As underground pipes for steam distribution are constantly at a temperature above the boiling point of water, any water that reaches them is rapidly converted into steam, besides operating to destroy the effectiveness of their covering, since water is a good conductor of heat. The formation of steam is much the more serious cause of loss where water reaches steam pipes. Steam formed at atmospheric pressure from water at 40 degs. F. absorbs 1139 heat units per pound. The evaporation of 1 lb. of water at the surface of a pipe conveying steam at a pressure of 1 to 20 lbs., thus wastes as much heat as is lost from $(1139 \div 79.5) = 14$ square feet of the surface of such pipe hourly when well insulated. Unless pipes and their coverings can be kept dry the heat wasted by evaporation becomes so large in amount as to render paying operation impracticable.

The loss of heat per hour for each square foot of pipe surface having been established for any case, the total amount of heat escaping from the entire system of distribution may be calculated when the surface areas of all of its pipes are known. When the loss of heat from a system of pipes is determined in this way the result may be compared with those obtained by other methods, and also with the amount of heat delivered to consumers. In the case of water and steam distribution the loss of pressure should be compared with the waste of heat in the pipes to see whether their diameters may be changed to advantage. For water pipes the loss of heat is readily computed when the quantity of water that completes the circuit of the system per unit of time, its temperature when leaving and on returning to the central station, and the drop of temperature while on the premises of consumers are known.

Assume a case, for example, where 1000 lbs. of hot water leave and enter a heating station per minute. Let the water start from the station with a temperature of 212 degs. and return to it with one of 162 degs., a difference of 40 degs. existing between the supply and return pipes where they enter the heated building. As the water drops from 212 to 162 degs. in temperature, each pound of it gives up almost exactly 50 heat units, so that the 1000 lbs. yield $1000 \times 50 = 50{,}000$ units of heat per minute. Since 40 degs. of the fall in the water temperature takes place in the heated buildings one-fifth of the total heat supplied is wasted by the distribution pipes. A calculated loss of heat based on the surface areas and temperature of the hot-water pipes and on the temperature of their conduit should agree with the loss found above.

When a system for the distribution of hot water is to be designed the loss of heat from the pipes cannot be determined from data covering the quantity of water moved and its fall in temperature in the several parts of the system, because this data does not exist; the loss must therefore be calculated. In order to compute the loss of heat from hot water pipes it is necessary to make certain assumptions which can easily be carried out in practice. Take for illustration, a case where water is to leave the heating station at a temperature of 212 degs., pass through outflow and return pipes where it suffers a loss of 10 degs. in temperature, and let this loss of temperature occur to the extent of 6 degs. in the outflow pipe and 4 degs. in the return pipe. It is now desired to know the fall in the temperature of the water while it is in the heated buildings, and on its return to the station. The outflow and return pipes, through which this water passes between the heating station and the heated buildings, are presumed to be laid side by side in the same conduit, so that they are of equal length and the temperature of the surrounding air is uniform for both. As the fall of temperature has been assumed to be 6 degs. in the outflow pipe, between the station and the distant end, the average temperature for this pipe is $212 - 3 = 209$ degs. The average temperature of the return pipe obviously depends for its value on the temperature of the water as it leaves the heated buildings. Let this temperature of the circulating water as it enters the return pipe be represented by X, then since the total fall of temperature in the return pipe is by assumption 4 degs. its average temperature is equal to $X - 2$. As the same amount of water passes through both the outflow and the return pipe, the heat energy lost by the water while it is in each pipe is directly proportional to the total fall of temperature therein. On the assumption of a fall of 6 degs. in the outflow pipe and 4 degs. in the return pipe, the loss of heat must be 1.5 times as great in the former as in the latter. Both the outflow and the return pipe are of equal length, diameter and outside surface, being in one conduit the temperature of the surrounding air is the same for each. It follows that the excess of the average temperature of either pipe over the temperature of the air in the conduit bears the same relation to the like excess of temperature for the other pipe, that the energy lost from the first pipe does to that from the second. It seems improbable that the temperature of the air in the conduit will ever fall below 60 degs. F. when the heating system is in operation, so this figure may be assumed in the present case.

The average temperature for the outflow pipe was found above to be 209 degs., and that for the return pipe $X - 2$ degs. The difference between the pipe and conduit temperature is thus $209 - 60 = 149$ for the outflow pipe and $X - 2 - 60$ for the return pipe. As the loss of heat from the outflow pipe is 1.5 times as great as that from the return pipe the equation $(149) = (X - 62)\ 1.5$ is established. Reducing for the value of X, $1.5X = 242$, and $X = 161.3$ degs. As X was taken to be the temperature of the circulating water when it leaves the heated buildings, and the fall of temperature in the return pipe is 4 degs., the final temperature of the water entering the station is $161.3 - 4 = 157.3$ degs. As the water leaves the station at 212 degs. its total fall in temperature is equal to $212 - 157.3 = 54.7$ degs., and since a drop of 10 degs. occurs while the water is in the outflow and return pipes, the fall of the water temperature in the heated buildings is 44.7 degs. Of the total heat given off by the water from the time it leaves the station until its return, in this case, $44.7 \div 54.7 = 81.7$ per cent, is used in the heated buildings, and 18.3 per cent lost from the distribution pipes.

The fall in the temperature of water while in buildings where the air is maintained at a given degree of heat, may obviously be varied by changing the velocity of the flow or the amount of radiating surface through which the water passes. If such changes are made there will be a corresponding variation in the relative losses of temperature for the water in the outflow and return pipes. The greater the fall in the temperature of water while in the heated buildings, the smaller is the amount of water that must be circulated per unit of time to supply a certain amount of heat. But as a large fall in the temperature of the water while in buildings implies an increase over the ordinary amount of radiating surface, a limit is soon reached beyond which a further reduction of the water temperature is not desirable. Obviously the loss of heat suffered by circulating water in distribution pipes will vary with the time it remains in them, as will also the relative loss of heat in the outflow and the return pipe. If the relative amounts of heat escaping from circulating water in the distribution pipes and in the heated buildings is not satisfactory, the velocity of the circulation, the sizes of the distribution pipes, the amount of radiating surface in heated buildings or the initial temperature of the water may be changed. When a new system for hot-water distribution is to be designed, if the assumptions first made for the relative losses of heat from the outflow and return pipes do not lead to satisfactory figures for the fall in the temperature of water while in the heated buildings, other assumptions may be made, and the fall of water temperatures for buildings again marked out.

It may be noted that the above reasoning, based on assumptions as to the initial temperature of the circulating water and on the losses of temperature in the outflow and return pipes, is entirely general as to the total amount of water sent out from the station per unit of time or the length of distribution pipes, or their diameters. It may therefore be desirable to illustrate the application to pipes of given length and diameter, or to a case where a certain amount of heat is to be delivered per hour. Take for this purpose the case of two seven-inch wrought iron pipes, laid side by side in one conduit from a heating station to a group of buildings one mile distant. Let the amount of heat escaping from these pipes and supplied to the buildings per minute be determined, also the velocity of circulation, for the case where the temperature of the water on leaving the station is 212 degs., or its return to the station 157.3 degs., and where there is a drop of 6 degs. in the temperature of the water while it is in the outflow pipe, and 4 degs. while in the return pipe.

Further, let the loss of heat from each square foot of pipe surface be 0.5 heat unit per hour for each degree difference in temperature between the pipe and the air of the conduit, and let the temperature of the conduit air be 60 degs. The outside circumference of a seven-inch wrought iron pipe is almost exactly 2 ft., so that a pipe of this size one mile in length has an outside surface of $5280 \times 2 = 10{,}560$ square feet. If this mile of pipe is so insulated that 0.5 heat unit is lost from each square foot of its surface hourly, for each degree difference between its temperature and that of the conduit air, the total hourly loss from the mile of pipe is $10{,}560 \times .5 = 5280$ heat units per degree of temperature difference. As the temperature of the water on entering the outflow pipe is 212 degs. and its loss therein 6 degs., the average temperature of this pipe is 209 degs., and its elevation above the temperature of the conduit $209 - 60 = 149$ degs. The loss of heat from this pipe is thus $5280 \times 149 = 786{,}720$ heat units per hour, 13,112 per minute, and 218.4 per second. Since the temperature of the water on entering the station from the return pipe is 157.3 degs. and there is a fall of 4 degs. in its temperature in this return pipe, the average temperature for the water in this pipe is $157.3 + 2 = 159.3$ degs. The air in the conduit is at 60 degs., so that the temperature elevation of the return pipe is $159.3 - 60 = 99.3$ degs., and the heat loss from it is $5280 \times 99.3 = 524{,}304$ units per hour, 8768.4 per minute and 146.1 per second. As the loss of heat per second from the outflow pipe was found above to be 218.4 units, the total heat loss from the two pipes is $218.4 + 146.1 = 364.5$ units for that time.

It was shown above, in the reasoning on the general case, that the 10 degs. of temperature lost by the circulating water while in the distribution pipes represents 18.3 per cent of the total amount of heat given off by this water from the time it leaves the heating station until its return. It follows that the total heat given off by the circulating water in this case amounts to $364.5 \div 18.3 = 1992$ units per second. As 1 lb. of water yields one heat unit in cooling 1 deg. F., to yield 1992 heat units with a fall of 54.7 degs. in the entire heating system, the weight of water leaving and also that entering the station must equal $1992 \div 54.7 = 36.4$ lbs. per second. At 212 degs. the weight of water is 59.8 lbs. per cubic foot, so that $36.4 \div 59.8 = .609$ cubic foot must complete the circuit of the system in this case per second. The internal area of the cross-section of a standard seven-inch wrought iron pipe is 38.7 square inches, or .268 square foot. To pass .609 cubic foot of water through an opening of .268 square foot per second the velocity of flow must be $.609 \div .268 = 2.27$ ft. per second. If this velocity is not suitable, new assumptions may be made and results for another velocity calculated.

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An American Smelting Plant at Ellesmere Port, England.

An interesting plant of American electrical and steam apparatus is now in use at Ellesmere Port, England, for use in the Fry smelting plant of the Smelting Corporation, Limited, for treating refractory sulphide ores. In this process the flux adopted to overcome the difficulties encountered in the smelting of ores containing zinc, is sulphate of soda and oxide of iron. With this flux, the ores after their calcination are passed through an ordinary cupola. Nearly all the lead and silver is at once obtained as bullion, and the zinc passes into the slag to be dealt with in that shape. The works are said to be the largest of their kind in England, and furnish a striking illustration of the many advantages of electric power.

The works are close to the Manchester Ship Canal, and the power plant was laid out before the smelters had been erected. It comprises two Crocker-Wheeler 400-kw direct-current generators, operating at 250 volts and direct connected to two horizontal cross-compound E. P. Allis engines, running at 100 r. p. m., with a steam pressure of 120 lbs. They are arranged as shown, side by side, with vertical Allis jet condenser placed behind the cylinders and below the level of the floor. There are six Babcock & Wilcox boilers in three batteries, with automatic stokers and forced draft furnished by two electrically driven fans. The delivery from the feed water heater is taken directly into a Hoppes purifier placed above the boilers.

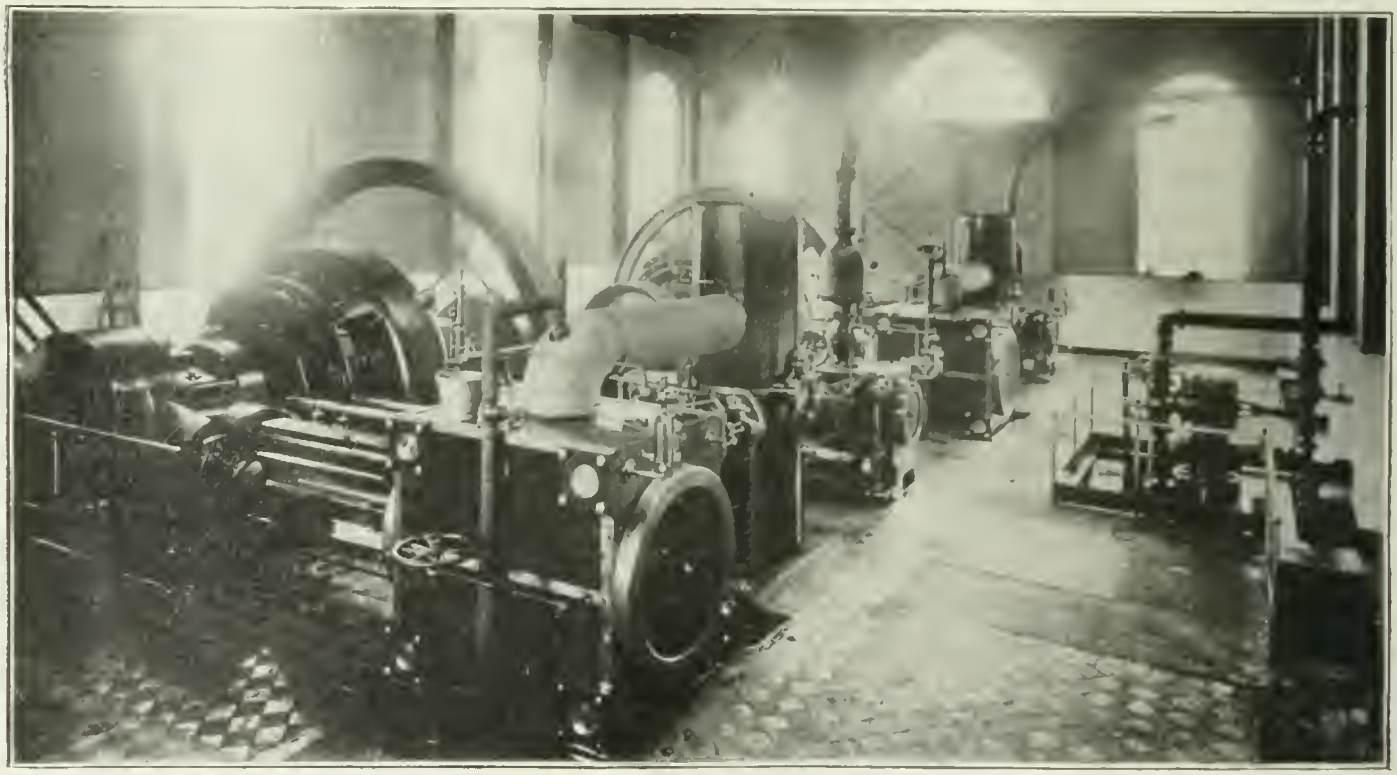

Fig. 1.—Generating Plant, Ellesmere Smelting Works, England.

The current from the generators after being taken to the switchboard is distributed to no fewer than 30 Crocker-Wheeler motors, ranging from 5 to 100 horse-power, used for a variety of purposes, such as blowing, pumping, crushing, grinding, briquetting, hoisting, driving the revolving furnaces, fans, etc., and fed, with a large number of arc and incandescent lamps, by 5 miles of main cable circuits.

In operating the plant, the ore is brought by the Ship Canal alongside the corporation's wharf, suitable for vessels of 5000 tons, and is discharged at this point by a Temperley transporter capable of discharging 60 to 80 tons per hour, worked by a 35-hp motor. The transporter delivers the ore into the crushing plant adjoining the wharf. This plant has a capacity of 90 to 100 tons a day, and is worked by a 100-hp motor. It was built by the Gates Iron Works, of Chicago, and is so fitted with elevators and transporters that the ore after being crushed is automatically moved to the ore bins adjoining. Thence the ore is hauled to the calcining department, equipped with 10 calciners of the Godfrey revolving table type. The roof of these calciners is fixed, but the floor revolves. There is an open sector in the roof where the ploughs are fixed. These ploughs stir the ore as it moves against them, and, being in the open air, are kept cool, and the oxidizing advantage of cool air is fully obtained. The grate is attached to the calciner at one side of the open sector, and the gases pass round the furnace and out at the flue on the other side of the opening, and thence to the dust chambers and big stack. The roof is low to bring the heat of the gases effectively to the ore. Each pair of calciners is driven by a 3-hp motor. After

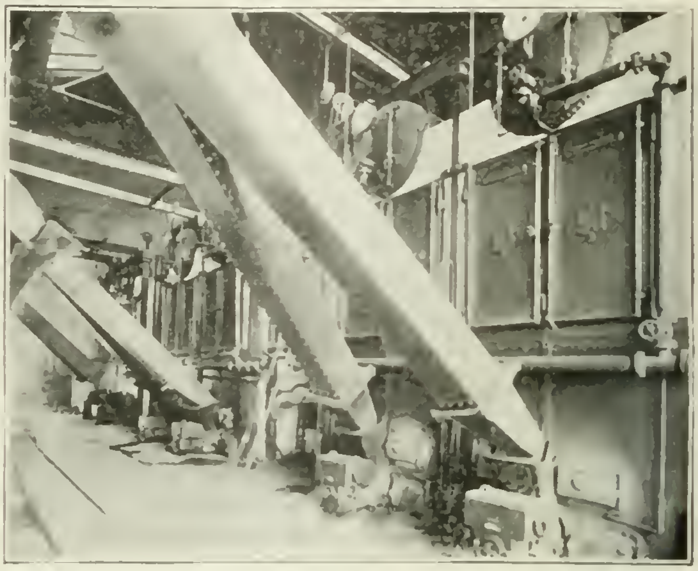

FIG. 2.—STEAM PLANT, ELLESMERE

calcination the ore is briquetted. The cupola is of the steel jacketed type, made by Fraser & Chalmers, of London. It is 18 ft. high and 140 in. by 42 in. at the tuyeres. At present the corporation does not desilverize the bullion that is obtained from the cupola. Slag is tapped at each end, and, after passing through settling pots, runs into the usual conical molds, and is taken thence to the zinc department. The blower is driven by a 100-hp motor. The pressure of air varies from 1½ to 1¾ lbs. More than 90 per cent of the lead and 80 per cent of the silver are recovered in the bullion, the remaining 20 per cent of the silver passing into the zinc slags, and being recovered in the zinc department. The slags are mixed with a small quantity of fuel, and the heat of the Siemens furnace does the rest. The oxide fumes, after passing through the regenerators, are taken through cooling towers, and then into dust flues. The flues are so arranged, that by means of baffles and pockets the dust is caught to a very considerable extent. The slag remaining in the furnace is then tapped into a large 20-ton ladle, where it settles into a heavy material called matte, and a lighter material, which is the worthless slag and is thrown away. The matte, however, which is about a quarter of the whole, is found to contain the bulk of the silver that was in the slags and any of the zinc that has not been driven off as oxide. This matte is weathered and crushed, calcined to drive off sulphur, and then mixed with the ore, briquetted and smelted. It is specially valuable as an addition to the ore, for it has, owing to its contents of iron and soda, a specially good influence in keeping the furnace open. Of the zinc entering this department, about 70 per cent is now being recovered, but the corporation considers that this is by no means the whole of what will be caught later on.

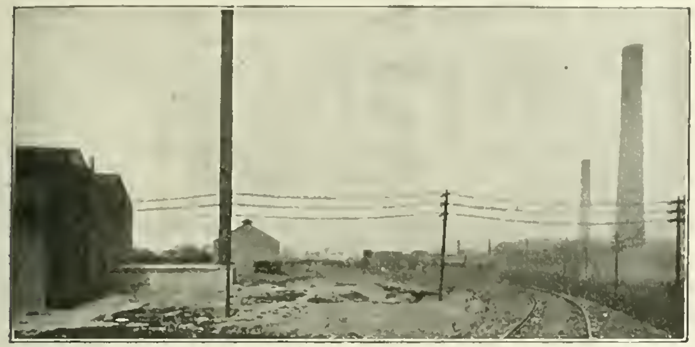

FIG. 3.—VIEW OF TRANSMISSION LINE.

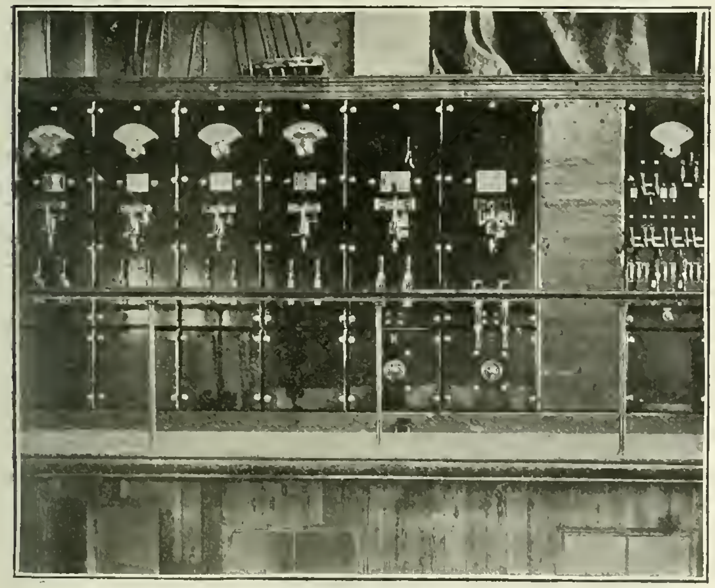

FIG. 4.—SWITCHBOARD, ELLESMERE PLANT.

The corporation, in conjunction with the United Alkali Company, is working out a very interesting method of recovering the zinc from the zinc oxide by means of electrolysis.

The power plant was installed by Robert W. Blackwell & Co., Limited, whose work in the introduction of American apparatus in England and on the Continent of Europe is already well known to our readers.

Telephone Rates in Canada.

Upwards of 40 petitions from municipalities in Ontario, have been presented to the Dominion House of Commons, praying that the Bell Telephone Company be restrained from increasing the rates to subscribers. The company has given notice of application for legislation to increase its capital stock, and the bill, which was to include other provisions seeking power to advance rates, now only asks power to increase the capital stock to $10,000,000.

The company has for years persistently sought to nullify the regulation of the Dominion Parliament, which regulation prohibits any increase of the rates charged subscribers under the law of 1892. At that time the Canadian Parliament provided that the then existing rates for service should not be increased without the authority of the Railway Committee of the Privy Council of Canada. On several occasions since then, however, the company has tried to free itself from this regulation of rates, and regain its freedom of charge. The company, it is alleged, is now evading the clear intent of the law by charging higher rates for new subscribers, and municipalities throughout Ontario are, therefore, petitioning the Dominion Parliament to put a stop to this discrimination.

When the case in respect to rates was last argued before the Railway Committee, about three years ago, the company in support of its contention presented statements showing that, in 1897, its revenue was $56,147 less than the cost of operation in the city of Montreal, while Toronto showed a loss of $44,900 and Ottawa $10,000. The fact was brought out, however, that in this cost of operation there was included a large sum for plant renewal. The general financial statement also was apparently against the company's plea, for it showed that, outside the large cities, the company earned $689,000 in 1896 on an expenditure for operation of $321,000. In the company's annual statement for 1898 there were shown to be 32,082 instruments in use in Canada, the revenue being from ordinary exchanges, $935,703; long-distance service, $264,455, and from all sources, including the above, a total of $1,302,944. In the company's financial statement for last year, the instruments in use had increased to 38,360; the revenue from exchanges to $1,125,911; from long-distance lines to $359,800, and from all sources to a total of $1,614,262. The capital increase, namely, the liability to stock and bondholders, has been from $4,497,000 to $6,200,000.

It is, however, upon the figures showing operating expenses that the company's officers base their case for an increase in rates. It is claimed that the cost of operation is increasing in greater ratio than the revenue, and that under a continuance of such conditions the business must soon cease to be profitable. The cost of operation in 1898 was $897,138 on $1,302,944 of revenue, and in 1900 it was $1,146,852 on a revenue of $1,614,262, thus making an increase of operating expenses from 68.8 per cent in 1898 to 70.1 per cent in 1900. This is regarded by the opponents of the company as too trifling to warrant any increase in the rates chargeable to the telephone subscribers, and any application having that purpose in view will not, it is said, be entertained by the Canadian Parliament.

Electrical Interests in Montreal.

The bill incorporating the extensive consolidation, known as the Montreal Heat, Light & Power Company, has passed the Quebec Legislature, and has become law in that province. The company is to have a capital of $25,000,000, of which about $17,000,000 of stock will be issued. Mr. Rudolph Forget is the chief promoter of the consolidation, which includes the Chambly Manufacturing Company, the Royal Electric and the Gas companies. The Lachine Hydraulic Company is expected to be amalgamated, and the remainder of the stock may be utilized to buy out this company if deemed essential to the success of the enterprise. The net revenues of the first three companies for the past year were over $1,000,000, and as a result of the amalgamation a still more favorable showing is anticipated. Instead of 8000 horse-power from Chambly, they would have 35,000 horse-power, with an auxiliary steam power of 20,000 horse-power. The first machinery for the additional power at Chambly will be installed by April 15, and the whole completed by the middle of July. The placing of the company's wires underground would probably take three seasons, Mr. Forget says, and work has begun on the tunnel under the Lachine Canal for the Chambly wires coming into the Queen Street station at Montreal.

Recent Electric Railway Patents.

A budget of 10 patents relating to details of electric railway equipment were issued early this year, the patents in each case being assigned to the Lorain Steel Company. Following are analyses of the patents:

A patent granted to G. H. Parmelee has for an object the provision of means for preventing of improper operation of a controller of a street railway motor by ignorant and careless motormen. Such controllers usually provide a reversing and controlling spindle, and in Mr. Parmelee's invention these spindles are equipped with cams. These cams are so shaped that the operation of one spindle will drop the handle controlling the other spindle into a socket, inaccessible to the motorman, and will not be restored until the other handle has been placed in a position so to connect the circuits in such a manner that it will be proper for its mate to be operated. Thus, in an ordinary street railway controller with the reversing lever in middle position, the controlling handle will be dropped to its inaccessible socket, and will not be restored to the reach of the motorman until the reverse lever is either at the head or back position. Conversely, if the controller handle is at "on" position, the reverse lever will be dropped into an inaccessible socket and cannot be grapsed by the motorman until the controller is turned to "off." The sockets are of such shape that neither controller handle can be removed unless it is in a proper position so as to disconnect all circuits.

A patent granted to F. W. Garrett relates to means for preventing improper manipulation of controller handles, which is accomplished by a mechanical system of cams in the following way: When the controller handle is at "off," the reverse lever is raised and can be conveniently manipulated by the motorman. With the controller handle at any of the "on" positions, the reverse lever, which is flat and semi-circular in section, is hugged tightly down against the flat plate, in which position it is very difficult to manipulate.

A patent granted to F. W. Garrett and G. H. Parmelee covers an electromagnetic latch as applied to street railway controllers, and which will prevent the controller handle from being turned beyond a predetermined notch. This latch is provided with current to make it operative by making the circuit connections of the motor such that current flows through the coils of the magnet when one of them is cut out. This throws the latch and prevents the controllers from being turned to the parallel notch where undesirable circuit conditions might obtain.

A patent granted to F. A. Merrick, which seems to be quite broad, provides for a device whereby the end bearings of electric railway motors and the circular plate carrying the same, may be secured in either the upper or lower half of the railway motor as desired. This is a much used device now common to most railway motors having divided casings, and is utilized in various modified forms.

An electric fuse box is the subject of a patent granted to E. W. Stull, where the fuse wire is held under tension and the moment that it breaks due to melting, the terminals carrying it are rapidly separated by springs. The opening of the fuse box forces the spring terminals back to a convenient position for placing a new fuse.

A device for controlling electric railway motors having numerous field coils is the subject of a patent granted to B. C. Shipman. Preliminary notches connect the field coils in multiple and place them in series with the motors. Final notches connect the field coils in series and place them in multiple with the motors. The last two notches, however, have the additional feature of placing the motors themselves, which were previously in series, in parallel for the purpose of obtaining additional changes of speed. In one of the drawings is shown a mechanical interlock which prevents one handle from being moved unless the other is in a proper position for this purpose. The main object of the invention seems to be the shunt-series combination of the field coils and the series parallel connection of the armature. The patent contains 28 claims.

A patent issued to F. W. Garrett is on a method of controlling electric motors. A friction clutch on the armature is shown in a drawing to be electro-magnetic, but an additional means of control provides for changing the motors from series to parallel relation. This latter feature is important in view of the present situation with respect to motor control.

A patent granted to F. W. Garrett provides a system for governing the use of a number of controllers by a master controller. The arrangement is electromagnetic, the spindle of the controller being provided with numerous poles corresponding to the notches and which engage themselves in magnetic interlock with a stationary pole. It is plain that the controller will assume its several positions according as the various poles are provided with exciting current. The poles on the spindle are provided with a commutator in order that their notches be successively brought into position, and means are provided for automatically opening the circuit of the motors in case the current supply fails, and keeping the circuit open until the motor controller has been turned to its off position.

A similar means for controlling several controllers by a master controller is the subject of a patent granted to E. W. Stull. The controller spindles are operated electromagnetically through the provision of numerous magnetic circuits, which engage with one another when energized, and thereby lock the controller in different position. Means are provided to protect the motors from injury or failure of current from any cause. A further object of the invention is to provide means whereby the car circuit breakers may be reset from any desired point on the car, and means are provided to indicate to the motorman if any circuit on the car be open. The invention provides for a master controller and a sub-master controller. The sub-master controller has but two positions, which are fixed by the electromagnetic device already described. Resistances are used which are cut out of circuit by solenoidal switches brought successively into play. The invention also comprises a motor reverse switch, an actuator therefor and master reversing switch which controls said actuator. The invention is quite complicated and subject to many modifications within the claims.

A patent issued to F. W. Garrett is on an alarm device for armatures. This invention is intended to give timely warning when the bearings of a motor have worn, and there is danger of surface of armature striking the pole piece. As applied to railway motors, as shown in this patent, the armature strikes a contact, thereby causing appropriate lamps suitably placed to become lighted and giving due warning of the extreme decentralization of the armature axis.

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New York Electrical Society at an Automobile Station.

A most interesting evening was spent by a large gathering of electrical people in this city on March 27, when, through the courtesy of the New York Electric Vehicle Transportation Company, the New York Electrical Society held its two hundred and thirteenth meeting at the new main station, Eighth avenue and Forty-ninth street. The society was welcomed by Mr. Henry Sanderson, president of the company. The meeting was held in one of the upstairs departments, where Mr. George Herbert Condict, consulting engineer of the company, mounted on an automobile as a rostrum, delivered a brief practical address on electric automobile work in New York City, and gave various details with regard to the system. Mr. Condict stated that the company now had over 300 vehicles in operation, with capacity for at least 700, whereas only four years ago it had but twelve in operation. He attributed the great success and popularity obtained to the fact that when he himself was unable to reach New York from Philadelphia for three days, owing to the blizzard of 1899, and when none of the horse vehicles could ply the streets of New York, the electric automobiles were found able to plough their way through the snow drifts with comparative ease. But for the performance of the electric automobiles on that memorable night, New York society would have been paralyzed, and, even as it was, the vehicles were busy till late the next morning, carrying home society people who had been stalled at balls, theatres and private residences. Strangely enough, the New York Electrical Society visited the old stables of the company that same night, upon which occasion Mr. Condict was to have addressed it. At the present time, the company's vehicles in this city are making a mileage of 100,000 miles a month, and as many as 900 calls a day have to be turned down, because coming in when the entire available rolling stock is already engaged. The plant was then briefly described by Mr. Condict along the lines of the illustrated article which appeared in the Electrical World and Engineer last January.

After Mr. Condict's remarks the whole of the vast building, in all its departments, was thrown open to the visitors, numbering between 300 and 400, who roamed about freely at will, watching the machinery in operation, and taking particular interest in the ingenious methods and appliances by which the batteries are taken to and from the charging room and inserted into and removed from the vehicles in service. After this examination, the Company served coffee and other refreshments, and it was not until 11 o'clock that the members dispersed, the society having scored another emphatic success in its plan of visiting electric installations, so as to enable its members to see for themselves the processes and details of operation.

President Martin announced that on April 25th, at Columbia University, Mr. Charles F. Scott, electrician of the Westinghouse Electric & Manufacturing Company, would deliver a lecture, illustrated by apparatus and experiments, on "Alternating Current Motors." Mr. Scott's well-known ability as an inventor and his gift of clear exposition will render this one of the most valuable meetings held by the society during its remarkably active and successful season, which, before it closes, will include one or two more very interesting evenings. The secretary requests us to announce that the striking lecture on "Systems of Electric Transmission and Distribution," delivered before the society by Mr. C. P. Steinmetz, has been issued in a neat and handy pamphlet, octavo size, which can now be secured from him at 120 Liberty Street, or by mail at 25 cents a copy. This is one of the best popular treatments of the alternating current now available, and requests for it are already such as to insure its wide circulation.

The following members were elected: E. H. Mullin, 1 West 102d street, New York City; J. Lloyd Wayne, engineering department, New York Telephone Company, 15 Dey street, New York City; Franklin S. Holmes, 108 Fulton street, New York City.

Rapid Transit Plans for Brooklyn.

Mr. Albert L. Johnson recently made a proposition to the committees of the Municipal Assembly to provide a rapid transit system for Brooklyn. President Orr, of the Rapid Transit Commission, stated that the Rapid Transit Board would consider the proposition if it were made in a form enabling the commission to deal with the matter. Mr. Johnson, therefore, presented the matter in definite form at the meeting of the commission on Thursday last. He stated that if his plans are adopted he will put up the $1,000,000 cash deposit required by law, and give additional bond to build and equip the tunnel and railroad at the lowest cost to the city; to wait for his reimbursement as to so much of the cost as may be in excess of the city's present constitutional debt limit, until the city can lawfully pay him; to carry passengers for three-cent fares within the city limits; to pay union wages in construction and operation, and to provide an adequate sinking fund for the cost of construction and equipment. Mr. Johnson is reported to have said in a subsequent statement that he will furnish, free of cost to the city, his own plans for a route. He will begin the route at the Jersey shore on Staten Island, at the nearest point to Philadelphia, his object being to make this as nearly as possible an air line between New York and Philadelphia. The plans, it is stated, contemplate a tunnel under the Narrows, between Brooklyn and Staten Island, and tunnel, depressed, elevated or surface construction on land, according to the topography. Besides the Brooklyn system, it is part of the proposed plan to make a connection with the New York rapid transit system, now being constructed. Mr. Johnson's proposition was, in the opinion of the Rapid Transit Board, not sufficiently definite, and President Orr was instructed to so notify him, and that the commission would not withdraw pending plans for rapid transit in Brooklyn on such "vague statements" as were contained in Mr. Johnson's letter.

Equipping the London Metropolitan Underground.

A special dispatch from London of March 28 says: "It was learned to-day that Charles T. Yerkes has obtained control of enough of the stock of the Metropolitan & District Underground Railway to prevent the installation of the Ganz high voltage alternating current (British) system. Mr. Yerkes arrived in London after the directors had adopted the Ganz system subject to the approval of the Board of Trade. The representatives appointed to interview the Board of Trade were interdicted by the influence of Mr. Yerkes. the matter is now in statu quo. The experts appointed by the London directors having pronounced in favor of the Ganz system, the matter will now be taken out of their hands, and the subject will become a question of financial negotiations between Mr. Yerkes and the London board. There is little doubt that Mr. Yerkes will succeed, his object being to establish a uniform American continuous current system on the Metropolitan line in connection with London's 'tuppenny tubes.' Mr. Yerkes and the London directors are now working for a compromise, which it is anticipated will amicably result from the daily conferences which are now being held."

With regard to this matter, we have cabled the representative of the Electrical World and Engineer in London, Mr. A. C. Shaw, and are advised by him that the contract for the Metropolitan has not yet been awarded to the Ganz Company, in spite of the statements cabled from England to that affect, and printed in many of the newspapers here.

Opposition Telephony in New York.

Although much has not been heard lately of the opposition telephone movements familiar to the New York public during the past few years, another one has cropped out to keep things lively. The name of the newcomer is the Atlantic Telephone Company. It has a capital of $5,000,000, with main office at 20 Broad Street, and the officers are W. H. Stayton, president; C. B. Reid, secretary and treasurer; D. A. Reynolds, manager. At the present time, the upper part of the city is being canvassed, and it is understood that a large number of subscribers have been secured in Harlem. The "contract" is a novel one. The installation of the apparatus will be made free of charge, and a rate of 5 cents per message will be charged. On the other hand, the subscriber has to agree that the contract shall run for five years at that rate, and must give the company exclusive telephonic use of the premises. How this would work out in case of a change of tenancy or ownership does not appear quite clear.

A citizen of Harlem who had been approached by solicitors of the new company for permission to wire buildings for the service, took the precaution, before granting the exclusive wiring rights in his property asked for, to make inquiry of the Commissioner of Public Buildings, Lighting and Supplies, regarding the status of the company. Commissioner Kearny is also generally known as Commissioner of Subways, as he takes the place of the old Board of Electrical Control, and has general supervision of all concerns running wires under, through or over the streets of the city. The Commissioner's reply was as follows: "Not to my knowledge has it any franchise to do business in the city of New York, or to build or to occupy subways; nor has it made any application for the right to erect poles and string wires within the city of New York, a formality that must be gone through with before it can do business."

The company informs us that it cannot discuss at present its plans as to exchange, apparatus, etc., and that it prefers just now to maintain silence on the subject.

In the meantime, the New York (Bell) Telephone Company has issued notice of a special Harlem rate, which is developing considerable new traffic. Service will now be supplied to subscribers connected with the Harlem exchange from the minimum of $3.25 a month. Moreover, a charge of only 5 cents a message is made on all purely local communications, of which the number increases rapidly. The rates apply to the district between 110th and 140th Streets, on Manhattan Island, from river to river.

Failure of Public Electric Automobiles in Massachusetts.

A special meeting of the stockholders of the New England Electrical Vehicle & Transportation Company will be held in Jersey City April 29 to vote upon the recommendation of the directors that the company be dissolved. A circular, which is being sent to stockholders, states that there are 223,498 shares of stock outstanding, par $10, fully paid, and 1674 subscription certificates upon which $5 per share had been paid in. The company owns, free of mortgage, the land and buildings in Boston, Mass., known as the Cyclorama building for which $163,350 was paid and the building in Newport, R. I., used for the company's station, for which $21,503 was paid. In alterations and additions to the buildings in Boston and Newport there has been expended the sum of $165,374; and for machinery and appliances necessary to the conduct of the business in the Boston and Newport stations and in the sub-stations about Boston the sum of $156,648. Until Feb. 28, 1901, there had been expended in the purchase of vehicles and batteries the sum of $769,036.

The company had on hand on March 1, 1901, in cash $607,084 and 245 vehicles of various types. It also controls the capital stock of the Boston Transit Company, a Massachusetts corporation with a cash capital of $100,000. For the six months ending March 1, 1901, the gross income including profits on sales and exclusive of interest on deposits and rentals has been $95,310, and total expenses $211,969. The directors state that in carrying on the public carriage and delivery wagon business in Boston, in spite of every effort in economy, the expenses exceed the receipts. The reduction in operating expenses has been continuous; but "your board is of the opinion that, in view of the large outlay necessary to establish the present business and the limited scope of the same the returns confidently expected at the beginning will not be realized. They have not felt justified in paying out the cash in the treasury in the purchase of other vehicles, nor do they feel it to be for the interest of the stockholders of this company that this cash and the valuable real estate owned by the company should be longer applied to a business from which they believe under existing conditions a return cannot be obtained commensurate with the amount of capital. The company has no debts other than current liabilities. There are a number of cases pending for personal injuries; but the company is insured, and it is not believed that the damages in any case will exceed the limit named in the policy. Your board is therefore of the opinion that the interests of the stockholders will be best served by stopping operations and dissolving the corporation in the manner provided by the statutes of New Jersey, by converting the assets as promptly as possible into cash, and distributing the same ratably among the stockholders."

The Electric Vehicle Company will agree to a cancellation of the contracts between the two companies.

A French Manufacturer on Edison and Tesla.

Mr. Edison's efforts to separate magnetic iron ore economically appears to have attracted no little attention in Europe recently, although they have been familiar for some years to the American public, which has watched with no little sympathetic interest his unceasing hard work in that direction. The following dispatch from London of March 3 bears on the subject: The *World* correspondent interviewed Eugene Schneider, head of the Creusot Iron Works, the most important rail, locomotive and gun factory in France, about Thomas Edison's new claim that he has discovered a process which will blast America's steel supremacy. This process has created great excitement here and in England lately, because if Mr. Edison could really separate hematite from magnetite, converting the former into Bessemer steel, enormous European ore deposits now unprofitable would yield richly. Mr. Schneider and his chief mining engineer expressed themselves skeptically regarding the new discovery. Mr. Schneider said: "What is the use of discussing Edison's advertising dreams? He has no special knowledge of metallurgy, and the problems he claims to have solved have engrossed scientists all over the world. Let Edison occasionally do what he claims he can do and then we will be willing to give him attention. But Edison's tactics, like Tesla's, consist of finding what difficulty puzzles scientists and announcing that their own genius is about to solve it. But when the time comes neither realizes his glowing promises.

"Let it be said once and for all that real scientists all over the world consider Edison and Tesla a pair of humbugs. What has Edison discovered except the phonograph, which was a chance discovery and not the result of scientific perspicacity. Not electrical incandescence, for that was really invented in Germany, nor the biograph, which was discovered here by Lumiere, nor anything of real importance.

"On the other hand, has Tesla destroyed the Spanish fleet, as promised, or telephoned across the ocean, or lighted houses without wires, or entered into communication with the planet Mars? It is a perfect wonder that the American public, with its quick sense of humor, has not long ago shamed these two cheeky pretenders into silence."

This dramatic outburst on Mr. Schneider's part is to be explained perhaps by the following special cable dispatch of the same date: Joseph Lawrence, chairman of the Linotype Company, Sheriff of London and head of the British syndicate comprising 55 ironmasters, which acquired the Dunderland iron deposits in Norway, containing 80,000,000 tons of ore, speaking to the *World* correspondent respecting the statement that his syndicate would counterblast J. P. Morgan's, said: "Seeing that we purchased the property 18 months ago, you can judge how far it was a calculated attempt to countervail the European operations of the Morgan syndicate, though in the event that it promises to work effectually in that direction by the application of Edison's new crushing and magnetic extraction processes, our property in Dunderland promises to provide, under English control, a supply of high-grade Bessemer ore adequate to the needs of Great Britain for many years to come."

Manufacturing Exports from the United States.

Exports of iron and steel manufactures from the United States continue to increase. An analysis of the February report figures has just been completed by the Treasury Bureau of Statistics, and it shows that the total for the eight months ending with February, 1901, is six and a half millions in excess of the unparalleled figures of last year, and nearly three times the total for the eight months ending with February, 1891, thus showing an increase of 10 per cent in a single year and 333 per cent in the decade. In the eight months ending with February, 1891, iron and steel formed but 3 per cent of the total domestic exports from the United States; in the eight months just ended they form 8 per cent, being $81,553,132—against $75,053,768 in the corresponding months of the fiscal year 1900, and $18,823,384 in the same months of 1891.

Not only is the total larger in the aggregate, but it covers a greater diversity of products, thus showing that the manufacturers of the United States are not only increasing their output, but each year fabricating a larger proportion of their product and thereby securing for themselves and the labor employed thereon a greater share of the profits accruing from such manufacture. A decade ago such articles as typewriters, bicycles, electrical machinery, cash registers, laundry machinery, pumps and pumping machinery, shoe machinery, and other articles involving a high degree of manufacture, had no place in the export schedules of the United States. Now they constitute an important part of our annual exportations of iron and steel, and are steadily increasing both in volume and in the number of foreign markets in which they find profitable sales. In 1891 no exports of electrical machinery were recorded, but by 1900 the figures for eight months' transactions had reached about $2,500,000, and for the eight months ending with February, this year, amounted to $3,777,673, an increase of $1,345,000 in a single year. Exports of steel rails increased from $395,484 in the eight months ending with February, 1891, to $4,818,226 in the corresponding months of the fiscal year 1900, and $6,889,079 in the same months of the fiscal year 1901. Scales and balances have increased in export value over 50 per cent during the decade; locomotives over 200 per cent, printing presses over 300 per cent, and builders' hardware over 300 per cent. Every item in the entire iron schedule shows a substantial increase in 1901 as compared with 1891, but in a few instances there are decreases as compared with 1900, presumably due to the advanced prices consequent upon the increased cost of material.

The area of distribution steadily and rapidly enlarges. In builders' hardware, for instance, the exports now go not only to the principal countries of Europe, but to Mexico, Central and South America and the West Indies, British East Indies, China, Japan, Australasia, Africa, and the Islands of Oceania. Sewing machines and typewriters find a market in the most distant inslands, and the demand from the European and the other leading countries is increasing, while the demand for electrical machinery is growing in every direction.

	Eight months ending	
	Feb., 1891.	Feb., 1901.
Total iron and steel	$18,823.384	$81.553.132
Steel rails	395.484	6,889,079
Builders' hardware	1,353.848	6,053.126
Electrical machinery	Not stated.	3,777.673
Locomotive engines	837.308	2,828.156
Steel bars	Not stated.	2,637.813
Structural iron and steel	Not stated.	2,296.287
Wire	534.530	2.499.946
Pumps and pumping machinery	Not stated.	1,497,136

The above table shows the exports of some manufactures in eight months ending with February, 1901, compared with the eight months ending February, 1891.

French Trade in Electrical Machinery.

From the official statistical returns for the year 1900, just published by the French Government, we gather that France imported during that year dynamo-mechanical machinery to the value of 11,963,250 francs, as against 6,018,473 francs in 1899, and 3,740,562 francs in 1898. Parts of electrical machinery were imported to the value of 4,348,160 francs, as compared with 2,080,760 and 1,569,651 francs in 1899 and 1898, respectively. The imports of electric accumulators represented a value of 64,650 francs in 1900, as against 101,859 francs in 1899 and 136,691 francs in 1898. Incandescent lamps were imported to the value of 480,000 francs in 1900, 506,440 francs in 1899, and 479,040 francs in 1898. It will be seen from these figures that the total imports of electrical machinery and incandescent lamps amounted in value to

16,856,060 francs in 1900,
8,597,532 francs in 1899,
5,926,004 francs in 1898.

The great increase in the imports of 1900 is largely to be traced to the great demand for machinery created by the Exposition. The exports of electric machinery from France are relatively small. The principal figures for 1900 and 1899 and 1898 are as follows: Dynamo machinery, francs, 1,647,720, 2,074,754 and 1,434,873; parts of electrical machinery, francs, 2,079,000, 1,991,736 and 2,250,315. The statistics above referred to are but a résumé of the foreign trade of France and details on the exports and imports as to the countries of origin, etc., are not yet available.

Telephonic Development at Pittsburg.

The present telephone situation in Pittsburg is peculiar and presents phases that appear problematical: withal, however, it is interesting. There are three live companies there and two silent or retired companies that may be rejuvenated at any moment; and all five have franchises well worth fighting under. Of the three live companies the Bell is naturally the largest and most strongly intrenched. In its Pittsburg exchange district, comprising practically all of Allegheny County, and which includes the cities of Pittsburg, Allegheny and McKeesport, 40 boroughs, 44 towns and villages, and about 20 railroad stations, it lists nearly 16,000 subscribers. Then it has as many more subscribers in the remainder of its territory in the State.

Next to the Bell is the Pittsburg & Allegheny Telephone Company, the new independent company promoted by Baltimore capitalists. It claims that 2000 telephones are now connected to its switchboard in Pittsburg and about 500 connected to its exchange in Allegheny. At the present writing, it has no service outside these two cities, but expects soon to have toll-line connections with the home exchanges in Braddock, Homestead, Wilkinsburg and Verona. The rumor is again prevalent that this property will soon pass into the hands of the Federal Telephone Company, an event that will be heralded with satisfaction by all the subscribers to the new service who desire out-of-town connections.

Third in order of prominence comes the Federal Telephone Company, an organization that has been most vigorously fought on every hand from the day of its formation to the present time, but which appears as fresh as a daisy after every battle. The Bell Company fought it bitterly and found itself outclassed. The Pittsburg & Allegheny Company did all in its power to crush the Federal, filling the daily papers with stories about its being a Bell ally, and even going so far as to try to induce Judge Thomas to use the power of the National Association to exterminate the Federal. Yet the P. & A. employees are now said to be questioning how many days will elapse before they will be on Federal pay rolls.

The Federal Company paralleled the Bell's main trunk line along the Beaver road on the north bank of the Ohio, beginning at the city limits of Allegheny and running to Rochester, in Beaver County, a distance of 25 miles. It did likewise along the Monongahela River from McKeesport to Brownsville, a distance of 44 miles. In the 18 months that have elapsed since its organization, the Federal Company has secured franchises and completed its lines in 42 boroughs and connected nearly all by toll lines. In addition, it has purchased nearly a score of companies, all of which, save one, have been absorbed by the Federal Company, and it has applied for franchises in 47 boroughs. Thus, should it succeed in purchasing the Pittsburg & Allegheny Telephone Company, it could have 100 cities, towns and villages connected to the Pittsburg exchange within 30 days from the date it assumed control.

Without these out-of-town connections, there can be no true competition in Pittsburg. For there is no longer any value in merely local service. It must include all the towns in the same county at least. The Federal Company can give these out-of-town connections, but can give no Pittsburg service. The P. & A. can give a limited Pittsburg and Allegheny service, but no out-of-town connections. The rational procedure would be a consolidation of interests or a working agreement, but the P. & A. refuses to enter into either one. As the Federal has invested more than a half million dollars, it must have a Pittsburg connection in order to preserve the integrity of its investment, even if it purchase one at an exorbitant price. Of course, it can build under its own franchise rights, but to do so under existing circumstances would necessitate a local investment of more than $500 per telephone. That is, to install 13,000 telephones in Pittsburg (the number required to successfully compete with the Bell Company) would require an investment of about $7,000,000, owing to the fact that few if any pole lines could be used, an ordinance being in force in this city, which makes it prohibitive for more than two pole lines being constructed on one street. What will be the outcome of the present telephone entanglement in Pittsburg it is difficult to predict just now, but the developments promise to be very interesting.

Buffalo Automobile Endurance Test.

At a recent meeting of the executive committee of the National Association of Automobile Manufacturers, the endurance test of the Automobile Club of America, to be run next September from New York City to Buffalo, was fully discussed, and the following resolutions were adopted:

Whereas, It has been brought to our attention by both the press and members of the association, that the Automobile Club of America is contemplating giving an endurance contest of automobiles from New York to Buffalo next fall; and

Whereas, The manufacturers deem that they are largely interested in the contest and feel that suggestions from them in regard to the proper conduct of such a contest would not be objectionable to the Automobile Club of America; therefore, be it

Resolved, That the executive committee of the National Association of Automobile Manufacturers convey to the Automobile Club of America the resolution passed by this committee, putting forth their views as to the proper management of the run.

The resolution mentioned above is as follows:

Whereas, The National Association of Automobile Manufacturers, having discussed fully among themselves the proposed endurance contest of the Automobile Club of America, next fall, and having come to definite conclusions as to their opinions regarding the proper conduct of such run; it is

Resolved, That the National Association of Automobile Manufacturers believe that the basis for judging the said contest should be average speed of miles per hour; that each vehicle should be required to maintain a certain average speed per hour for each morning's run and the same average speed per hour for each afternoon's run. In other words, a vehicle must maintain a certain average speed from control to control. Judges shall be placed at each control, and the records of each vehicle taken. Each vehicle that maintains the average speed required by the club from each control to control for the entire distance shall be considered to have made a perfect run, and will be entitled to a certificate of first award of honor, from the Automobile Club of America. Every vehicle that maintains an average speed that may be fixed for the second class shall be entitled to a certificate, stating that they were in the second class, and performed the trip at an average speed of so many miles per hour. Every vehicle that maintains an average speed that may be fixed for the third class shall be entitled to a certificate of the third class, stating that they maintained a certain average speed per hour.

Classes: We recommend that the vehicles be divided by weight into four classes—A, B, C, D. Class A, vehicles of four wheels under 1000 pounds; class B, vehicles of four wheels from 1000 to 2000 pounds; class C, vehicles weighing 2000 pounds and over; class D, motor cycles, motor tricycles and motor quadricycles.

In counting the average speeds above required, each vehicle can stop as many times as desired between controls for any purpose whatever. No manufacturer or individual to be allowed to enter more than three vehicles in each class.

Development of Electric Car Lighting and Refrigeration.

For some time past there has been talk of bringing to the front in practical shape the new car refrigerating system which has been in the hands of the allied interest, and this plan it would appear is now to be carried out in the proposed purchase of the stock of the Consolidated Railway Electric Lighting & Equipment Company by the Consolidated Railway Lighting & Refrigerating Company. The circular issued by President Isaac L. Rice to the stockholders of the Consolidated Equipment Company states that the system of refrigeration to be adopted is greatly superior to the old system owned by the equipment company, and claims that its acquisition will add very largely to the company's earning capacity. Mr. Rice says:

"In my effort to secure control of this system for the Consolidated Equipment Company I was met by the objection that the owners of the patents were not willing to sell their rights for stock unless a suitable working capital, aside from that of the Consolidated Equipment Company used for its lighting purposes, would be provided. There being no means of providing such working capital on the part of the Consolidated Equipment Company without another large issue of stock, owing to the present market price of the stock of that company, the only method remaining was for the holders of the patent to organize a new company, reserving sufficient amount of shares in their treasury for such working capital which was ready to be underwritten, but permitting the stockholders of the Consolidated Equipment Company to obtain the corresponding interest in the shares of that company upon the condition of furnishing such working capital. After numerous consultations the following plan was therefore agreed upon between the owner of the Refrigerating Company patents and a number of leading stockholders of the Consolidated Equipment Company.

"A company to be organized, which would issue a total of $4,600,000 of its stock to acquire the refrigerating patents, and also, incidentally, the patents of the Safety Third Rail Company, which is controlled by the same interests, both companies requiring machines, etc., that could be profitably manufactured by the Equipment Company at their plant at Derby, Conn.; $16,000,000 to be issued in exchange, share for share, for the present stock of the Equipment Company upon the payment of $2 per share by such stockholders for the working capital of the refrigerating business; that is to say, the new company will have a total capital of $22,000,000, of which $16,000,000 will be issued to acquire the shares of the Consolidated Equipment Company and $4,600,000 to acquire the following:

"Four million eight hundred thousand dollars of the total of $6,000,000 of the Refrigerating Company; $5,400,000 of the $10,000,000 of the Safety Third Rail Company, and $3,000,000 of the $5,000,000 of the European Refrigerating Company, leaving $1,400,000 of the stock in the treasury for the further uses of the company.

"By means of this arrangement the stockholders of the Equipment Company will retain all their previous rights and all the profits of the Equipment Company, the affairs of which look extremely promising at the present day, and in addition will acquire the control of the chloride of ethyl refrigerating process, as well as the control of the safety third rail, and, in my opinion, therefore, bring the dividend period on their stock decidedly nearer.

"The books of the Equipment Company show to-day a surplus of over $600,000; and, if all the stockholders unite in this exchange, the new company, by ownership of such stock, will show a surplus of nearly $1,000,000, which would be ample to carry out all the plans of the company and do sufficient business to put the new company on a dividend basis.

"The relations which the Equipment Company has formed with Messrs. Vickers, Sons & Maxim, Limited, in England, will, in my opinion, be still further improved and cemented by the acquisition of the refrigerating business on the part of the stockholders of that company through the instrumentality of the new corporation, which will, I believe, give the European business of the company a very considerable impetus.

"I desire to impress upon the stockholders that this arrangement which I have succeeded in making is purely an option secured for them, and that they will not in any way prejudice their present position by declining to avail themselves thereof. The two companies are not at all competing, as the refrigerating company controls no lighting patents; while the methods of refrigeration controlled by it, being much simpler and more practical, of necessity preclude competition on part of the Equipment Company for refrigeration business, whether the shareholders of the two companies become identical or remain distinct."

CURRENT NEWS AND NOTES.

ANGLO-GERMAN CABLE.—The work of laying a new cable line between Emden, Province of Hanover, Prussia, and Bacton, County of Norfolk, England, has been begun. This will be the seventeenth Anglo-German cable line laid.

AUTOMOBILE SLEIGH.—Consul-General Guenther, at Frankfort, Germany, reports the appearance at Nuremberg of an automobile sleigh. He states that the vehicle moves with considerable speed and with easy motion, but gives no details as to motive power or mechanism.

A LONG TRIP ON AN AUTOMOBILE.—A dispatch from Cannes, France, March 27, states that M. Hinde, a member of the Automobile Club, recently made a trip in a 12-hp. automobile from Frankfort-on-the-Main to Cannes, a distance of 708 miles, which was covered in forty-four and one-half hours. The dispatch further states that severe weather was encountered during the trip, and frequently the vehicle was axle-deep in snow. The route was by the way of Switzerland and the lower Alps.

STORAGE BATTERY BOOSTER SYSTEM.—In the application of the storage battery to electric railway work boosters are often employed to cause a battery to discharge and co-operate with the main generator during periods of more than average load, and to charge during periods of less than average load. A patent granted March 26 to J. B. Entz has for its object to make the booster in such cases act promptly and thus to increase the efficiency of the regulation. It is customary to provide such boosters with a separately excited or shunted field coil, but a departure from the average load tends to produce in this coil a change of current opposing the magnetic effect desired to be produced in the field of the booster, and thus delaying the regulation sought to be accomplished. To obviate this defect there is inserted in the above mentioned circuit an impedance coil, this coil constituting a resistance of high self-induction which also tends to resist the above mentioned changes of current in the circuit.

ELECTRICAL HEATING RESISTANCE.—In many heating tools a very high temperature is required, and hitherto the application of electric heating to such tools has not been possible for two reasons—first, because the ohmic resistance of the compounds hitherto employed has been found to decrease rapidly as the temperature was raised; and, second, because the combinations used rapidly deteriorate and finally fall to pieces. The principal causes to which these difficulties are ascribable are that the various powders used to dilute the carbon have always formed carbides with the same when subjected to very high temperatures, and that the reduction in volume which occurs when such compounds are frequently subjected to high temperatures and the relaxation of pressure in part due to this contraction, finally deprive the frail resistance of necessary support. In a patent granted March 26 to Wm. S. Hadaway, Jr., a compound is described which is claimed to obviate the above defects. This compound is composed of an intimate mixture of finely powdered carbon, preferably graphite, and finely powdered crystalline magnesia oxide united by any of the proper binding cements. In preparing the compound ordinary magnesia is subjected to the action of an electric furnace in order to change its form to a crystalline mass of maximum density on cooling. The graphite is very finally powdered and then thoroughly baked at a high temperature, which may be the same temperature as that to which the magnesia is subjected in fusion; the two powders are then thoroughly mixed. It has been found that a mixture of 10 per cent of graphite and 90 per cent of magnesia is suitable for use with 110 volts where a temperature of about 900 F. is required. The mixture so produced is molded into the required shape with molasses water and then after baking is ready for use.

WIRELESS TELEGRAPHY IN SPAIN.—The Administration of Posts and Telegraphs contemplates the introduction of wireless telegraphy in Spain on a large scale. It is rumored that Marconi will soon go to Madrid to arrange matters with the Government. The Balearic and Canary Islands are first to be connected by this system, which will then be extended from these islands to the Continent. Several places on the coast of Morocco, such as Ceuta, etc., will be connected with Algeciras and Tarifa.

A NEW COHERER.—It has recently been established that the harder the metal particles are which are used in a coherer, the greater is the accuracy in breaking contact; it has also been established that this function of the metal depends even in a higher degree on the hardness of the electrodes together with their corresponding capacity for being highly polished, than on the hardness of the metal filings used. In a patent issued March 26 to Adolph Koepsel, Charlottenburg, Germany, a coherer is described, in which the electrodes have their effective or acting surfaces made of hardened steel or hardened cast iron, the filings interposed between the same being of steel.

PHILIPPINE CABLE TOLLS.—The estimated cost to the Government of cable tolls on the messages between Washington and the Philippine Islands is $1,000 a day. The House Committee on Interstate and Foreign Commerce, when considering a bill for the construction of an American cable between San Francisco and the Philippines, was not able to get this important datum with any precision. Representatives Sherman and Corliss succeeded in learning that the War Department alone had spent as much as $365,000 a year. This did not include the messages of the State Department or the Navy Department, or the private mesages sent and received by the President from the "war room" in the White House. This subject assumes importance because of the proposals before Congress looking toward a Pacific cable, owned and operated by the United States. Nothing was done at the last session, but the subject is sure to be revived.

THE FIRST ELECTRIC TRAMWAY IN BULGARIA.—On the 29th of January last the first electric street railway of Bulgaria was opened at Sofia, the capital of the country, after the city had been equipped with an electric light system a few months before. The French engineer, Bertolus, who had been granted a concession for 40 years for the light and tramway plants, succeeded in utilizing the fall of the Isker River for the generation of the required amount of electric power. A tunnel, some 4600 ft. in length, was built and the fall of 105 ft. thus obtained, produces 3000 horse-power. Bertolus ceded his concession for the light plant to the "Société de Grand Travaux," of Marseilles, and that for the tramway to the "Trust Franco-Belge des Tramways de Sophia." The Marseilles company is said to have invested 4,000,000 francs, and the Trust 3,500,000 francs in the enterprise. The city of Sofia receives light at the low rate of 18 centimes (3.474 cents) per kilowatt-hour. The tramway has a length of about 12½ miles. Cars, dynamo machines and turbines were imported from Belgium; steam engines and underground cables chiefly from Germany, which country also supplied a certain number of cars; rails came from the United States and copper cables for the tramway from France.

IMPROVEMENT IN DIRECT-CURRENT DYNAMOS.—In direct-current machines whose armature field is neutralized by means of an opposite field of the same strength, such as when the Ryan system is employed, and also in rotary converters where no armature reaction exists, it is nevertheless necessary to shift the brushes on the commutator from the neutral zone in order to attain a commutation free from sparking, and this shifting of brushes gives rise to a reaction of the armature and an undesirable variation of voltage. In a patent issued March 26 to Max Déri, of Vienna, Austria, a method of magnet winding is described which renders it possible to attain in these classes of machines a commutation without sparking with a fixed position of the brushes, while at the same time drop of voltage is prevented or the armature voltage may be varied in any desired manner. A special compensation winding is provided on the field magnets, through which the main current passes and gives rise to a field that combines with the main field to produce a resultant of the necessary intensity and position. The required conditions of this arrangement are as follows: First, that there shall exist no armature field, or but a very weak one; second, that the main field and the compensating field shall develop and combine as uniformly as possible, preferably in sine form, this being effected by arranging the field magnet all around and equidistant from the armature; and, third, the main field shall be excited with uniform strength (shunt-wound machine). As illustrated, the field consists of a ring completely surrounding the armature and having no salient poles. The winding of the shunt and series field is such that the two fields produced are at an angle to each other, and produce a resultant field variable in strength and position, according to the value of the main current, whereby one component effects sparkless commutation, while the other component effects the regulation of the pressure. On the field magnet opposite the armature coil short-circuited by the brushes a closed winding is provided, consisting of one or more convolutions, which oppose a resistance to the rapidly changing flux in the short-circuited section.

ELECTRO-CHEMICAL PRINTING.—A patent was issued March 26 to William Friese-Greene, London, England, on an electro-chemical printing process intended to replace the ordinary process of typographic printing and printing on textile fabrics, and to dispose of the uses of inks or colors and enable the ordinary printed fabric to be replaced by a cheaper and more durable one. The process is based upon a discovery that with a material impregnated or incorporated with an oxygen derivative of benzine which will reduce a haloid salt of silver, and traversed by an electric current in the presence of slight moisture, an exact reproduction of the electrical conductor in contact therewith is instantaneously produced; such reproduction being independent of the material of which the conductor consists and of the direction of the current. In typographic printing the type form is connected to the negative pole of the circuit, since type or printing plates are made of an attackable metal which is destroyed if connected to the positive pole. In carrying out the process the paper, textile, fabric or other surface is coated or impregnated with a photographic developer such as amidol, ametol, or hydroquinon. In practice it is found that amidol may be added to the paper pulp. The prepared paper or fabric is placed upon or caused to travel over a conducting surface, with an interposed layer of more or less moist material, such as cloth or blotting paper, the conducting surface being connected with the positive pole of a direct-current source of electricity. With the paper or fabric are brought in contact the words, figures, designs or the like to be produced, these being connected with the other pole of the circuit. An ordinary stereotype or electrotype plate is used in ordinary printing. The electric circuit being closed, the current will pass through the prepared paper and at once reproduce thereon a clear black or color fac-simile of that which is in contact, the color depending upon the particular substance employed in the paper. The reproduction can be effected, for example, by feeding sheets of paper prepared in succession as in ordinary printing by means of a platen or other machine that prints on the flat; or the reproduction can be effected by a machine like an ordinary cylindrical printing press, in which case the prepared paper can be run from a reel. In practice it is found that direct current of 4 amperes at a voltage of 100 is sufficient. The inventor states that he has been able to electrically print 25,000 pamphlets per hour by adapting the invention to a printing machine. The specifications give full details of the adaptation of the process to a cylindrical printing machine and to a flat printing machine. The claims are on the disposition of the parts in printing, and on the use of a paper or material impregnated with a photographic developer which is an oxy derivative of benzine, and which will reduce a haloid salt of silver.

LETTER TO THE EDITORS.

Alternating-Current Arc Periodic Curves.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to a letter of Mr. Wiler in your issue of Feb. 16, I wish to express to him my regret if my remarks in your issue of Feb. 2 appeared unduly personal in their bearing, for it was far from my thought to make them so. I fear I may have been the cause of Mr. Wiler expending some valuable time in seeking for anticipations of my paper of 1893 on alternating-current curves, which could have been spared him had I stated that according to my invariable custom, all prior work was duly referred to and discussed in the said paper, and that the very important articles of Heubech and Steinmetz were unfortunately anticipated by my own publication on the same subject in *La Lumiere Electrique* of April 26, 1892, page 136. Moreover, upon reading the papers quoted, I was struck by the paucity of the information conveyed and the contradictory statements contained, and this is what led to my undertaking a complete and an entirely independent study of the question of periodic curves. Such curves as those of Tobey and Walbridge are entirely misleading, as I showed in my paper.

If Mr. Wiler would do me the favor of reading the article referred to in *La Lumiere Electrique*, I hope that the opinions he has expressed would be modified, unless indeed he feels more competent to deal with the subject than those who have studied it during the last decade. I am much indebted to him for his kindly wishes relating to the oscillograph, and hope that the instrument will eventually be as helpful to him and to the electrical profession in the United States as it has been to myself and to Mr. Duddell.

Paris, France. A. Blondel.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Reference.

Transformer Efficiency.—Boehm-Raffay.—A theoretical investigation of the question of how the iron losses and the copper losses in a transformer must be proportioned to obtain high efficiency. At a given load the efficiency is a maximum if the iron losses are equal to the copper losses. If a transformer is to be used in general at full load, as in sub-stations, the iron losses should be made equal to the copper losses. If a transformer is to be used, in general, underloaded, the iron losses should be smaller than the copper losses at full load. The iron losses must be the smaller, the smaller the number of hours during which the transformer is loaded.—*Elek. Neu. Anz.*, March 1.

Lights and Lighting.

Nernst Lamp.—An illustrated description of a method of gradually inserting into the circuit of the mains an incandescent rod which is a bad conductor at low temperatures, as in the Nernst lamp. In the first moment only a very small length of the filament is connected to the circuit. When this has become a good conductor, the length of the connected part is increased. This is done automatically by means of a sliding contact, which is operated by a solenoid in series, so that when the current increases the contact slides further and increases the length of the part of the filament which is connected to the circuit.—*Zeit. f. Beleucht.*, Feb. 28.

Boron and Silicium Filaments.—Blondel.—An article in which it is suggested to use boron or silicium wires as filaments of incandescent lamps. A homogeneous filament can be made, the specific resistance of which may be a hundred times that of a carbon filament. Its fusibility is not very different from that of carbon. The methods of making such filaments are discussed.—*Zeit. f. Beleucht*, March 10.

References.

Arc Lamps.—An illustrated article on open and enclosed arc lamps of the General Electric Company, of Berlin.—*L'Elec.*, Feb. 16.

Train Lighting.—Dick.—A long and detailed description of the Dick system of electric train lighting, as applied. for lighting single cars.—*Zeit. f. Elek.*, Feb. 17, 24; March 3, 10.

Power

Factory Drive.—Holding.—A comparison between electrical and mechanical transmission. He gives the results of tests in three factories with belt transmission. In one, which is called a fairly average factory, the average load is 166 horse-power, the friction load 78 horse-power, the average useful energy 88 horse-power, the efficiency at average load 53 per cent. He gives curves for the efficiency of electric transmission. They show the better efficiency of the electric system. Tests in a factory of a total capacity of 300 horse-power gave a net efficiency of 70.7 per cent, while from the curves a full-load efficiency of 74 per cent is found. In the actual plant large quantities of shafting had been retained. He points out the well-known other advantages of electric transmission. He recommends the recording of energy delivered to separate departments in the factory. When each department has charged to it pro rata the cost of power, the item of factory expense no longer remains a general charge, but is an item chargeable directly to the cost of the manufactured article. This will not only facilitate the determination of the factory cost of the article manufactured, but will enable the detection of sources of excessive expense, and consequently suggest the points where improvements can be made. The record will also indicate the presence of faults in shafting, pulleys, etc.—*Rose Tech.*, March.

Electricity in Coal Mining.—Irwin.—An article on the use of electric power in mines, especially in Western Pennsylvania fields. In the Windber mine, of the Queen Coal Company, formerly eight mules and eight drivers were required to haul 200 tons daily, at a cost of 10 cents a ton, while now two electric locomotives bring out 1000 tons daily at a cost of less than 1 cent a ton.—*Min. and Met'y*, March 15.

References.

Electrically-Driven Pumps.—An illustrated article on the electrical driving of pumps, with large numerical tables for practical purposes.—*Elek. Anz.*, March 3, 7.

Electric Driving of Looms.—The first parts of an illustrated article, giving mechanical details of electrically-driven weaving looms, installed by the General Electric Company, of Berlin.—*Elek. Anz.*, March 17.

Traction.

Mono-Rail Electric Traction.—Some editorial notes on a lecture by Behr on the high-speed mono-rail road between Manchester and Liverpool, proposed by him. A speed of 110 miles per hour is proposed. Braking at such high speed is a serious question. Behr expects to be able to stop a train, in case of dire emergency, within 500 yards. He relies, however, mostly on the extreme improbability of this emergency ever arising. The perfected character of the railway and the elaborate system of signalling, contribute to this high degree of safety. By a development of the electric interlock and block system of signalling, the rear of every train is covered by danger signals for a distance of 14 miles, and on appoaching the first signal guarding this danger limit two alarms, one electrical and the other mechanical, are automatically rung in the driver's cabin, and continue to ring until stopped by him. The normal acceleration at starting is well within the limits of comfort to passengers, the full speed of 110 miles per hour being attained in 1¾ miles from the start. Centrifugal acceleration in pasing round a curve must also be carefully kept within limits. "The mono-rail principle is one that is eminently adapted to high-speed electric railways, and, even for this consideration alone, it may be expected to meet with considerable acceptance by railway promoters and engineers in the immediate future. Certainly the Manchester-Liverpool scheme ought to have a fair trial."—Lond. *Elec.*, March 15.

Electric Railways.—Cardew.—A note on the first of his Cantor lectures on this subject. He attaches great importance to the separate excitation of motors on locomotives or motor cars. One of the advanatges of this is the possibility of returning kinetic and downgrade energy to the line, instead of wasting it by brakes. A system of electric traction which he will describe later, is said to return no less than 66 per cent of the energy to the line, owing to the use of separate excitation in regulating the motors.—Lond. *Elec.*, March 15 A longer abstract of this lecture begins in Lond. *Elec. Eng.*, March 15.

References.

Automobile Wagon.—An illustrated description of the electric automobile wagon of the Say refinery in Paris for transportation between the works and the railroad depots. The battery consists of

84 Phœnix cells, weighing 5000 lbs., and giving 50-kw hours.—*L'Elec.*, Feb. 16.

Conduit System.—An article in which the weak points of the proposed London County Council conduit are criticized.—Lond. *Elec. Rev.*, March 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Birkenhead.—A description of the Birkenhead lighting and traction plants. For lighting the three-wire system with 460 volts between the outers is used. There are one 225, two 150-kw and three 50-kw dynamos. The three larger machines generate at 460 volts, and the three smaller ones at 230 volts, to balance the three-wire system. Two miles off, on the boundaries of the borough, a battery sub-station has been erected to serve outlying townships. It contains a 600 ampere-hour battery and motor-driven boosters. The cells are charged in the daytime and discharged at night, the load being entirely a residential one. An electric tramway line of 2½ miles has recently been opened in quite a different direction, with a small station at about the center point of the line. It contains two 150-kw, four-pole over-compound direct-driven units, each being fitted with a switch for adjusting the amount of compounding if desired. The feature of the station is a compound "reversible booster." This machine carries further the principle of the reversible boosters in use at St. Helens, as it can be used with compound-wound instead of shunt dynamos, thus keeping the feeder pressure at its correct value automatically. During the hours of light load the machine boosts up the pressure of the accumulators so that they can supply the line, and subsequently it acts in the reverse direction, adding volts to enable the batteries to be charged from the switchboard bus-bars, and to take up at the same time the peaks of the load. The machine has given absolute satisfaction since it has been running. The battery is made up of 240 cells, with a capacity of 630 ampere-hours at a 7-hour discharge rate, and the use of the booster renders regulating cells and their connections unnecessary.—Lond. *Elec.*, March 15.

Trafford.—The first part of an illustrated description of the Trafford Park power plant. This is the first electrical station to be worked in England with the special object of supplying power in bulk to large manufacturers. In the design of the works a new combination of a steam plant with a gas-producer is used. A gas-producer plant has been laid down with the special object of providing a gaseous fuel for boilers. This gas-producer is of the Mond type.—Lond. *Elec. Eng.*, March 15.

Petersborough.—An illustrated description of this new British municipal plant. The three-wire direct-current system with 460 volts between the outers is used. There are two 60-kw steam dynamos, and also a booster and a balancing set, consisting of two multipolar dynamos as balancers, coupled directly to two bipolar dynamos used as boosters. There are also two batteries with a capacity of 325 or 240 ampere-hours, when discharging at the rate of 36 or 60 amperes, respectively.—Lond. *Elec.*, March 15.

WIRES, WIRING AND CONDUITS.

Insulation on Cables.—O'Gorman.—The first part of a very long abstract of a paper read before the Brit. Inst. of Elec. Eng., on light and power cables. He urges that purely scientific experimental researches ought to be made to find a new dielectric. Electrolytes should be avoided and dielectrics should be confined to chemically inactive organic compounds, or non-electrolytes, whose class distinction is non-conductivity, and, that they exert a normal osmotic pressure. He thinks that rubber makers sin in this particular way by using electrolytic salts in their compounding. A test for disruptive strength on small thicknesses, proves nothing about a large thickness of the same material, because a diminishing dielectric strength with increasing thickness is apparently inherent in most insulators. The best way to test a dielectric is on a length of cable. The area of surface of insulator under strain in a length of cable, is enormously greater than in the case of a slab. The contact between metal and dielectric is more thorough, the curve of stress is totally different, the cable material will necessarily have to be beat about and handled, and, most important, the average value of the insulator, bubbles and all, is tried, instead of a single selected square decimeter. Bubbles are a great enemy of permanency, and tend to a loss of energy. The reason for objecting to bubbles is not only that the possibility of a single bubble increases the thickness of the dielectric throughout and thus adds to the cost of the cable, but even the increased thickness is not as effective as the thinner dielectric if the insulator were continuous. It is usual to make rubber cables with the latter grade material next to the pure rubber, because a higher test is gotten in this way with less of the high-grade material; but unless the specific capacity of the high and low grade is properly adjusted or made to be the same, which it usually is not, the disruptive strength of the finished cable will suffer under alternating pressures. He suggests the same "grading" for a method of adjusting the specific capacity, dielectric strength and conductivity of the covering of a cable, so that the materials composing it occupy the best possible positions, whether for resisting puncture or diminishing the energy loss in the insulation. He discusses three methods. The first is to make the dielectric strength of the insulation in each layer proportional to the stress or voltage gradient in that layer. This may be done by multiplying the number of layers so as to utilize skin resistance or by using special materials for the inner or highly stressed layers of high strength, like mica, gutta percha, etc., but only a small improvement is possible in that way. The second and third methods of diminishing the thickness of insulation consist in utilizing the apparently objectionable qualities of conductivity and specific inductive capacity and adjusting or grading them in each layer of the covering of the cable. If the specific conductivity of the inner layers of the insulation is made greater than the average, the difference of voltage between the two sides of each of these layers is reduced; in fact, the specific conductivity of all the layers may be so adjusted that the fall of potential in each of them is a minimum and is uniform. If the insulation of the cable is paper and resin oil, the conductivity of the inner layers is easily lowered 50 or 100 per cent, as required by the curve of gradients, by adding to the impregnating fluid used on the layers a very small percentage of linseed oil, which has no appreciable effect on the disruptive strength, and is too small in quantity to effect any practical alteration in the specific capacity of the layers "graded" by its use. This method loses value because of the large effect of small impurities and because of the temperature coefficients of the oils. The paper is to be continued. It is discussed in an editorial.—Lond. *Elec.*, March 15. The discussion which followed is abstracted in *Lightning*, March 14. and Lond. *Elec. Rev.*, March 15.

Aluminum Conductors.—A note stating that a beginning is being made in the introduction of aluminum conductors in European transmission plants. For the electric power transmission in the Pompei Valley, near Naples, aluminum wires are used throughout. The plant contains three 100-kw, three-phase generators; current at 3600 volts is transmitted to three different places by aluminum lines. These lines have a length of 1.8, 9 and 2 miles, respectively.—*Elek. Neu. Anz.*, March 1.

ELECTRO-PHYSICS AND MAGNETISM.

Lecture Experiments with a Braun Cathode Tube.—Simon and Reich.—An illustrated description of suitable arrangements for a series of lecture experiments with a Braun cathode tube. The magnetic deflection of the cathode rays in this tube is used for current measurements, demonstration of alternating curves and of curves due to interrupters, for demonstrating and investigating the phase difference between current and e. m. f., the action of a Graetz valve cell in an alternating-current circuit, Lissajous figures, the rotation of a rotary field, hysteresis curves, and oscillating discharges. The following interesting experiment is also described. Two coils are used on two arms, one perpendicular, the other horizontal. The horizontal coil contains an iron rod of 1 meter length, so that the coil may be displaced on this rod. In the vertical coil there is a shorter iron rod. When the alternating current passes through both coils in series, the light spot in the Braun cathode tube describes a straight line declined by 45 degs. against the horizontal line. When the coil is displaced on the horizontal iron rod, the light spot describes an ellipse, which proves that the phase difference between the magnetic deflections increases when the coil is removed from the tube. Braun thinks that the magnetism needs a certain time to be propagated from the coil through the iron to the cathode tube. An interesting application of this apparent velocity of propagation of magnetism, is the generation of a rotary field by means of a single-phase current. Braun bends at one end of a solid iron rod of 8 mm diameter a semi-circular hook of 7 cm diameter. A coil is put around the rod, and a Braun cathode tube is so arranged that it is grasped by the semi-circular hook. When a single-phase alternating current is sent through the coil, the light spot in the cathode tube describes a circle which is the sign of a rotary field.

This rotary field is due to the superposition of the field generated by the coil and of the field due to the eddy currents in the iron. The eddy current magnetizes the iron as it would be magnetized by a coil placed upon the hook. The eddy currents have a phase difference of 90 degs. against the exciting current, so that a rotary field results. Braun has designed a meter based upon this principle. —*Phys. Zeit.*, Feb. 9.

Oscillator for Stationary Electrical Waves.—Bernouilli.—An article in which he recommends the Blondlot-Coolidge oscillator. By the help of this apparatus the nodes and loops of stationary electrical waves can be shown on wires which are not in a vacuum, but in the open air. This apparatus has also the advantage of enabling one to isolate, measure, and, if desired, photograph several of the overtones as well as the fundamental. The Hertz oscillator plates are replaced by two semi-circular conductors, which terminate at one end in small brass spheres, and are connected with the secondary terminals of a high frequency coil. The sparks which give rise to the electrical oscillations pass between the two brass spheres. A second spark-gap serves to increase the intensity of the oscillations. Both spark-gaps can be very delicately adjusted by means of insulated screws. Directly beneath this primary circuit of the insulator, and insulated from it by means of a sheet of mica, is a secondary circuit. This latter consists of a wire bent into a circle of the same radius as the primary circuit, its ends terminating in binding screws, and corresponds to the condenser plates of Hertz's apparatus. The vessel in which the two circuits are fastened is filled with kerosene. The copper wires, of 0.1 mm diameter, are held at one end by those screws, and at the other end by an insulated stand. If the apparatus is set in operation and the spark-gaps are properly adjusted, the wires become highly luminous throughout their entire length; and if, by bridges properly placed on the wires, stationary waves are allowed to form, the wires at the nodes for a length of a few centimeters become invisible, while the other positions, and especially those half way between the nodes, remain luminous. The phenomenon recalls the dust figures in the Kundt tube.—Lond. *Elec.*, March 8.

Dielectrics.—von Hoor.—A very long, illustrated account of a series of experiments. He found that the dielectric constant is not independent of the polarizing e. m. f., but varies between rather wide limits; therefore the electrostatic induction and hence also the charge of the condensers which he has investigated, is not a linear function of the polarizing e. m. f. The induction curves, found by him, have the same character as the well-known magnetic induction curves of nickel and iron, which proves the analogy between the conditions of magnetic and electrostatic polarization.—*Elek. Zeit.*, Feb. 21, 28, March 7.

Secondary Radio-Activity.—Becquerel.—A description of the following experiment. A leaden block 34 mm long, 31 mm wide and 7 mm high, had a groove 1 mm deep cut along its upper surface, and filled wtih a radium preparation of great activity. The block was placed on a sensitive plate for 48 hours, and the latter was then developed. A strong impression was found to have been made, in spite of the fact that the rays had to penetrate from 6 mm to 20 mm of lead. A peculiarity noticed by him was that a strong geometrical impression was created where the lower surface of the lead block had rested upon the plate, and that this impression was not eliminated by inserting a plate of mica. Small plates of any metal laid within reach of the rays, instead of weakening the impression by absorption, actually strengthened it by virtue of the secondary radio-activity produced, more especially at the edges directly exposed to the rays. Such secondary Becquerel rays have, however, very little penetrative power.—*Comptes Rendus*, Feb. 18, abstracted in Lond. *Elec.*, March 15.

REFERENCES.

Radio-Activity.—Becquerel.—A summary of the results of the newer researches on "the radio-activity of matter."—*Nature*, reprinted in *Elec. Rev.*, March 13.

Circular Magnetization.—Trowbridge and Adams.—An account of an experimental research on the intensity of magnetization produced by an oscillatory current in an iron wire and on the magnetic permeability.—*Am. Jour. of Sc.*, March.

Electro-Chemistry and Batteries.

Theory of the Storage Battery.—Kendrick.—A summary of the work of Dolezalek on this subject. The sulphate theory of Gladstone and Tribe assumes the consumption of sulphuric acid during discharge for the formation of sulphate of lead, and the formation of sulphuric acid during charge. The changes of concentration of the acid in the proportion indicated by the chemical formula of this theory, have been directly determined by experiment. Whether the action indicated by the formula is direct and primary, or results indirectly and is therefore secondary, cannot be determined from the experiments. For this a study of the e. m. f. must be made. Dolezalek gives three different methods of calculating the e. m. f. and compares the results with measurements. The first is based on the formula of Helmholtz. When the acid has a density of 1.044. the temperature coefficient of the cell is zero, and Thomson's rule is strictly correct, from it and from the known heat-tonings of the chemical processes, 1.88 volts is found in agreement with the measurements. The e. m. f. of the cell changes with the concentration of the acid. This is used by Dolezalek for the following experiment: He takes two storage cells with acid of different densities, joins them in series, but positive against positive. When this battery works, there results a change of concentration of the acid, due to the formation of sulphate in one and reduction of sulphate in the other, and the corresponding changes in the amount of the solids, lead, peroxide of lead and lead sulphate. The change of free energy, however, is involved only in the changes of concentration produced in the acid, since the solid substances are in the same condition before and after any action of the cell. This is like the deposit of copper on a copper electrode and solution of copper electrode in a copper sulphate solution. The energy involved in the concentration change can be calculated in two ways: First, by the heat of dilution involved, second, by the thermodynamic process of distillation of water from one acid to the other. This gives two independent methods for reckoning the same value. The agreement of the calculations with measurements is remarkably good. Nernst's osmotic theory of e. m. f. gives another entirely independent method of calculating the e. m. f., and the agreement with the measurements is also very good. The reversible, electro-chemical process, assumed by the sulphation theory, appears therefore to have been proved as thoroughly correct.—*Rose Tech.*, March.

Electro-Silvered vs. Plain Copper Plates in Gold Milling.—Halse.—An abstract of a paper in which he shows that electro-silvered plates are highly advantageous, at least for a certain class of ore, and that such plates not only catch more gold in proportion than plain copper plates working under similar conditions, but that such gold is of an increased fineness. Although their first cost is very high in comparison with that of plain copper plates, they soon pay for themselves in economy of labor alone, as they require much less attention than the latter.—Lond. *Elec.*, March 15.

REFERENCES.

Edison Storage Battery.—An illustrated abstract of an English patent to Edison, dated Nov. 20, 1900. A translation of practically the entire abstract is given in another column of this issue.—*Centralblatt f. Accum.*, March 15.

Solvay Electrolytic Alkali Cell.—J. B. C. Kershaw.—An illustrated description of this improved form of mercury cell, operated in two plants in Belgium and Russia for the production of caustic alkalies and bleach. The Solvay cell differs from the usual form of mercury cell in the absence of any mechanical movements for bringing about the desired circulation of the metal.—Lond. *Elec.*, March 15.

Graphical Treatment of the Action of Cells.—Weber-Sahll—A long illustrated article on tests of primary and secondary cells, and on the graphical representation of the results in curves. The article seems to contain nothing new.—*Schweiz. Blaetter. f. Elek.*, March 8.

Electrolytic Bleaching.—Brochet.—An article on the industrial manufacture of hydrochlorides. Brief descriptions are given of the processes of Hermite, Corbin, Kellner, Haas and Oettel.—*Elektrochem. Zeit.*, March.

Electro-Chemistry in 1900.—Krueger.—Continuations of his review, giving brief references to theoretical researches, published in 1900 in electro-chemistry; also on progress in primary and secondary cells, auxiliary apparatus and in electrolysis; also in electro-metallurgy and electric plating.—*Electrochem. Zeit.*, Feb., March.

Units. Measurements and Instruments.

Alternating-Current Wattmeter.—Drysdale.—A long illustrated article on the theory and use of the alternating-current wattmeter. He discusses at some length the errors to which it is liable and the corrections which must be applied. He gives the following rules for the construction of wattmeters. The self-induction and capacity of the shunt circuit should be small in comparison with its resistance. In order to measure a power-factor correctly to an accuracy of 0.001 on a 100-volt circuit, the resistance R in ohms must be at least 628,000 times the self-induction in henrys; the capacity error is KRp, where $p = 2n$ times the frequency, hence for the capacity error to be only 0.001, the capacity in farads must not be greater than $0.001 \div R p$. To fulfill the first of these conditions the control of the wattmeter must be small. Deflectional pivoted wattmeters, therefore, as those of the Weston type, cannot be accurate at low power-factors, since the pivot friction requires considerable control, and hence great self-induction. To avoid capacity errors, the non-inductive resistance should be split into a number of separate bobbins. As the effect of capacity is opposite to that of self-induction, both of these quantities might be comparatively large if balanced against one another. This has often been done or proposed, but he is strongly of the opinion that as it is easily done, each error should be separately eliminated for accurate work. The balancing of the errors looks much easier on paper than in practice. Where, however, a fairly accurate instrument is required for general use, a suitable condenser may be used to shunt the non-inductive resistance. Mutual induction between the series and shunt coils, should be avoided. This is always the case when the coils are at right angles and the readings are taken, not by deflections, but by a torsion head. Eddy currents should be avoided by getting rid of all metal near the coils, even screws and brass cases should never be used.—Lond. *Elec.*, March 15.

REFERENCES.

Phase Meters.—Armagnat.—His paper in full, on industrial phasemeters read before the Internat. Soc. of Elec. in Paris, an abstract of which was noticed in the Digest, Jan. 26.—*Bull. de la Soc. Int. des Elec.*, Dec.

Magnetic Measurements.—Montpellier and Aliamet.—The first part of an article on industrial magnetic measurements. In this part they give general remarks on magnetic tests.—*L'Elec.*, March 9.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Braun.—A summary of two lectures recently held by him, in which he discusses the advantages of his system of wireless telegraphy over that of Marconi. The main difference is in the transmitter. Condensers with a capacity of about the order of the usual Leyden jars were charged singly or in combination, to a high potential, and their discharges through appropriately dimensioned self-inductions were used to feed the transmitter directly or indirectly. It is evident that slower oscillations than those of Hertz are here used. He calls special attention to his "inductive excitation of the transmitter." It is characterized by the fact that the transmitter is left quite sparkless, and that the oscillations are excited in it by induction. The condensers discharge through a primary circuit, and this excites the oscillations in the lower spirally-wound end of the transmitter. The lower end of the latter remains insulated from earth. The advantages of his connections are said to be the following: In the primary circuit a large amount of energy can be employed usefully. The action of the transmitter increases with the energy employed by a much greater extent than with the Marconi connections, and can be augmented by increasing the capacity of the condensers as well as by increasing the potential. This is proved by a series of experiments. The oscillations of the transmitter are hardly active physiologically, in spite of their high potential, and a danger from unintentional contact is therefore quite excluded. Less attention need be paid to the insulation of the transmitter than in the case of electro-static excitation. The oscillations of the primary condenser circuit are slightly damped. They excite in the sparkless transmitter waves which are still less damped. If, therefore, both are brought to resonance, they increase in the latter case to a very high amplitude. Thus they fulfill the fundamental conditions necessary for electrical tuning between a transmitting and receiving apparatus; the region of useful rays of oscillations will at the same time be extraordinarily extended, as is particularly desirable for this purpose. Experiments in the open air have demonstrated a superiority over the Marconi transmitter under all conditions. The distance attainable should be, from the present facts and material, two and a half to three times that by the Marconi transmitter. To increase the receiver effects, he concentrates the energy on the receiving apparatus, so that the latter benefits by it, as far as possible, exclusively. He showed by experiments that the electric waves which pass the receiver can be concentrated 20 times or more. He also showed in his lectures the sharpness of the tuning. "Very slight changes in the tuning immediately diminished the localized energy very considerably. As the energy only collects in the tuned parts, the other parts will refuse to act, and thus the problem of the so-called multiplex telegraphy is solved in a very complete manner."—Lond. *Elec.*, March 15.

Telegraph Wires on Snow.—Brunhes.—The fact that snow is a good insulator, has been practically recognized by the employees of the Puy de Dome Observatory for a number of years. The double line which connects the observatory with the station of Rabanesse is often interrupted during the winter season. The breakage is due to the fact that the poles, covered with a layer of hoar frost, "which can attain a diameter of 3 ft.," offer too large a surface to the winds, which blow with great violence. It often happened that in the execution of repairs the workmen drew a line of wire across the snow so that the wire was in contact with the snow over a length of 30 or 40 yards. Even when the poles remained standing, it often happened that their tops were covered with snow, and that as much as 1000 yards of wire were in immediate contact with it, without the messages being disturbed on that account.—*Comptes Rendus*, Feb 25; abstracted in Lond. *Elec.*, March 15.

Subterranean Telegraph Cable.—An article on the underground telegraph cable of the Brit. Postal Tel. Dept. between London and Birmingham, a distance of 117½ miles. This is said to be the longest underground telegraph cable in the world. The cable consists of 76 wires, each of which is insulated in specially desiccated paper, and the whole enclosed in a leaden sheath to prevent the admission of moisture. It is laid in cast iron socket pipes, built in sections of 150 yards each.—*Sc. Am.*, March 16.

REFERENCES.

Theory of Wireless Telegraphy.—Abraham.—An article in which he gives a theory of wireless telegraphy, based upon Maxwell's electrodynamic equations. He gives the formulas for the damping of electric oscillations. His conclusions are in agreement with those of Slaby.—*Phys. Zeit.*, March 2.

Telegraphy and Telephony.—A summary of progress and inventions made in telegraphy and telephony from October to December, 1900.—*Elek. Anz.*, Feb. 24, 28.

Cleveland.—A long illustrated description of the Cuyahoga Telephone Company's exchange system in Cleveland.—*West. Elec.*, March 23.

Telegraphy.—A continuation of the illustrated serial on modern telegraphy. Descriptions are given of the Breguet, Morse, Hughes and Baudot apparatus, which are generally used in France.—*Cosmos*, March 9.

Rowland Telegraph.—Robichon.—A continuation of the illustrated description of the Rowland telegraph. This part deals with the reception of the signals, synchronism and the transmission of the signals.—*Jour. Tel.*, Feb. 25.

Multiplex Telegraphy.—Luginbuehl.—An illustrated article on a system of quadruplex telegraphy for a line having a branch, and on the use of the Baudot apparatus in connection with such a system.—*Jour. Tel.*, Feb. 25.

Railway Signals.—Ledrouant.—A detailed description of the Timmis-Lavezzari system of electric railway signals, which was shown at the Exposition.—*La Nature*, March 2.

Signals.—Dary.—An illustrated description of the apparatus of Siemens & Halske for transmitting signals electrically, especially on board of battleships. Direct current is used. The apparatus is of the "revolving magnetic field" type, which was described before in the Digest.—*L'Elec.*, Jan. 26.

MISCELLANEOUS.

Effect of Invisible Rays Upon the Eye.—The impression produced by Becqueral, Röntgen and ultra-violet rays upon the human eye might possibly be utilized in the case of blindness. Rays which penetrate opaque bodies may reach an optical nerve cut off from the outer world by turbid humors or integuments. A long series of experiments in this matter has been made, but practically useful results are much interfered with by the rapid "fatigue" of the eye. After a few exchanges the subject is unable to say which of two packets, one filled with sand and the other with a radium preparation, contains the active element, though at first the latter produces a general luminosity in the eye. It appears certain that none of these rays produce fluorescence in the human eye, though they do in the eyes of some animals. Also that it is the rods and not the cones of the retina that are chiefly affected. Geometrical impressions may be temporarily created in a blind eye by means of Röntgen rays transmitted through lead plates in which patterns are cut. A radium preparation produces a luminous sensation which appears to proceed from the side on which the preparation is held. This is a hitherto unexplained effect.—*Ann. der Physik,* No. 3; abstracted in Lond. *Elec.,* March 15.

Electric Furnace.—A brief illustrated article on a process of Machalske for the production of yellow phosphorus from phosphate rock, by means of the intense heat of an electric arc in the electric furnace; also on another process for the production of chlorides of carbon in the electric furnace. If in a furnace a mixture composed of salt, carbon and sand is treated, and the vapors are condensed, there is obtained carbon tetra-chloride, a colorless liquid of a pleasant odor, which is thought may find an extensive application in the extraction of oils, greases, etc.—*Sc. Am.,* March 23. See ELECTRICAL WORLD AND ENGINEER, March 2.

REFERENCES.

Filipino Electrical Machinery.—MAYSE.—An illustrated article on electrical machinery made in workshops in the Philippine Islands, which is said to answer all practical purposes, although the finish is imperfect. The demand for electrical machinery is, however, far in excess of that supplied by the native builders.—*West. Elec.,* March 23.

Paris Exposition.—HAUSEGGER.—Continuations and the conclusion of his very long, detailed and well illustrated article on the exhibits of Ganz & Co.—*Zeit. f. Elek.,* Feb. 10, 17, 24; March 3.

New Books.

BOOK RECEIVED.

STEAM BOILER ECONOMY. A Treatise on the Theory and Practice of Fuel Economy in the Operation of Steam Boilers. By William Kent, A. M., M. E. New York: John Wiley & Sons. 453 pages, 134 illustrations. Price, $4.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., Sept. 4, 1901.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Next meeting, Houston, Tex., April 19-22, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

Frequency Changer.

The development of polyphase current working has been so rapid that questions thought to have been definitely determined when a plant was originally erected have afterwards been revived in troublesome form. In early days, for example, the very high frequency of 133 was settled upon as being most likely to satisfy all future requirements. Not many years later it was recognized that this was too high, and a periodicity of 60 became current practice. Still more recently it has developed that while this frequency is apt to stand with respect to lighting, it is too high for certain power purposes, and it has also been found that the best frequency for the latter purposes is too low for lighting. These considerations have brought forth the desirability of a piece of apparatus whereby a frequency may be transformed from a higher to a lower value or vice versa, thus enabling power plants of low frequency to supply lighting current, and permitting lighting plants of high frequency to supply current of the best frequency for power purposes.

An apparatus of this kind, made by the Stanley Electric Manufacturing Company, is shown in the accompanying illustrations. In addition to being a frequency changer, the machine can be built to deliver current of a different phase relation and voltage from that with which it is supplied. The machine, though it performs the function of two different machines, presents the same general appearance as the S. K. C. standard inductor alternator. In operation one-half of the frequency changer is essentially an asynchronous motor and the other half an alternating-current generator. There is, however, but one field coil, which furnishes the excitation for both the motor and generator ends of the machine. The ratio of voltage transformed may be as high as 10 to 1, not, however, exceeding 5000 volts in machines of less than 250-kw capacity. The S. K. C. system of independent phase regulation applied to these machines makes possible also an individual voltage variation of 10 per cent on each phase.

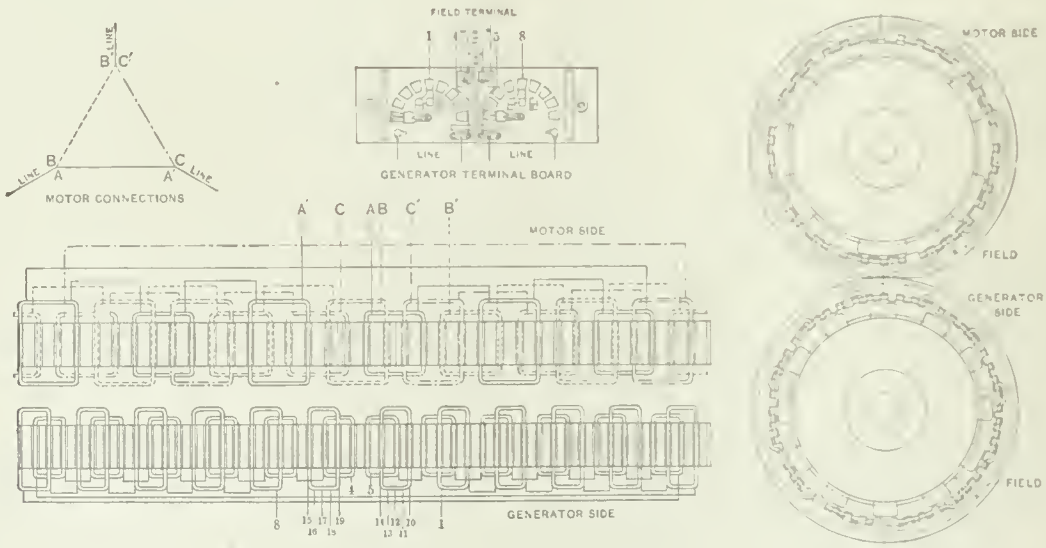


FIG. 1.—PLAN OF CIRCUITS.

The plan of circuits of the machine is shown in Fig. 1. The armature and armature coils are stationary. The armature is built up of laminated iron and the comparatively small coils are wound and insulated separately and placed in the generator in the exact shape in which they are wound. The inductor or revolving part consists of a mass of cast-steel secured to the shaft with laminated iron projections on its surface, and is without wire connections of any kind.

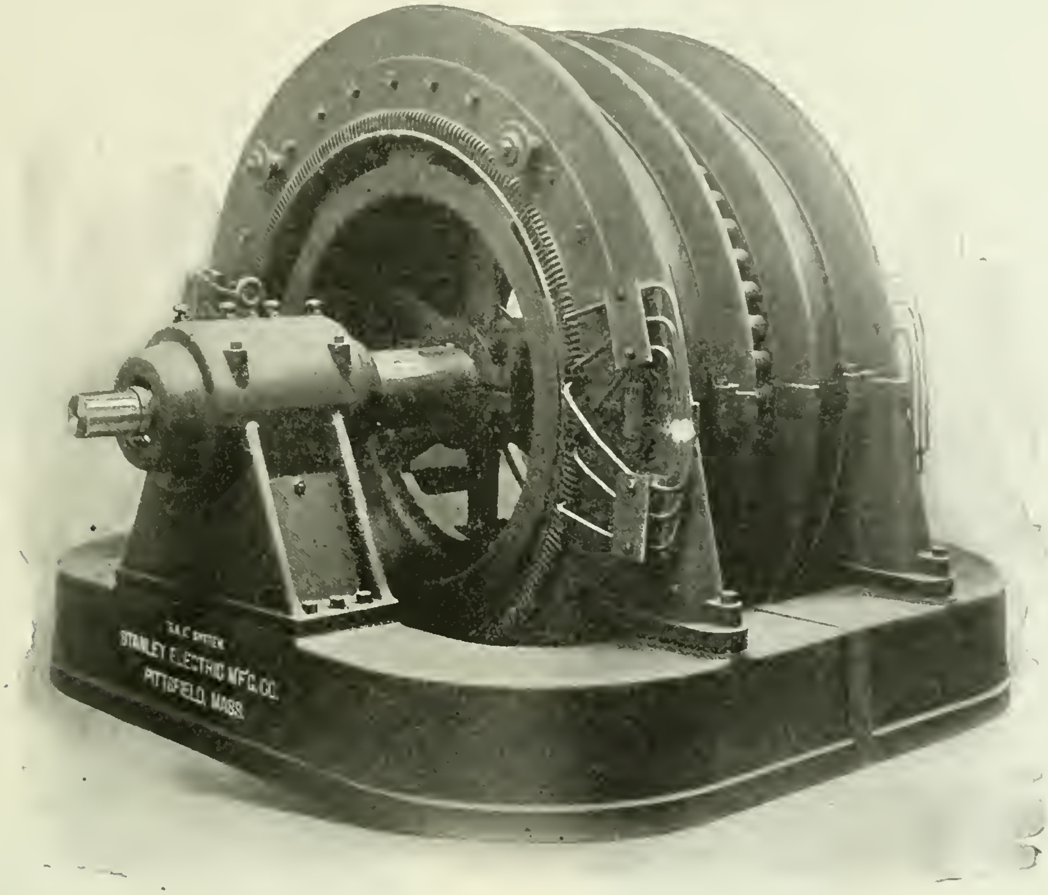


Fig. 2.—Frequency Changer.

The armature leads of the generator half and the field leads, are brought to a marble terminal board placed on the machine. The phase regulators may be placed either upon the marble terminal board or on the switchboard panel controlling the machine, as may be desired. The armature leads of the motor half are connected to the line terminals from the switchboard. As illustrated in Fig. 1 all the armature leads are numbered to correspond with the numbers on the terminal board. The field coil, which is stationary, is wound on a copper spool, thereby removing the danger of a discharge breaking down the insulation should the field circuit be opened when fully charged.

English Polyphase Direct Current Motor Generator.

We are glad to be able to present to our readers a description of the latest type of polyphase direct current motor generators and induction motors, manufactured by the Electrical Construction Company, Ltd., of Wolverhampton, England. The Electrical Construction Company is one of the largest British manufacturers, and has recently made extensive additions to its factory, whereby it is now able to manufacture electrical apparatus of the largest size. As one of the first English manufacturing companies to enter heavily into the manufacture of the polyphase apparatus, a description of their latest designs in this line will doubtless prove interesting.

The motor-generator set illustrated consists of a synchronous polyphase motor, driving a six-pole direct-current generator. The normal output of the generator is 140 kilowatts at 200 to 230 volts, with a 25 per cent overload for two hours. In order to save floor space, and also to give the highest efficiency, it was decided to have only two bearings for the combined machine, and in order to get sufficient rigidity in the rotating element, both the rotor of the motor and the dynamo armature are built upon one cast-iron frame, with a specially long boss, into which the shaft is driven under hydraulic pressure. The shaft being by this construction relieved of all torsional stress, except the small amount due to friction of the bearings, it is unnecessary to key it to the boss.

The motor is wound for eighteen poles, and therefore gives a synchronous speed of 400 revolutions per minute, when supplied with current at sixty periods per second. The two-phase supply is at 1000 to 1100 volts, the separate phases being connected on opposite sides of the stator, to terminals covered by glass doors. The stator winding consists of 216 form-wound, interchangeable coils, well insulated and imbedded in open slots cut in the laminated core, which is supported by and bolted to a strong cast-iron frame, accurately bored out to receive the core plates.

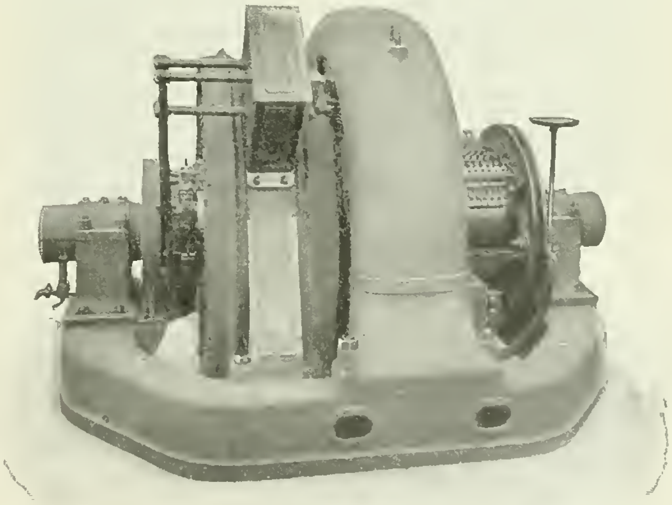
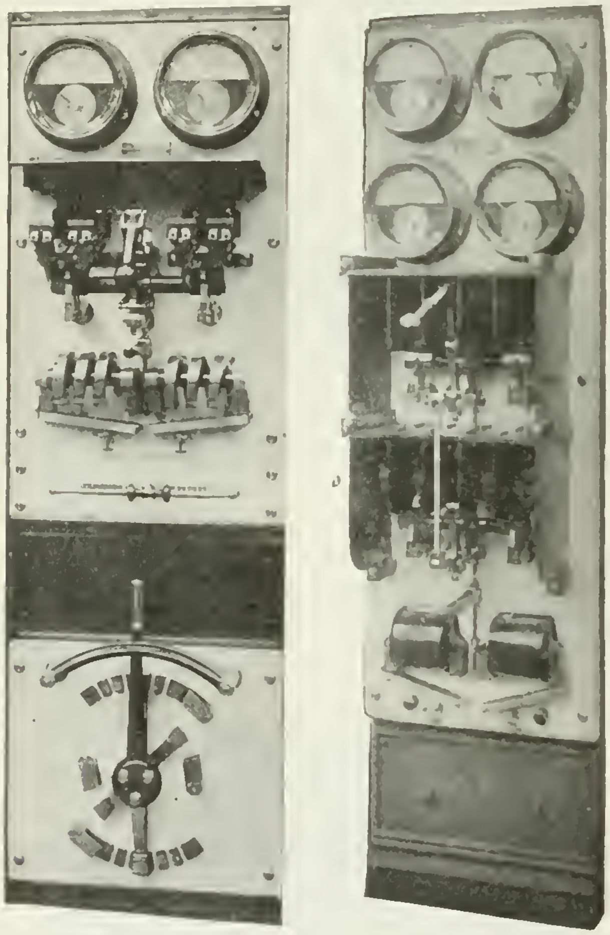


FIG. 1.—200-HP POLYPHASE DIRECT-CURRENT MOTOR-GENERATOR.

The rotor has 165 equal and equally spaced, partially enclosed slots, each slot having one conductor of solid copper; the conductors are connected by sheet copper connections to form a three-phase star winding, one terminal of each group being bolted to the cast-iron frame of the rotor, while the other ends are connected to three collector rings on the other side of the core. From these collectors the rotor current is conducted by triplicate sets of copper brushes through three bare copper rods to the resistance and short-circuiting switch, which is carried by the stator frame.

The dynamo is of the multipolar, slot-wound type, usually adopted for electric traction work. The armature is of the barrel-wound type, the conductor loops being machine formed, continuous, and without joint except at the commutator. They are imbedded in straight-sided slots and held in position at the core by hardwood keys and additionally held by metal bands, which secure the helical portion of the winding. The laminated core is rigidly bolted direct to substantial cast-iron side cheeks, and the laminæ, which are sixteen mils thick, are effectively ventilated.

The commutator is twenty-four inches in diameter, and has a working face of ten inches, the average e. m. f. between the segments being approximately 6 volts. There are forty-two carbons for the collection of the current, each carried in a separate holder having the usual adjustments, the brush ring being also in connection with the worm gear.



FIGS. 2 AND 3.—DIRECT AND ALTERNATING SWITCHBOARD PANELS.

The magnet system consists of a massive cast-iron yoke ring, divided about the horizontal axis, and into which are cast six projecting magnet cores each formed of high permeability steel plates. The pole shoes, which are readily removable, are laminated, the magnets being shunt wound on removable ferrules.

The following are the leading dimensions of the machine:

	Feet.	Inches.
Distance centre to centre of bearings..........	7	2
External diameter of dynamo yoke ring.......	7	0
External diameter of stator frame.............	5	9
Internal diameter of stator core...............	4	4
External diameter of rotor....................	4	3⅞
External diameter of D. C. armature..........	3	6
	Tons.	Cwts.
Weight of rotating portion....................	5	0
Weight of bed-plate..........................	2	1
Weight of stator..............................	2	4
Weight of magnets............................	7	4

Fig. 2 shows one of the direct current switchboards. This is fitted with an ammeter, a voltmeter, a double pole automatic circuit breaker, shunt regulating switch, and motor starting switch. The automatic circuit breaker is fitted with renewable carbon contacts to take the arc when opening circuit. The design of this is such that it can also be used as a main switch. Should it be closed on an overload or short circuit it immediately opens, the contact maker being independent of the handle. The resistances for starting and regulating are fixed at the back. The panel slabs are of white marble, and the framing is built up of wrought-iron angles.

Fig. 3 shows one of the alternating current switchboards. These have iron frames and marble slabs similar to the direct-current panels, each panel is fitted with an ammeter, a voltmeter, and a double-pole circuit breaker in each phase. The two circuit breakers are operated by one handle; the design of these is similar to those on the direct-current switchboards. The circuit breakers being for high tension, the contacts are protected by deep partitions of non-inflammable insulating material. The voltmeters are operated at low tension, pressure reducing transformers being provided for each and fixed on the back of the board.

The switching gear provides for the machines being started either from the direct or the alternating current side. When starting from the alternating side, the resistance carried on the stator frame is in circuit with the rotor, and prevents too large a current passing, on closing the main switch. After the machine has speeded up, this resistance is short-circuited by means of the three-way switch. The resistances are made of German silver plates.

The same company makes a line of inducion motors in various sizes up to 50 horse-power, one of which is shown in Fig. 4. They have short-circuited rotor windings, the starting current being reduced when necessary by the insertion of an auto-transformer between the mains and the motor. The stator coils are machine-formed and insulated, before fixing in the slots, which are of the open type. The heavy cast-iron frame is accurately bored to receive the core plates, which are fixed by end rings locked by a notched ring of phosphor bronze, and fitting into recesses in the frame. The rotor winding consists of rectangular copper bars bolted to solid gun-metal end rings, thus making good contact without using any solder. The slots are semi-enclosed, while the core plates are carried by a cast-iron spider with end plates locked similarly to those of the stator. The bearings are cast with the side flanges. The brushes are of phosphor bronze lined with white metal, lubrication being by means of oil rings. The radical clearance between the rotor and the stator is one-thirty-second of an inch in the one horse-power and one-sixteenth in the fifty horse-power size. The rotors are carefully balanced and every machine thoroughly tested before being despatched. The particular machine illustrated is the enclosed type, and specially suited for working in fiery mines, flour mills or in dusty or wet situations.

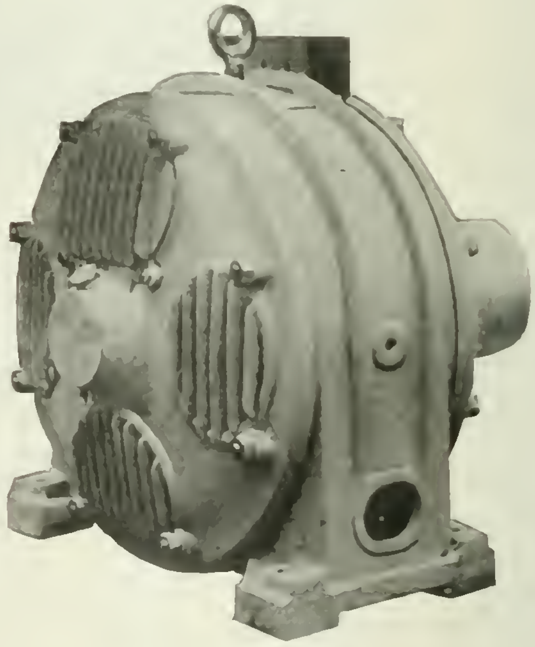


FIG. 4.—E. C. C. INDUCTION MOTOR.

The Development of Telpherage.

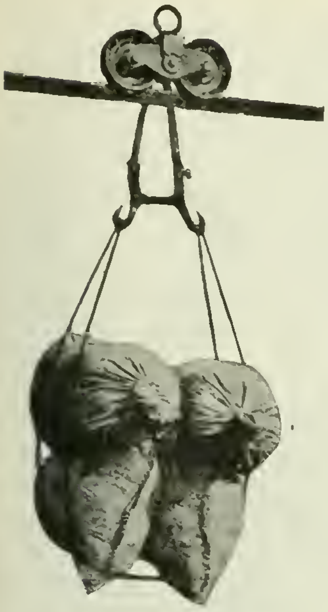
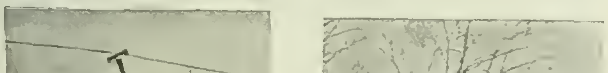


FIG. 1.—TRAILER WITH BAGS IN SLING.

The word "telpher" and the art of telpherage bid fair to attract considerable attention in the mechanical and electrical fields, owing to the persistence and success with which the new industry is being pushed. It will, perhaps, be remembered that an article appeared in these pages in the issue of May 19, 1900, in which some details were given as to the system and its proposed development. Since that time a great activity has been shown by the Consolidated Telpherage Company in preparing to place its system on the market, and it may now be confidently stated that nothing stands in the way of rapid extension on commercial lines. During the past year the company has had a line in constant operation at the factory of the Crocker-Wheeler Company, at Ampere, N. J., crossing the grounds and connecting two departments of the works. More recently a contract has been closed for a brewery in St. Louis, while a plant is being installed in the Yale & Towne Works, at Stamford, Conn., and another has been contracted for to handle ashes at the Singer sewing machine factory, at Elizabethport, N. J. Earlier demonstrations having thus proved satisfactory to all concerned, and the inrush of inquiries, orders and new business from every quarter of the globe demanding proper capitalization, so that even the largest contracts can be fulfilled, the United Telpherage Company has been formed, with headquarters at 20 Broad street, and with the following officers: H. McL. Harding, president; C. M. Clark, treasurer; W. T. Wallace, secretary; Clark & MacMullen, consulting engineers; to whom may be added Messrs. E. D. Adams and C. F. Clark, trustees. It is rarely that any new enterprise in electrical development starts out under such promising auspices, both with respect to conservative management and commercial and engineering ability. Mr. Harding, who has been prominent for several years past in the affairs of the Sprague, Westinghouse and Walker companies, has of late given his whole time to the exploitation of telpherage, and to him more than to any one else is due its present promising condition. The new company has a capitalization of $1,500,000, and is organized under the laws of New Jersey.



FIGS. 2 AND 3.—TELPHERS CARRYING FREIGHT AND MAIL BOX ACROSS LOTS.

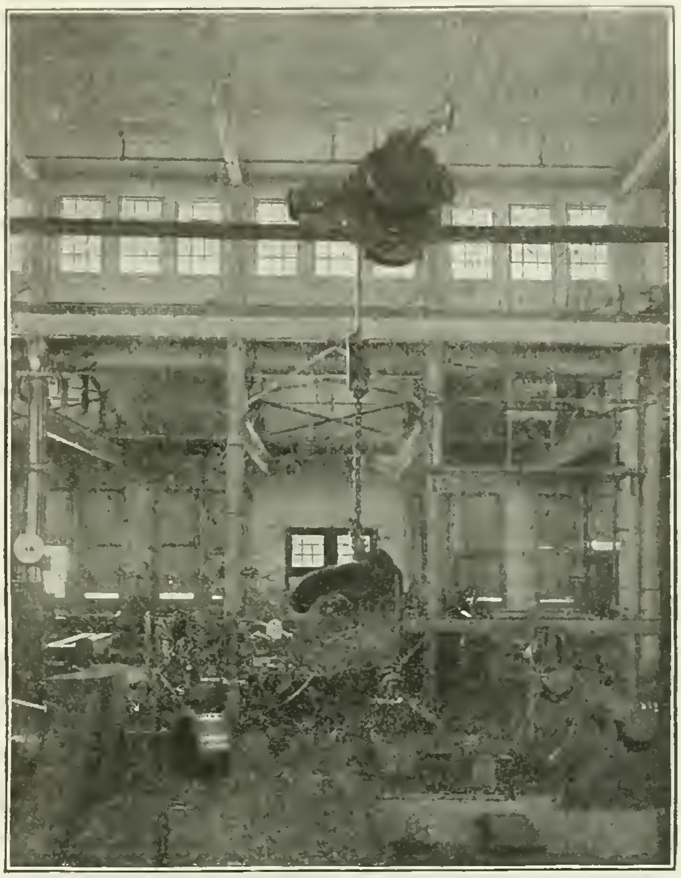


FIG. 4.—TELPHER LINE IN FACTORY.

In our former article of about a year ago, just referred to, some illustrations were shown of the apapratus and methods of operating telpher lines, in which, as our readers are aware, the telpher travels along a bearing cable and takes current by rolling contact from a lighter wire suspended just above it. We are now able to illustrate the standard apparatus, which has been developed and perfected in the interval, and to show some of its performances. Either a single unit telpher or a double unit may be employed for the work, with or without a trailer, the single unit consisting of two small enclosed motors and the double unit of four motors. The hanging or slinging arrangements attached to the telphers or the trailers are of a great variety of shapes and styles, adapted to the transportation of all kinds of loose or easily divisible material, such as bags, barrels, sand, coal, ashes, ores, bricks, fruit, etc.; while a ready combination of one or two trailers lends itself easily to the transportation of long pieces, such as lumber, rails, tubes, drain pipe, etc. One of the most remarkable things in connection with the work is to witness the manner in which telpher units of not to exceed one-fourth to one-half horse-power will travel at a rate of five or six miles an hour with loads of several hundred pounds on lines running around sharp curves and even up sharp inclines. The current consumption is surprisingly small.

At the present time, in addition to the production of its apparatus, the company has found it a task of no mean description to attend to all the applications which have poured in upon it from commercial and engineering concerns for agencies, and these, both domestic and foreign, are being assigned as rapidly as possible. The development has attracted the liveliest interest abroad, and was recently investigated by the engineers of a leading English electrical firm; while one of the requests from Russia came from Prince Hilkoff, who desires to equip several miles with the system, which is obviously much lighter and cheaper to construct than railroads, while it does not encroach in any way on highway rights and does not impose any difficulties as to crossings, etc., along the routes it traverses. The utilization of the system for transporting mail and express matter has already been taken up, and applications have been received from managers of telephone and trolley lines, who see in this light and flexible electrical system a means of getting an additional service out of their pole lines, while at the same time subserving for purposes of varied freight transportation the necessities of the districts they cover. The conveyance of mail matter is peculiarly within the function of this apparatus, as letters and papers can be concentrated into very small bulk for transportation, and the deliveries can be made with great frequency where, under existing conditions, the postman can go over his route but once or twice a day at the most.

In connection with the handling of mail matter it may be stated that the company has already been invited to consider the question of transporting mail in cities by means of underground tube systems, where the conditions would if anything be even more favorable than with ærial lines. At the present time mail in transit from post-office to railway depot is subject to all the vicissitudes of interruption by street blockade, weather, etc., and is frequently delayed on that account. The use of pneumatic power has already been tried in this direction, but it is plain that in this field, as in others, electricity will readily prove its superiority and be generally adopted for such work. In the meantime the company has its hands more than full of propositions for equipping wharves and docks, railroad depots, factories, plantations, mines, and a host of other establishments where goods have to be transported continuously in relatively small bulk; and it is only reasonable to predict that we shall now see the fruition of the work in this new industry, which was attempted even before the electric railway began its great development, and which may be said to have awaited the perfecting of apparatus and details not available in the earlier days. Except so far as it may do some of the work hitherto assigned to cable haulage systems, telpherage appears to cut out an entirely new province of its own, and it thus gives opportunity for considerable utilization of current and motive power, as well as new and profitable employment of capital.

A Simple Connection Between Turbines and Generators.

The illustrations given herewith show an arrangement of turbine-driven generator, which has been installed for the Massachusetts Chemical Company at Walpole, Mass., and manufactured by the Thresher Electric Company. The object in view was to make the simplest possible mechanical connection between the dynamo and the turbine, which is in accordance with the present trend of engineering. In the form shown, the generator is an essential portion of the turbine. This construction obviates the friction of bevel gear or belting ordinarily used with water powers, which amounts in the first case to about 18 to 22 per cent, and in the latter from 15 to 19 per cent. A considerable saving of power is thus effected, which in the ordinary form of connection between the generator and turbine is lost in transmission from the turbine to the generator.

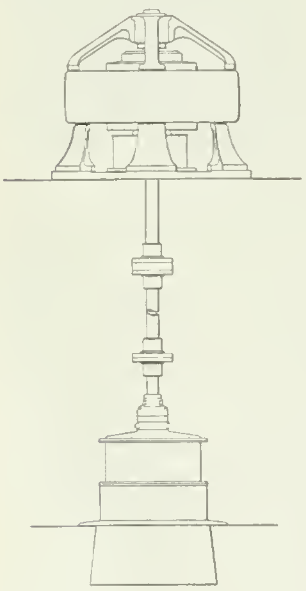


FIG. 1.—GENERAL ARRANGEMENT OF TURBINE AND GENERATOR.

In the general plan (Fig. 1) are shown the entire turbine and generator with the manner of connection between the shaft of the latter and the waterwheel. In Fig. 2 the general arrangement of turbine and generator is shown, with the plan of the oil pockets and bearings. Fig. 3 gives a full view of the generator on its pedestals, which happened in this instance to be the top of the turbine itself, as the head was only about 15 ft.

Certain original features are embodied in this mode of construction, among them the flexible coupling on the shaft between turbine and generator, the feathered coupling permitting free longitudinal action and making the machine self-contained and supported separately on its own thrust bearings. These are composed of several annular rings about the shaft, which bear on a number of babbitted projecting surfaces. The shaft of the turbine may be varied in length, depending upon the head of water, and having the generator either over the penstock or over the head of the tail race, the flexible coupling taking care of any expansion or contraction of the shaft without throwing any compression strains on the turbine shaft. The lower and upper bearing of the generator are overhung, having a heavy umbrella-shaped form projecting into the oil pocket containing the lubricant. An oil bath surrounded by a water jacket encloses the annular rings, and projecting surfaces mentioned above.

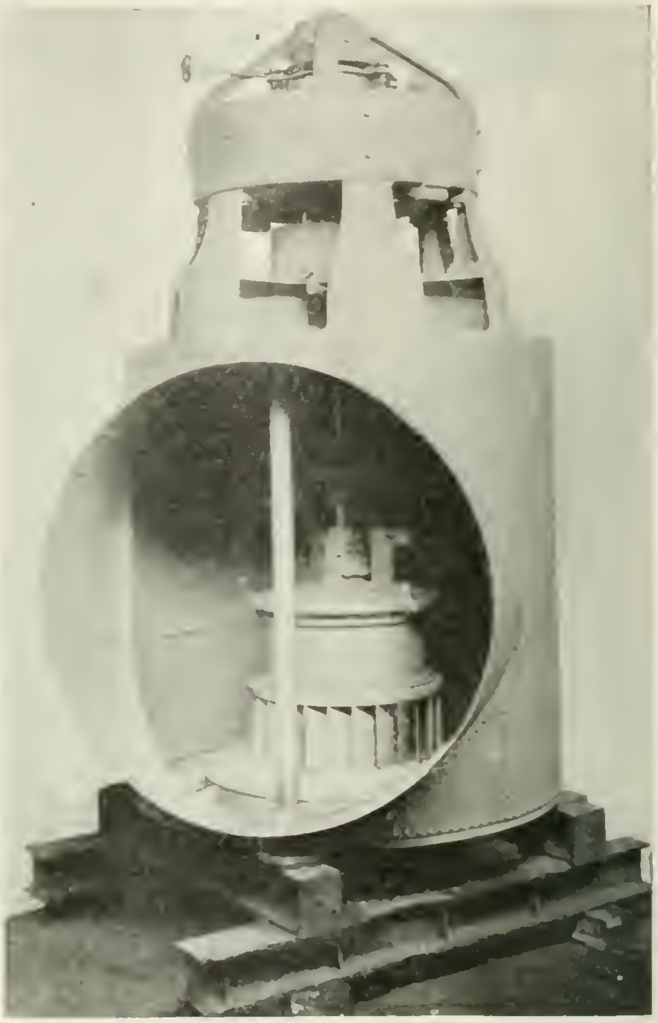


FIG. 2.—TURBINE AND GENERATOR.

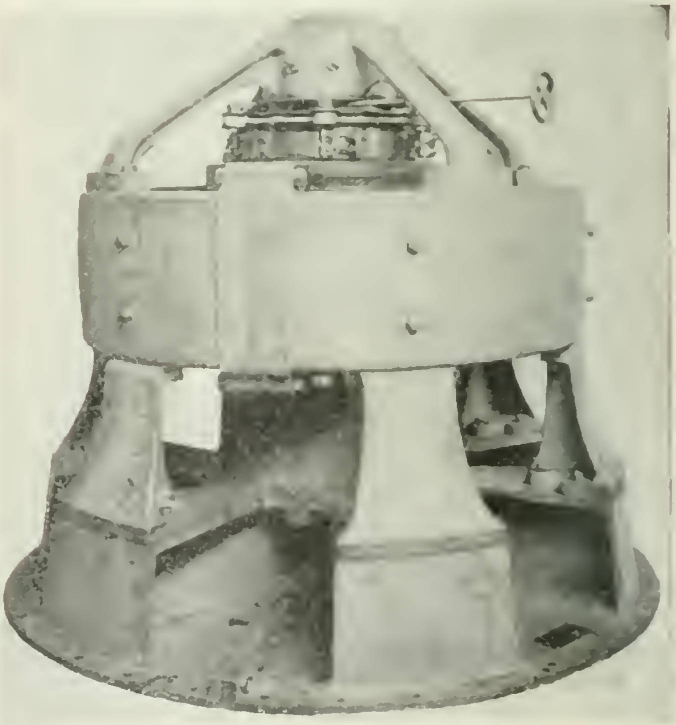


FIG. 3.—THE GENERATOR.

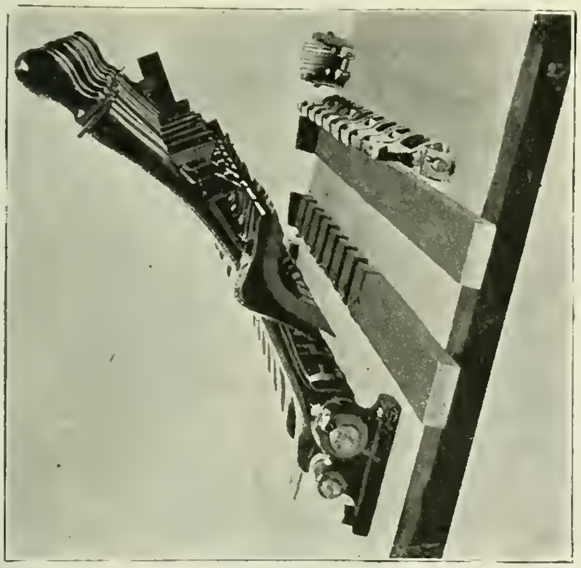
Oil circulating ducts with which the pocket is provided, keep the oil in constant circulation, which is also kept cool by the surrounding water jacket. No oil can get down the shaft, and perfect alignment is secured for the armature.

In the plant of the Massachusetts Chemical Company there were two sizes of machines used, one of 80 kilowatts and 150 r. p. m. at 600 volts, the other of 125 kilowatts and 200 revolutions at 600 volts. The turbines employed were made by the Stillwell-Bierce & Smith-Vaile Company.

It can be easily seen that a simple design of this nature possesses great advantages over the belting or gearing arrangements, and is more easily regulated. First, the moving parts are simpler, and presenting to the whole revolving mechanism less inertia (upon which the regulation largely depends), they respond more quickly and with greater harmony to the controlling device, which is connected to the gates that regulate the turbine. Second, the generators dispense with the racket and vibration produced by gearing from turbines to horizontal generators. Third, there is greater efficiency of transmission. Fourth, the unit is more certainly regulated for speeds of variable loads, and since it takes less space and foundation, no provision is needed for any movement of the commutator along the length of the brushes, since these generators do not need lateral movement of the commutator to produce uniform wear.

Multiple Switch Automatic Starting Rheostat.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has designed a new starter for large motors, which, in construction, differs from that ordinarily used for small motors in that the sliding contact is entirely done away with and a system of switches substituted therefor. With this multiple switch system there is no sparking at the switch in starting a motor, whether under load or not, and it is not necessary to divide the rheostat into as many sections, as is usual in the case of the ordinary type. The peculiar construction of the contact on these switches insures a good contact the instant any contact at all is made. The switches differ from the ordinary knife switch in that they do not have to be pushed into clips before their full carrying capacity is obtained. The contact is made by a large number of thin leaves of brush copper which press up against a hard-rolled copper surface with sufficient scraping motion to keep the surfaces clean and bright. A switch built on this principle will carry, without heating, 250 amperes per square inch of contact surface, whereas the ordinary commercial knife switch is rated by the underwriters at but 50 amperes per square inch of contact surface.

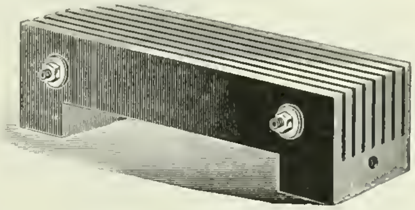

MULTIPLE SWITCH-STARTING RHEOSTAT.

Referring to the illustration, it will be noticed that the first switch on the right hand side is held closed by an electromagnet, and that all the other switches are held closed by latches. In front of each switch is placed a pivoted cast iron stop, so arranged as to prevent any of the switches from being closed, until the switch next to it on the left has previously been closed. The cast iron stops, therefore, constitute the interlocking mechanism. When the supply of current is shut off the first switch on the left opens and allows the stop on switch No. 2 to drop so that this switch also opens, and releases the catch on switch No. 3, and so on until all the switches open automatically.

Interchangeable Shunts.

The interchangeable shunt feature lately developed in connection with the Whitney instruments handled by Messrs. Machado & Roller, 203 Broadway, New York, has, it is stated by this firm, been meeting with much approval from critical station men and other large users.

The scheme that has been developed involves not only making all shunts of the same capacity interchangeable with each other, but all of the ammeters themselves, whatever their capacity or style likewise interchangeable in so far as each requires the same number of millivolts difference of potential to cause the needle to swing to full scale. By adopting this plan, it is possible to compare all of the ammeters on a given board with one another irrespective of their capacities and without interfering with the shunts or busses. To do this the leads of each meter are disconnected from their several shunts and connected in parallel to a single cell of dry battery, sufficient resistance being, of course, interposed to cut down the potential to a point where the meters show full scale. If any one of them should fail to so indicate it is evidently out of calibration by the percentage that the indication bears to the full scale indication, and the meter can either be run with this correction factor or sent away to be adjusted. A point of particular value in the latter event is that the shunt itself need not be removed, as the drop that it gives across the contact studs is a standard and known quantity.


INTERCHANGEABLE SHUNT.

In the larger plants it is usual to keep on hand a portable millivoltmeter, which can always be attached to any shunt, and its readings compared with the station instrument to check it, and which can be used in place of the latter if at any time it should be necessary to send it away.

It is claimed that the shunts themselves will never vary, as they are specially made by milling out solid blocks, so as to obviate the soldered contacts usually employed, and which are sources of possible error. As the accompanying illustration shows, the terminals on the shunts to which the instrument leads are attached are exceptionally heavy in order that contact errors at these points, which are another source of difficulty with shunt ammeters, may be minimized.

Other features of the devices, such as the temperature coefficient of the shunt material, have been the subject of much careful thought and investigation, and the final form arrived at is said to be conducive to highest commercial accuracy.

A British Motor Driven Feed Pump.

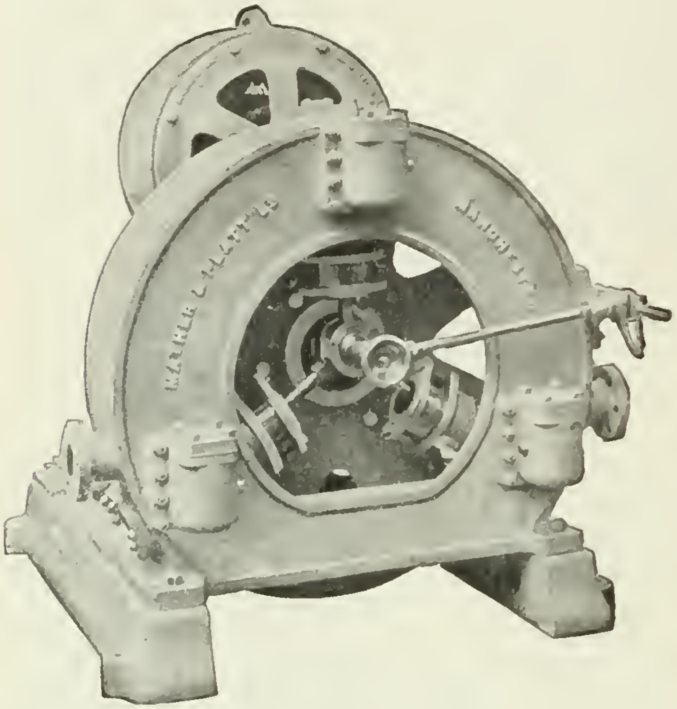
A compact and satisfactory type of motor driven feed pump outfit has been introduced recently by the well-known English firm of Mather & Platt, Ltd., of Manchester, to be used with either a direct or an alternating current motor.

The entire regulation of the pump is a mechanical one, and consists in altering the stroke of the plungers according to the required output, the result being that the work of the plant can be quickly reduced from the maximum to zero, or *vice versa*, without any wasteful absorption of power by resistance.

This pump consists of three cylinders mounted radially on a frame at angles of 120 degs. with each other, the plungers being driven from a crank-pin by connecting rods in the ordinary manner. The crank-pin is arranged eccentrically on a disc fitted into a recess in an internal toothed wheel, which engages with a pinion on the motor shaft. The rotation of this disc, which causes the desired alteration of the stroke, is obtained by gears situate in the hub of the internal wheel, and operated by a suitable hand-lever conveniently arranged.

An indicator, fixed to the stroke varying attachment, shows the length of stroke, and therefore the corresponding output of the pump at the time. To change the stroke, all that is required is to raise the hand-lever until the indicator shows that the desired amount of water is being discharged, whereupon the lever is released. The lever can be operated directly in the manner described, or from a distance by suitable connections, and in the latter case is peculiarly adapted for use with hydraulic accumulators, when it can be readily attached to and controlled by the ram.

The main framework, cylinders, and valve-boxes are of cast-iron, and the plungers, bushes and glands of gun-metal; mild steel connecting rods drive the plungers through the medium of ball and socket joints, which are readily adjustable. The gland flanges are not rigidly attached to the bodies, but are designed to accommodate themselves in case of the gland-nuts being tightened unequally, thus preventing undue friction on the plungers. One of the principal features is the arrangement of the valve boxes, which are easily removable, and in which the valves themselves are readily accessible. The motor is steel-clad, with the windings entirely protected from injury. The openings in the end plates can be covered with gauze if desired, and this, while not interfering with the ventilation, allows the motor and pump to be used in coal mines and other places where such protection is highly desirable.



MOTOR-DRIVEN FEED PUMP.

◆

Carborundum for Commutator Polishing.

A matter of much interest to power station superintendents, and all who are operating direct-current apparatus, is the new field which has been entered by the Carborundum Company, of Niagara Falls, N. Y., in the use of carborundum paper for polishing commutators. Heretofore this work has been done with sandpaper, a material little adapted for metal work of any kind on account of its comparative softness and inability to keep a sharp cutting edge. Emery paper might, of course, have been adopted for this purpose, except for the fact that it consists largely of iron, which finds its way between the segments of the commutator and quickly short circuits them. In carborundum has been found a material which is absolutely a non-conductor, and at the same time many times harder and sharper than sand or emery, making it an ideal abrasive for this important operation. Too much stress cannot be laid on the proper care of commutators. Properly and intelligently polished, they require turning down only at long intervals. However, if the high spots and flat places are once fully developed, no amount of polishing will again bring the commutator to a true circle. Here let us consider the action of sandpaper. It is a comparatively slow-cutting material, and in applying pressure to make it cut, follows all the irregularities of the surface, leaving the contour the same as before. Carborundum, being of such great sharpness, the same pressure is unnecessary, and the high spots are cut more rapidly than the flatter portions, the tendency being always to bring the commutator back to its original perfect form.

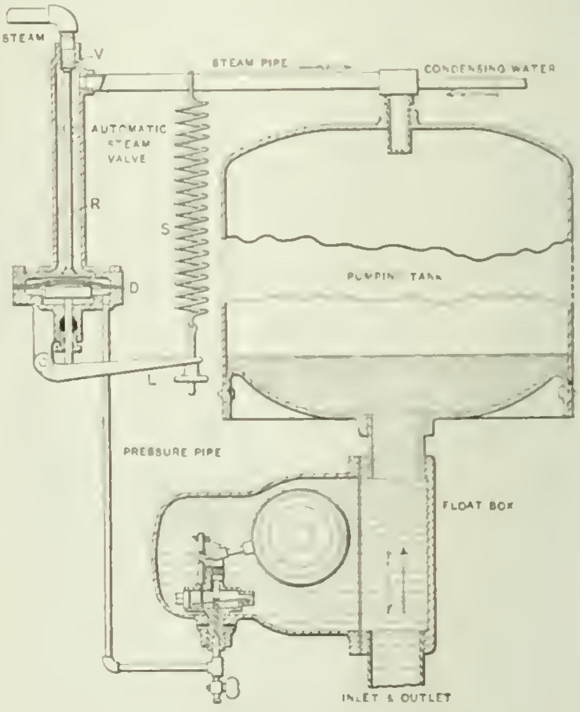
Recent tests at some of the large power stations at Niagara Falls have shown that one sheet of carborundum paper does the work of from 10 to 20 sheets of sandpaper. In addition, the commutator is left with the high glassy finish always sought for by the experienced dynamo tender; and the labor is considerably lessened.

◆

Automatic Steam Boiler Feeder.

An apparatus known as the "Waterhouse Automatic Steam Boiler Feeder," is now being shown in practical operation by Harrison & Watson at the works of William H. Harrison's Sons, 1708 Ludlow Street, Philadelphia, Pa. By means of this apparatus, water is fed into the boiler from a well or from any level, and the water maintained in the boiler at a constant level by automatic means. The system is illustrated in the accompanying figure, in which, however, the water reservoir or "pumping tank" is shortened in section.

The water tank is placed above the level of the boiler and water drawn into the same by a vacuum formed by the condensation of steam. When the tank is filled the water is caused to flow in the boiler by gravitation, being displaced by steam from the boiler. Steam is let on and shut off by the action of the inflowing and outflowing water. The direction in which the water flows while on its way from the supply tank to the pumping tank, is shown in the sketch by whole arrows, while half arrows show the direction from the tank to the boiler. The steam path is shown by the arrows passing through an *S*. Steam enters through the automatic steam valve shown, to the top of the pumping tank. This valve is normally closed by the spring *S* acting through the lever *L* and a sliding stem, against a flexible diaphragm *D*, on this latter rests a disk-headed rod *R*, having at its upper end a valve *V*, which closes the steam passage with the full force of spring *S*.

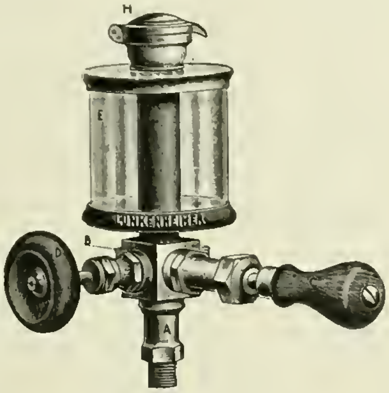


SECTIONAL VIEW OF BOILER FEEDER.

After the steam has been condensed in the pumping tank and the latter is filled with water, a small quantity of condensing water returns from the boiler under pressure, as shown by arrows with a circle, and imparts pressure within the tank which is transmitted through the steam pipe to the automatic steam valve. This pressure acting upon the greater surface of the flexible diaphragm *D* depresses it and allows the valve *V* to open, thereby admitting steam, which continues the pressure upon the diaphragm *D* and keeps the valve open. The steam then presses upon the water and sets up a flow by gravitation into the boiler. When the level of the water settles below the float box, a float is caused to fall, which opens a very small check valve. When this valve is opened pressure is transmitted through a small pressure pipe to the automatic steam valve and acts under the diaphragm *D*, which counteracts the pressure of steam above it and allows the spring *S* to close the valve *V*, which operation completes the cycle above described.

Hand Oil Pump.

The "Universal" hand oil pump illustrated herewith has been brought out by the Lunkenheimer Company, Cincinnati, Ohio. It is easy to attach, fill and operate, and is said to work well under high pressure. It can be made to attach either vertically or horizontally by transposing plug *B* and shank *A*, which are interchangeable. This permits of adapting the pump to meet any requirements of position; i. e., it can be connected either into the steam pipe or steam chest.



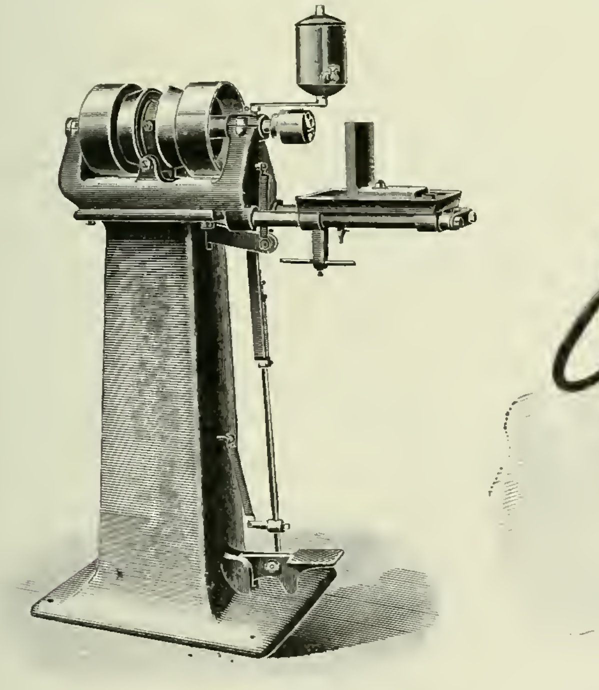
HAND-OIL PUMP.

The filling-hole is closed by a hinged cap, which keeps out dust and dirt, and in addition, there is a removable wire gauze strainer to insure clean oil. All parts about the pump are heavy, large, well constructed and not liable to get out of order easily. Where required, these pumps can be furnished with brass instead of glass body, as shown.

◆

Improved Tapping Machine.

The accompanying cut illustrates a recently designed machine for tapping a large variety of work not too heavy to be readily handled, such as nuts, couplings, brass, malleable and cast-iron fittings, straps and castings of frames of light machines, etc. It will carry a tap from the smallest size to ⅝ inch, while ¾ inch and 1 inch taps can be used on a large variety of work. Ball bearings, as thrust collars, lessen the friction and enable the machine to perform its work with much less power. The spindle is driven with two 3-inch belts, and runs at a speed of from 400 to 600 r. p. m., according to the size of tap and nature of the work.



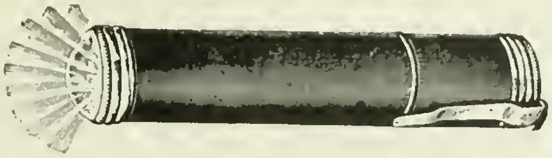
TAPPING MACHINE.

The machine is fitted with a trip that reverses the tap automatically after reaching any given depth, thereby saving time and breakage of taps.

It is built in three different sizes by Mr. Harvey Hubbell, Bridgeport, Conn.

Miniature Portable Searchlight.

The portable searchlight illustrated herewith is manufactured by the Strobel & Wilken Company, 591 Broadway, New York. It is stated that the batteries used do not deteriorate when not in use, and consequently the lights can be shipped long distances. It is stated that with ordinary use one set of batteries will last from four to six months. The searchlight is provided with an improved contact lever made of tempered steel, and cannot get out of order. The case is covered with black leather with nickel-plated trimmings. It is 1⅝ inches in diameter and 8 inches long. It is, therefore, a compact and portable device. It is called by the makers the "Yankee Searchlight," and is recommended for the use of meter readers, sportsmen, doctors, tourists and all others requiring a temporary and satisfactory light.

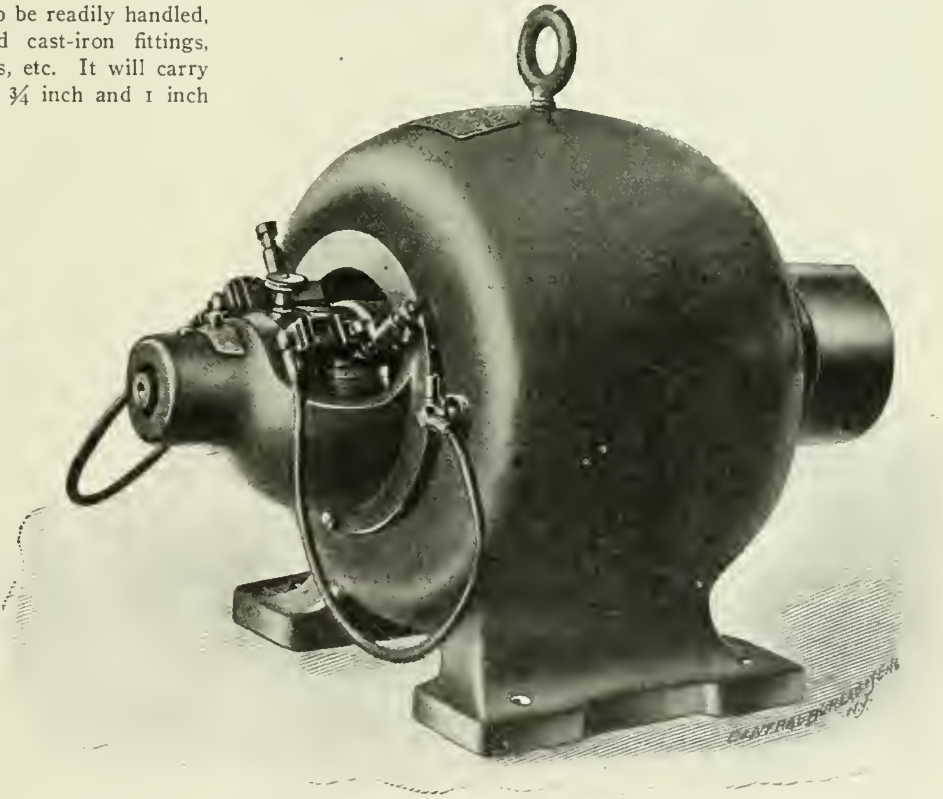


PORTABLE SEARCHLIGHT.

◆

Improved Designs of Dynamos and Motors.

The accompanying illustration shows a motor of new design now being placed upon the market by Messrs. Palmer & Olson, 210 Centre street, New York. This machine is of the multipolar type, and differs from others in the fact that the entire body and base are one casting. The bearing at the commutator end is the only separate part. It is closely fitted to the main casting, and held securely in place by two bolts. The pulley end of the field frame has ample radial opening for a full circulation of air around the armature, thus keeping the temperature of the latter as low as possible. It is evident that this motor is built for work, and in that regard the makers claim for it a high efficiency.



NEW IRON-CLAD DYNAMO AND MOTOR.

Among the features claimed for these machines are: Noiseless running, interchangeability for floor or ceiling work; it will run on full load for an indefinite period with very slight rise in temperature; accessibility to the self-adjusting brushes; protection of the armature from mechanical injury, besides others of practical importance. Apart from the electrical and mechanical features of these machines, their graceful design is striking.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2½ per cent, nominally. Time money during the week was practically unchanged as to price. The closing rates are 3¼ to 3½ per cent for 60 to 90 days, 3½@4 for 4, 5 and 6 months. Mercantile paper was quiet during the week and closed at 3½@4 per cent for 60 to 90 days; bills receivable, 4@4½ for choice 4 to 6 months single names and 5 for others. Stock values continued to advance; speculation was bullish and untempered and displayed great activity. The steel stocks are higher on the success of the consolidation plan, and the shares of the constituent companies are also higher. The United States Steel stocks were admitted at the Stock Exchange on Thursday and developed strength on general buying and confident talk of their dividend prospects. The other industrials are to some extent favorably influenced by the activity and strength of the steel stocks. The traction stocks were irregular and active, there being good trade in Manhattan, which stock advanced on reports that the equipment of its lines with electrical power will soon be completed, and may have a favorable effect on the net earnings of the company. Metropolitan Street Railway closed with a net gain of 4⅝ points, the closing price being 166¼ ex-dividend. The number of shares sold was 50,910. Brooklyn Rapid Transit displayed less activity than during the previous week, the sales amounting to 159,360 shares. The stock closed, however, with a net gain of ¼ point; the range of prices was between 78¾, the lowest, and 84 the highest. Great activity was shown in Western Union, which is rapidly approaching par. There were 218,800 shares sold, which is the highest point reached in many weeks. The closing price was 96. General Electric continues to advance and closed with a net gain of 4 points. The transactions were rather limited, the sales amounting to 7000 shares. Electrical Lead Reduction was active the latter part of the week, and sold above 5, closing at 5 bid. American Bridge was active and strong toward the end of the week, the common stock selling up to 47⅝. The preferred stock sold above 104, with a net gain over the previous week. Southern Light & Traction bonds advanced to 80½. As far as reported there has been no trading for the past few days in the stock, although the bonds have recently shown considerable activity. During the week trade on the outside market was reduced by the withdrawal of United States Steel to the Exchange, which had, however, the effect of bringing other distinctive outside securities into greater prominence. The general tendency of prices during the week was upward. St. Louis traction securities were easy. The weakest issues were Consolidated Equipment and the transportation stocks. The former lost 3¼ points net and the latter uniformly sagged under the low prices previously recorded. Following are the closing quotations at the centers named:

NEW YORK.

	Mar. 23.	Mar. 30.		Mar. 23.	Mar. 30.
General Electric	215	217	Electric Vehicle	15	13
Brooklyn Rapid Transit	82¾	83	Electric Vehicle, pfd	25	25
Metropolitan Street Ry.	163⅝	166¼	General Car	2	2
American Tel. & Cable	97	97	Illinois Elec. Veh. Tran.	1	1
Western Union Tel.	88⅜	96	Hudson River Tel.	—	120
American Dist. Tel.	36	—	N. E. Elec. Veh. Tran.	2⅞	2¾
Commercial Cable	160	—	N. Y. Elec. Veh. Tran.	4	3¾
Electric Boat	24	24	Tel. & Tel. Co. of Am.	7	6
Electric Boat, pfd	51	51	N. Y. & N. J. Tel.	—	178
Electric Lead Reduc'n.	5	4⅞			

BOSTON.

	Mar. 23.	Mar. 30.		Mar. 23.	Mar. 30.
New England Telephone	139	—	Erie Telephone	50¾	49½
Mexican Telephone	—	3¼	General Electric, pfd	192	—
Westinghouse Electric	62	62½	Am. Tel. & Tel	169	167½
Westinghouse Elec., pfd.	71	—	Boston Electric Light	—	—

PHILADELPHIA.

	Mar. 23.	Mar. 30.		Mar. 23.	Mar. 30.
Electric Storage Battery	72	72	Philadelphia Electric	6⅛	5¾
Elec. Storage Bat., pfd.	74	74	Pa. Electric Vehicle	½	½
Elec. Co. of America	8⅝	8¼	Pa. Elec. Veh. pfd	½	½
General Electric Auto	—	—	Am. Railways	38	39½

CHICAGO.

	Mar. 23.	Mar. 30.		Mar. 23.	Mar. 30.
Chicago Edison	154½	154	Chicago Telep. Co.	265	220
Chicago City Ry.	260	260	Union Traction	15	16
National Carbon	15¾	15¾	Union Traction, pfd	56½	56
National Carbon, pfd	82	82	Northwest. Elev. Com.	39	40

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*Asked.

WESTINGHOUSE ELECTRIC & MANUFACTURING.—The stockholders of the Westinghouse Electric & Manufacturing Company, at a special meeting on Feb. 20, authorized the increase of the company's stock from $15,000,000 to $25,000,000, the new stock to have the same rights and privileges as the "assenting stock" now outstanding. They also authorized the board of directors to sell the new stock in their discretion at not less than par. The directors have authorized the sale of $3,000,000, par value, of the new stock at $55 for each $50 share, the stock to be offered at that price to the stockholders at the rate of one share for every five shares of stock now held. Stockholders of record at the closing of the transfer books on April 9 are offered the privilege of subscribing. A syndicate has been formed to take the portion of the stock which shall not have been subscribed for by the stockholders on or before the 20th day of April, 1901. The new shares will be entitled to participate in all dividends declared after May 15 upon stock of the same class. Failure to pay the final installment of the subscription price will forfeit all rights in respect of the stock subscribed for and of the installment previously paid.

WESTERN UNION.—Insiders, like Mr. Frank Gould, are said to be very bullish on Western Union, which they claim has not yet had an advance commensurate with the advances in other stocks. It is alleged that there is a plan whereby the Postal Telegraph Company will cast its interests with those of the American Telephone & Telegraph Company (the Bell) and arrange some sort of a working alliance. Such a combination as this, it is argued, would force the Western Union to adopt counter measures. In short, Western Union would probably close with the independent telephone interests. Experts agree that such an array of competitive forces would be of immense advantage to the Western Union. Another rumor talks of a Bell guarantee. Some of them, whose information on the stock has been good heretofore, say they have no knowledge of any deal whereby Bell Telephone would guarantee 6 per cent or upwards on the stock. If it were true they would be likely to know something of it. President Chandler, of the Postal, and President Eckert, of the Western Union, do not know of any negotiations whatsoever.

CONSOLIDATION AT PORTLAND, ME.—The Cumberland Illuminating Company, Sebago Power Company and Deering Electric Light Company, all of Portland, Me., have been consolidated under the charter of the Cumberland Illuminating Company, and the combined corporations have adopted the name of Portland Lighting & Power Company. The Company bearing this name and controlled by the same interests is also to be absorbed by the new company. The Portland Lighting & Power Company is capitalized as follows: Stock, preferred, $100,000; stock, common, $250,000; bonds, $350,000. The officers of the Portland Lighting & Power Company are as follows: President, J. R. Libby; vice-president, M. H. Kelly; treasurer and manager, E. H. Mather

BOSTON LIGHTING CONSOLIDATION.—We are authoritatively informed that large interests identified with the Edison and Boston electric light companies have agreed to a consolidation. Under the terms of agreement the Edison Company is to absorb the Boston Company, and issue new Edison shares in exchange. It is understood that the basis of exchange agreed upon is 10 Edison shares for 11 Boston shares. Formal action has not yet been taken by the boards of directors of the two companies, and probably will not be taken until the permissive bill now before the manufacturers' committee of the Massachusetts Legislature has been acted upon by that committee.

DIVIDENDS.—The New England Telephone & Telegraph Company has declared a regular quarterly dividend of $1.50, payable May 15. Directors of the N. Y. & N. J. Telephone Company have declared a regular quarterly dividend of 1½ per cent, payable April 15. The Louisville City Railway has declared a semi-annual dividend of 2½ per cent on its preferred stock, and a quarterly dividend of 1 per cent on the common stock, payable May 1.

MORTGAGE.—A $20,000,000 mortgage given by the United Electric Company, of New Jersey, to the New Jersey Title & Guarantee Company has been filed recently in the Essex County Register's Office at Newark. The lien is to guarantee the first mortage bonds issued by the company to take the place of collateral trust bonds outstanding.

ILLINOIS ELECTRIC VEHICLE.—A statement comes from Chicago that the management of the Illinois Electric Vehicle Transportation Company has received more than enough proxies from stockholders to carry through the plan to liquidate the concern.

ERIE TELEPHONE DIVIDEND.—Erie Telephone directors have deferred dividend action pending the examination of the company's books by the Eastern auditors. Three months ago the regular quarterly dividend of 1¼ per cent was declared.

THE TRUCKEE RIVER GENERAL ELECTRIC COMPANY, Floriston, Calif., paid its regular monthly dividend of 10 cents per share on March 20.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing trade conditions, *Bradstreet's* notes that there is a rather more cheerful tone in general trade and the close of the first quarter of the year finds the business world contemplating a total trade for that period in many cases in excess of all preceding periods, while the future, with some exceptions, is viewed with apparent hopefulness. The advance of the spring season is partly responsible for this feeling, allowing, as it does, better opportunity for a wider range of operations than is possible in the winter months. Railway earnings testified to an immense volume of merchandise passing into consumption, more than has for some time past. The active demand at advancing prices for iron and steel is regarded as a reliable index of the general trade to come. Building is becoming more active and promises this spring to be the heaviest for many years past. Western trade advices are relatively most favorable, Chicago, St. Louis and Kansas City being notable as reporting business for the first quarter larger than a year ago. The labor situation is more tranquil, and mining differences in the soft coal region are settled. Railroad earnings in three weeks of March show an increase of 10.2 per cent over the same period last year and 33.2 over the same period in 1899. The failures for the week as reported by *Bradstreet's*, number 189, against 231 the week previous and 178 the corresponding week last year. *Dun's Review* computes the liabilities for the four weeks of March at $8,134,731, against $10,349,796 the corresponding week last year. In the copper market there is no change of note; the demand is still rather light and prices are held to the nominal figure of 17 cents for Lake and 16⅝ cents for electrolytic. These prices are, however, admittedly artificial. The reports are showing up less favorably than was expected. Thus far this month only 5600 tons were sent out, while 2600 tons arrived.

TRACTION IN MEXICO.—The prosperous City of Merida, capital of Yucatan, Mexico, will shortly have a modern electric traction system. There is at present operated in that city and its immediate surroundings some 50 miles of mule tramways. It will be recalled that the contract for the electric lighting of Merida was recently awarded to the Siemens & Halske Company, the German concern which installed the City of Mexico electric lighting plant. The power house, etc., for the projected road will, it is estimated, mean an expenditure of some $200,000. Certain New York bankers, who have largely financed various industrial enterprises in that part of the world, have already been approached with a view to their securing a financial interest in the scheme. The City of Mexico Tramways Company is about to make a purchase of 20 cars from the St. Louis Car Company. These cars will be of the most up-to-date build, and fitted with the most improved contrivances, and are to cost some $6,000 each. The Mexican company already operates five cars which were manufactured by the St. Louis concern.

THE DEEP LEADS ELECTRIC TRANSMISSION COMPANY, LIMITED, of 26 St. Swithins Lane, London, England, an English concern operating a transmission line for the purpose of working gold mines in the Moolart Mining Camp in the vicinity of Melbourne, Australia, is purchasing considerable equipment, etc., rendered necessary by an extension of the plant. J. G. White & Co., of London, who act as consulting engineers to the enterprise, have recently closed contracts, through their New York office, with the Lambert Hoisting Company, of this city, for the furnishing of four double drum electric mine hoists, each to be operated by 75-hp motors furnished by the General Electric Company. R. Poole & Son Company, of Baltimore, has obtained a contract for a gear train to be used for operating a Cornish pump. This machinery will weigh about 130 tons, and will constitute one of the largest equipments of the description ever shipped abroad.

THE AMERICAN BRIDGE COMPANY reports its foreign trade as developing very rapidly. Within the past few years it has received a contract for 20,000 tons of bridges for the Guayaquil & Quito Railroad Company in Ecuador, South America, and a large group of buildings for the Cananea Consolidated Copper & Silver Mining Company, of Mexico; and also several large contracts for manufacturing buildings to be shipped to Australia, and a large railroad bridge to go to the Sandwich Islands. It is also announced that its tender for a large foreign contract exceeding in size anything which it has taken has been accepted, and that one of its engineers sailed this week to consummate the arrangements. The officials of the American Bridge Company decline to say anything about this matter until the contract is definitely consummated, but admit the facts substantially as above stated, that it is the most important foreign contract that it has yet taken.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York City, has been awarded the contract for the supplying of conduit to be utilized by the Charing Cross & Hampstead Underground Road, London. Some 500,000 ft. of material have been requisitioned. J. F. Cummings, the general manager of the European division of the American Company's business, with headquarters in London, sailed for the other side last Wednesday by the St. Louis. One of the company's engineers accompanied him for the purpose of superintending the laying down of the conduit. Mr. Cummings feels assured that the important contract for the furnishing of conduit to carry telephone wires between Brussels, Lille and Antwerp will be placed in the United States. The project is being carried out by the Belgian Government, and will mean the employment of fully 3,500,000 ft. of conduit. A decision is expected to be arrived at as regards the awarding of the Belgian contract within the next few days.

THE AMERICAN ELECTRIC TELEPHONE COMPANY reports that it has recently installed additional central energy switchboards in the following places: Bowling Green, Ohio, 150 drops; Salem, Ohio, 100 drops; East Liverpool, Ohio, 100 drops; Wellsville, Ohio, 100 drops; Rome, N. Y., 125 drops. Among the recent orders for switchboards filled by the American Company during the past week are Nelsonville, Ohio, 200 drops; Hartford City, Ind., 400 drops; Mt. Pelier, Ohio, 200 drops; Manning, Ia., 100 drops; Nicholasville, Ky., 300 drops; Timpsonville, Texas, 150 drops; Logan, Ia., 200 drops; Bluffton, Ind., 300 drops. In addition to the above it has closed for several very important installations for both central energy and express type switchboards. The company reports that it has experienced a large increase in business since the Berliner decision.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Hamilton, Grimsby & Beamsville Electric Railway Company, of Hamilton, Ontario, for the installation of a battery of chloride accumulators at Grimsby, a point 10½ miles from their power house. The installation consists of 229 elements to give a discharge rate of 160 amperes, and is to be used to regulate and maintain the voltage on the line. The containing jars for this battery are sufficiently large to allow a future increase of 50 per cent upon the addition of extra plates.

ELECTRIC RAILWAYS IN SWEDEN.—Consul Bergh transmits from Gothenburg, March 16, 1901, blue prints and specifications calling for bids from manufacturers desiring to furnish rails, switch and cross frogs, and electric cables for the electric street railroads to be built in Gothenburg. The bids must be delivered to the street railroad office in that city not later than on April 10, 1901, and the time is too short to have the specifications translated. They are on file in the Bureau of Foreign Commerce, where they may be consulted by interested parties.

THE J. P. McDONALD COMPANY, of New York City, contractor for the construction of the Guayaquil & Quito Railroad, Ecuador, South America, has just awarded a contract for the supplying of 400 miles of telegraph wire to a European concern. A representative of the contracting concern says that our competitors on the other side quoted a lower price for the wire delivery in South America than the closest American bidder offered the material f. o. b. New York. Delivery is to be made inside of 60 days from date of contract.

THE AMERICAN SUGAR REFINING COMPANY, through its electrical engineer, Mr. Holmes, has closed a contract with the Bullock Electric Manufacturing Company for the building of two 750-kw generators, several motors of various sizes and a quantity of miscellaneous electrical machinery, etc., to be installed in the Williamsburg plant. The value of the contract is said to be $25,000 approximately.

NEW ELECTRIC PLANT FOR CINCINNATI.—Mr. J. A. Kammerer, an electrical engineer of Toronto, Canada, says he represents a syndicate of wealthy Canadians who have subscribed $1,500,000 toward the erection of a large electric plant in Cincinnati, Ohio. Cincinnati parties are said to be interested to a like amount. Mr. Kammerer expects to return to Cincinnati about the second week in April.

STANLEY PEACH, electrical engineer, of 28 Victoria Street, London, S. W., is, according to private advices, about to make some important awards regarding the furnishing of structural steel to be utilized in various power houses about to be constructed by various British traction concerns. The contracts will, it is said, involve an expenditure of fully $200,000 with American steel concerns.

THE PIERCE ELECTRO VEHICLE COMPANY will build an electric vehicle at Bound Brook, N. Y., where Dr. Pierce, of Buffalo, is already heavily interested in the American Engine Company. The concern has already built one electric delivery wagon, which is in use by the Denver *Times*.

NEW CARBON FACTORY.—Cincinnati capital may become interested in a large carbon factory in Weston, W. Va. The output of one factory in this gas belt (recently discovered) was 5400 lbs. of carbon, which was produced much more cheaply because of the natural gas facilities.

EXPORTS OF ELECTRIC MATERIAL—The following were the exports of electric material from the port of New York for the week ended March 20: Antwerp—6 cases motor carriages, $997; 34 packages electrical material, $3,285. Alexandria—1 package electrical machinery, $78. British East Indies—8 packages electric material, $287; 11 packages electrical machinery, $7,765. Brazil—212 packages electrical material, $14,137; 50 cases electrical machinery, $4,747; 1 case electros, $50. Bremen—3 packages electrical material, $110. British Australia—1 package electrical material, $25. All other British Possessions—1 case electrical machinery, $125. British West Indies—56 cases electrical material, $1,411; 1 case electrical machinery, $45. Central America—667 packages electrical material, $6,909; 3 packages electrical machinery, $401. Cuba—96 cases electrical material, $7,286. China—9 packages electrical material, $322. Dutch West Indies—23 packages electrical material, $718. Frankfort—1 case electrical material, $150. French Possessions in Africa—94 cases electrical material, $12,350. Genoa—48 packages electrical material, $16,255. Havre—43 packages electrical material, $2,250; 33 packages electrical machinery, $3,125. Hayti—58 packages electrical material, $381. Hamburg—3 packages electrical machinery, $2,339; 40 packages electrical material, $2,705. Japan—49 cases electrical material, $17,414. Korea—66 cases electrical machinery, $14,207. Lisbon—30 packages electrical machinery, $30,876; 54 electric cars, $112,006. Liverpool—201 packages electrical machinery, $8,500; 316 packages electrical material, $6,694; 3 packages auto vehicles, $920; 241 packages electrical machinery, $17,189. London—24 packages motor vehicles and parts, $6,000; 208 packages electrical material, $10,563. Marseilles—45 cases electrical material, $2,702. Mexico—798 packages electrical material, $7,011. Newcastle—4 packages electrical machinery, $400. Newfoundland—20 packages electrical maferial, $586. Nova Scotia—92 packages electrical material, $865. The following were the exports of electrical material and apparatus from the port of New York for the week ended March 27: Antwerp—5 packages electrical material, $384. Alicante—8 packages electrical material, $1,347. British Possessions in Africa—2 cases electrical machinery, $75; 110 packages electrical material, $12,701; 3 cases motor vehicles, $925. Barcelona—12 packages electrical machinery, $573. Brazil—14 packages electrical material, $1,296. Bournemouth—1 case electrical machinery, $700. British East Indies—19 packages electrical material, $1,116. British Guiana—4 packages electrical material, $38. British West Indies—9 packages electrical material, $201. British Australia—6 cases electrical material, $314. Central America—13 packages electrical material, $916. Christiania—1 package electrical machinery, $300. Copenhagen—6 packages electrical machinery, $90. Cuba—175 packages electrical material, $4,589. Chili—9 packages electrical material, $434. Ecuador—5 packages electrical material, $60. Glasgow—75 cases electrical machinery, $13,184; 172 cases electrical material, $23,072; 73 reels electrical cable, $28,376. Genoa—1 package electrical machinery, $20; 36 packages electrical material, $3,652. Hamburg—14 packages electrical machinery, $2,463; 69 packages electrical material, $4,197; 58 cases electric material, $2,825; 29 cases electrical machinery, $7,611. Liverpool—77 packages electrical machinery, $11,834; 24 packages electrical material, $1,035. Leith—3 packages electrical material, $178. London—225 cases electrical machinery, $9,906; 57 packages electrical material, $4,404; 4 packages motor vehicles, $1,930. Liecester—2 cases electrical material, $230. Milan—6 cases electrical material, $269. Mexico—30 cases electrical material, $1,478. Manchester—1 package electrical material, $375. Newcastle—90 packages electrical machinery, $48,677. New Zealand—1 package electrical material, $28. Naples—2 cases electrical material, $285. Preston—1 package electrical material, $25. Peru—15 cases electrical material, $242. Rotterdam—7 cases electrical material, $74. Sheffield—16 cases electrical machinery, $2,000. Southampton—1 case electrical machinery, $500; 2 packages electrical material, 101. St. Petersburg—2 packages electrical machinery, $150. United States of Colombia—205 cases electrical material, $1,075; 2 reels cable, $29. Venezuela—139 cases electrical material, $738. Zurich—1 case electrical machinery, $70.

THE TOTAL EXPORTS for the eight months ending with February, 1901, show an increase of more than $95,000,000 over last year, but those of manufactures alone show but a slight increase, and there is reason to believe that the recorded total of manufactures for the full fiscal year will fall somewhat below that of the preceding year. This is due to the fact that a large proportion of exports to China are manufactures, and that the apparent reduction, in the Hawaiian and Porto Rican figures relates almost exclusively to the class of exports designated as manufactures. Another condition which has a tendency to reduce the total value of exports of manufactures is found in the fact that prices of manufactured articles in many cases have fallen because of the reduction in the cost of the raw material from which they were produced, and that the exportation of an equal or even greater quantity supplies a smaller figure in the statement of values by which the export movement is necessarily measured. It is quite probable, in view of the facts above outlined, that the record of exports of domestic manufactures in the fiscal year 1901 may show an apparent reduction, though the fact that more than $20,000,000 worth of actual shipments from our ports which were formerly counted as foreign commerce no longer appear in these statements will account for the reduction, which will thus be more apparent than real.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports that the orders booked for the month of March exceed by a considerable percentage the largest manufacturing business which the company has had at any time during its previous history. Among the more important contracts which have been closed are the following: Philadelphia Engineering Works, 500 horse-power in crane motors; Messrs. Witherbee, Sherman & Co., one 150-kw belted type generator, and 160 horse-power in motors; General Electric Company (1900), Limited, Glasgow, Scotland, one 150-kw belted type generator; Newport News Shipbuilding & Dry Dock Company, two dynamotors, one bipolar dynamotor, one dynamotor; the New United States Mint at Philadelphia, 19 motors aggregating 115 horse-power; Newton Street Railway, Newton, Mass., one engine type, 400-kw railway generator; the Guggenheim Smelting Works, Perth Amboy, N. J., two engine type, 520-kw electrolytic generators; Alsen's American Portland Cement Company, of West Camp, N. Y., three engine type, 4[illegible]-kw power generators, and one engine type, 100-kw lighting and power generator, also 43 motors aggregating 2000 horse-power; Brandywine Traction Company, Brandywine, Pa., one engine type, 200-kw railway generator; John B. Stetson Company, Philadelphia, Pa., two engine type, 300-kw lighting and power generators; Western Union Telegraph Company, 36 machines for telegraphic work.

ACTIVE DEMAND FOR ELECTRICAL APPARATUS.—The Bullock Electric Manufacturing Company reports an increased demand for electric machinery, principally for power equipment. Among orders of the past week are the following: The American Sugar Refining Company, of Brooklyn, one 20 and one 50-hp, type N motors; Beaman & Smith, Providence, R. I., one 5-hp and one 6-hp, type N, motors, direct connected, and one of 9-hp direct connected; H. Y. Cyphers, Pittsburg, 150-kw engine type generator; St. Louis Electric Supply Company, 150-kw engine type generator; Armour & Co., Chicago, four 100-hp type H motor, slow speed; American Tin Plate Company, Pittsburg, one 100-kw engine type generator; United States Printing Company, Cincinnati, two 25-hp and two 7½-hp type H motors; Charles H. Beardsley, Chicago, one 8-hp type N motor for direct connection with grinder; National Casket Company, Allegheny, two 6-hp and one 25-hp type N motors; Charles Kaestner & Co., Chicago, 11-hp elevator motor; Newton Machine Tool Company, Philadelphia, one 4-hp and one 1½-hp and two 5-hp type N motors; Fore River Engineering Company, Weymouth Mass., four 8-hp motors, type N (tenth order), and the Fisher Foundry & Machine Company, Pittsburg, 3 or 4 machines for a small multiple voltage plant.

BALL ENGINE ORDERS.—The Caxton Building Company, of Cleveland, Ohio, has recently installed an engine for its electric light plant. The engine is of the self-oiling type, built by the Ball Engine Company, Erie, Pa. Among recent installations by the Ball Engine Company of engines for electrical purposes are the following: Marion Steam Shovel Company, Marion, Ohio, 115-hp engine; Kentucky Wagon Manufacturing Company, Louisville, Ky., 125-hp direct-connected engine. Among other recent installations by the Ball Engine Company of its engines for electrical purposes are the following: Pittsburg Plate Glass Company, Cincinnati, Ohio, 125-hp direct-connected engine; Texas & Pacific Coal Company, Thurber, Texas, one 150-hp direct-connected engine; American Clay Working Machinery Company, Willoughby, Ohio, one 175-hp direct-connected engine.

THE ELECTRIC VEHICLE COMPANY, of Hartford, Conn., report that it has received contracts for carrying the Pan-American Exposition mails, and for distributing books from the Congressional Library. For these services it will use its Mark XI delivery wagons, which have a carrying capacity of 1000 lbs. beside the driver and attendant. For the mail service the vehicle will be required to cover 60 miles a day. The service will begin April 15. The vehicle will be painted black, with the Government seal on each side.

BLISS IN ITALY.—The E. W. Bliss Company, of Brooklyn, says that owing to its increasing European business it has found it necessary to open a branch at Viale Monfort, Milan, Italy. Bliss punches, presses, etc., are known and in widespread use throughout England and the Continent.

QUEENSLAND, AUSTRALIA.—The Westinghouse Electric & Manufacturing Company has been awarded by the Railroad Commissioner of Queensland a contract to furnish a complete electrical equipment for a new railroad shop at Ipswich. It is said that this will be a large order.

MONTREAL STREET RAILWAY COMPANY is at present making considerable purchases of equipment in this market. The Bullock Electric Manufacturing Company is said to have obtained a contract calling for six 500-kw motor generators.

Special Correspondence.

ENGLISH NOTES.

London Office of Electrical World and Engineer.
March 25, 1901.

AUTOMOBILE EDUCATION.—In order that the chief constables of England may have a more intimate knowledge of the automobile and its ways, and so be in a position the better to judge of the proposal to limit the rate of speed and label each vehicle, a number of these officials have been taken out for runs by the Automobile Club. Some of the chief constables and members of the executive council of the County Councils Association were taken out to Sheen House, Richmond, others being taken for educational purposes through certain of the busiest thoroughfares of the city. In this practical way the question of speed was studied, and interesting and instructive demonstrations of starting, stopping and turning were given by the various drivers. The chief constables met in conference the committee of the Automobile Club. The chairman was Mr. Roger Wallace, the president of the club. A number of the constables spoke upon the question for increased facilities for identification, the unanimous opinion being that some sort of distinguishing number or mark was absolutely necessary for the detection of the callous "scorcher." The best suggestion, according to the chairman, was that automobiles owned by members should bear the club's monogram, and that outside owners should carry numbers.

INDIAN POWER TRANSMISSION—The remarkable scheme for working the Kolar gold mines of Mysore by electricity transmitted from the falls of the Cauvery (Kavari) River has now assumed a practical shape, Captain de Lotbiniere, R. E., having visited England and the great Niagara works in America. Colonel D. M'Neill Campbell, chief engineer of the Mysore Public Works Department, has isued his complete report. The works are now designed and contracted for, to transmit over a distance of ninety miles 4000 horse-power, with extensions to Bangalore afterwards. All the parties have agreed—the British Government, which has water rights over the falls; Messrs. Taylor & Sons, of London, who represent the gold companies, and the Prime Minister of the Hindu State of Mysore, Sir K. Sheshadri Iyer, with whom is Colonel Robertson, C. S. I., the British Resident. Captain de Lotbiniere has been guided by a reference committee of such experts as Professors Forbes and W. C. Unwin, and Captain J. Thomson, late R. A. American, Swiss and German manufacturers have tendered, with the result that the works will be carried out by the General Electric Company, of America, and by Escher, Wyss & Co., of Switzerland, for the hydraulic plant. The total cost is estimated at £287,391, and the net income after all deductions at 10.2 per cent. The Mysore Government calculates on a total profit in the first ten years of more than half a million sterling, and the mines on saving £572,000 in working expenses. The scheme is the most magnificent, thus far, in the early annals of practical power. Its development is being watched by those interested in utilizing the cataracts of the Nile and the Zambezi.

ELECTRIC LIGHTING IN LONDON.—An important inquiry has been opened by the Board of Trade at the Westminster Town Hall in reference to the application made by the various electric lighting companies in London for an alteration of the proviso to Clause 6, Section B, of the regulations made by the Board on the 4th of March, 1896, for the efficient supply of electrical energy to consumers. The companies in general, in their desire to increase the carrying capacity of the electric lighting mains, have been engaged for some time past on the work of changing over the pressure of supply to consumers from 110 volts to 220 volts for the purpose of obviating further large capital expenditure on new mains, extending the scope of supply and avoiding the necessity for again opening the carriageways and footpaths to the inconvenience of the public. Unfortunately for the companies, some of the consumers have refused to accept a supply at the increased pressure, nothwithstanding that the former have agreed to undertake all the expenses incidental to the change of lamps and alterations of fittings where necessary, and have, it is believed, also offered a certain reduction in price. The result has been that a few obstinate customers have been able to disorganize the supply on the particular distributing system affected, and as the alteration to the increased pressure can, according to the proviso referred to, at present only be carried out with the consent of the consumers, the position of the companies has been rendered somewhat difficult. With a view to remedying the situation the Westminster Electric Supply Corporation has organized the other electric lighting companies in London for the purpose of presenting their case to the Board of Trade, and in this direction they have received the support of some, if not all, of the metropolitan borough councils which operate municipal electric supply works. The view of the companies and authorities is that the above-mentioned proviso, which requires the consent of consumers, should be so altered that failing an agreement between the companies and comsumers, the question of a change of pressure shall be referred to the Board of Trade, which, it will be contended, should appoint an arbitrator to finally settle the differences.

General News.

THE TELEPHONE.

MT. OLIVET, KY.—A five-mile telephone line is to be established from Mt. Olivet to Piqua.

KIRKWOOD, PA.—The Southern Telephone and Telegraph Company has been incorporated; capital, $10,000.

KANSAS CITY, MO.—The Terrace City Telephone Company has been incorporated with a capital stock of $500.

LOUISVILLE, KY.—The Louisville Home Telephone Company has been incorporated under the Delaware state laws.

MASSILLON, OHIO.—The Massillon Telephone Company has applied for a franchise to install an exchange in Canal Fulton.

ANSTELL, GA.—The Anstell Telephone Company has been chartered. J. H. Lauch and B. H. Veal, of Douglas county, are interested.

CUMBERLAND, MD.—The Woodford Telephone Company, of Elkins, W. Va., has applied for a franchise to construct a system here.

COLLEGE PARK, MD.—The Chesapeake & Potomac Telephone Company contemplates the establishment of a telephone system here.

VIENNA, OHIO.—Edward Hodge, of this place, is preparing to build a telephone line from Vienna to Plattsburg and is securing subscribers in both places.

LONDON, KY.—A. W. Huggins, of this place, is in the market for wire, brackets, insulator pins, etc., for construction of about seventy-five miles of telephone line.

FRENCH LICK, IND.—The Star Telephone Company of French Lick has been incorporated; capital stock, $2,000. Directors: L. Ellis, Harry Roland and J. L. Sutton.

BEDFORD, IND.—The City Council granted a franchise to the Carter Telephone Company, and Mayor Johnson vetoed it. The council promptly passed it over his veto.

PITTSFORD, N. Y.—This village will be equipped with a local telephone service by the Home Telephone Company of Rochester, whose line was recently put through here.

BLOOMDALE, OHIO.—The Central Union Telephone Company is establishing a rural telephone system among the farmers within a radius of five miles of this place.

WINDER, GA.—The North Georgia Telephone & Telegraph Company has been organized, and is in the market for supplies and equipment for the construction of a system.

PORTSMOUTH, OHIO.—The Ohio Telegraph & Telephone Company is constructing a direct line from Pittsburg to Cincinnati and has asked for a franchise through this place.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for Scott County Telephone Company and the Sugar Creek Township Farmers' Telephone Company, of New Palestine, Hancock county.

INDIANAPOLIS, IND.—The Central Union Telephone Company and the New Telephone Company have each paid to the city treasurer the sum of $6,000 for the privilege of making use of the streets.

BISHOPVILLE, S. C.—The Bishopville Telephone Company, with a capital stock of $5,000, has been incorporated by W. S. Smith, of Smithville; Nat. Barrett, of Mannville, and J. E. McLure, of Bishopville.

JACOBSBURG, OHIO.—The Peoples Telephone Company, of this place, has been incorporated by W. G. Simpson, Miles R. Hart, G. C. Meek, P. W. Helpinger, and Albert McKelvey. Capital stock, $10,000.

POPLAR HILL, VA.—The Poplar Hill Telephone Company has applied for a charter to operate telephone plants in Giles and Pulaski counties, Va.; capital, $5,000. C. W. Shannon, R. L. King and others of Poplar Hill are interested.

NEW YORK, N. Y.—It is reported that the Knickerbocker Telephone & Telegraph Company is pushing construction work in the upper part of the city and towards Yonkers. The Company, it is stated, is centering its efforts in the Borough of the Bronx.

INDIANAPOLIS, IND.—Mr. Simon P. Sherin, vice-president of the New Telephone Company, says that "the telephone business is such a good profit earner that moneyed men are casting about the country trying to finance weak and penniless companies."

WINTHROP, MINN.—The People's Telephone Company has been organized here by the business men. The officers are: President, R. R. Stoner; vice-president, C. M. Peterson; secretary, J. A. Larson; treasurer, C. A. Benson. The capital stock is $10,000.

CLINTON, N. Y.—The Clinton Telephone Exchange has a 100-drop Stromberg-Carlson board and one hundred subscribers. The company is expecting to build several toll lines in the near future. With its connections, it reaches 5000 subscribers in Central New York.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has decided to increase the capacity of its exchange and cables and switchboard will be added to accommodate 500 subscribers. About 3000 feet of cable will be strung. At present the company has 400 subscribers.

DAYTON, OHIO.—The Board of City Affairs has again recommended an ordinance granting a franchise to the Dayton Home Telephone Company and the City Council after investigating the matter has adopted a resolution asking the Probate Judge to assume his prerogative and grant the franchise.

BICKNELL, IND.—The Independent Telephone Company, organized by Bicknell and Vincennes parties, will erect an exchange here at once. The company has arranged with the Central Union Company to furnish long distance service over the toll lines of that company. It will also build lines to all surrounding villages.

RICHMOND, VA.—The Southern States Telephone Company has filed a deed of trust at Norfolk, Va., to the Fidelty Deposit Company, of Baltimore, to cover $50,000 previously borrowed and $100,000 for improvements now begun. The company will soon be connected with the principal cities of Virginia by connection with the Long Distance Telephone Company of Virginia.

MANSFIELD, OHIO.—The Farmers' Co-operative Telephone Company which covers the rural districts of Ashland, Knox, Richland, and Morrow Counties, has made an assignment to Archibald H. Brown, of Bellville. The company has a capital stock of $10,000. The liabilities are between $8,000 and $10,000, and the assets about $4,500. E. E. Shafer is president of the company and E. R. Leedey secretary.

CLEVELAND, OHIO.—The directors of the Federal Telephone Company have effected a deal for the sale to an underwriting syndicate composed of local people of practically the entire issue of the bonds of the Cuyahoga Telephone Company. The holders of the bonds have been asked to turn them in at $87.50, less 2½% commission. Some of the bondholders deem $85 too low and have declined to sell at that price.

FT. WAYNE, IND.—A telephone deal of considerable magnitude was completed here last week, whereby the stockholders of the Home Telephone Company, of Ft. Wayne, purchased from the Telephone, Telegraph & Cable Company, of New York, all the interests represented by the National Telephone Company, for $120,000 cash. The National company has 1100 miles of wire, connecting Sturgis, Mich.; North Baltimore, Ohio; Auburn and Kendallville, Ind., and numerous intermediate points with this city.

AUSTIN, TEX.—The charter of the Bell County Telephone Company has been filed in the Secretary of State's office. The capital stock of the company is $120,000, and its headquarters are at Temple, Tex. The stockholders are for the most part the same men who compose the other independent telephone companies in Texas. The incorporators are: James King Duffy, of New York City; James S. Brailey, of Wauseon, Ohio; Z. B. Campbell, of San Antonio, Tex.; C. N. Haskell, of Ottawa, Ohio; J. B. Earle and J. E. Boynton, of Waco, Tex.; H. M. Daugherty, of Columbus, Ohio.

TERRE HAUTE, IND.—The American Electric Telephone Company reports that the central energy switchboard being installed by it for the Citizens' Telephone Company, at Terre Haute, Ind., is rapidly nearing completion, and that it is expected that operation will be commenced shortly. The American Company is equipping this exchange complete in every respect and says that it will be one of the finest equipments of central energy switchboards ever installed by an independent company. The Raleigh Telephone Company, of Raleigh, N. C., has a similar switchboard, and according to the latest reports the equipment is giving excellent service.

AUSTIN, TEX.—The independent telephone movement is having a rapid growth in Texas. The latest company of this character to be organized for business in this State is the Grayson County Telephone Company, with headquarters at Sherman, Tex. It has a capital stock of $150,000. Its purpose is to build and operate a telephone system in Grayson county, including the cities of Denison and Sherman. The incorporators are: James S. Brailey, of Wauseon, Ohio; W. A. Armstrong and F. B. McElroy, of Sherman, Tex.; R. S. Legate, of Denison; Z. B. Campbell, of San Antonio; James King Duffy, of New York City, and C. N. Haskell, of Ottawa, Ohio.

SAN ANTONIO, TEX.—The San Antonio Telephone Company, which recently established an independent exchange here in opposition to the Southwestern Telegraph & Telephone Company, now has about 650 instruments in operation, and this number will be increased to about 1500 on the arrival of additional cable, which has been ordered. It is announced that the San Antonio Telephone Company, in connection with the several other independent exchanges of the State, including those of Houston, Austin, Waco, and a number of smaller towns, will soon be connected by long distance wires. Preliminary to starting the work of constructing these long distance lines in Texas, a number of general officers of the National Contracting Company, whose headquarters are at Cleveland, Ohio, and who are in charge of the independent telephone construction work in this State, have arrived at San Antonio. In the party are James L. Brailey, general superintendent; W. H. Harper, Jr., treasurer; C. N. Haskell and H. N. Daugherty, of the executive committee, and James King Duffy, vice-president. It is stated by General Superintendent Brailey that there has been considerable delay in the construction of the San Antonio and other independent telephone systems in Texas on account of the non-arrival of much-needed material from Eastern factories. These factories are said to be far behind their orders in turning out construction material.

ELECTRIC LIGHT AND POWER.

STURGEON BAY, WIS.—The city contemplates building an electric lighting plant.

JACKSON, GA.—The Pepperton Cotton Mills are installing an electric light plant.

SPOKANE, WASH.—Wenatchee, Wash., is about to order an electric light plant.

VAN BUREN, ARK.—The Van Buren Electric Light & Power Company has been sold out.

YORKTOWN, TEX.—The citizens of Yorktown will erect an electric light and ice plant at a cost of $8,000.

GLACE BAY, C. B.—The Town Council will likely install an electric light plant during the coming summer.

BURNSIDE, KY.—The Burnside Electric Light & Power Company has been chartered, with a capital stock of $4,500.

TWO RIVERS, WIS.—At a recent election it was voted to issue $20,000 in bonds for an electric light plant and waterworks.

SHEFFIELD, ALA.—H. Hahler has applied for a franchise for the construction of a $75,000 electric light plant and waterworks.

EL PASO, TEX.—The Southern Electric Company, capital stock $10,000, has been organized by B. L. Berkey, G. A. Andrews and others.

BRISTOL, TENN.—It is proposed to issue bonds for $25,000 for the construction and equipment of an electric light plant in this city.

WINCHESTER, TENN.—Bonds to the amount of $30,000 have been voted by the citizens of this place for an electric light plant and waterworks.

OTTAWA, ONT.—A by-law to provide for the installation of an electric light plant for the town of Thessalon, Ont., will be submitted to the ratepayers on May 6.

BUTLER, MO.—The City Council has decided to submit a proposition to the voters at the election to issue $20,000 bonds for the purpose of building an electric light plant.

FRANKFORT, KY.—The Union Light, Heat & Power Company, of Covington, filed articles of incorporation with the Secretary of State. The capital stock is $1,500,000.

WHEELING, W. VA.—The Wheeling & Elm Grove Railway Company has absorbed several electric light and street railway properties in this city and will issue $1,250,000 bonds.

COOPER, TEX.—The Cooper Electric Light Company, with capital stock of $10,000, has been incorporated by Charles Tuttle, Wm. R. Evans and Ed. S. Kelley, of Kaufman, Tex.

THE KERO ARC LIGHT COMPANY has been incorporated in New Jersey to manufacture lamps; capital, $300,000. Incorporators: Wiliard B. Mack, E. H. Fessenden and J. F. Place.

CINCINNATI, OHIO.—After the expiration of the present electric lighting contract there will be no gasoline lighting in this city. No gasoline lamps will be considered in the new contract.

SAN FRANCISCO, CALIF. City Engineer Grunsky, of San Francisco, recently filed an elaborate report on a projected municipal electric lighting plant. The estimated cost of operation is about $242,000 per year.

ATCHISON, KAN.—The Atchison, Railway, Light, Heat, Power & Water Company, capital $800,000, has been incorporated. Incorporators: B. P. Waggener and W. P. Waggener, J. A. Bendure, all of Atchison..

GREAT FALLS, MD.—It is stated that a Great Falls Power Company will expend $2,000,000 in establishing a power transmission plant at Great Falls, on the Potomac River. The company's headquarters are in Washington.

HALIFAX, N. S.—The City Council has decided to establish a municipal electric plant, and thus enter into active competition with the Halifax Electric Tramway Company. The estimated cost of a suitable plant is placed at $100,000.

CINCINNATI, OHIO.—The Board of Public Service of this city has approved resolutions ordering electric lights in the middle of squares in the heart of the city. Hitherto they have been placed at intersections of streets only.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company has purchased property on Central avenue, on which will be erected at once a new power station with a frontage of 340 feet. The new plant will be equipped with new engines of 5000 horse-power.

CLINTON, IA.—The Clinton Gaslight & Coke Company is inviting bids on second-hand machinery in first-class condition for the equipment of an electric light plant. One engine, one alternator, arc lamps and a full line of material are specified for delivery in Clinton.

BLOOMINGTON, IND.—The Bloomington Light, Heat & Power Company has closed a contract with the Lakon Company, of Elkhart, Ind., for transformers of 5000-light capacity to replace those now in service. The company will expend $25,000 for improvements to its system.

SAN FRANCISCO, CALIF.—The electric lighting station in Petaluma, Calif., will soon discontinue the use of coal as fuel, and a 15,000-gallon cemented tank is being constructed to hold a supply of petroleum oil. This will be the second trial of oil fuel at this plant, and the estimated reduction of expenses is 10 per cent.

BLOOMFIELD, IND.—An electric light and power company is to be incorporated here with a capital stock of between $10,000 and $20,000. The principal incorporators will be: E. H. Dugger, Jonas E. Meredith and Will B. Maddock. The company will need an entirely new equipment. Nothing has as yet been purchased.

READING, PA.—The mayor has signed a bill granting a franchise to the People's Light & Power Company, of Reading, to establish a plant and system in this city. The company will soon be reorganized and its capital stock increased to $100,000. Plans will then be drawn up for the erection of a plant, and contracts awarded.

SAN FRANCISCO, CALIF.—The California Central Gas & Electric Company has been incorporated by John Martin, Fred H. Pierson and H. U. Roeding, of San Francisco, and John A. Britton, of Oakland. Capital stock, $1,500,000. The company will carry on its operations in Sacramento, Butte, Marin, Napa and Sonoma counties.

SANDERSVILLE, GA.—Messrs. Holt & Brother are organizing an electric light company and are now in the market for electrical equipment for the same. They propose to install a plant with a capacity of about 35 arc lights and 1000 incandescents. About 60 per cent of this total capacity, it is stated, will be required at the start. The company's capital is $30,000.

NEW ALBANY, IND.—The Commercial Club, of this city, and business men of Louisville, have revived the project to utilize the immense water power of the falls of the Ohio River at this place. It is claimed there is power enough to run the street railways, electric light plants and all the factories of Louisville, New Albany and Jeffersonville. Steps are being taken to devise a plan of operation.

SPRINGFIELD, MO.—The City Council will give a 20-year electric light franchise. A gas franchise will also be included. One hundred and eighty arc lamps will be required, and the city will give a seven-year contract. The present company has no franchise or contract with the city. There is a good opening for 7000 incandescent lights in this city, which has a population of 30,000 inhabitants.

CHARLOTTE, N. C.—A representative of C. C. Howell and associates, of Knoxville, Tenn., will visit Charlotte, N. C., and endeavor to make contracts to supply electric power to be transmitted from Motts' Shoals, thirty miles distant. It is stated that the Howell company is making arrangements to harness Motts' Shoals, and if the project succeeds, it will be prepared to furnish other towns with electric power.

TRENTON, N. J.—The Federal Water Power & Cable Company, capital $1,000,000, has been incorporated to construct public works of all kinds, including railroads, wharves, water works and electric light works. Incorporators: John W. Avery, Osborn Congleton, New York; A. J. Ream, P. W. Masten, Hugh C. Brady, all of Kansas City; J. A. Hill, Enid, Okla.; Walter Grieg, Joplin, Mo.; H. G. C. Thornton, Cranford, N. J.

SNOHOMISH, WASH.—The City Council have entered into a contract with E. S. Aldrich, J. B. Brown and O. Lewis, composing the Snohomish Electric Company, to pump the city water and light the streets for a period of five years, beginning August 1, 1901. The present light plant will be rebuilt at the city pumping plant and changed to the alternating current system. About a 150-hp. engine and 75-kw. alternator will be installed, as well as wire, transformers, enclosed arcs, etc. The company also contemplates installing a plant at Arlington, Wash. E. S. Aldrich is manager.

THE ELECTRIC RAILWAY.

BELLEVUE, KY.—An electric railway is to be built between this place and California, Ky., a distance of three miles.

NEW CASTLE, IND.—The work of surveying the route of the New Castle & Muncie Interurban Electric line is completed.

DALEVILLE, IND.—The Union Traction Company will soon begin the construction of a line from here to Middletown.

CANTON, OHIO.—The Canton-Massillon Electric Railway Company has applied for a franchise in the village of Navarre.

APPLETON, WIS.—The Fox River Valley Electric Railway Company has completed arrangements for the rebuilding of the entire local line.

CINCINNATI, OHIO.—The new traction company, an outgrowth of the Consolidated Street Railway, will erect a large central power house.

MARION, OHIO.—The Marion, Green Camp & Prospect Electric Railway Company has secured a franchise from the County Commissioners.

EAST LIVERPOOL, OHIO.—A company headed by E. H. Hill is securing right of way to build an electric railway from this city to Chester and Congoe, W. Va.

GUELPH, ONT.—The Guelph Railway Company has secured a charter to construct an electric railway to Hespeler, via Puslinch Lake, and also to Berlin, Ontario.

MARYSVILLE, OHIO.—The Union Electric Railway Company has been granted a twenty-five year franchise to operate three separate lines over certain pikes in Union County.

SPRINGFIELD, OHIO.—After a fight against three rival lines, the Little Miami Traction Company has secured a franchise through Springfield for its road to Xenia and Cincinnati.

RICHMOND, VA.—The Richmond & Petersburg Electric Railway Company has had plans made by B. W. Poindexter for its proposed $15,000 power plant to be erected near Manchester.

WORCESTER, MASS.—The Worcester and Blackstone Valley Street Railway is building a model power plant at Millbury. Among the up-to-date features will be a Green economizer.

JERSEY CITY, N. J.—The stockholders of the Consolidated Traction Company re-elected all the old directors with the exception of Henry Lembeck, who is succeeded by James E. Hulshizer.

CHARLESTON, W. VA.—The Ohio & West Virginia Interurban Railway Company has been incorporated; capital, $50,000. Incorporators: Eugene E. Grannan and four others, of Baltimore, Md.

NEW ORLEANS, LA.—It is announced that the St. Charles Street Railroad Company will build several extensions in the city. The company is considering an increase in its capital stock of $200,000.

ALBANY, N. Y.—Paul Smith and Wallace Murray are promoters of a plan to build a trolley line from Bloomingdale to Saranac Lake thence to Lake Placid, to Keene Valley and down the Ausable Valley to Keesville.

WARREN, OHIO.—It is said that a Philadelphia syndicate of street railway promoters will purchase sixteen franchises for trolley line routes through Ashtabula, Trumble and Geauga Counties, Ohio, and Crawford County, Pa.

KOKOMO, IND.—It is reported that contracts have been signed for the Indianapolis, Tipton, Elwood & Kokomo Electric Railway, and that the money is secured. S. Smithers & Co., bankers, of New York, will finance the project.

COLUMBUS, OHIO.—The Urbana, Bellefontaine & Northern Railway Company has been incorporated with $50,000 capital stock by J. H. Harshman, John G. Webb, C. W. R. Niven, Charles A. Alderman, Wm. T. Haviland and John Green.

JERSEY CITY, N. J.—At the annual meeting of the stockholders of the North Jersey Street Railway Company, Joseph D. Bedle and Edward L. Young were chosen respectively to succeed the late F. O. Matthiessen, and A. Q. Garrettson resigned.

CINCINNATI, OHIO.—The Cincinnati Traction Company's car barns at the head of Elm Street were destroyed by fire, entailing a loss of about $40,000. Sixteen new cars, some old rolling stock, paints and electrical supplies valued at $25,000 were destroyed.

OTTAWA, ONT.—An act incorporating the London, Aylmer & North Shore Electric Railway, of Ontario, has passed the railway committee of the Ontario Legislature. This road will run from London, Ont., to Aylmer and Port Burwell. Capital stock is $850,000.

AKRON, OHIO.—The Northern Ohio Traction Company is planning to increase the capacity of its power house here, in order to take care of extensions. Plans for the extension are being prepared and contracts for the equipment will be closed in the near future.

CLEVELAND, OHIO.—A Cleveland syndicate has purchased the Aurora Street Railway Company of Aurora, Ill., and the Aurora & Geneva Electric Railway Company. The two roads are to be consolidated with the Elgin City, Carpentersville and Aurora Railway.

NEWARK, N. J.—The stockholders of the Worcester Traction Company, of Worcester, Mass., voted to accept an offer from Vermilye & Co., of New York, for the company's stock, franchise and plant. The company operates fifty miles of track and has a capital of $5,000,000.

CINCINNATI, OHIO.—It is reported that capitalists back of the Little Miami Traction Company, in addition to building an interurban line between this place and Springfield, will run connecting lines to Columbus and Dayton, and build several roads in the southern part of the State.

COLUMBUS, OHIO.—The Lakeside, Napoleon & Western Electric Railway Company has been incorporated with $300,000 capital stock to build a line from Marblehead to Bryan, and probably to Montpelier, Ind. The promoters are Indianians, headed by G. H. Brown, of Fort Wayne.

NOBLESVILLE, IND.—The City Council has extended the time for the completion of the Indianapolis & Kokomo Electric line for one year. The road in financed by Smithers & Co., New York bankers, and the contract for construction has been awarded to J. G. White & Co., of New York.

SYDNEY, N. S.—The Cape Breton Electric Railway Company, of Sydney, will shortly commence construction of an electric tramway line between Sydney and Glace Bay. A representative of the company has gone to Boston, Mass., where all arrangements are being made for the building of the line.

FAYETTEVILLE, N. C.—The Fayetteville & Wilmington Steamboat Company has been chartered in North Carolina, with a capital stock of $100,000, to operate a steamboat line, a street car system and electric light plant in Fayetteville. W. L. Holt and W. W. Morgan, of Fayetteville, are interested.

PHILADELPHIA, PA.—The Schuylkill Traction Company has authorized the creation of a new mortgage of $2,000,000 to provide for extensions to Pottsville, Tamaqua and Hazleton. These directors have been elected: Clarke Merchant, J. A. McKee, John F. Finney, H. W. Lippincott, Herman Hoopes, Spencer Cosby and Dallas Sanders.

TORONTO, ONT.—The Niagara, St. Catherines & Toronto Railway Company, which operates an electric railway between Port Dalhousie, Ont., and Niagara Falls, N. Y., has made an offer for the purchase of the St. Catherines, Merriton & Thorold Street Railway. The figure named in the negotiations is $100,000. The road will, when acquired, be put in first-class condition.

TACOMA, WASH.—Extensive improvements are to be made on the line of the Everett Street Railway Company, and a modern electric lighting plant will be installed by the company. Contracts will be let immediately for an engine of 1400 horse-power, rolling stock and electrical apparatus. Mr. E. P. Burch, engineer of the company, has gone to Minneapolis to complete arrangements for the new work.

SAN FRANCISCO, CALIF.—The Market-Street Railway Company, San Francisco, recently closed a contract for 25,000 barrels per month of crude petroleum, the contract to run three years. The Union Iron Works will use about 100,000 barrels of fuel oil per year, and has also entered into a three-year contract for petroleum. Several other large concerns in and around San Francisco have already commenced burning oil.

NEW ALBANY, IND.—The Commercial Club of this place is reviving a project to utilize the large water power of the falls in the Ohio River. The committee, including Hon. Thos. W. Armstrong, Judge J. H. Stotsenburg, Chas. Van Dusen and Geo. E. Steinhauer, will develop a plan. It is expected to furnish power sufficient for the street railways, electric light plants and many of the factories of Louisville, New Albany and Jeffersonville.

NEW YORK, N. Y.—The business of the Metropolitan Street Railway Company throughout the winter is reported to have been very satisfactory. Not only were earnings largely beyond the expectations of officials, but as there was no trouble with snow, operating expenses were relatively small. With the opening of spring work will be resumed on the improvements designed to round out the system. The Fourth Avenue, Third Avenue and other lines will be connected up with Broadway, when electric traction is installed on the latter line.

CINCINNATI, OHIO.—The Cincinnati Traction Company proposes a radical change in the system of paying death benefits to employees. The new company asks employees to pay $1 each into a general fund for both death and accident insurance, which will aggregate about $30,000 a year. The men prefer to handle their own money. Under the rules of the fund, any member discharged from the employ of the company loses all interest in the fund. The men feel that if the company should have charge of the fund it would be used as a menace to them.

YOUNGSTOWN, OHIO.—The organization of the Youngstown & Sharon Railway & Light Company was perfected in New York recently. The directors and officers are as follows: A. M. Hyatt, H. W. Whipple, P. F. Thompson, W. A. De Vitt, George F. Penhale, Randall Montgomery, W. H. Park, H. G Hamilton, W. J. Hitchcock, C. B. Wick, George D. Wick, H. M. Garlick, G. M. McElvey, G. H. Morris, Grant Hamilton, M. A. Morris, Simon Perkins, W. L. Wallace, Alex. McDowell, M. A. Fruit, and Peter L. Kimberley. President, M. A. Hyatt; vice-president and chairman, H. W. Whipple; secretary, Leighton Calkins; treasurer, O. W. Bright.

PHILADELPHIA, PA.—Albert L. Johnson of New York, C. B. Bates of New York, Francis S. Drake and T. B. Lynch, of Philadelphia, and Robert E. Wright of Allentown, completed arrangements to apply for a franchise to 175 miles of unoccupied streets in Philadelphia. They hope to introduce three-cent fares to Philadelphia and secure the terminal for a trolley line to New York. It is reported that Mr. Johnson said it was the intention to charge 50 cents from Philadelphia to New York. There are to be no crossings at grade. In case of failure to secure a franchise Mr. Johnson said there would be a house to house canvass to arouse public sentiment to the advantage of the new line.

KENOSHA, WIS.—For a long time several attempts have been made by the Chicago-Milwaukee Electric Railway Company to obtain a franchise to pass through this city, and in each case failure has been the result. Now the City Common Council has dealt a death blow to any schemes for interurban electric railways passing through the city. The committee in charge of the amended railway ordinance recommends that the Kenosha Street Railway Company be given the use of West Main street. This action will give the Kenosha company an absolute monopoly of the streets of the city, and if the Milwaukee company desires to build through the city it will be necessary for it to purchase a right of way from the Kenosha company.

THE AUTOMOBILE.

THE AUTOMOBILE CLUB OF CINCINNATI was organized March 28 at the Business Men's Club. The board of governors is as follows: R. A. Holden, Jr., Howard S. Rogers, Dr. L. A. Colter, Max Fleishmann and T. C. Meadows. Officers will be elected later. A clubhouse and speedways for automobiles are early possibilities. The securing of good roads is one of the objects of the club.

NEW YORK STATE.—Automobiles will shortly be classed with carriages and subject to all laws enacted for horse vehicles, providing the bill which has passed the Assembly becomes a law. It probably will, according to Mr. G. F. Chamberlain, of the law committee of the Automobile Club of America. Several advantages will be gained. The highways and the park roads will thus be opened in all parts of the State to the automobile. Local legislation cannot bar them out. The automobile is barred, however, from those highways such as the Speedway and Cycle Path, set aside especially for horses or bicycles. Local legislation may not limit the automobiles to less than eight miles an hour in a city or fifteen miles in the country. Where no local laws exist the chaffeur may travel as fast as he likes.

NEW INDUSTRIAL COMPANIES.

WARRENTON, VA.—The Warrenton Electric Company has been chartered by Geo. B. Stone, president, and others, of Warrenton. The capital stock is placed at $15,000.

THE CRESCENT ELECTRICAL MANUFACTURING COMPANY, of Rochester, N. Y., has been incorporated; capital, $2,000. Directors: C. R. Elliott, A. L. W. Miller and H. W. Russell, Rochester.

THE AUTOMATIC TROLLEY CATCHER & CONTROLLER COMPANY, of Syracuse, N. Y., has been incorporated; capital, $100,000. Directors: H. D. Milloy, Buffalo; J. H. Devire and W. S. Farmer, Syracuse.

SAN FRANCISCO, CALIF. The Rotary Corliss Engine Company was recently incorporated in San Francisco, by Charles B. Lastretto, Samuel N. Goldby, Emilio Lastretto, Grant Hammond and Thomas Flint, Jr. Capital stock, $200,000; fully subscribed.

THE WISWELL-PRITCHARD ELECTRIC MANUFACTURING COMPANY, of Niles, Ohio, has been incorporated by P. J Pritchard, W. H. Pritchard and F. W. Stillwagon, of Niles, and Henry W. Wiswell and Charles M. Wilkins, of Warren. Capital stock, $30,000. The company will manufacture electric lamps, transformers and other electrical specialties.

THE CONSOLIDATED RAILWAY LIGHTING AND REFRIGERATING COMPANY was incorporated at Trenton, N. J., on March 21, with an authorized capital stock of $6,000,000, the incorporators being William C. Stemmerman, John H. Thompson, Jr., and Clifford W. Perkins. The company is to engage in the construction and equipment of railway cars, including heating, lighting and refrigerating apparatus. Liquid or compressed air, according to the charter, is to be used for the latter purpose.

PERSONAL.

MR. V. C. GRACE has returned to Chicago to open a Western agency for an Eastern firm.

MR. BRIGGS S. CUNNINGHAM, president of the Citizens' Bank of Cincinnati, was elected a director in the Cincinnati Gas Light & Coke Company, to succeed the late Captain George N. Stone.

MR. JAMES D. REID, the veteran telegrapher, has had a serious illness at his residence in this city, and has undergone critical operations, but is reported better. The "grand old man" is well over eighty.

MISS F. OLIPHANT WARD, the daughter of Mr. George Gray Ward, of the Commercial Cable Company, is to be married on April 16 to Lieut. H. H Hough, U. S. N., at the Church of the Heavenly Rest, in this city.

MR. SAMUEL INSULL, president of the Chicago Edison Company, is in town, and his brother, Mr. Martin J. Insull, of the General Incandescent Arc Light Company, has also just returned from a trip to the Far West, much benefited in health.

MR. T. A. EDISON returns this week from his holiday in Florida and resumes work at once on his new storage battery, which he hopes to exhibit next week at the conversazione of the American Institute of Electrical Engineers at Columbia University.

MR. F. J. ALLEN has been sworn in as United States Commissioner of Patents, and states that he is in no wise interested in or connected with the Bell telephone. He was at one time a stockholder and director in the Empire State Telephone Company, but sold out.

MR. H. T. NEWCOMB, chief of the division of agriculture in the United States Census, has resigned that position, and will hereafter have full charge of the news and editorial columns of the *Railway World*, with headquarters at 137 South Fifth street, Philadelphia.

MR. FRANCES RAYMOND, late Western manager of the General Incandescent Arc Light Company, has establisbed himself as a manufacturers' agent at 48 West Jackson Boulevard, Chicago, and is selling "G. I." arc lamps, Paragon fan motors, World incandescent lamps, etc.

MR. E. H. COX, who for the past five years has been with the De la Vergne Refrigerating Company, and has secured a large amount of business, including many Government contracts, for the Hornsby-Ackroyd oil engines, has resigned his position. He can be reached by addressing P. O. Box 1699, New York City.

MR. FRANK SUTTON has secured offices in the new Atlantic Building, Wall Street, New York, where he will continue his consulting engineering practice. Although still a young man, Mr. Sutton's experience as an advisor in electrical, steam and mechanical engineering problems has been quite extensive, and his numerous friends wish him increased success in his new quarters.

MR. S. F. B. MORSE, who is the general passenger traffic manager of the Southern Pacific Railroad, states that he recently saw Prof. L. H Kenner bypnotize two men by long distance telephone, from Houston, Tex., to Beaumont, a distance of eighty-five miles. Several physicians were present. Mr. Kenner is an employee of the railroad company.

PROF. M. I. PUPIN is credited in the New York Sunday *World* with an interesting talk on Edison, whom he characterizes as "the greatest inventive genius this country has ever produced." He bestows praise on Edison's low resistance dynamo, phonograph, and quadruplex and asserts that without him there would have been no great incandescent lighting art.

MR. E. J. WESSELS, formerly well known in electrical circles and lately publisher and editor of the *Great Round World*, has sold out that excellent journal to Mr. W. C. Gates, late business manager of the *Review of Reviews* and will take a long, well-earned rest. It is his intention to sail shortly with his family for the Continent. His personal address is East Orange, N. J.

PROF. HARRIS J. RYAN, of the electrical engineering department of Cornell University, has sustained an irreparable loss in the death of his father. On March 14 Mr. Ryan senior, who for more than twenty years was cashier of the Bank of Halifax, Pa., lost his life in defending the bank against two robbers, who have been captured and convicted of murder in the first degree. Prof. Ryan has the deep sympathy of the entire profession.

MR. A. L. SCHULTZ, formerly president and general manager of the Schultz Bridge & Iron Company, Pittsburg, Pa., has been appointed to take charge of the operating department of the American Bridge Company, covering the Pittsburg district, comprising the Keystone Pittsburg, Schultz and Schiffler plants at Pittsburg, the Wrought Iron plant at Canton, Ohio; the new Columbus plant at Columbus, Ohio, and the Youngstown Bridge plant at Youngstown, Ohio.

MR DAVID R WALKER, chief of the electrical bureau of the city of Philadelphia, who has held office continuously for forty-five years, is to retire on June 1. His successor is likely to be Manager John C. Sager, who has been twenty-five years in the department. The bureau began with an annual appropriation of $6,100 and now requires $1,250,000 for all the work it has to do.

EDUCATIONAL.

THE ARMOUR INSTITUTE, Chicago, founded by the late P. D. Armour, will, it is said, in all probability soon be affiliated with the University of Chicago. It now has 1000 students and 38 professors.

MR. S. D. BENOLIEL has just completed a course of eight lectures on chemistry and electricity, which were delivered at St Bartholomews Lyceum Hall, New York City. The course was one of a number of "Free Lectures to the People," annually arranged for by the New York City Department of Education.

Trade Notes.

THE CHICAGO, ST. PAUL & MISSOURI RAILWAY has placed a contract for 36 bridges with the American Bridge Company.

THE UNITED STATES NAVY YARD, Bremerton, Washington, was recently equipped with Cross oil filters by the Burt Manufacturing Company, of Akron, Ohio.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, is carrying a full stock of swinging ball lightning arresters, so that orders can be shipped same day they are received.

THREE-WIRE TRANSFORMERS. The core type of transformer for three-wire secondary service is the subject of a recent pamphlet issued by the General Electric Company. The transformer is illustrated in detail, and its construction concisely described.

THE AUTO ELECTRIC COMPANY, 61 Elm street, New York, announces that it has greatly improved its facilities for the manufacture of its "Light-of-Asia" lamps, and other products. It is sending out an announcement of the fact that will be of interest to the trade.

STEAM PUMPS.—The Jeanesville Iron Works Company, Jeanesville, Pa., gives some valuable working data on steam pumps in Advance Sheet No. 9, just issued. The manner adopted of listing pumps is thought to be new, and will be found very handy in selecting a size for a given work.

ELECTRICAL AND STEAM MACHINERY.—Messrs. Rossiter, MacGovern & Co., 141 Broadway, New York, carry a full line of second-hand machinery of standard make; also, second-hand steam and street railway equipment. A recent pamphlet of forty pages gives a complete list of the apparatus the firm has on hand.

MOTORS AND DYNAMOS.—The Three Rivers Electric Company, Three Rivers, Mich., in a catalogue describes its new line of dynamos and motors. It gives some interesting details of construction and also points out some new features which will be appreciated by purchasers. The machines are illustrated complete and in parts.

OIL FILTERS IN HAVANA.—The Burt Manufacturing Company, of Akron, Ohio, was recently favored witb an order for two 150-gal. Cross oil filters to equip tbe new modern power house of the Havana Street Railway Company, Havana, Cuba. As only the best, modern machinery was selected, tbis is a strong endorsement in favor of this filter.

THE EDISON THREE-WIRE SYSTEM.—A recent publication of the General Electric Press is a 60-page pamphlet, thoroughly descriptive of the principles and material of the Edison three-wire system. Tbe pamphlet forms, in fact, a complete technical treatise on the system, tbe value of which is enhanced from the text referring to the very latest developments of the system.

ELECTRIC MEASURING INSTRUMENTS.—Whitney improved electrical measuring instruments and accessories are described and illustrated in a new 1901 catalogue issued by Messrs. Machado & Roller, 203 Broadway, New York. Tbe interchangeable shunt feature which has been developed in connection with these instruments, is also described. A copy of the catalogue can be obtained by addressing the firm.

THE CHARLESTON EXPOSITION.—We have received a copy of a pamphlet giving an outline of the plans of the proposed South Carolina Interstate and West Indian Exposition, which is to be held in Charleston, S. C., from December 1, 1901, to June 1, 1902. In contains some interesting facts regarding the South and its industries. Illustrations of the various buildings, and a plan of the grounds are shown.

POWER TRANSMITTING MACHINERY.—Messrs. T. B. Wood's Sons, manufacturers of power transmitting machinery, Chambersburg, Pa., in their Catalogue No. 12, give a price list, dimensions and other information concerning their power transmitting appliances, which include shafting, couplings, pulleys, hangers, friction clutches, belt dynamos, etc. The catalogue has 160 pages and is printed in two colors, brown and black.

PROTECTIVE DEVICES.—A full line of D. & W. enclosed fuses, motor cutouts and safety devices of all kinds is carried in stock by the Central Electric Company, of Chicago, which is selling agent for all D. & W. material. These devices reduce to a minimum the danger of fire through blowing of fuses, and are a great protection to life on high tension circuits. The Central Company will send illustrated bulletins of these goods upon application.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, of Philadelphia, Pa., has issued its usual monthly calendar blotter, announcing thereon the fact that it has just received a carload of Emerson alternating desk and ceiling fans. Accompanying this blotter is a circular describing the Roberts fixture block, with steps to fit four different sizes of standard canopies, and also a very pretty circular describing the standard Bryant-Edison sockets.

THE EAGER ELECTRIC COMPANY, Watertown, N. Y., is the name of a new organization which has taken over the electrical business of A. C. Powell & Son. The company is equipping its factory with special machinery of the latest and most improved design. It has a modern factory building, 60 by 200 feet and thirty stories high, nearby a fine water power, which gives it exceptional facilities for the manufacture of dynamos and motors. Mr. Henry Eager is the manager of the company.

THE OLDS MOTOR WORKS, Detroit, Mich., which were destroyed by fire recently, started up in new temporary quarters on March 20. New machinery has been set up. All of the concern's automobile patterns and drawings were saved, as well as large quantities of material in the warehouses, which were not burned. This is intact for the manufacture of "Oldsmobiles." The fire was caused by leakage of natural gas. The company reports that it has now on its books orders for 334 "Oldsmobiles" and gasoline runabouts.

LUNDELL MOTORS.—We are reminded of approaching hot weather by the appearance of fan motor catalogues. The Sprague Electric Company has just issued its 1901 catalogue of Lundell fan motors, in which the different types of machines are attractively illustrated. A complete price-list is also given. The frontispiece represents what is said to be "the real North pole." It shows a Lundell fan motor surrounded by icebergs, and ice everywhere, blowing the frigid air down to the Southern latitudes. Behind it the aurora borealis bursts forth in all its glory.

THE AMERICAN ELECTRICAL HEATER COMPANY, 195 River Street, Detroit, Mich., manufacturer of electrical heating devices, has just issued a new catalogue and price list which it will send without cost on application to any one who is interested in the subject of electric heating. The general use of electrically heated apparatus during the summer months is a subject that deserves more attention than it has yet received. Such apparatus answers admirably the conditions of the hot weather, owing to its concentration of form, and the fact that it inflicts the minimum of discomfort on those who have to use it.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has issued two new bulletins. Bulletin No. 114 illustrates and describes the S. K. C. frequency changer, a single machine accomplishing exactly what its name implies. In addition to altering the periodicity, it can be arranged to deliver current of a different phase relation and voltage from that which is supplied. This machine is described and illustrated elsewhere in this issue. Bulletin No. 115 contains diagrams and a description of high voltage testing sets, arranged for pressures up to 120,000 volts. Either or both of these bulletins are at the disposal of those interested and will be mailed upon request.

CORLISS ENGINES.—The Vilter Manufacturing Company, Milwaukee, Wis., has closed contracts for Corliss engines as follows: Moore-Cortes Canal Company, Wharton, Tex., one 14x28x42 tandem compound; Hunter Canal Company, Milton, La., one 17x34x48 tandem compound; J. P. Suberville, New Iberia, La., three 15x36; Thieme & Wagner Brewing Company, Lafayette, Ind., One 12x30; Plymouth Refrigerating Water, Light & Power Company, Plymouth, Wis., one 12x30; Saladin Pneumatic Malting Construction Company, Chicago, Ill., one 16x36; Standard Manufacturing Company, Appleton, Wis., one 14x30; Wisconsin Foundry & Steel Works, Cedar Grove, Wis., one 12x30; Mount Airy, N. C., one 14x36; Dorschel, Schultz & Co., Lumber, Chilton, Wis., one 12x30; Wm. Jacobs, South Bethlehem, Pa., one 10x30; Columbia Malting Company, Chicago, Ill., one 24x42.

TELEPHONE SWITCHBOARDS.—In an artistic 24-page pamphlet just issued by the Kellogg Switchboard & Supply Company, of Chicago, Ill., considerable information is given concerning the company's line of small switchboards, particularly the "Express" switchboard. It is interesting to note in this connection that the Kellogg company is building some very large exchanges. It states that it has already built two switchboards, either one of which is larger than any other switchboard in this country, and one of which is the largest in the world. The pamphlet contains some very excellent illustrations of the "Express" switchboard, giving different views of the same, also of its combined drops and jacks, ringing and listening keys, clearing-out drops, etc. The detailed views are very clearly executed, and are excellent examples of the engraver's art. At the back of the pamphlet are given some illustrations of desk pattern switchboards.

THE NEW "GENERAL CIRCULAR" issued by the International Correspondence Schools, Scranton, Pa., is a forty-eight page pamphlet describing briefly each of the courses of instruction offered by the schools. Portraits of the professors, views of the schools' handsome buildings, and other illustrations, add interest to the circular, while the earnest letters from students who have secured better positions as a result of their studies testify to the successful methods employed by the schools in teaching by mail. The number of students enrolled in the International Schools is about double the number attending all the colleges in the United States. The schools receive from their students over 15,000 lesson papers and drawing plates every week, which are immediately corrected and returned by mail, many of them going to the most remote parts of the world. Considerably more than $1,000 a week is spent for postage.

THE STUART-HOWLAND COMPANY, Boston, had ample cause for celebrating its first birthday, which event occurred on April 2, for in the one year of its life it has risen from nothing to one of tbe largest supply businesses in New England. The phenomenally rapid growth which this fact indicates has not been confined to any one department of the business, but has been general throughout all lines—lighting, railway, telephone and telegraph supplies—a fair indication of the magnitude of the transactions handled is the statement that the Stuart-Howland Company has on its books to-day unfilled orders for the overhead equipment of over 275 miles of electric railway on eleven different lines. From the beginning the employees of this house have been experienced and capable, and have included some of the most widely known men in the supply business. The growth of the business has necessarily increased tbe working force extensively, and among the more recent additions are Mr. Bruce Wetmore, to the store force, and Mr. Huntington Lee, to the force on the road. The house is to be congratulated on the large measure of success that has filled its first year of life, and is to be commended for the energy and capacity that has made this success possible.

THE MICA INSULATOR COMPANY reports gratifying increase in the demand for its patented specialties in mica and micanite insulation. Quite recently it was compelled to enlarge its factory in order to meet this increased demand, and it now has under consideration a further enlargement of its works in order to handle the extra volume of business. Its material was recognized at the Paris Exposition as a standard for electrical insulation, and was given a gold medal. It has completed quite recently several specified forms of insulation, which were used in some very novel and original installation. These forms of insulation were designed and executed by the company's engineers, who are prepared at all times to give the benefit of their experience in the insulating field to the customers of the company. A detailed description of these special forms of insulation will be given later. This company is the originator of moulded mica insulation under the trade mark of "Micanite," and has had several years of successful manufacturing to which it can point with pride. Its product is not a new one, and its workmen are thoroughly educated and experienced in the manufacture of these goods. Nothing is used in the construction of micanite but pure India or amber sheet mica, with the best shellac. No scrap mica is used. This company has offices in New York, Chicago and London, and works in Schenectady, N. Y., and Stansted, England.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 26, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

670,415. ELECTRICALLY OPERATED BRAKE; G. D. Burton, Boston, Mass. App. filed April 13, 1899. Opposing solenoids are arranged to act upon a cross head, which is connected with the brake levers, so that when current is put through one solenoid the brakes will be applied and when through the other solenoid the brakes will be positively released.

670,420. RAILWAY BRAKE; A. Duppler, Jersey City, N. J. App, filed June 12, 1900. By manipulating the regular brake handle a moderate braking force is first mechanically applied, and then by a further movement an electrical brake is gradually applied.

670,425. SWITCH MECHANISM FOR SURFACE CONTACT RAILWAYS; G. T. Hanchett, Hackensack, N J., and J. M. Murphy, Torrington, Conn. App. filed July 27, 1900. Besides improvement in the general construction of the switch box, the switch magnets are provided with two windings, so related that momentary breaks of the current caused by chattering of the contact shoe, will not permit of the releasing of the armature and opening of the circuit.

670,454. COMMUTATOR; G. W. Nistle, Chicago, Ill. App. filed January 29, 1901. To hold the segments in place upon a slate disk; the disk is perforated by holes running at right angles to each other, one of which passes through the segment and intersects the other; a screw passes through the segment and engages witb a metallic body at the intersection of the two holes.

670,463. ALARM ATTACHMENT FOR DRIP PANS; L. Wahl and G. Keyes, Brooklyn, N. Y. App. filed January 21, 1901. A float carrying a circuit closer is arranged to be supported by a bracket attached to the edge of the pan.

670,474. STORAGE BATTERY; J. B. Entz, Philadelphia, Pa. App. filed July 9, 1900. A laminated combined separator and support provided internally with a series of openings constituting wells and externally upon its faces with a series of projections.

670,475. STORAGE BATTERY; J. B. Entz, Philadelphia, Pa. App. filed July 9, 1900. A combined separator and support consisting of a fluted sheet of non-conducting material, having its alternate flutes perforated and its intermediate flutes imperforate.

670,476. ELECTRICAL DISTRIBUTION. J. B. Entz, Philadelphia, Pa. App. filed September 1, 1900. (See Current News and Notes.)

670,510. PROCESS OF PRINTING AND PRODUCT THEREOF; W. Friese-Greene, London, England. App. filed June 18, 1898. (See Current News and Notes.)

670,538. SUBSCRIBER'S TELEPHONE CIRCUIT; W. W. Dean. Chicago, Ill. App. filed April 28, 1899. The microphone is in circuit with four primaries, located in the respective branches of a Wheatstone bridge, the secondaries being connected to the line, which thereby receives the added effect of all the primaries.

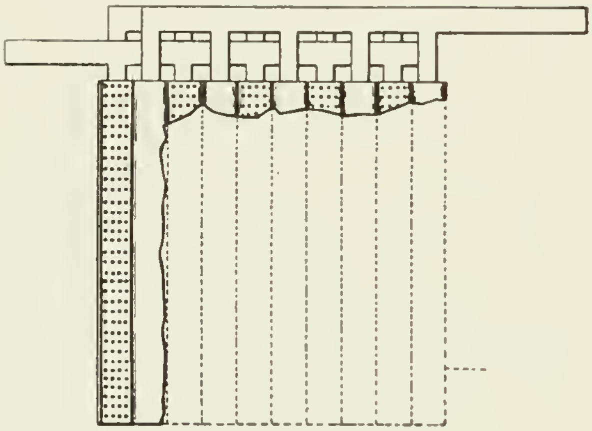
670,547. ELECTRICAL CONNECTING DEVICE; J. S. Schenck, Brooklyn, N. Y. App. filed January 20, 1900. Details of a fuse block.

670,556. ROCKER ARM; A. Cowperthwait, Brooklyn, N. Y. App. filed February 4, 1901. The rocker arm is provided with a channel in which the cross connecting conductors are lodged.

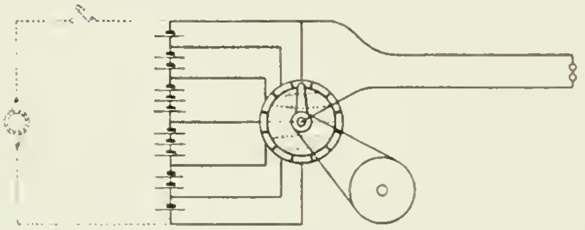
670,557. CONTINUOUS CURRENT MACHINE AND APPARATUS; M. Deri, Vienna, Austria-Hungary. App. filed March 24, 1900. (See Current News and Notes.)

670,564. TELEPHONE RECEIVER; C. H. North, Cleveland, Ohio. App. filed September 27, 1899. A construction intended to minimize the disadvantages resulting from the different rates of expansion of the material comprising the receiver.

670,573. SUSPENSION CUT OUT; J. J. Wood, Fort Wayne, Ind. App. filed December 19, 1899. Details of a suspension cut out upon which the lamp is supported.



670,475. Storage Battery



670,697. System of Telegraphy.

670,583. PRIMARY ELECTRIC BATTERY; J. P. Fontaine, Paris, France. App. filed January 9, 1900. A double fluid battery having active elements consisting of zinc and of soda lye on the one hand, and nitric acid on the other hand in combination with a porous vessel of cardboard and fabric placed together, and having a rigid internal substance permeable by the acid solution.

670,634. ELECTRIC CLOCK; F. L. Gregory, Chicago, Ill. App. filed March 2, 1900. Details.

670,648. ELEMENT FOR SECONDARY BATTERIES; J. T. Storey, Philadelphia, Pa. App. filed June 25, 1900. The plate consists of a tape wound upon itself and supported in a suitable frame.

670,651. ELECTRIC RAILWAY; W. T. Van Dorn, Chicago, Ill. App. filed April 27, 1900. A third rail is supported by brackets above the roadbed and shielded above and on the side by a hood; the collector is a spring-pressed shoe carried on the end of a rigid arm extending from the truck.

670,658. ELECTRIC ARC LAMP; E. A. Beck, Los Angeles, Cal. App. filed May 7, 1900. Details of the gas check.

670,667. ELECTRIC HEATER; W. S. Hadaway, Jr., New York, N. Y. App. filed September 24, 1898. In a heater for sad irons, the heating resistance is compressed into a chamber between two electrodes, which are adjustable with respect to each other.

670,669. ELECTRIC STOVE; W. S. Hadaway, Jr., New York, N. Y. App. filed February 1, 1899. The stove is adapted for heating flat irons, and the heating surfaces are shaped to fit the irons.

670,670. ELECTRIC STOVE; W. S. Hadaway, Jr., East Orange, N. J. App. filed June 30, 1900. A heater having two sections with active surfaces in substantially the same place, one surrounding the other, means for heating the central section by electric current and means for producing a lower degree of heat in the outer section.

670,671. ELECTRICAL HEATING RESISTANCE AND METHOD OF MAKING SAME; William S. Hadaway, Jr., East Orange, N. J. App. filed September 24, 1898. (See Current News and Notes.)

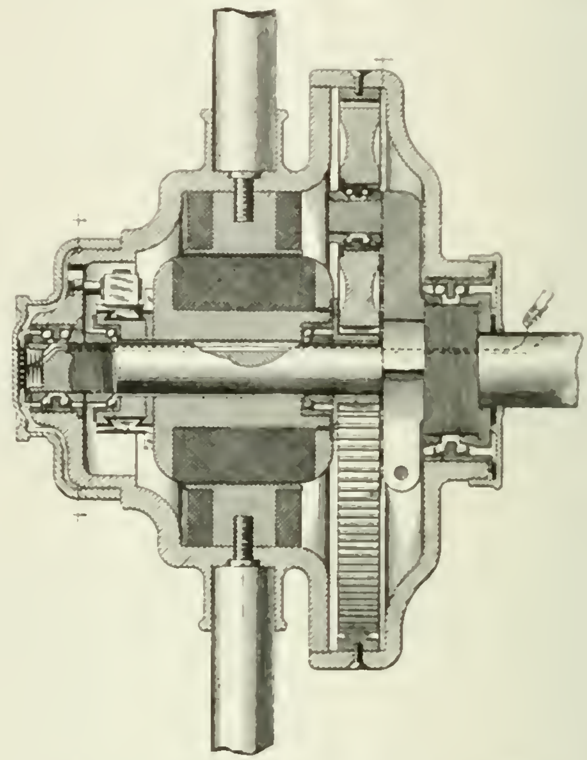
670,697. SYSTEM OF TELEGRAPHY; F. Bedell, Ithaca, N. Y. App. filed October 20, 1899. In this system there is provided any desirable sources of direct electromotive force, from which are derived a series of direct current impulses, gradually rising from and falling to zero by including and excluding in any desired order the several sources of electromotive force, so that the circuit may be closed, opened, short-circuited or grounded at the zero point between successive impulses, thereby avoiding the undesirable reactive effects from the line or table which would accompany the sudden insertion or removal of the maximum electromotive force.

670,711. COHERER FOR DETECTING ELECTRIC WAVES; A. Koepsel, Charlottenburg, Germany. App. filed August 25, 1900. (See Current News and Notes.)

670,712. TROLLEY WHEEL; R. Kuhn, Cincinnati, Ohio. App. filed November 10, 1900. The working face of the trolley wheel is covered with a detachable layer of wire.

670,774. APPARATUS FOR FORMING ELEMENTS FOR ELECTRIC ACCUMULATORS; W. Gardiner, Chicago, Ill. App. filed April 28, 1900. The apparatus is constructed so that the current passing through the plates undergoing formation can be graduated.

670,808. METHOD OF ELECTRIC WELDING; I. C. Perry, Clinton, Mass App. filed September 15, 1899. The welding is accomplished by applying a mechanical pressure nearly equal to the crushing strength of the material to be welded and simultaneously applying a current of great volume.



11,899. Means for Propulsion of Vehicles by Electricity.

670,855. SAFETY TROLLEY DEVICE; C. W. Diamond, New Orleans, La App. filed July 18, 1900. Details of a device for releasing the tension of the spring when the trolley flies upward on leaving the wire.

670,873. RAILWAY BRAKE; A. Green, Rochester, N. Y. App. filed March 1, 1901. Devices are applied to the brake controller whereby the point at which the brake goes into action, in the travel of the brake handle, can be adjusted, the object being to allow for lost motion in the parts.

670,877. PRIMARY BATTERY AND PROCESS OF REGENERATING SAME; H. K. Hess, Philadelphia, Pa App. filed December 21, 1900. The process consists in reducing the density of a concentrated battery fluid with water, and after employing said fluid in a battery, regenerating it and vaporizing out the excess water to restore it to its original density.

670,895. UNIT MULTIPLE SYSTEM OF ELECTRICAL TRAIN CONTROL; F. C. Esmond, Brooklyn, N. Y. App. filed August 2, 1898. A variation in the wiring and connections for carrying out the well-known multiple unit system of control.

670,896. UNIT MULTIPLE SYSTEM OF ELECTRIC RAILWAYS; F. C. Esmond, Brooklyn, N. Y. App. filed August 2, 1898. A modification of the preceding.

670,897. UNIT MULTIPLE SYSTEM OF TRAIN CONTROL; F. C. Esmond. Brooklyn, N. Y. App. filed January 25, 1900. A further modification.

670,898. UNIT MULTIPLE SYSTEM OF TRAIN CONTROL; F. C. Esmond, Brooklyn, N. Y. App. filed April 10, 1900. Another modification.

11,899. (REISSUE) MEANS FOR PROPULSION OF VEHICLES BY ELECTRICITY; F. J. Newman and J. Ledwinka, Chicago, Ill. App. filed December 5, 1899. The vehicle motor is mounted in and combined directly with the driving wheel.

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POWER TRANSMISSION IN UTAH.

The situation in Utah as regards the electrical transmission of power from waterfalls has always been an interesting one from the fact that much pioneer work along that line has been and is being done there. One special point of interest is the running together in parallel of various stations feeding into the same distribution centers, and there is every prospect that this will be done even more extensively in the future than in the past. Parallel running of different stations has also been practiced on a larger scale by the companies centering at Los Angeles.

The Utah water-power plants are, without exception, small as compared to the possible demand for power in that portion of the State in which they are located. The question is not, as often is the case elsewhere, how to find a market for the power developed, as some may have supposed, but how to find power for the waiting market. This fact does not make cut-throat competition necessary among companies in the field, and there is every reason why they should live peaceably together and help each other out to mutual profit. In view of the possible interruptions to the various water power plants, the throwing together in parallel of a number of them greatly increases the reliability of current supply. The plan works well.

Almost without exception the water powers that have been developed in Utah have fallen far short of the minimum capacity figured on when the plants were built. This is a common failing of water powers (or perhaps we should say of the estimates of water-power promoters), but in Utah there were special reasons which could not well be foreseen why the power counted on has not been available. The difficulties lay in the great depth of bedrock, and the consequent impossibility in many locations of getting storage reservoirs that would hold water. The cañons in the Wasatch Mountains seem to be in the nature of immense volcanic cracks into which the streams have washed boulders to a great depth. The seepage of water through these boulders is enormous, and dams which do not go to bedrock lose nearly all their water in this way. The plan now being adopted is to go higher up the streams into the mountain valleys above the volcanically formed cañons and there build a number of low dams for storage purposes. Our special correspondent on the Pacific Coast, Mr. J. R. Cravath, has recently contributed to our pages some very interesting articles on the development of water-power enterprises in the Utah region.

THREE-PHASE MOTORS IN ELECTRIC RAILWAYS.

It is interesting to observe that the Metropolitan Underground Railway, in London, proposes to employ 3000 volts on its working conductors, and that the primary pressure admitted to the three-phase motors, is to be approximately this amount. If this is done in London, which has hitherto been most conservative in regard to pressures employed in working, we may fully expect that 10 kilovolts or more may be employed on electric-traction conductors in this country provided proper safeguards are adopted. It would, probably, be unwise to employ a high pressure in the operation of ordinary trolley lines, but where a separate structure is employed, as in the elevated railway, there seems to be no reason why the motors should not be operated at high primary pressure. If this is accomplished, the cost of conductors becomes comparatively small and the cost of transformers is also greatly reduced. The progress of the London electric railway will certainly be watched with much interest.

It is to be hoped that electric traction may before long become commercially possible without being obliged to generate alternating currents and feed direct current to the motor. No one can examine the standard long-distance American system of electric traction, with its high-tension alternating-current generator and transmission system, its converters and its 550-volt direct-current motors, without feeling that the business of electric traction, on its engineering side, is in a transition state, and that the direct-current equipment is bound to disappear in time. The difficulties have been in the way of controlling the motors efficiently and in maintaining necessary uniformity of pressure in the transmission lines in the absence of storage batteries. Higher electric pressures on the working conductors will partly compensate for the want of storage-battery control, and special alternating-current compensation can no doubt be worked out. As for the motors, their improvement will surely develop when the necessity for obtaining them has to be faced.

EARTH POTENTIAL CURVES FROM CHICAGO, TOLEDO AND COLUMBUS.

Some interesting equipotential curves, drawn for the cities of Chicago, Toledo and Columbus, are printed elsewhere in this issue. They represent the contour lines of electric pressure in the earth under the influence of the electric railway system of current distribution. Unfortunately, the amount of information which can be deduced from such diagrams is practically restricted to the limitations of electric pressure in which a buried conductor will lie when following a given curve through the streets. If the current generated by one of these central stations was distributed with radial uniformity in all directions from the power house, so that along any one radius the delivery at a given distance was substantially the same as along any other radius, then it is evident that the system of equipotential lines would be circles if the conduction of the ground or return circuits was uniform and symmetrical. Consequently, any deviation of the observed equipotential lines from circularity would indicate a difference in the local conductivity of the return circuit. But since the current flow is not radially uniform from such a station but follows the course of certain principal routes of delivery, the equipotential curves could not be expected to have any simple regular form, even if the conductivity of the ground-return circuit were entirely homogeneous. It is interesting to observe, however, that the curves do not seem to indicate that the water of Lake Michigan or of the Maumee River change the shape of the equipotential lines, and if this is correct, it means that the conductivity of the Lake is not materially different from that of the land. If the water conducted either much better or much worse than the land, it would be reasonable to expect that the contour lines would be bent either inwards or outwards from the center of distribution, where the curves encountered the water.

It is by studying the difference of potential produced in cities by trolley systems that an intelligent opinion can be formed as to the danger which exists of producing electrolytic corrosion. As soon as the actual distribution of return pressure is known and can be checked from month to month, it becomes possible to detect the weak points in the return system of conductors and to remove the defects by a judicious expenditure of copper, either in rail bonds or in return feeders. It is interesting to note that though these surveys were undertaken in the interest of a telephone company, they have not been used, notwithstanding some unfavorable showings, as a text for denunciation of the trolley system. On the contrary, Chief Engineer Abbott points out that the situation with respect to electrolytic trouble from return currents furnishes no cause for alarm, merely demanding intelligent attention and the application of well-known remedies when trouble appears.

CONSERVATION OF ENERGY.

We have recently received a printed publication from England which, if it were to be believed, would threaten to revolutionize the existing methods of developing mechanical power from steam; and if that were not sufficient cruelty, would destroy "the modern accepted theory of energy so far as regards its universal application." All this is said to be accomplished by "Poleforcia; a New Power Produced by the Multiple Energizing Momentum Engine," alleged to be connected with the disclosures of no less than seven United States patents already granted.

Pictures of such engines are shown, representing their installation in connection with the Glen Echo Railway, Maryland, in Washington, in Philadelphia, in London and in Paris. According to one statement, one five horse-power engine supplied 227 16-cp incandescent lamps or about 11 kilowatts. According to another statement, the addition of the patented devices to certain steam engines trebled their power without apparently altering the coal consumption, the patented devices consisting seemingly of certain flywheels and mechanical connections. No one will dispute the advantages of momentum in general, and the momentum of engine flywheels in particular for producing useful results in steadying loads and assisting some engines in their work; but engineers will unite in condemning any attempt to claim that momentum can constitute a motive power by which energy can be created.

It seems astounding that in the twentieth century it should be possible so far to impose on credulity as to assert that the modern accepted theory of energy is destroyed by the application of a few flywheels to a driving shaft. Attempts to shake belief in the principle of the conservation of energy, and to suggest that in the way of energy something can be obtained for nothing, are not only immoral, but barbarizing, tending to uncivilize and to destroy those principles for the recognition of which so much human energy and effort have been expended.

ELECTRICAL DEVELOPMENT IN GREAT BRITAIN.

In a paper recently read before the British Institution of Electrical Engineers, Mr. W. L. Madgen made a forcible presentation of the obstacles which beset electrical development in Great Britain. The difficulties appear to arise largely—if, indeed, not altogether—from the manner in which private enterprise is subjected to restrictive legislation bearing on electrical undertakings. The effect has been to place Great Britain far in the rear of this country and the Continent of Europe with respect to electric lighting and electric traction. Mr. Madgen rightly says that there is no occasion for any apology to be offered for this deplorable state on the part of the electrical profession of the United Kingdom, and all acquainted with the circumstances will agree with him that the present backwardness cannot be attributed to any lack of ability or courage, or inventiveness on the part of British engineers. To us on this side of the water it appears almost unbelievable that the development of electric traction in Great Britain has been subject to and controlled largely by obstructive legislation passed in 1870. The onerous provisions of this legislation throttled electric railway development in Great Britain during the period when it was proceeding by leaps and bounds in

America, and it was not until 1896 that an attempt was made to ameliorate some of its provisions. It appears, however, that the measure of relief then afforded is limited in its action to a period of four years, and Mr. Madgen serves warning that unless some further measure of enfranchisement is passed, the country will again be thrown back upon the act of 1870.

In electric lighting, the conditions have been scarcely more favorable in Great Britain. In 1882 an act was passed regulating the supply of electrical energy, the effect of which is described as similarly disastrous to British electrical engineering as a national industry. Until 1888 practically nothing could be done in the way of establishing electrical supply undertakings, and the extent to which development has been retarded by these legislative trammels is shown by the fact that throughout the whole of the United Kingdom, there are only about 250 central stations, while this country has more than 3000. There are now several bills before Parliament to ameliorate the present conditions, and which would have a fair prospect for success were it not that they are meeting with bitter opposition from municipalities. Here we find the crux of the difficulty—the dog-in-the-manger policy of many British municipalities. Fearful of according franchises from which private enterprises might reap large profits, they often either oppose development directly, or indirectly by obtaining authority to establish municipal plants which are never built. Recently it seems that a number of special bills have been passed through Parliament authorizing large electrical supply undertakings, and while these are a step in the right direction, they are far from meeting the general issue. As Mr. Madgen points out, in the case of steam railways, Parliament did not limit participation in their development to particular promoters of bills, but placed the entire matter under general legislation. It is in this direction that relief is now being sought, and the object of the paper read by Mr. Madgen was to enlist support in the cause. The British brethren have our own heartiest good wishes for success in their struggle with the powers of darkness as personified in sundry Government satraps and municipal obstructionists.

Wireless Torpedo Steering.

We note in some recent newspaper articles the renewal of activity in wireless telegraphy for steering dirigible torpedoes. It was Mr. Tesla, we believe, who came forward with a suggestion of this kind during the Spanish war, but until the recent notes of Lieutenant Fiske's projects we had supposed that the proposition had been retired to that limbo of undeveloped devices in which so much of the world's inventive energy has been stored in a form permanently potential. Far be it from us to criticize the scheme with acerbity, and we shall gladly give it publicity when the cruises of the lethal monster shall have ceased to be circumscribed by the modest limits of a bathtub or tank. To all those who are investigating the subject, however, we beg leave to offer a few practical hints which may be of service in their fascinating pursuit. As our readers are doubtless aware, no small amount of inventive skill has been spent in the development of dirigible torpedoes, which, instead of being launched in a straight line at their prey and trusting to the original aim for their chance of working destruction, shall be capable of being steered to their mark by the operator on shore or ship. Of these the Sims-Edison and the Halpin—the latter based upon the Lay torpedo—have been developed to a point of considerable usefulness, the former receiving its driving power over a cable laid by it as it runs, the latter laying merely a light steering cable. A variety of modifications of the idea have been tried, and it is not without the mark to say that at the present time the dirigible torpedo is an extremely ugly customer. It is by no means difficult to build such a torpedo quickly and with comparatively little special work, and the manoeuvering gear is easy of design and construction, following well-known lines of procedure.

The difficulty with such torpedoes lies not in the motive power or mechanism, nor with the need for paying out cable, at least for steering purposes, but in the practical work of the operator. Long before the end of the reel has been reached steering becomes exceedingly difficult on account of the practical impossibility of locating the torpedo itself. Unless the portion of the apparatus which protrudes from the water is not outrageously conspicuous, it becomes very hard to locate accurately from a point near the level of the water before it has gone half a mile, even with a glass. Perhaps the markers can be seen in the chop by persistent attention, but the chance of aligning them and locating them with reference to the mark is very small. At a mile the task is nearly impossible, and in the experiments carried out by the United States Corps of Engineers, such torpedoes have repeatedly run ashore or turned completely around, owing to no failure of the mechanism, but solely to the inability of the operator to see what he was doing. In other words, up to the present the trouble with dirigible torpedoes has been not inability to carry or pay out sufficient cable, nor mechanical imperfection, but the sheer impossibility of seeing well enough to work the thing at any except quite short range. Hence, unless those who deal in etheric vibrations can devise some very radical aids to vision, their inventions cannot make any great change in the status of dirigible torpedoes as such. The new steering agency may, on experience, prove better or worse than a trailing cable—that remains to be seen—but under the limitations due to other causes it must be regarded as an alternative method still subject to the general condition of the art.

Harmonic selective mechanism has not been a very shining success, even when worked over an ordinary electric circuit, and it does not plainly appear how the matter is to be remedied by omitting the conductor. Even in wireless telegraphy, harmonic selection is at present in a rather dubious practical state in spite of the clever work of Slaby and others, and its application to torpedo steering is by no means as simple as the multiplication table. Steering, too, is but a small part of the problem. To be really useful as a weapon such a torpedo must be able to stop and start at the will of the operator, and should, in addition, be capable of reduced speed so as to be kept well in hand until the final spurt. And particularly the operator should be able to explode it at will, so that it may do its work in spite of a necessarily glancing blow, or collision with a yielding net. All these functions to be performed require a fairly comprehensive method of selection and add greatly to the practical difficulty of working by impulses of varying frequency. We shall be greatly interested in seeing the results obtained from the apparatus of recent experimenters, and every month assuredly adds to our knowledge of wireless working; but the torpedo problem is a stiff one. Even if successfully solved, from a technical standpoint, it may fail of military usefulness; but the recent advances in submarine boats tend to weaken the defense by fixed mines, and may add greatly to the practical importance of such weapons as we are here considering. Against sweeping and countermining conducted by boats upon the surface, the rapid firing gun can give a good account of itself, but submarine operations are a very different matter, so that perhaps methods of harbor defence will have to be materially changed. At all events, those who are working for its improvement have our best wishes, albeit their path is a thorny one.

Report of the Massachusetts Board of Gas and Electric Light Commissioners.

The report of the Massachusetts Board of Gas and Electric Light Commissioners for the year ending Dec. 31, 1900, shows that at the end of 1900 there were 76 companies in the State, supplying only electricity, and 23 supplying both gas and electricity. There are also 15 municipal electrical plants and three municipal plants supplying both gas and electricity. Three companies and one municipality were added during the year. One of the plants coming under the supervision of the Commissioners is located at Marion, Iowa, which belongs to a corporation organized under the laws of Massachuseets. Among the companies reported are several which distribute current only to consumers located in the block containing the generating plant.

Among the recommendations of the report is one concerning a statute providing for the testing, under State authority, of electric meters. The proposed consolidation of the Boston Electric Light Company and the Edison Electric Illuminating Company, of Boston, is the subject of critical comment. The original plan was to lease the two corporations for a long term of years to a third organization. The report states that the nature of this third organization, whether it is to be incorporated, or whether it is to be an unincorporated trust, or whether under the laws of Massachusetts or some other State—has not yet transpired. "By the terms of the proposed lease, however, the new organization is to guarantee annual dividends of 10 per cent upon the stock of the first-mentioned company, and 11½ per cent upon the stock of the second during the life of the lease, and to issue at par its preferred shares to the amount of not less than $3,600,000, or 50 per cent of the outstanding stock of the two existing companies, with perhaps common shares to an equal amount in addition. Such an arrangement appears to be in violation of the policy of the Commonwealth, as declared in the well-known anti-stock watering law of 1894, and has a tendency to seriously embarrass, and perhaps wholly defeat the application to these corporations of that wholesome restraint in the public interest which is undoubtedly intended by the present statutes." It is added, however, that no authority exists in the Board to prevent or in any way control combinations of this character, whether effected through the medium of a third organization, corporate or unincorporate, or by contracts between the companies themselves, and the attention of the Legislature is called to this condition of affairs. The consolidation has since been taken up on other lines and approved.

The total income of all the electric light central stations during the year ending June 30, 1900, was $5,678,111.77, an increase of $585,997.87 over the preceding year. The net profit was $2,132,879.25, an increase over the previous year of about $280,000, and the largest in the history of the companies. Three of the companies do not appear to have earned expenses, and 24 others have not earned sufficient to warrant the declaration of dividends. Of the total amount paid for dividends—$724,108.87—the two large Boston companies contributed $498,204, one paying at the rate of 7 and the other at the rate of 8 per cent. Of the other companies one paid 11 per cent, four 8 per cent, two 7 per cent, one 6½ per cent, seven 6 per cent, ten 5 per cent, eight 4 per cent, two 3 per cent, and one 2¼ per cent.

The Cost of Train Lighting.

In the summing up of a most interesting paper on "Train Lighting by Electricity," read before the St. Louis Railway Club, Professor G. D. Shepardson presented some data as to the cost of train lighting, which is given below. The paper was an admirable treatment of the whole subject. The following are the figures he cited:

The report of Pohl (*Archivs fur Post und Teleg.*, 1898; *Elektrotechnische Zeitschrift,* Feb. 24, 1898; vol. 19, p. 121), tabulated the cost of lighting 627 mail cars, whose batteries were charged at nine stations, to be 3.5 pfennig ($0.00875) per hour per 12-candle lamp. He concludes: "Electric lighting costs scarcely more and probably less than gas."

A report by Pohl in 1896 (*L'Electricien*, Aug. 1, 1896), was that gas cost $0.010 per 12-cp lamp per hour, while electricity cost $0.008 for equal light, a saving of 21 per cent; this on the basis of electricity costing $0.04 per kilowatt-hour.

A report on battery-lighted trains between Paris and Lisle gives the cost as $0.0048 per 10-cp lamp-hour (*Railroad Gazette,* 27:611, Sept. 13, 1895).

A report from a road 280 miles long, running out from Adelaide, Australia, with axle-lighting equipments, states that the cost is $18.43 per week, per five-car train, against a previous cost of $20 per week with oil lamps. (*Railroad Review,* 1895; *Western Electrician,* Nov. 23, 1895.)

A report by Buettner (*Elek. Anzeiger*, Aug. 28, 1897; *Engineering Magazine*, August, 1897; *Elec. World,* 30:196), states that gas is cheaper for short runs, while electricity is cheaper for long runs.

A report by New (London *Electrical Engineer,* June 28, 1895), gives a cost of $0.00372 per 17-cp hour on a battery-lighted train in North Staffordshire, England.

A report from the Jura-Simplon Railway (*L'Eclairage Electique,* 12:552-562, 1897), is that the total cost of electric light by storage-battery system is .0031 franc ($0.0006) per 10-cp hour, which must include a misplaced decimal.

Kohlfurst (*Schweiz, Bauzeit.*, March 31, 1900), states that the cost of a 10-car train with 10 candle-power per car, for six hours, is for each 10 candle-power $0.0176 from storage battery, $0.0056 from oil lamp and $0.0026 from axle-driven dynamo.

A report in *Railroad Gazette* (28:519, 1896), gives cost of Pintsch gas as $1.085 per car day, $0.944 for storage battery and $0.55 for oil, on the basis of equal amounts of light.

A report on the Stone axle-lighting system, used in English trains (*Railroad Gazette*, Sept. 16, 1898), gives the cost as $0.00294 per 16-cp hour, including all expenses, which was only one-third the cost to them of Pintsch gas.

Another report from the London, Brighton & South Coast Railway in England (London *Electrician*, 33:69, May 18, 1894), gives as the first cost for equipping a train of 10 coaches (English) including its share of the charging plant: For gas, $3,500; for oil, $600; for axle-lighting system, $2,000. The yearly cost of maintenance is given as: Gas, $600; oil, $350 to $650; axle-driven electric, $250. At the same time they report 15 per cent more work obtained from the electric-lighted trains.

The above figures are simply quoted from published accounts. The writer had not had opportunity to verify or analyze them. The indication is that for equally good illumination the electric light can compete with oil or gas in point of economy, while its general advantages leave it far ahead.

The Language of International Intercourse.

Some day one language will perhaps be freely used in all international intercourse, with perfect understanding by all concerned. Today it is not so, as the subjoined communication will once more prove. It originates in Barcelona, Spain, and has kindly been sent us by an official of a large electrical corporation in this city. On the whole, it shows an idiomatic grasp of English that deserves no small praise, and we trust and believe that some business has been done on the strength of it.

"We confirm you our cablegram and letter of 24th January last, do not doing you a mystery of our great astonishment, because also do not thinking to reply at our cablegram by the same manner, only for a sentiment of duty, you could reply by letter, whilst 15 days after we received nothing at all. After our last letter, we have done a large propagation on your types of machines, expending so time and money, but the high rate of exchange and lower of business on our market have impossibilitate arrangements until now, and only after long pouparlers we obtained the order for which we inquired you by cablegram; you must understood, therefore, that we are very surprised to see that our efforts are not rewarded by a but one reply from you. . . . We hope in any case that your silence will be caused by a reason we must not understand, hoping to hear from you very soon. In this await, we remain."

Trolleys and Homes in Prussia.

The Prussian Government has sent a circular decree to all provincial authorities and to the municipality of Berlin regarding measures to lessen the scarcity of dwellings in Prussia. The decree advises that communities should erect at their own risk cheap dwellings for employees, the laboring population, and persons of relatively small incomes. It also urges electric lines for quicker suburban communication, and mentions a number of legal steps that would hinder excessive real estate speculation, in which it sees a very great danger. Finally, it promises to introduce a bill in the Diet dealing with the whole matter

Speed Variations of Engines Direct-Connected to Alternators—I.

By A. H. Kruesi.

THE subject of this article derives its present importance from the large number of plants of recent date which have been laid down for the generation of electricity in the form of alternating currents, in which the alternators are directly connected to their engines and where, of course, the machines must be electrically connected in parallel, as in the case of direct-current central stations. For example, in New York City alone three stations are now being completed which will contain 31 generators of an average normal output of 3900 kw, or a total of 160,000 hp.

Of the various factors which determine the success of parallel running of alternators, the most important is the degree of uniformity of the speed of the prime mover. By speed here we mean, first, the average velocity from minute to minute, and second, the instantaneous velocity at any and all points in a single revolution.

The average speed will vary with the load of the engine, and is controlled by the governor. It is desirable that it should not be too close, say, in the neighborhood of 2 per cent or 3 per cent at full load, to secure proper division of the total load between the several engines. With direct-current machines the load on any machine may be changed by altering the field excitation, and thus its voltage. In the case of alternators this would only result in a cross current flowing from the armature of the first machine to that of the second, which would magnetize the weaker field and bring its voltage to equality. This cross current being a magnetizing current, is wattless, but nevertheless detrimental. Each alternator will take load in proportion to the power supplied to it, and therefore to divide the load properly, the governor must maintain the speed and power on an equality with the other engines, or, in other words, must alter the cut-off and thus the mean effective pressure. Obviously if the governor is set for very close speed regulation, slight inaccuracies will largely vary the power and an unstable condition ensues, which is magnified by the inherent tendency of all governors to "hunt" or oscillate. This hunting tendency alone may render parallel operation impossible unless corrected by the use of a dash-pot, which yields to a continuously applied force, but prevents any sudden change. A dash-pot developed for this purpose is described and illustrated in the Electrical World* and Engineer of Jan. 20, 1900.

Hunting of the governor, and hence of the power, manifests itself in a synchronizing or motor current between the alternators, whereby the alternator which tends to run ahead accelerates the others and maintains synchronism, but at the expense of a periodic rise and fall of the voltage of the system, and it is easy to see that if the period of these oscillations bears a suitable relation to the natural period of the revolving masses intolerable surging is sure to result and ultimately the machines must fall out of step.

The foregoing difficulties can generally be overcome by the means indicated, but lack of uniformity in angular velocity is not so easily prevented, and is generally far more serious in its effects. In water and steam turbines the forces are uniform for a fixed load, and the speed is sensibly uniform throughout a whole revolution, hence they seldom require consideration on this point, but in any reciprocating engine, whether the working fluid is used expansively or not, the force acting on the crank-pin varies considerably, and hence unless the flywheel has infinite inertia, the velocity must rise and fall during a revolution in the same measure. This variation in crank effort is primarily due to the use of a connecting rod to transform the straight line motion into a rotatory one, so that, however constant the acting forces may be, the crank effort must vary between wide limits.

If the engine has only one crank there will be two impulses per revolution, and the speed will rise, fall, rise and fall again, and unless the piston of each engine begins its stroke at exactly the same instant the rise in speed of one engine will not coincide with that in the other, so that there will be a relative motion between the two alternators to which they are coupled, and therefore a difference in phase between the two units, resulting in a cross-current between the two machines which is only limited in amount by the impedance of the two armatures in series. In Europe it is generally the practice to synchronize both the alternators and the engine cranks, synchronism of the alternators being indicated by the usual lamp or synchronizing voltmeter, while synchronism of the cranks is indicated, for example, by an electric bell circuit, which is only completed when both piston rods press push-buttons simultaneously.

While this suffices for alternators in parallel, it is not sufficient when synchronous motors or rotary converters are to run from the alternators. These machines generally run at high speed, and in any case have large inertia, hence a tendency to maintain uniform speed, and thus run ahead and fall behind their alternators, giving rise to "pumping" or surging of current on the alternating or direct-current sides, or both.

As a result of experience and from considerations of the impedance of the machines, it is found that the total phase displacement between two parallel-connected alternators should not exceed 5 electrical degrees, that is, 2.5 degs. above or below the mean. Since in a two-pole machine one revolution or 360 degs. is equivalent to 360 electrical degrees of phase (Fig. 1), this would mean that in such a machine the total *angular* displacement must not exceed

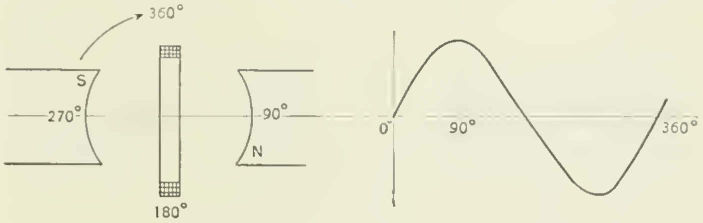

FIG. 1.—DIAGRAM OF TWO-POLE MACHINE AND WAVE.

$$\frac{5^\circ}{360^\circ} \times 360^\circ = 5^\circ$$

or a point on the armature must not advance ahead or fall behind the position it would have at uniform velocity by more than 2.5 degs.

If we assume that the velocity rises and falls in straight lines, the velocity curve with respect to space for a single-crank engine may be roughly represented by Fig. 2, where the speed is high during half an impulse and may have such an average value that the generator passes through 92.5 degs. in phase instead of 90 degs. The ratio $\frac{92.5^\circ}{90^\circ} = 1.0275$, or the *average* increase of velocity is 2.75 per cent, while the maximum variation in such a triangular figure will be seen to be twice this, or 5.5 per cent above the mean. Obviously an engine with two cranks at right angles may have twice this increase in speed, or 11 per cent, and still keep within our limit of 5 degs. displacement, since now the increased velocity occurs during only ⅛ of a revolution or half the time.

This permissible variation of 11 per cent seems large, but it must be remembered that we are dealing with a two-pole machine, which, at a speed of 120 r. p. m., would give only two cycles per second, while the frequencies in common use are 60, 40, or 25 cycles per second, so that a 300-kw machine for 60 cycles, whose engine would run at, say, 150 r. p. m., would have 48 poles, and since the limiting phase displacement remains the same the angular variation will be proportionally reduced; that is, to

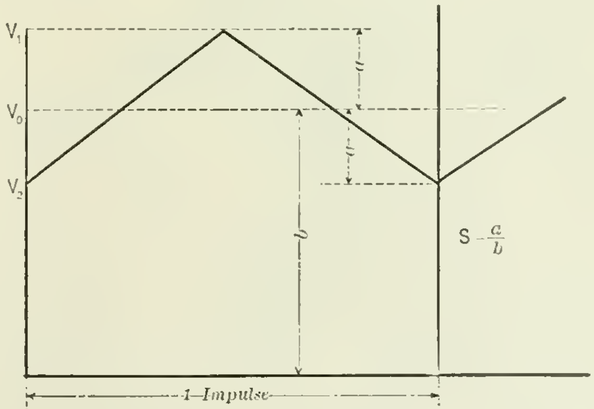

FIG. 2.—VELOCITY CURVE OF SINGLE CRANK ENGINE.

$$\frac{2.5^\circ}{\frac{48}{2}} = .104 \text{ of one degree}$$

and the velocity variation will be in the case of a two-crank engine as follows: $\frac{11\%}{\frac{48}{2}}$ = .46 of 1% above and below the mean for the two engine cranks.

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* See also *Electrical World and Engineer* of April, 7, 1900, page 513.

In general, if p is the number of pairs of poles, we may write:

Permissible velocity variation for single-crank engine........ $\frac{5.5\%}{p}$

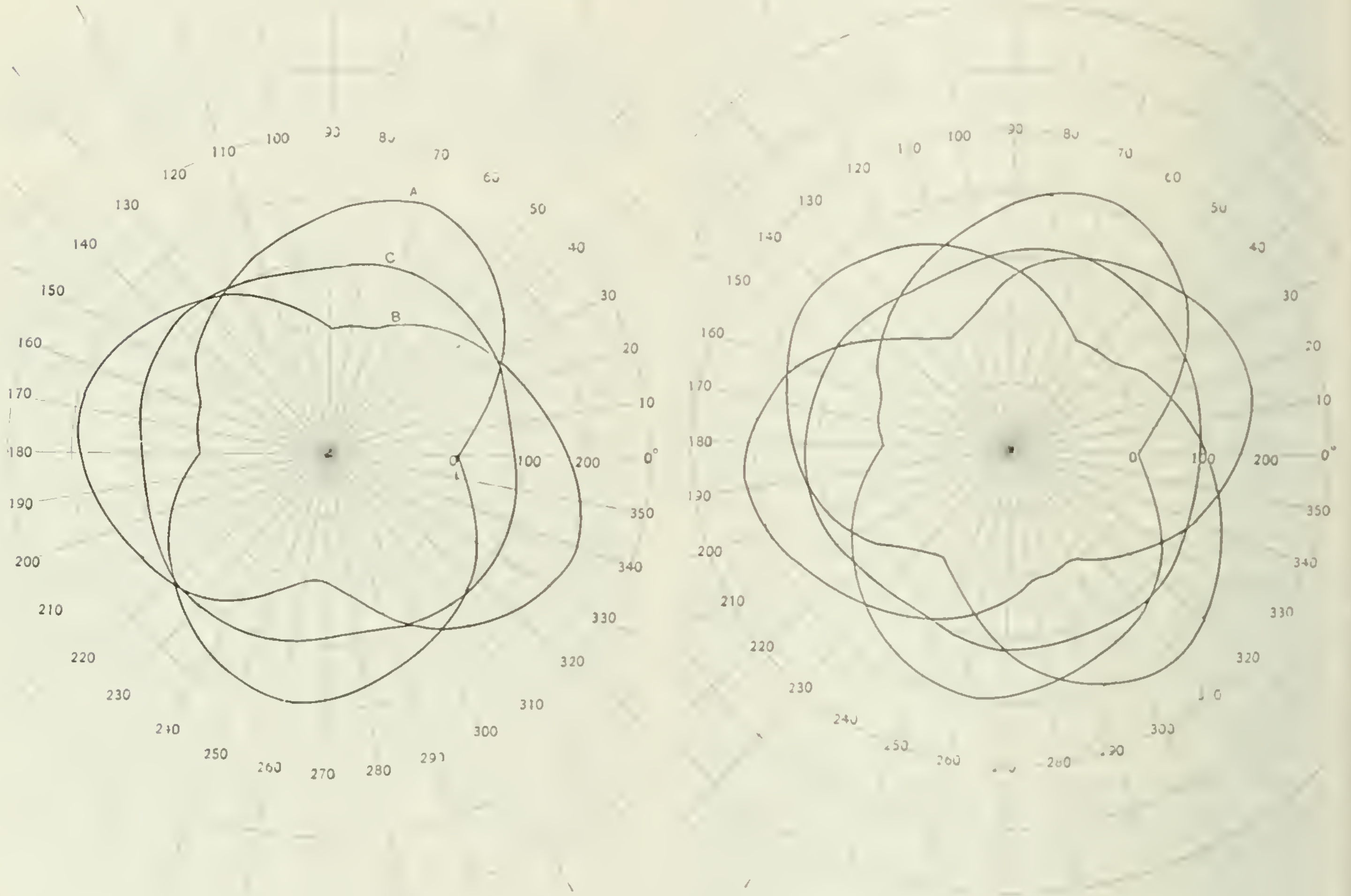
Permissible velocity variation for two cranks at right angles.. $\frac{11\%}{p}$

Permissible velocity variation for three cranks at 120 degs.... $\frac{11\%}{p}$

But it must be remembered that these figures are approximate only, since they are based on an assumed velocity curve made up of straight lines.

The other causes of non-uniform crank effort in a steam engine are:

Steam pressure variable throughout the stroke, due to expansion.



FIGS. 3 AND 4.—CURVES OF IMPRESSED TANGENTIAL EFFORT AT CRANKPINS OF SINGLE-CRANK AND THREE-CRANK ENGINES

Inertia of the reciprocating parts, piston, rod, cross-head, connecting rod, etc.

Weight of reciprocating parts in the case of vertical engines.

The speed of the engine is, of course, a resultant of all these forces, and to calculate the speed curve they must be combined for each crank, and then summed up in the same phase relation as the cranks bear to each other. Thus the variation in effort at each crank being the same (it is usually very different), the variation in the resultant turning moment will vary according to the number of cranks and the angle they make with each other. In Fig. 3 curve A represents the impressed tangential effort at the crank-pin of a certain single-crank tandem compound engine. The coresponding mean effort would be represented by a circle drawn through the point marked 100, and the maximum variation from this has a vector magnitude of 220 at 68 degs., or a variation of 120 per cent. Curve C shows the combined effort if there had been two cranks at right angles, each acted on by forces one-half as great. The mean would still be 100 lbs., but now the maximum variation is only about 10 per cent. The corresponding curves for an engine with three cranks at 120 degs. are given in Fig. 4, and here it will be noted that the maximum variation is about 23 per cent, so that this engine is no better than the two-crank engine, a result which agrees with experience, so that we may write the same equation for the permissible velocity variation, as has already been done above.

CALCULATION OF CRANK EFFORT, VELOCITY AND DISPLACEMENT.

If actual indicator cards are not available they may be calculated in the usual way on suitable assumptions where necessary as to clearance, etc., the expansion and compression curves being taken as rectangular hyperbolas, that is, pv equals constant. The force required to accelerate the reciprocating parts (piston, rod, cross-head and connecting-rod) at the beginning of the stroke and to retard them at the end must then be ascertained. This is simple for those parts which have a straight-line motion, and may be made simple for the connecting-rod by supposing it to be divided into two parts, one having the motion of the cross-head, and the other that of the crank-pin, the latter being neglected in this case, since the acceleration is then only centrifugal and uniform throughout the revolution. If the length of connecting-rod is l, the distance from its center of gravity to crank-pin x, and its weight W, and if we assume the weight $\frac{xW}{l}$, to be concentrated at the cross-head, the error involved is entirely negligible,* aside from the fact that in any case the weight of connecting-rod is small as compared with that of the piston, and roughly we may take one-half the weight of connecting-rod as having the same motion as the cross-head and be on the safe side.

If l = length of connecting-rod in feet (see Fig. 5).
r = radius-crank circle or length crank in feet,
θ = angle of crank from dead-point position,
$M = \frac{r}{l}$ = ratio crank length to connecting-rod, and
n = r. p. m.,

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* Perry: The Steam Engine, pp. 534 550.

the acceleration* at any point is, accurately,

$$a = \frac{-4\pi^2 n^2 r}{3600}\left\{\cos\theta + \left(\frac{m\cos 2\theta + m^3\sin^4\theta}{(1-m^2\sin^2\theta)^{\frac{3}{2}}}\right)\right\} \tag{1}$$

in feet per second per second.

And the position of the piston is given for any angle θ accurately by the equation:

$$X = r\cos\theta - l\left\{1-\sqrt{1-\frac{r^2}{l^2}\sin^2\theta}\right\}$$

Where X is the distance to the left of the middle of the stroke, or with sufficient exactness, if l is not less than five times r by

$$X = r\cos\theta - \frac{r^2}{4l}(1-\cos 2\theta)$$

A curve of accelerative forces for both strokes may be calculated by equation (1), remembering that the value of a will be the same for any two values of θ equally distant from 0 deg., or 180 degs. (*e. g.*, a has the same numerical value for 30 degs. and 330 degs.), but it is often sufficient to draw a curve through three points easily determined as follows, or a graphical method, such as Klein's,* Perry's† or Kennedy's‡ may be used.

Substituting $\theta = 0$ deg. and $\theta = 180$ degs. in equation (1), we get§.

$$\left.\begin{aligned}\text{For } \theta = 0,\ a &= \frac{4\pi^2 n^2 r}{3600}\left(1+\frac{r}{l}\right)\\ \text{For } \theta = 180^\circ,\ a &= \frac{4\pi^2 n^2 r}{3600}\left(1-\frac{r}{l}\right)\end{aligned}\right\}\ \text{or } a = \frac{v^2}{r}\left(1 \pm \frac{r}{l}\right)$$

$$\text{For } \theta = 90^\circ,\ a = \frac{4\pi^2 n^2 r}{3600} \div \sqrt{l^2-r^2} = \frac{v^2}{\sqrt{l^2-r^2}}$$

And for this angle the piston is the distance $l - \sqrt{l^2-r^2}$ to the right of its mid-stroke. Or we may as easily find the point at which the velocity is a maximum; that is, where the acceleration is zero and changes sign, which is near 90 degs. and is given by the equation,

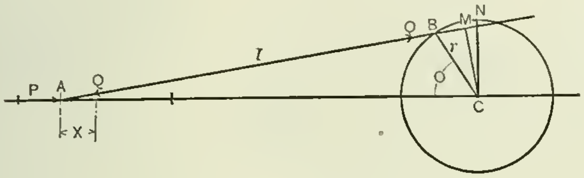


FIG. 5.—CRANK DIAGRAM.

$$\sin^6\theta - \frac{\sin^4\theta}{m^2} - \frac{\sin^2\theta}{m^4} + \frac{1}{m^4} = 0$$

The value of θ which satisfies this equation has been plotted¶ in Fig. 5, so that the angle corresponding to zero acceleration may be read directly therefrom, for any ratio of connecting-rod to crank.

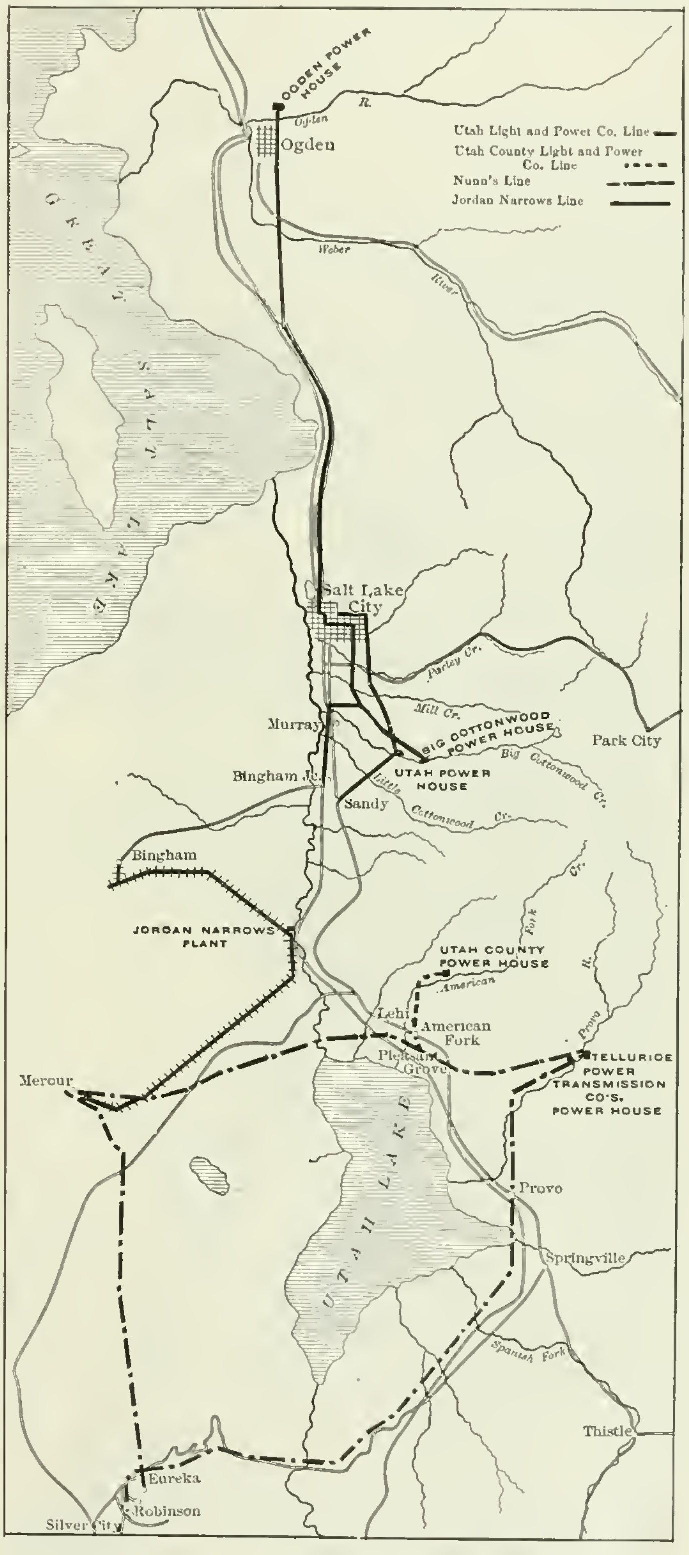
The force (in pounds) required for acceleration is found from the relation $F = ma = \frac{Wa}{32.2}$, and this is conveniently reduced to pounds pressure per square inch of piston, and plotted with the indicator diagram in order to find the resultant effort at the cross-head.

Electricity on the Stage.

A theater electrician, Mr. P. C. Armstrong, has originated a stage effect, known as the "electric ballet," which has been very favorably received by the audiences before which it has been produced. From the center of the stage garlands of electric light depend, the lower ends being fastened at the back and sides of the stage so as to provide a tentlike effect. Each dancer holds a lamp-illuminated string of roses, the upper end of which is secured to a revolvable pendant proceeding from the apex of the tent, these strings corresponding to the banners of a Maypole. The costumes of the dancers are completely wired and each costume contains seven sets of lamps. The wires leading from the costumes are concealed in the strings of roses, and at the top of the stage are connected to a commutator from which leads are taken to a switchboard like a piano keyboard.

Power Transmission Lines in Utah.

The accompanying map shows the extent of the high-tension transmission lines now in operation in Utah. All these plants obtain their water power from the mountain streams of the Wasatch range, which bounds the fertile Salt Lake Valley on the east. The 105 miles of system of 40,000-volt three-phase circuit belonging to the Telluride Power Transmission Company, was described in the Electrical World and Engineer of Feb. 23, 1901, page 307. This company occupies the southernmost portion of the district shown by the map. Its transmission line completely encircles Utah Lake. The principal part of its business is supplying power to the mines at Mercur and Eureka, and it also lights all the villages along the line. Next, north of this, is the Utah County Power Company, which is a small concern supplying light to Lehi and American Fork. The Jordan Narrows plant has lines to Bingham and Mercur. Cen-



MAP OF HIGH-TENSION TRANSMISSION LINES IN UTAH.

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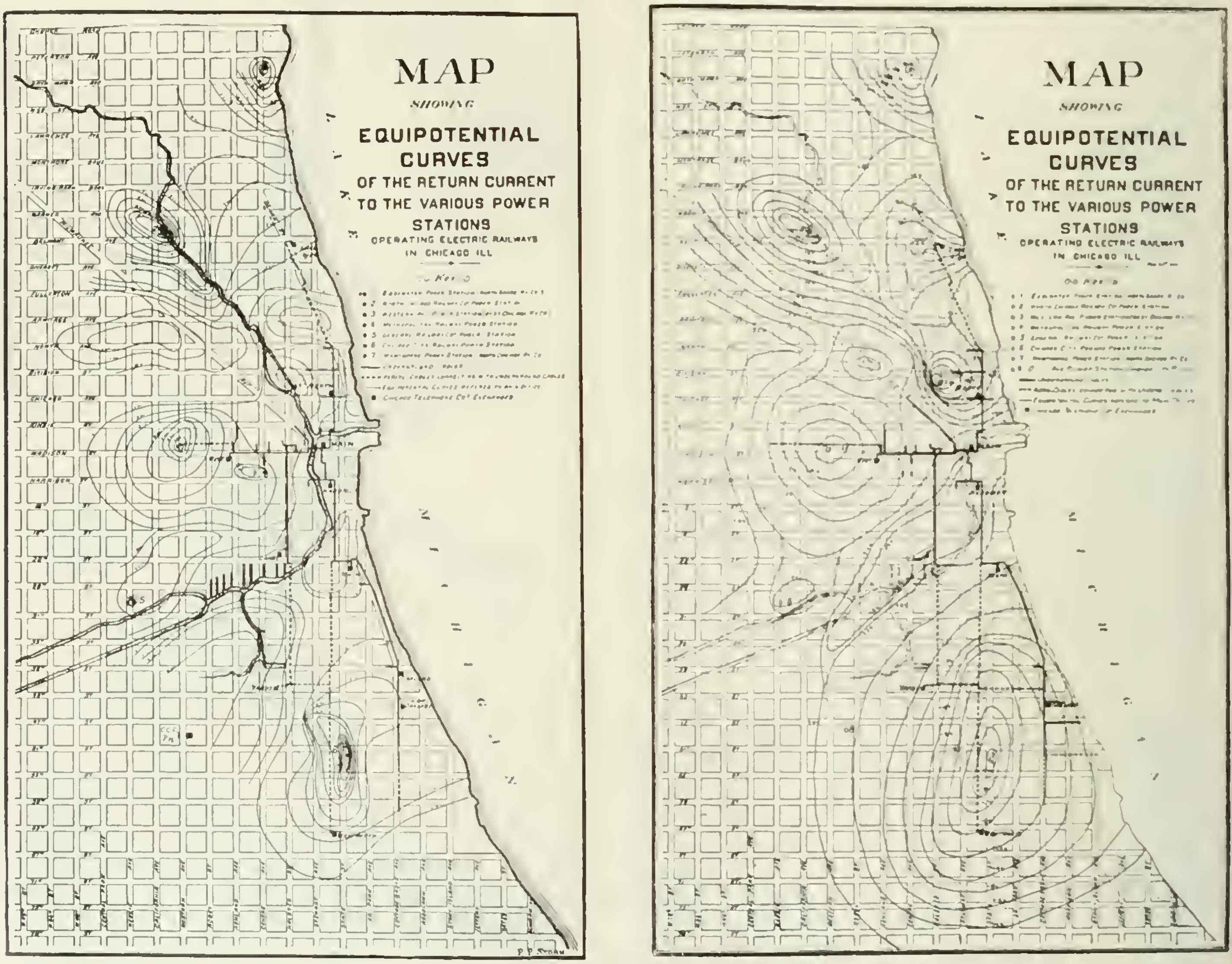
* Perry: The Steam Engine, p. 543.
* Ewing: The Steam Engine and Other Heat Engines, p. 315, second edition.
† Perry: The Steam Engine, p. 538.
‡ Kennedy: The Mechanics of Machinery, pp. 105-200.
§ Perry: Page 543.
¶ Numerical values from Ewing.

tering in Salt Lake is the large system controlled by the Utah Light & Power Company, which has two plants in the Big Cottonwood Cañon feeding into Salt Lake City over two different 10,000-volt lines, and supplying power service at points south of the city. Feeding into Salt Lake City from the north is the 16,000-volt line from the Ogden power house, which power house also supplies Ogden. The Ogden plant and the Big Cottonwood plant are operated in synchronism through the 2300-volt secondary circuits at Salt Lake City, and this work has also lately been described in the pages of this journal.

Earth Potential Curves from Chicago, Toledo and Columbus.

At the meeting of the Chicago Electrical Association, March 15, 1901, A. V. Abbott, chief engineer of the Chicago Telephone Company, gave a very interesting lecture on the subject, "The Electrical Conditions of Chicago," the electrical conditions referred to in the subject being the electrical conditions of the earth in that city. Mr. Abbott's method of investigating the potential of the earth is more thorough and scientific than many of those heretofore followed, and his position as chief engineer of the Chicago Telephone Company, for which the investigations were made, enables him to obtain more complete information as to earth potentials in that city than would be available to any one else. The telephone system of a large city with its wires running to every part of the city offers a chance to obtain the potential of the earth at different points not afforded by anything else. In addition to the results of an electrical survey of Chicago, Mr. Abbott also showed maps prepared in a similar way by S. G. McMeen, chief engineer of the Central Union Telephone Company, for Columbus and Toledo, Ohio.



FIGS. 1 AND 2.—EQUIPOTENTIAL CURVES IN CHICAGO PLOTTED RECENTLY AND IN 1897.

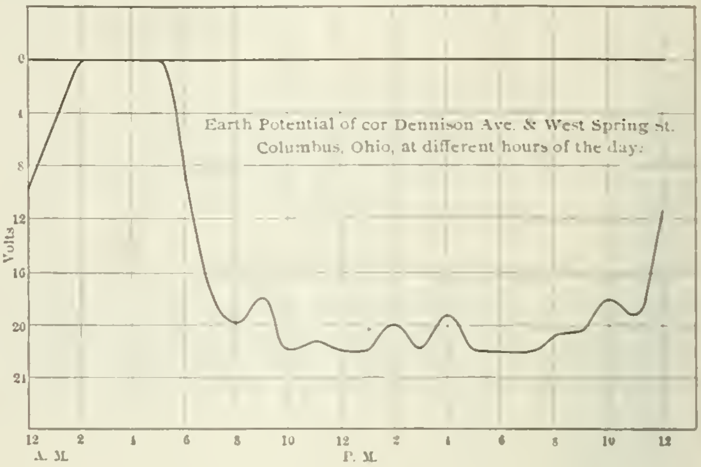


FIG. 3.—CURVE SHOWING VARIATION OF EARTH POTENTIAL.

Mr. Abbott's method is to measure the potential of the earth at different points over the city as compared to some central point. In the case of Chicago, the central point from which all earth potentials were measured was the corner of State and Madison Streets. By utilizing a telephone line grounded at the corner of State and Madison Streets and running from there to the point to be measured, the difference of earth potential between the two points could be measured with a low reading voltmeter—the telephone line serving as a voltmeter lead. In most cases the grounds used were waterpipe connections. After voltmeter readings had been taken in this way all over the city it was possible to plot such a map as shown in Fig. 1. In this map all the points which were at the same relative potential have a line drawn through them constituting an equipotential curve.

On the completed map, the electric railway power houses from a series of "electrical hollows" to use Mr. Abbott's expression, and the outer lines correspond to the "electrical high ground." A map of this kind gives a much more complete knowledge of the electrical conditions in a city than a series of readings between waterpipes and rails, or anything of that kind. By the inspection of such a map the electrolytic danger to a cable or any other conductor cutting various equipotential lines can be seen at a glance, and the proper precautions taken to prevent it. It may be said here as evidence that electrolysis is not by any means the bugbear that it has sometimes been made out to be, that although Mr. Abbott is connected with a company that is likely to be harmed by electrolysis as much as any, he does not consider there is anything to be alarmed about in connection with electrolysis, but that it must simply be intelligently watched like anything else, and the proper steps taken at the proper time to prevent its action. There has never been any serious trouble in Chicago. The remedy is simple, and lies in good bonding and return circuits, and in making such connections as will reduce the difference of potential at places where electrolysis is possible. In addition to the recent map (Fig. 1), a map made in 1897 (Fig. 2), was shown, which compared with Fig. 1, gives the difference of conditions in four years. In both these maps only the streets on the half section lines, one-half mile apart, are shown. The distances can be measured from them with this in mind. Fig. 4 is a map of Toledo, Ohio, prepared in a similar way, and Fig. 5 is the Columbus situation. In all of these maps the relative voltages to which the lead cable covering is exposed can be quickly seen. To determine the variation of earth potential at different hours of the day with the traffic on the electric road, the curve in Fig. 3 was plotted. It shows the earth potential at the point of reference for 24 hours at a certain corner in Columbus. Such investigations are of value to all companies concerned, and should be made in all cities.

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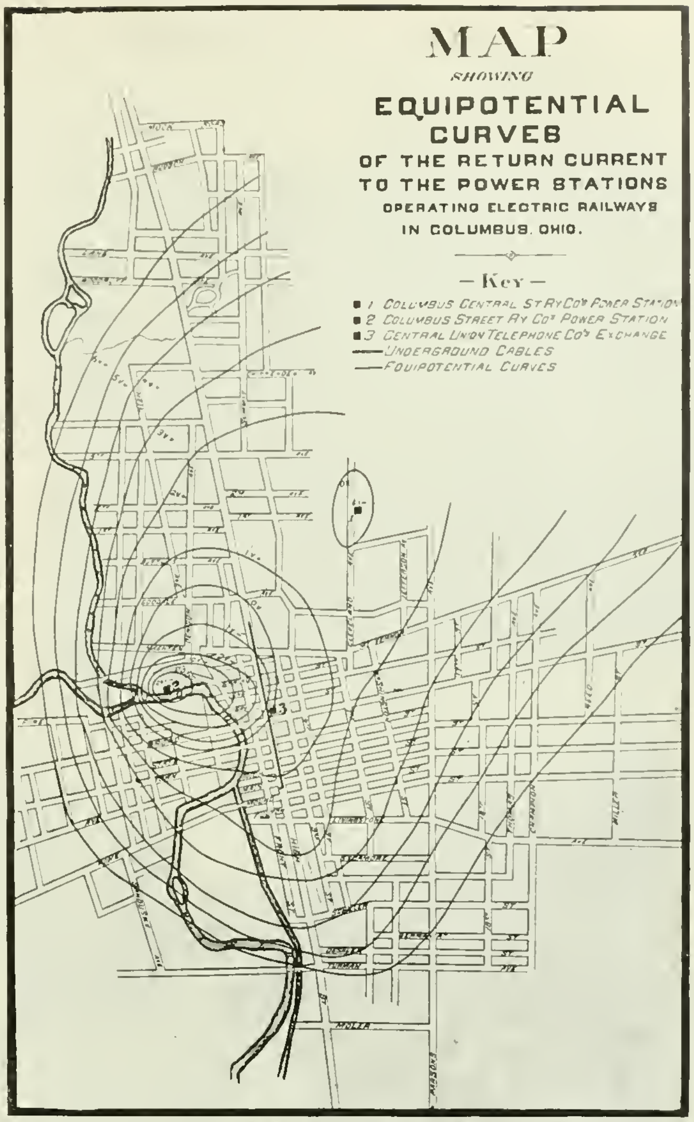
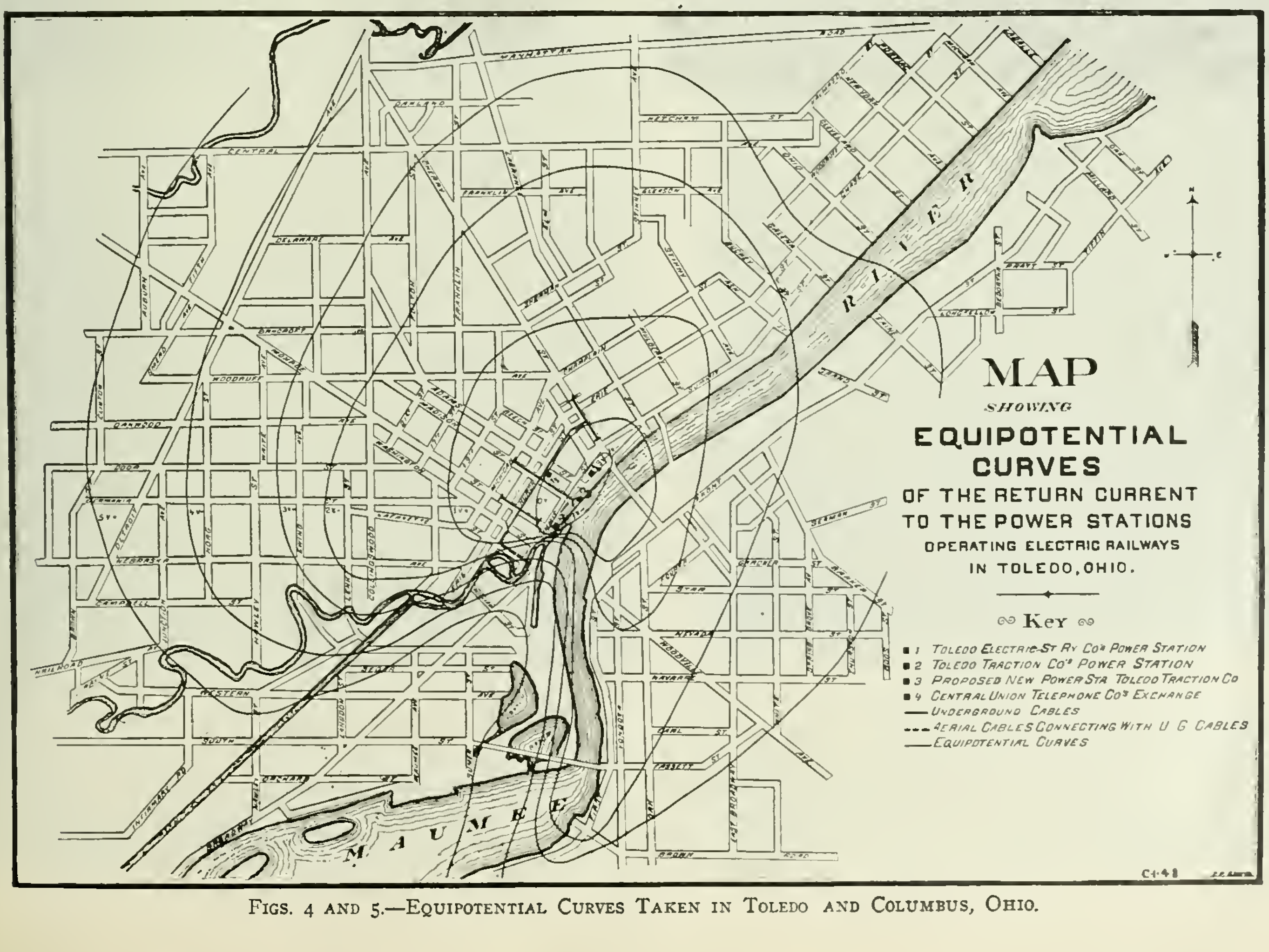
Telephone at Public Expense.

A bill has been introduced in the Minnesota House of Representatives providing for the construction of a State telephone system at public expense, to be extended over the entire State and connected with every business place, residence, town hall, school house and church.


MAP
SHOWING
EQUIPOTENTIAL
CURVES
OF THE RETURN CURRENT
TO THE POWER STATIONS
OPERATING ELECTRIC RAILWAYS
IN COLUMBUS. OHIO.
— Key —
■ 1 Columbus Central St Ry Co's Power Station
■ 2 Columbus Street Ry Co's Power Station
■ 3 Central Union Telephone Co's Exchange
Underground Cables
Equipotential Curves
1
2
3


MAP
SHOWING
EQUIPOTENTIAL
CURVES
OF THE RETURN CURRENT
TO THE POWER STATIONS
OPERATING ELECTRIC RAILWAYS
IN TOLEDO, OHIO.
Key
■ 1 Toledo Electric St Ry Co's Power Station
■ 2 Toledo Traction Co's Power Station
■ 3 Proposed New Power Sta Toledo Traction Co
■ 4 Central Union Telephone Co's Exchange
Underground Cables
Aerial Cables Connecting With U G Cables
Equipotential Curves
RIVER
MAUMEE
C+4 1

Figs. 4 and 5.—Equipotential Curves Taken in Toledo and Columbus, Ohio.

Work on the New York Underground.

From time to time attention has been called in these columns to the large amount of work which is being done in New York City on the rapid transit tunnel, which in a few years is to furnish New Yorkers with underground electric railroad service. The route of this road will traverse Manhattan Island from south to north, and on the west side of the city will follow Broadway from Forty-second up to Washington Heights and Fort George. At the upper end of Central Park a branch will run eastward across the Harlem River to Bronx Park. The subway at some places is near the surface, and at others will go very deep, so that elevators will be necessary. The elevator stations will lie apparently at the extreme end of the road at Manhattan Valley. The entrances to most of the stations will be generally 14 ft. above the tracks. As a matter of fact, the road will be partly subway and partly tunnel, but the whole structure will be light and airy, being lined with white tile and glazed brick or painted white. As is well known, the motive power of the road as well as its lighting is to be electrical, so that there will be nothing to dim or blacken the pristine whiteness of the structure, while electric fans will also asist in the ventilation of the subterranean portions of the line.

VIEW OF WORK ON THE NEW YORK UNDERGROUND ROAD.

The view given here illustrates the character of the work in one of the uptown sections of the road, and it will be remembered that a month or two ago we illustrated in these columns the manner in which an overhead electric cableway was employed to operate the buckets removing rock and dirt from the excavations. A motor with a cage carrying the operator travels up and down the cable, raising or lowering the buckets. There is, however, a good deal less use of electricity in connection with the work of drilling and excavating than might have been expected, and it is believed that electricity could have been employed to advantage for expediting the work. In several places throughout the city the excavations parallel or underlie the electric street railways, but so far very little interruption has attended such work. At several points along the track temporary bridges have had to be constructed for carrying the conduit cars across the holes caused by the subway excavations. The magnitude of the operations can be best judged from the work at such points as 136th Street, not far from where the illustration was taken, and where the elevated structure over Manhattan Valley will connect the two subways. No fewer than five rows of steel columns are to be noted there, providing the divisions for the two outer tracks for the local service and the two middle tracks to be occupied exclusively by express traffic.

Anglo-Pacific Cable.

The cable steamer Quadra, which made a survey of the British Columbia coast for a landing for the Pacific cable, has returned to Victoria, B. C. It is understood that a more favorable place for landing than that at San Juan was found in Barclay Sound, and that the cable station will be in Alberni. Engineer Peake left Australia by the steamer Miowera on April 4 to select a landing place in the Southern colonies.

New Bell Telephone Common Battery Exchange, Newark, N. J.

THE advance of the common battery system in the Atlantic Seaboard States is now quite rapid, and cities below the first and second class are being added to those like Greater New York, where the system has already been adopted for the Borough of Manhattan by the New York Telephone Company and for the Borough of Brooklyn, by the New York & New Jersey Telephone Company. The latter progressive corporation has now carried this improvement into its New Jersey territory, and has equipped its Market Street, Newark, office with a fine modern plant, and modeled quite closely after the superb installation in the Willoughby "main" exchange in Brooklyn. The aim of the company is to so standardize and harmonize its system that the "talking" with be equally good at every point.

As already noted, the new Newark exchange is of the common battery type, which need not here be again discussed. The exchange building is a fine six-story and basement structure, of Perth Amboy terra cotta, with a frontage of 50 ft. on Market Street. There are 75 pipes at the cable entry, and scores of cables have been brought in, some of them being 200 metallic circuit. These cables terminate at a distributing rack, which at present accommodates 6000 wires or 3000 circuits. The generating plant is provided with two sources of power and two separate generators. In the cellar of the building have been placed an adequate gas engine belted to a Western Electric generator. On the third floor of the telephone building, adjacent to the power switchboard, is another Western Electric generator coupled to a motor of the same make. Either generator can be used to charge the storage batteries, which are directly employed in the operation of the exchange. These batteries consist of 11 type G17, chloride accumulators, which deliver current at a pressure of 24 volts. Two ringing current motor generators, equipped with tone test and busy back attachments, are driven by the accumulators. The storage batteries are conveniently grouped and inclosed in a large cabinet, so arranged that the batteries are accessible for inspection at any moment.

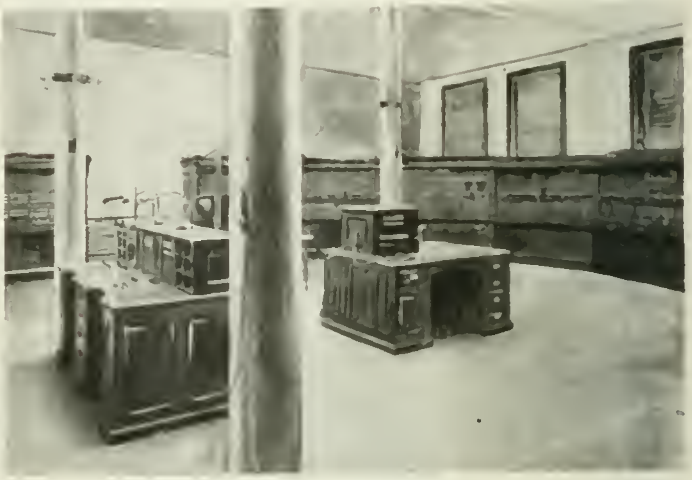


FIG. 1.—OPERATING ROOM AND SWITCHBOARD.

On the third floor of the building is also located the intermediate distributing rack, which supplements the main distributing rack, located on the second floor, and enables the central office manager to further assort and classify the work to be done by the individual operators. Each circuit, after leaving the intermediate rack, passes in cables along the back of the switchboard throughout its length. At each section, forming three operators' positions, the circuit is connected or bridged to a spring-jack, in order that every operator may have within reach every subscriber's circuit in the exchange.

Another set of cables starting out from the intermediate rack and carrying the same circuit throughout the board terminates them in groups at the operators' positions, where are located the answering jacks and the corresponding signal lamps. The board in the operating-room is equipped for 3000 subscriber circuits and 225 trunk circuits, and has an ultimate capacity, it is said, of 5000 circuits. The fitting up of this room with the apparatus to operate it and to supply circuits, etc., and the equipping of the main and toll boards and desks of the manager and chief operator, monitors, etc., required over six months' constant labor. The board contains 35,500 spring-jacks, 4691 lamps, 7 miles of cable, aggregating, it is said, over 450 miles of wire, and a total of 498,611 soldered joints, distributing over the main and intermediate rack, relay and coil racks, switchboards and desks.

As far as possible the various classes of service are grouped in the board, and there are eight distinctive kinds of lines, which are known as message rate, direct line; pay station, direct line; message rate, party line; pay station, party line; flat rate, direct line; flat rate, party line; automatic pay station line, and message rate and pay station party line. These different classes of service all require different methods in detail of handling, and so far as possible lines requiring the same class of service are grouped together on the same board.

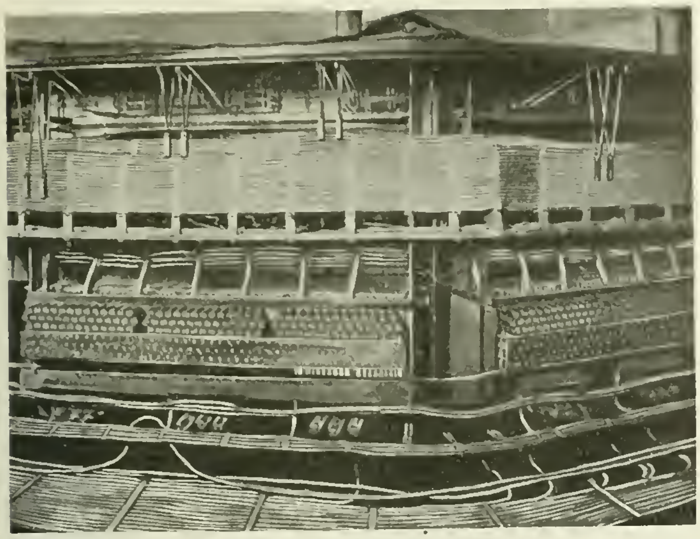


FIG. 2.—BACK OF SWITCHBOARD.

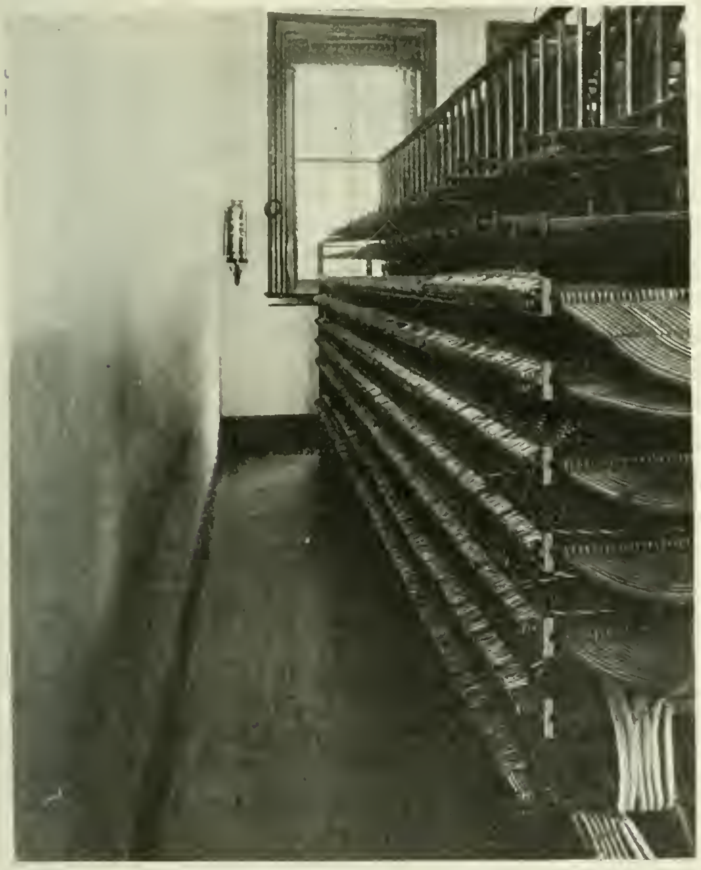


FIG. 3.—INTERMEDIATE DISTRIBUTING RACK.

In the Newark office alone some 30,000 connections a day of all classes are handled.

In Newark there are connected with the New York & New Jersey Company's system some 30 branch exchanges in office buildings, stores, etc., some of which have from 5 to 50 stations, and under the new arrangements these can reach a party through the intervening private branch board, and "central" even quicker than two parties could be brought together without such exchanges through the old distributed energy multiple boards. The operating room in question requires some 50 operators in continuous service, or about 100 all told for the various watches. The building also furnishes accommodation to at least as many more of the several hundred employees required by the company for the efficient operation of its growing system, which extends from Montauk Point, Long Island, far down the Atlantic seaboard and around the Hudson and the Passaic, throughout which region its network of metallic circuits are run. It will be understood that in such a territory the work varies greatly, including, as it does, the long stretch of seacoast to which in summer so large a proportion of well-to-do people resort from all over the country. Just now the Jersey coast as it awakens from its winter torpor, gives evidence of activity, chiefly in its use of the telephone, which will now be kept busy until late next fall.

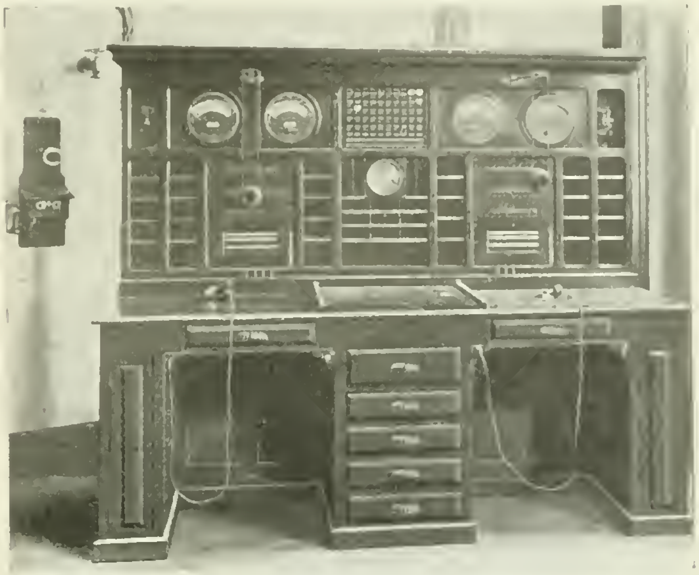


FIG. 4.—WIRE CHIEF'S DESK.

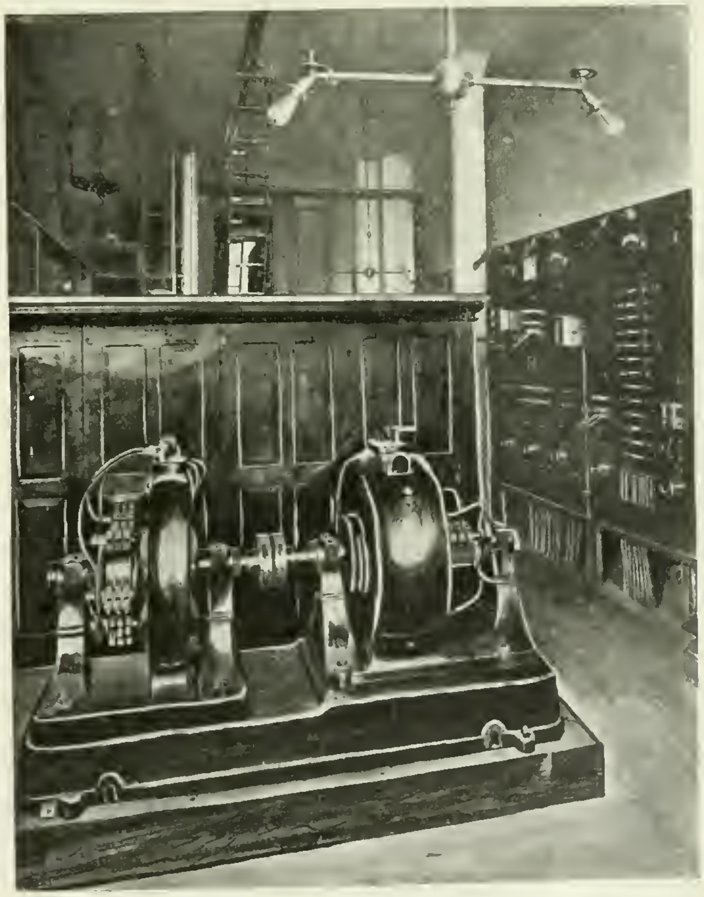


FIG. 5.—POWER PLANT.

Improved Fac-simile Telegraph Apparatus.

One of the earliest applications of electricity to utilitarian ends is the so-called "fac-simile telegraph," which has for its purpose the transmission and reproduction at a distance of pictures, designs, etc. It was an offshoot of that epoch-making invention—the telegraph—and the records show that the earliest attempts to reduce the conception to a practical basis was in 1850. In that year Mr. F. C. Bakewell, of London, brought out a machine to transmit the actual handwriting of messages, and the illustration of the instrument shows that, in its general features, it had a remarkably striking resemblance to the most improved machine of to-day. This invention was followed by the chemical copying telegraph of Cros, of Paris, and later on, in 1857, Abbe Caselli constructed a working model of an electro-chemical copying telegraph. In 1865 this apparatus was practically used both in France and Russia, and some very satisfactory results were obtained between Paris and Lyons. It is unnecessary to go into the details of construction and operation of the machine, further than to state that the principle involved was that of moving the stylus over the message with a reciprocating motion. The Bakewell instrument, however, embodied most of the essential features of the modern machines. The message or picture was attached to the surface of a cylinder which revolved under a laterally moving stylus, and the message was received in a like manner, the record being made on chemical paper.

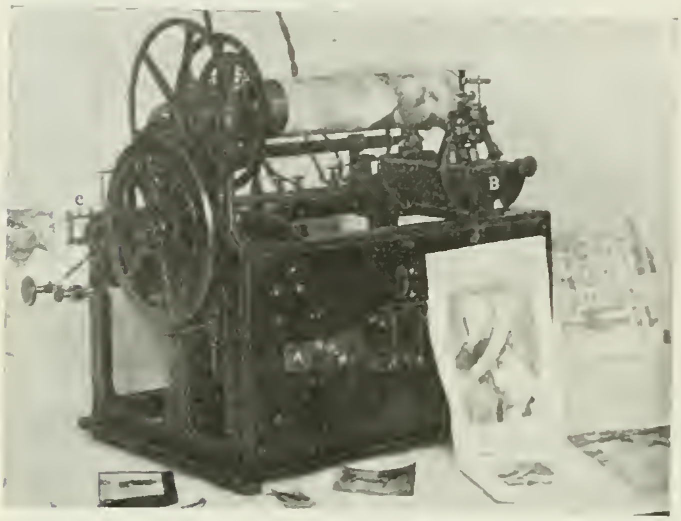


FIG. 1.—PICTURE TELEGRAPH MACHINE.

Other inventors after Caselli attacked the problem, with more or less successful results, but all of the systems possessed the common fault of being too slow in operation.

The development of the art of newspaper illustrating has in late years stimulated inventors to renewed attempts to devise a practical machine for transmitting pictures over a wire. The large dailies would welcome such a device, as it would enable them to illustrate the most important events reported to them by telegraph.

The weak point of the previous systems, as before stated, was their slow rate of transmission. This has been the point of attack by all later inventors, and how some of them have succeeded has been recorded in these pages.*

The requirements of the large newspapers, however, do not seem to have been fully met in the most recent inventions. The cry of the editor is still: "We want faster machines," and the echo "Faster machines" ringing in the ears of the inventor has spurred him on to greater efforts to satisfy the demands upon his ingenuity.

The most recent development in this line is the machine of Mr. H. R. Palmer, M. E., and Mr. T. Mills. This apparatus is now being brought to public notice and is attracting the attention of some of the most prominent daily newspapers. It has been practically tested between Cleveland and St. Louis on the wires of the Associated Press, with, we are informed, satisfactory results. The machine will be exhibited in practical operation at the Pan-American Exposition this year. It is controlled by the International Electrograph Company, of Cleveland, Ohio, of which Mr. Palmer is president.

The illustration (Fig. 1) shows one of the machines and represents either the transmitter or the receiver, since one is an exact counterpart of the other, with the single exception that in the transmitter, a stylus replaces the pen in the receiver. Both of these parts, however, are interchangeable, so that one machine may be used as a transmitter or a receiver.

This machine is said to be the only one ever developed which will transmit half-tone pictures. In accomplishing this result the original photograph or sketch is up to a certain point treated practically in the same manner as a regular half-tone engraving for printing purposes.

In the final preparation the zinc plate for the transmitting machine, the small spaces or depressions on the surface, due to the etching bath, are filled with an insulating substance, to give a smooth surface for the stylus to pass over. The plate is then bent to the curve of the cylinder of the transmitter and locked in place. The entire time required in the preparation of the plate is about 25 minutes. In transmitting, the cylinder revolves, and the stylus, which is actuated by means of screws of 40 or 80 threads to the inch, as desired, moves in a direction parallel to the axis of the cylinder. As the plate passes under the stylus the circuit is made and broken by the succession of insulated and uninsulated surfaces of the plate. The impulses thus sent over the line are recorded on the receiving cylinder by a pen which is operated in the same manner as the stylus. It is evident from the relative motions of the cylinders and stylus and pen that in effect the transmission and reproduction of the picture are in the form of a spiral line of small pitch. This line is broken up in a manner corresponding with the lights and shades of the original, and as both machines work in synchronism the recorded marks must necessarily correspond with the metal surfaces on the transmitting cylinder which caused them to be made, thus the pictures are built up by parallel lines. Eighty-seven impulses per second are imparted to the pen, which records a dot for each impulse.

The machines which have been on exhibition at the Astor House in this city for the past few days, are operated by Lundell 110-volt motors, each of 1/8 horse-power, running at 3400 r p. m. By means of gears the speed of the cylinder is reduced to 40 r. p. m. The receiving pen is actuated by an electromagnet, consisting of W. U. standard 150-ohm coils, at *B* (Fig. 1), the synchronizing device being similarly controlled by another pair of magnets at *C*, but not visible in the cut. The synchronizing is effected by sending an impulse through the latter magnets at a certain portion of each revolution of the cylinder, during which time the pen magnets are cut out of circuit. The synchronizing impulse, which originates at the transmitter, causes a small friction brake to be applied to the flywheel,

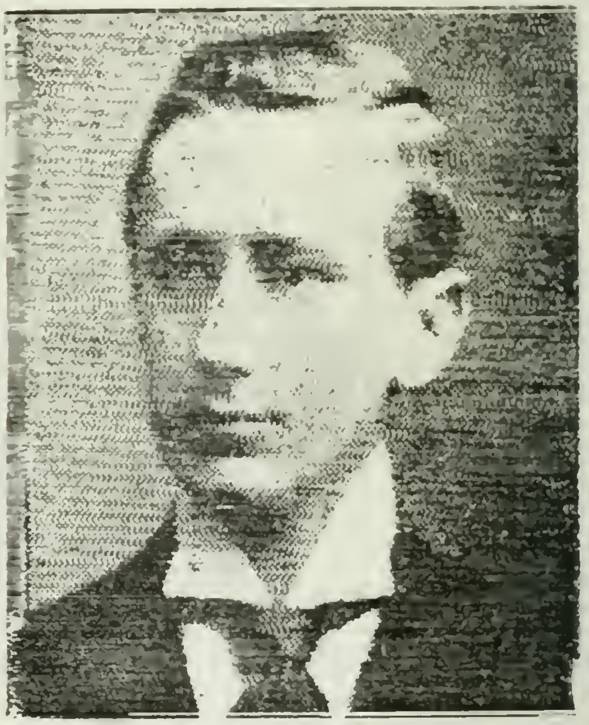


FIG. 2.—EXAMPLE OF RECEIVED PORTRAIT.

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*See Electrical World and Engineer of May 6, 1899, p. 581, and Feb. 17, 1900, p. 247.

some of the motion of the latter being thus imparted to a secondary mechanism which brings the cylinder into synchronism in case it gets out of step. The possibility of getting out of synchronism, however, is very remote, since synchronism takes place at every revolution of the cylinder, and this posibility is further reduced by the fact that the ratio of the speed of the cylinder to that of the motor is so large that it would require considerable variation in the speed of the motor to make any perceptible change in the speed of the cylinder in one revolution. In practice, however, it has been found rather an advantage not to have the machines in exact synchronism. When they exactly correspond there is a tendency to see-saw, which is obviated by retarding one of the machines slightly so as to insure both starting each revolution at the same instant, irrespective of their relative motions at the end of the revolution. By turning the switch *A* (Fig. 1) to a vertical position and substituting a stylus for the pen, the machine may be used as a transmitter.

Fig. 2 shows a reproduction of a picture of Mr. Marconi, which was received in the presence of a representative of the Electrical World and Engineer in about ten minutes. The cut was not reduced to the size of the original photograph, hence it appears somewhat "ragged" on the edges. It has not been retouched or "doctored" in any way.

The inventor of this machine does not make any claim for any new principles, but rather to improvements which enable him to reproduce half-tone pictures and to reproduce pictures at a much greater speed than has hitherto been possible—both considerations of prime importance to the modern daily newspaper.

The Slide Rule Adapted for Wiring Calculations.

By Geo. N. Tidd.

It is a surprising fact that the merits of the ordinary slide rule are so little recognized, and the instrument not more universally used, which no doubt is due, in a great measure, to lack of appreciation of the instrument, as well as the supposition that the operator must be an expert mathematician to use it.

The adaptability of the rule to all engineering problems is well known, but in no wise is it better exemplified than in the ordinary wiring calculations. There are many ingenious tables extant for this class of work, but I believe there are few, if any, which are handier than the ordinary slide rule with the wire gauge scale added.

We simply lay out between the "B" and "C" scale of the rule (the Faber 10-inch), upon the slide the diameter in mils corresponding to a given gauge number, and also below the "D" scale upon the stock of the instrument. These are inked in every two sizes from No. 0000 to No. 10, they being the practical sizes mostly used. Every gauge number of the table could be so laid out, but for ordinary work this is unnecessary. These additions, of course, interfere in no way with the ordinary use of the rule. The following examples will show in a measure the value of the wire table as added:

First, given the gauge number to find diameter in mils. This is determined by placing runner to the gauge number, or simply finding the gauge number, and corresponding to it will be its diameter in mils. Conversely, given the diameter in mils to find the size, we glance along the scale until we find the diameter, and corresponding to it will be found its gauge number or the one nearest.

We are concerned, however, in most calculations with the area in circular mils. This is easily secured by simply bringing the runner line to the given gauge number upon stock, and reading the result on "A" or "B" scale; or vice-versa, given the area in circular mils to find the gauge number, we bring the runner to the given area on "A" or "B," and find the result directly below on the slide or stock.

For example, given B. & S. No. 0000, what is the area in circular mils? Placing runner line to 4/0 on stock of instrument, we read directly over it on "A" 211,600. Given area of 27,000 to find gauge number. Placing runner line to 270 on "A" we read between No. 6 and No. 4—probably No. 6 would be used.

Second, given the gauge number of wire to find its resistance in ohm for desired length, and conversely, given the resistance to find length of desired gauge number.

We have the formula, resistance in ohms $= \frac{10.79}{d^2}$, *d* being the diameter in mils. Place the runner line to 10.79 on "A," move slide until gauge number thereon coincides with runner line, and over right-hand index of "B" scale we read result upon "A" scale.

It is obvious that resistance per unit length, given the gauge number, can be read off upon "A" scale, and conversely, given the resistance in ohms, we find the length upon "B" directly under desired resistance upon "A." Simultaneously, we obtain under the left-hand index of "A" the feet or multiple per ohm of the size upon "B" scale.

As an example, to determine the resistance of 564 ft. No. 1 B. & S. gauge wire, place runner line at 10.79 on "A," and bring slide to the left until wire gauge No. 1 marked thereon coincides with runner line, and over 564 upon "B" scale we read upon "A" 728 or .0728 ohms (the decimal point depending upon the value given to the index).

Given a resistance of .045 ohm to find the length of No. 2 B. & S. wire; placing runner line to 10.79 on "A" scale, we bring slide to left until No. 2 coincides with runner line, and under 45 on "A" we read 276 ft. on "B."

Third, to determine the weight per unit length of any gauge number, and conversely, given a gauge number and weight to find the length. This is readily obtained from formula $L = \frac{33{,}115\,W}{\text{circular mils.}}$

Placing the runner line to gauge number on stock, we bring 33,115 on "B" scale to runner line and read the weight per 1000, or multiple feet, over left-hand index of "B," and simultaneously the feet per pound, or multiple under right-hand index of "A."

As an example, to determine the weight of 500 ft. of No. 00 wire, place the runner line to No. 00 on the stock and bring the slide to the left until 33,115 of "B" scale coincides with runner line, and over 500 or "B" we read upon "A" scale 201 ft. Simultaneously, under right-hand index of "A" we read 2.49 ft. per pound upon "B" scale. To determine, say, the length of 540 lbs. of No. 8 wire, proceed as given in the foregoing, and read under 540 of "A" scale 1082 ft. upon "B" scale.

It is oftentimes necessary to secure the equivalent cross section in standard gauge numbers of a certain given number of circular mils. This is readily secured by simply dividing the given area by the circular mils of the sizes desired.

For example, given 1,000,000 circular mils, to determine the number of No. 0000 to secure equal cross section, bring No. 4/0 on the slide to coincide with 1 upon "A," and over right-hand index of "B,"' 4.71 or practically five No. 0000. Given one No. 4/0 to find its equivalent in the ordinary sizes; place the runner to No. 4/0 on the stock, bring the slide to right, and note that over index left-hand of "B" we have two No. 0, four No. 3, five No. 4, eight No. 6, thirty-two No. 12 to given an area equal to one No. 0000.

The solving of ordinary wiring problems brings forth the value of the wire scale. The gauge number of wire to deliver 50 amperes 750 ft. at 2.2 volts drop is desired. From the well-known formula, $\frac{\text{Current} \times \text{Dist.} \times 10.79}{\text{Drop}} = \text{circ.mils.}$, by the well-known method of combined multiplication and division we secure a result of 184,000 circ. mils, and coinciding with index upon stock of instrument, read between 000 and 0000. This formula can be simplified by cancellation and working out the constants for the work in hand, so that one setting of the slide will read directly in the given gauge number.

It would be an advantage to lay out upon the reverse side of the rule to correspond with the scales, all of the standard wire gauges, and results could be read off in any of them, and conversion readily made from one gauge to another.

The Marconi-Dolbear Infringement Suit.

By A. Frederick Collins, E. E.

The decision of Judge Cox, of the United States Circuit Court, in the Marconi-Dolbear infringement suit was, in the opinion of the writer, an exceedingly just one, and the grounds on which the suit was dismissed were well taken, as a comparison of the state of the art, theoretical claims and construction of the apparatus will demonstrate.

The art of transmitting telegraphic signals between two given points without metallic connection is not new, but a brief review of the several methods will assist in placing the two systems under discussion in their proper places with regard to each other. As early as 1795 the idea of telegraphing without wires was explained by a Spanish physicist. It is likewise evident from the writings of Edward Davey in 1838 that he had in mind a method of signaling by electricity without the aid of intervening wires; Steinheil, the discoverer of the "earth circuit," was an enthusiastic worker on space telegraphy, besides many others. Professor Morse, in 1842, tested in New York Harbor his own telegraphic system, using the water instead of a wire circuit for the conducting medium. This method is known as the conductivity system, and was improved upon by several inventors, the foremost among them being James Bowen Lindsay, who proposed to signal across the Atlantic Ocean.

The discoveries in electromagnetism then opened a new way to transmit messages through space electrically, and without wires. It found considerable favor with Professors Joseph Henry and John Trowbridge. Theirs was the ideal system of space telegraphy, since no earth connection was necessary, dependence being placed entirely upon the induced currents derived from closed coils of wires. This and the electrostatic system form three of the four available schemes whereby electric waves are propagated between two points without intervening wires. The fourth is the etheric wave system now in vogue.

The conductivity, the electrostatic and the magnetic induction systems represent the state of the art when Professor Dolbear attempted to solve the problem. He chose, as the most promising, the electrostatic theory, as the following claims copied from his patent specifications prove. He claims to "establish an electric communication between two or more places without the use of wire or other conducting medium, and consists of connecting the transmitting instrument with a ground, the potential of which is considerably above the normal, and the receiving instrument with a ground, the potential of which is considerably below the normal, the result being that an impulse from the transmitter is sufficient to cause the receiver to give intelligible signals transmitted through the earth without need of any circuit such as has heretofore been deemed necessary."

In the Marconi invention the specification briefly states the art as follows:

"According to this invention electrical signals, actions or manifestations are transmitted through the air, earth or water, by means of oscillations of high frequency, such as have been called the 'Hertz rays' or 'Hertz oscillations.' Usually all line wires are dispensed with."

It is evident that neither Dolbear nor Marconi could have obtained claims broad enough at this late date to cover the art of transmitting signals without wires, since this has been performed for the last hundred years. Accordingly, one inventor has an equal privilege with another to send "wireless" signals, assuming, of course, that he does not infringe his brother inventor's methods or apparatus. In the recent suit between these pioneers of space telegraphy there was no question raised involving the right of the defendant to send signals without wires by electricity, but it was the *method* by which these transmissions were effected and the infringement of device. The Dolbear claim, where the earth or "ground, the potential of which is raised considerably above the normal and the receiving instrument with a ground, the potential of which is considerably below the normal," sounds very like an extract from a paper read by Silvá, the Spanish physicist, on Dec. 16, 1795, before the Academy of Sciences in Barcelona. The excerpt referred to was thus written over one hundred years ago:

"One could arrange at Mallorca an area of earth charged with electricity and at Alicante a similar space charged with the opposite electricity with a wire going to and dipping into the sea. On leading another from the seashore to the electrified spot at Mallorca, the communication between the two charged surfaces would be complete, for the electric fluid would traverse the sea, which is an excellent conductor and indicate by the spark the desired signal."

It will be seen that the Dolbear patent claims and Signor Silvá's method are as nearly identical as they could possibly be, considering that a century elapsed between the written descriptions. From this curious coincidence one may infer why the Dolbear patent required four years before it was finally issued, although there were probably some other reasons equally as vital.

The method employed by Marconi is of comparatively recent date. Hertz, the German scientist, as every one knows, had by his brilliant deductions made, more than any other one man, the Marconi method possible. His etheric wave theory is well known, but the fact that a wire is necessary from the transmitter to the earth and from the earth leading to the receiver, made the Marconi method the equivalent of the Dolbear, in the opinion of the owners of the latter's patent. The absolute connection existing between the etheric waves and the electric action obtained through the earth is not clearly understood, but I consider that it is an electrostatic displacement primarily; when the instruments are employed for short distances, the spark-gap and coherer need not be grounded with a wire, but that the high-potential, high-frequency waves find their way between the transmitter and receiver through the apparatus, tables, floors and buildings, and through the ground, thus completing its course, is absolutely certain.

As to the art of Hertzian wave telegraphy, its evolution was so marked—though the time of its development was rapid—that it belongs to the world and not to any one man. Hertz, Calzecci, Branly and Lodge constructed etheric-wave apparatus, but failed to grasp its possibilities. Marconi followed with a practical working device in 1895.

It would seem, then, that the methods of space telegraphy employed by Marconi and Dolbear are signally different; in truth, they are, and so the Court decided. Since neither could establish a precedent in the art of space telegraphy and their methods of propagation are different, there remain but two points to be yet considered—that of commercial value and infringement of apparatus.

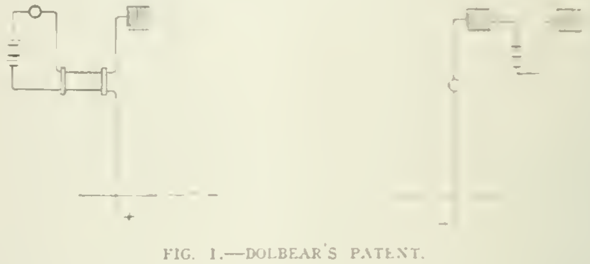


FIG. 1.—DOLBEAR'S PATENT.

Both the defendant and the plaintiff claimed the system of the opposing side to be useless commercially. The testimony proves that Marconi has transimtted signals nearly 200 miles, and it is a quetsion if Professor Dolbear transmitted signals the stated half mile. He certainly could not have with apparatus constructed according to his patent specifications. One of Mr. Marconi's experts, Dr. Fleming, of London, in his deposition stated that he had constructed instruments according to Dolbear's patent instructions and failed to obtain any results, as the specifications claimed. This is hardly the fault of either Dr. Fleming or Professor Dolbear. In the diagram shown the condensers illustrated of the ordinary dielectric type, but of condensers there are several types, as the Leyden jar, the human body and the earth itself. Had Dr. Fleming utilized his own body instead of the condenser shown in the patent drawing, his efforts would have been crowned with success. When the Dolbear system is operative it is not in accordance with the theory stated in his claims.

Now, let us compare the physical appliances of both systems and see if their essential features conflict. In Fig. 2 I give a diagrammatic view of the Dolbear coil, showing its special winding; also the connections.

With the exception of the transmitting keys, sounders and batteries employed in both systems, as they are in all wire systems, there is not a single point in common.

Dolbear uses a coil of simple construction and connected therewith is a key and a battery. One terminal of the "cut convolution" is attached to a condenser and the other end leads to the ground. This is his transmitter. Marconi employs a Ruhmkorff coil with an interrupter, condenser and oscillator. It is absolutely distinct from the coil of Dolbear. The spark-gap is the unique feature of the etheric wave transmitter.

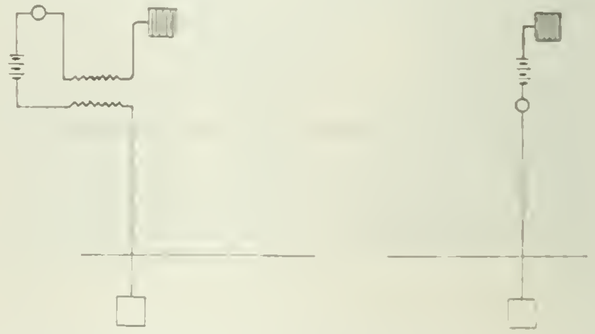


FIG. 2.—THEORY OF DOLBEAR SYSTEM.

A receiver connected to the earth by one of its terminals and to a condenser, which in turn leads to a battery and another condenser completes the receiving device of the plaintiff. The battery here and the last condenser is of no value whatsoever. The Marconi receiver bears no resemblance to the one just described, its essentials being a coherer in series with a battery and relay. There is no similarity between the two methods or the appliances for effecting the transmissions.

Such was the legal controversy of the first great "wireless" suit.

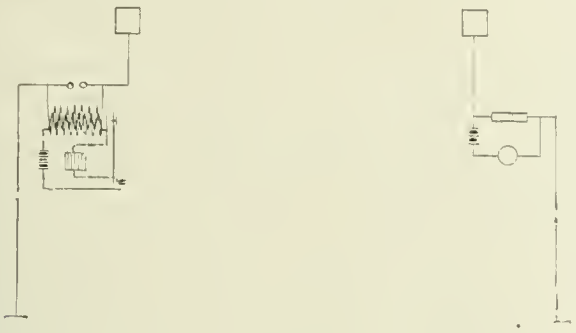


FIG. 3.—MARCONI SYSTEM.

In the future there can never be the gigantic legal battles like those fought by the "line wire" companies in the past, since no deep, basic claims can be obtained covering the art in the broad sense. In the case just closed—to my way of thinking, and, I believe, to all whose sense of justice lead them to desire that the right may win—the decision of the Court was entirely satisfactory.

Use of the Water Jet in Setting Poles.

By Walter O. Pennell.

THE water jet has been employed for a considerable time as an aid in sinking piles, and its usefulness for this purpose is now well known. Perhaps the earliest record of its use is in 1852 at Decrow's Point, Texas, where at the suggestion of Captain George B. McClellan the water jet was employed in sinking the piles for a wharf. The jet has been quite extensively used since then in Government work along the Mississippi, and in the erection of piers and jetties on the sea coast. In building the steel piers at Atlantic City, for instance, hollow steel piles were sunk into the sand by the insertion of a hose through the hollow of the pile, so that the jet could be applied at the extreme end.

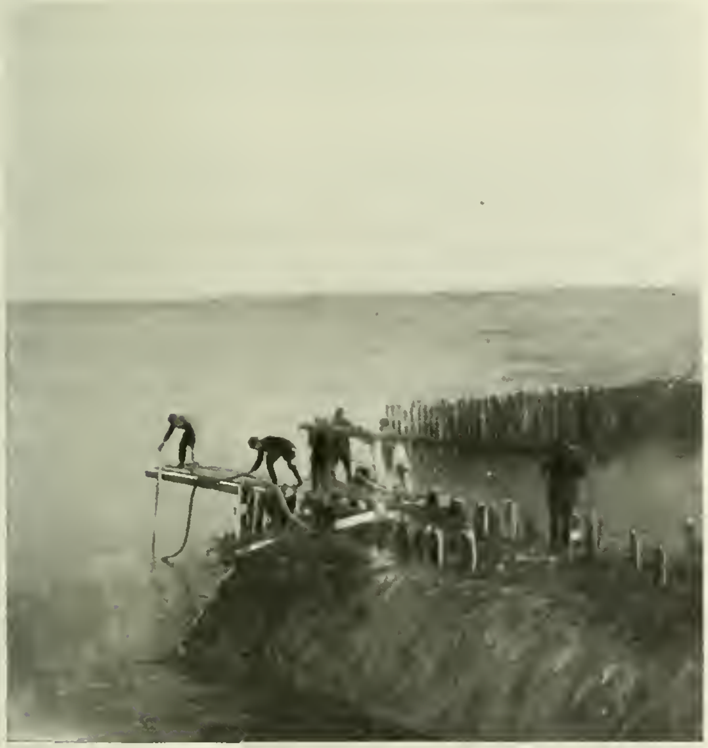


FIG. 1.—SINKING PILES FOR AN OCEAN JETTY.

The posts recently placed for an extension of the Boardwalk at Atlantic City are about 8 inches square, and are buried, I believe, 12 feet in the sand, the holes being excavated in a few minutes entirely by means of a water jet. Fig. 1 shows a gang working on an ocean jetty. The hole is being made, and the pole is ready and about to be placed in it. The hand pump can be seen in operation.

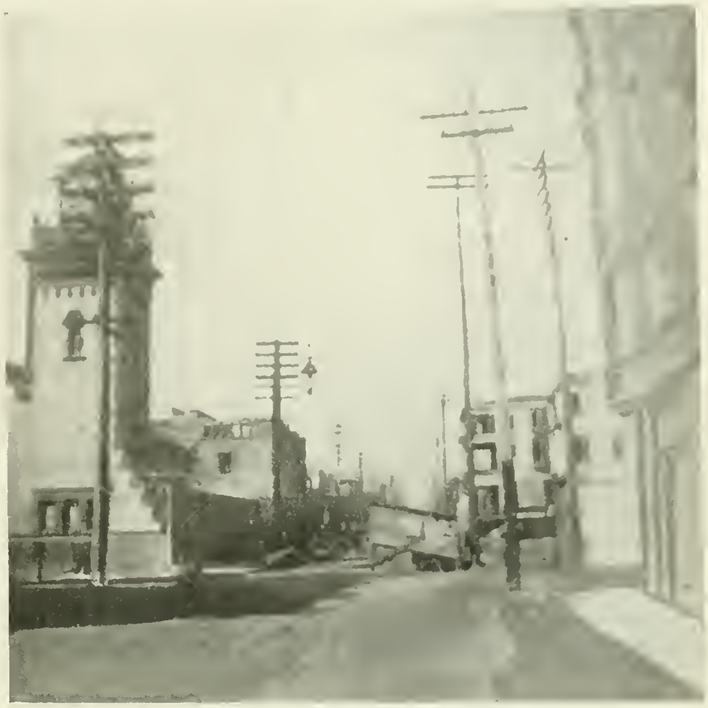


FIG. 2.—POLE LINE SET BY MEANS OF WATER JET.

It is the object of this article to call especial attention to the usefulness of the water jet in the setting of poles for aerial lines. If the land is sandy or the soil soft the water jet can be most easily used, and, on the other hand, in a clayey or rocky soil it easier to dig the holes. The use of the jet is evidently dependent on a supply of water under pressure either from the city or town mains, or from a hand or steam pump. The best procedure in most cases is to raise the pole to its vertical position and then apply the water jet by means of a hose or nozzle to the base of the pole until it has sunk to the required depth. Very good results are obtained in a hard, sandy soil by first excavating the hole to the proper depth by means of the water stream, and then placing the pole in it, this being the method followed in the illustration of the jetty. But, as a rule, especially in softer soils and with large spars, it is easier to use the other method, applying the jet to the base of the pole and letting both nozzle and pole sink together. In places where there is a hard outer layer, such as paving or turf, this should be removed with a shovel before using the water. Fig. 2 shows a pole line set by means of the water jet.

The water jet is especially applicable to setting poles or fixtures in marshes or inlets, which are submerged. A force pump, operated by hand, can furnish the stream, and unless the bottom is hard and rocky, the setting of a pole can be accomplished in a few minutes. The greatest saving is effected in towns where the hydrant water can be used.

This method of setting poles does not appear to be so widely known as might be expected, and it is believed that quite frequently a considerable saving over the more laborious process of digging each hole with a shovel can be effected if the water jet is employed.

On Wheels in France.

According to the official statistics recently made public by the tax office in France there were 975,878 bicycles in use during 1900, besides 11,252 motor bicycles and 5286 motor cars, each class being taxed separately. It is estimated that there are about 5 per cent more riders than these figures indicate, as many succeed in eluding the collectors. Reference to former statistics shows that the number of bicycles in France has doubled in the last 10 years, while the increase in automobiles has been even more rapid.

Annual Convention of the Ohio Independent Telephone Association.

THE Ohio Telephone Association, which heretofore has been known as the Ohio Independent Telephone Association, held its annual convention at the Chittenden Hotel, Columbus, Friday, April 5. Six years ago, at this same hotel, the association was organized by a handful of gentlemen representing all the independent interests in the State, it being the first association of the kind formed in the country. At the recent meeting there were 125 delegates, representing by actual count 85 companies, out of the 197 independent companies in the State. According to figures turned in at the meeting the 85 companies are operating 42,015 telephones at the present time, and have 4302 miles of toll line in use. From recent figures, it is estimated that there are at present about 75,000 independent telephones in use in the State and probably 7000 miles of toll lines. A number of important towns are now building systems, and before the close of the year there will undoubtedly be 115,000 independent telephones in use in Ohio.

The morning session was opened by an address of welcome by H. A. Lanman, president of the Columbus Citizens' Telephone Company, the host of the day. He said:

"It was a community of interests that brought into existence the Ohio Telephone Association—born as the result of a menace from a gigantic monopoly who were not content alone to cast a shadow upon its securities, but with an upheld club in the so-called Berliner patent, were ready to beat out the life of any one who might enter the field of fair competition. Since our meeting in Cleveland one year ago, this club has been broken. Our honored president, Judge Thomas, and our secretary, Mr. Critchfield, have not only served this organization efficiently in convincing the Supreme Court of the invalidity of the Berliner patents, but they are entitled to the lasting gratitude of all the people of the country who have been paying unjust tribute—not a deserving inventor, as contemplated by the patent law, but to a band of speculators and adventurers who have been holding the country up under outrageously false pretenses. The community of interests of which I have spoken has in addition to the material, also a social side—and it is with reference to the latter, that as representative of our local company, the Columbus Citizens', I wish to say: 'We are glad that in selecting a meeting place, you have been good enough to come to Columbus, and I want most cordially and heartily to welcome you to our midst."

Mr. Lanman was followed by John Y. Russell, secretary of the Columbus Board of Trade, who delivered an eloquent address of welcome in behalf of his organization. He referred to the promotors of telephone enterprises as being among the greatest benefactors of recent civilization. He predicted that the day was not far distant when the telephone would penetrate every portion of the globe and that the time would soon come when human utterances could be sent around the world in 40 seconds. He expressed great pleasure at the fact that the first independent association had been formed in this city, and welcomed the members back to the Ohio capital.

Judge Thomas, president of the association, responded, giving a brief outline of the history of the organized movement. He said that the original meeting held in the same hall in May, 1895, showed a striking contrast to the present session. At that time there were not more than a dozen independent companies in the State, and the meeting was held behind locked doors, for fear that the opposition would learn their plans.

"Those were the dark days of telephony," said he, "and to the organization effected at that time belongs the credit for the organized efforts in all portions of the country. If the independent companies had been allowed to run loose, I firmly believe we would not be in the business at the present time. Therefore, for the sake of old times we are especially glad to come back to Columbus.

"At that time there was no independent company in Columbus. Soon after Mr. Lanman and his associates assembled behind barred doors and determined to make an effort for an independent company in this city. But it was not for several years, after one of the hardest fights in the history of telephony, and the expenditure of immense sums by the opposition, that the franchise was finally secured. To-day, as you all know, the Columbus company is one of the largest and most successful in the country."

Mr. Kora F. Briggs, secretary and general manager of the Home Telephone Company, of Tiffin, Ohio, in a paper on "Our Country Patrons," said: "The first question which arises in the minds of those who are contemplating extending their lines to the country, is: Will it pay? After an experience of nearly three years with farmers' lines, I am prepared to assure you that they do pay. The rentals received therefrom will pay upon the investment necessary for their construction, 20 per cent gross earnings, and will add, on an average, three subscribers in town to every one installed on a farm, and this latter feature would make the investment a good one, even if the country lines did not more than pay the cost of operation and 6 per cent on the money necessary for their construction. You will find also that the farmers will ever be the most prompt paying subscribers, many of them paying from six months to a year in advance. The question of the rentals to be charged to these country patrons is one upon which the independent telephone companies of this State widely differ, and it would be for the common good if an agreement could be entered into whereby the same prices would prevail throughout the State. But it is probably too early in the independent development to expect concerted action along this line at this time. In most localities the telephone companies will experience little difficulty in securing contracts among farmers for six partly lines at $18 per year, for the full privileges of the exchange, the same as granted to town subscribers. We require the farmers to do all the soliciting themselves, and to bring to us the requisite number of five-year contracts already signed, and also to procure for the company all the necessary right of way. When figuring upon the rate to be charged, we estimate the cost of construction of the proposed line, and make the rates sufficiently high that the gross income from the initial number of subscribers on the line would be 20 per cent, figuring 6 per cent for the investment, 6 per cent for operation and 8 per cent for depreciation. For example, if the proposed line is four miles long, it will cost approximately $500 to build it, and equip it with instruments; 20 per cent on the cost would be $100. Hence, if we can put eight subscribers on the one circuit, we make them a rate of $12 per annum each, which gives us practically 20 per cent gross income. The sequel will show that inside of two years we will have two more circuits of eight telephones each, or 24 subscribers on that lead, and for the last 16 we have had no expense for poll line construction, as we require the farmer to erect, or pay the cost of erecting the lateral pole lines, leading from his house to the main line.

"Our experience has been that it pays to build a good substantial line of 25-ft. poles with 6-inch tops, and use 10-pin cross-arms for at least four miles from the exchange. Beyond that distance it is sometimes advisable to use 6-pin arms, but it always pays to look a long way into the future when you are building for telephone service.

"We use No. 14 B. B. double galvanized iron wire, the same as we use in the local exchange, and find that it gives good service to farmers living eight miles from the exchange, with occasional transpositions. All instruments should be bridged with 1600-ohm ringer, and equipped with "straight-way" generators. Our first farmers' lines were equipped with ordinary 1600-ohm bridged ringers, and they give fairly satisfactory service, but the frequent ringing was a source of much annoyance. A short time since we installed an eight-party line with "straight-way" generators, which allows the subscriber to signal central without ringing any of his associates on the line, and it is proving so popular that we shall be under the necessity of equipping all our party lines in the same manner. By using "straight-way" generators, fully two-thirds of the ringing is elminated, only the signal from central being audible at all the stations on the line, and any one who has installed or used a party line is cognizant of the fact that the paramount difficulty and chief cause for complaint is on account of the multiplicity of rings.

" 'How do we prevent eavesdropping on these lines?' some one asks. We do not prevent it. When the service is installed the subscribers are warned to remain away from the instrument when they hear another subscriber's call sounded, and shown that if they desire immunity from annoyance of other patrons of the line, they must remember and put into practice the Golden Rule. After the novelty of the thing has worn off, little trouble is experienced from this source. The farmers themselves find means to reduce that kind of trouble to a minimum, and generally make it pretty warm for that class of subscribers, called in up-to-date English, 'rubbernecks,' who are afflicted with an almost unconquerable desire to know what their neighbors are talking about."

Judge Thomas introduced Mr. James B. Hoge, secretary of the

United States Telephone Company, as one who deserves much credit for what may be called the second growth of independent telephony.

Mr. Hoge announced for his subject "Finances." He stated that while he had only been identified with the telephone business for the past two years, he had been in an excellent position to appreciate the great development being made, not only in Ohio but in the surrounding States. He referred to the many new companies springing up in various portions of the State and said that while now was the time to be aggressive, the movement should be on a safe basis. Great care should be used in financing new projects and sufficient funds should be raised, either by selling stock or floating bonds, to take care of the growth for some time to come. "Many failures," said he "have resulted from attempting to operate on too small a capital. Concerns which have enjoyed a rapid growth have attempted to provide for large improvements without securing additional capital, relying on their earnings to pay for extensions. For this reason they have been unable to pay dividends, causing their stockholders to become dissatisfied. This has had a tendency for force entrenchments, and in some cases the service has suffered.

In speaking of the defense of the Berliner patent suit, he said that great credit should be given to Messrs. Basin & Basin, the attorneys who conducted the defense; to President Thomas and Secretary Critchfield, who assisted, and also to leading manufacturers and heads of various independent companies who provided funds for conducting the defense.

Mr. Hoge stated that two weeks ago there was held at Chicago a conference of leading manufacturers and operators, for the purpose of raising funds to liquidate on an equitable basis the amounts pledged by certain prominent persons to fight the Berliner patents; also to provide a fund to cover expenses of defense in case the Berliner patent case should be carried to higher courts. He stated that it had been decided to raise $25,000 for this purpose. The manufacturers present at the Chicago meeting agreed to provide one-half that amount, the operators to provide the balance. As it had been impossible at that time to bring the matter before the Ohio Association, President Thomas and Secretary Critchfield had agreed, on their own responsibility, to pledge the Ohio Association to the amount of $4,000, this being considered an equitable portion of the total amount, in view of the numerous independent interests in Ohio.

Mr. Hoge proposed that the association support the officers in their action, and a discussion of the matter followed. One or two members took snap judgment and suggested that as the manufacturers in nearly all cases guaranteed protection to operators against infringement suits, it should be the duty of the manufacturers to bear the burden of any defense necessary.

Judge Thomas protested against this view as manifestly unjust, since the operators as well as the manufacturers are vitally concerned in the ultimate outcome of this suit. He stated that the money would be utilized wholly for the purpose of the defense of the Berliner and Carty patent cases, and that in event of a surplus the money would be returned to the members of the association. He said that the assessment would amount only to about 7 cents per telephone in operation by the various companies, and the same amount for each mile of toll line. A motion was adopted that the amount be raised pro rata per Judge Thomas' suggestion, and that Mr. Hoge be made trustee of the fund, with authority to collect at once. The report of the various companies represented showed the results above mentioned. The figures of some of the larger companies follow: Cuyahoga Telephone Company, Cleveland, 6050 telephones, 50 miles toll line; Columbus Citizen's Telephone Company, Columbus, 4983 telephones, no toll line; United States Telephone Company (long distance), 250 telephones, 2000 miles toll line; Columbiana County Telephone Company, 1905 telephones, 40 miles toll line; Tuscarawas County Telephone Company, 1500 telephones, 40 miles toll line; Akron People's Telephone Company, Akron, 2266; Youngstown Telephone Company, Youngstown, 1300; Sandusky Telephone Company, Sandusky, 1000; Millersburg, Wooster & Orrville Telephone Company, 1000.

Reports made by delegates from various portions of the State indicate that since the settlement of the Berliner patent case, the Central Union Company and other Bell licensees are showing a decided willingness and even desire to compromise with independents in the matter of distribution of territory. At Celina the Bell licensee offered to withdraw his application for a local franchise if the independent company would grant him connection with five independent toll stations. At Ironton the Bell Company agreed to keep out of the town if the independent company would allow them the use of a toll line through town. The independent company declined to consider the proposition, and the Bell Company undertook to secure a franchise through the town. The Council, however, declined to grant a franchise because a Bell licensee had formerly had a franchise which had been revoked because of poor service.

Judge Thomas stated that the American Telephone & Telegraph Company, the Bell long-distance company, was applying for franchises in a number of towns, assumedly for long-distance lines only. He stated, however, that a careful consideration of their franchises indicated that they were also securing the right for local exchanges in certain places. In some cases they had induced village councils to pass ordinances in one evening without giving an opportunity for careful considerations of the true status of the franchise. He advised independent companies to insist that all Bell franchise applications should be carefully considered.

Secretary Critchfield made some stirring remarks on the subject of compromising with Bell companies. He stated that two years ago the Bell managers would hardly speak to an independent man. Now, however, reports are coming from all quarters indicating a desire to compromise. He said that this was certain indication that the independent companies had secured the upper hand and that there could be no better acknowledgment of the fact by the Bell people. His views were seconded by several prominent managers.

The question of tax valuation on independent telephone properties came up for discussion. It seems that heretofore there has been no standard method of appraising the properties of the independent companies, while under a recent decision of the courts the Bell properties have been taxed at a straight valuation of $10 per telephone. In some counties the independents have been taxed on mileage of lines, others on the capital stock, and still others on the receipts. The State Board of Arbitration was quoted as being desirous of having a uniform measure adopted, and on a motion the chair appointed H. D. Critchfield, Cleveland; Edwin Kibler, Newark; D. J. Cable, Lima; Judge Hagarty, Columbus; Frank Davis, Columbus, and Harry Dougharty, of Columbus, as a committee to confer with the State officials on the matter.

At 1.30 p. m. the delegates visited the officers and exchange of the Columbus Citizens' Telephone Company, where they were handsomely entertained by the officers of the company. As has been previously stated, the exchange is the second largest independent exchange in the State, and one of the most complete in the country.

The afternoon session was opened by an address by G. P. Thorpe, of Wilmington, on the subject: "Toll Lines: Their Advantages as Auxiliaries to Local Exchanges." Mr. Thorpe explained that he had not found time to prepare a paper, but he made a few interesting remarks extemporaneously. He said in part: "There are two classes of toll lines. First those that pay, and, second, those that do not pay. The question of how to determine whether or not a toll line will pay, is a great problem for which no rule can be devised. As auxiliaries to local business, toll lines are unquestionably of great importance. A toll line does not mean simply a line which connects two villages. Such a line alone seldom pays. But it is the farmers who live near enough to connect with such a line that make it profitable. One subscriber in the country very often makes three new ones in the village or town. The farmer has numerous friends in the village with whom he is desirous of communicating, and in that way the local exchange is built up. In deciding whether it will be profitable to run a toll line out from the town, one must study all the conditions of the country people. One must learn their social, business and even political relations. Country lines should be built of good material, and at the same time they must be cheap to be profitable. However, the cheapest is seldom the best investment in the long run. A great many companies make the mistake of not securing the right of way before commencing to build. It is an inherent sentiment with every American, especially every American farmer, that he does not like to feel that he is being imposed upon. In nine cases out of ten if you go about it in the correct way, the right of way is granted without trouble. The farmer likes to feel that you are under obligation to him. But if you undertake to build a line over his property without permission, he will find all kinds of damage and make all the trouble possible. Not long ago we undertook to run a line past a farmer's house without permission, in the night. We built the line all right, but the next morning we found he had cut down every pole bordering on his premises. We had the man arrested and hired a lawyer to convict him, but he beat us, and after considerable expense we effected a compromise. It taught us a lesson, and in the future we shall go slow about forcing matters. Don't build a toll line for the sake of friendship. We have had influential farmers who lived on isolated roads come to us and ask us to build a toll line past their places, but unless they can show us where we can secure a profitable number of subscribers we do not build. To sum it up, I can only reiterate that toll lines are a great advantage to the town exchange, and if you get enough of them, they are more profitable than the local subscribers. In our town we have 600 subscribers, and we operate 100 miles of toll line through the surrounding district. We find that the toll lines are a better paying investment than the main exchange."

The manager of the Ross County Telephone Company, Circleville, stated that they had just secured a franchise and are preparing to build a main exchange at Circleville, a town of 7000 inhabitants, with toll lines connecting up exchanges in five surrounding towns, which will probably have from 75 to 100 telephones each to start with. From these points the company expects to cover the entire county. He asked for information regarding the most satisfactory method of toll charges.

Mr. W. W. Morrison, Bryan Telephone Company, expressed the opinion that a toll should be charged on even the shortest lines, it being his experience that free toll lines of any kind were a mistake. He had found that only about from 5 to 10 per cent of the customers in an exchange use the toll lines, and it is unfair that such lines should be maintained at the expense of the entire community for the benefit of the few. He believed that where no charge is made there is no incentive to keep up the service, and thus it is liable to become unsatisfactory to a person who is willing to pay. At first the company adopted a list of rates which was rather high, but recently it has reduced them somewhat and the income from toll lines has increased considerably as a result. The present scale is as follows: All points within 10 miles, 10 cents; 20 miles, 15 cents; 30 miles, 20 cents; above 30 miles, ½ cent per mile. It was reported from Circleville that the Central Union Company was about to inaugurate a rule giving free service throughout the whole of Ross County.

Mr. Briggs, of Tiffin, also expressed the opinion that it was poor policy to make the entire system pay for the advantages grasped by the few. The Bell people had at one time made a similar "free" inducement in his section, and then failed to keep their promises. Speaking of the presnt competition in his town, Mr. Briggs stated that his company had 825 subscribers, 210 of them being business houses, while the Bell Company has 500 subscribers, only 50 of them being business houses. The Bell rates are 50 cents and $1 per month, and in some cases telephones have not been paid for in months. The rates of the independent company are double those of the Bell. His company made it a point to build toll lines wherever there is a demand for them. Sometimes it is necessary to go to poor towns, and in a number of cases the lines are not a paying investment at present, but the company believes in covering the entire field and in keeping out the opposition at all costs. In the long run this proves a paying investment, since it is easier to secure local subscribers when it is shown that the entire community is thoroughly covered.

Mr. Edward Kibler, of Newark, manager of the oldest independent company in the State, held a similar view. This company's toll lines reach every post office in Licking County—32 in all. Some of the stations earn only $1.50 per month, while others take in from $16 to $20. On the whole, the toll lines are an excellent investment. Its rates are 25 miles for 10 cents. The Newark company has twice as many subscribers as the Central Union Company at that point, despite the fact the C. U. Company gives 50-cent rates and in some instances, free telephones. Mr. Kibler mentioned a case of an old lady who applied to the town authorities for assistance. An investigator called on her and found her to be in very straitened circumstances. He said he would go to a neighboring drug store and telephone for some food and coal, when the old lady remarked: "No need of going to a drug store; I have a telephone in the next room." "Perhaps it is not necessary to tell you what kind it was," said Mr. Kibler.

Mr. Henry Hildebrand, of Washington C. H., stated that his company has 424 telephones in the county. Free service is given to the county seat for ingoing messages, but charges are made for outgoing messages. Charges are also made for messages passing through the central exchange. The toll lines of this company net about $2,000 per year after paying charges to the United States Company on long-distance messages.

At the close of the discussions, nominations for officers were called for, and in less time than it takes to tell it, Judge J. M. Thomas and H. D. Critchfield were re-elected by acclamation to the offices of president and secretary-treasurer, respectively. Mr. B. J. Cable, of Lima, was chosen vice-president, and Mr. C. Y. McVey, of Youngstown, second vice-president.

Despite the fact that the convention was called on short notice, the trade was fairly well represented, among those present being Mr. Charles W. Stigler, the Stromberg-Carlson Telephone Manufacturing Company, Chicago; Mr. F. B. Cook, Sterling Electric Company, Lafayette, Ind.; Mr. P. J. Eubanks, American Electric Telephone Company, Chicago; Horace T. Reynolds, the Miller-Knoblock Electric Manufacturing Company, South Bend, Ind.; Mr. Kundtz, the Post-Glover Company, Chicago, and Mr. I. T. Maltby, of the Maltby Lumber Company, Bay City, Mich.

The Cleveland office of John Roebling Sons Company was represented by Messrs. W. W. Affleck and F. C. Anderson, two enterprising young salesmen who are securing a large portion of the wire trade in Northern Ohio.

In the parlors of the Chittenden Hotel there were arranged exhibitions by the following concerns: The Kellogg Switchboard & Supply Company, Chicago; the National Automatic Telephone Company, Chicago, and the Ernes-Hopkins Company, of Columbus. The latter company had an exhibition of a new insulated wire. This company's product will be used exclusively by the Stromberg-Carlson Company in its Pan-American exhibit. Much of it will be installed in underground conduits, some of which will be continually under water.

The Kellogg Switchboard Company had a very comprehensive exhibit of a number of different varieties of instruments connected to a new combination board, consisting of a complete central energy lamp signal board, with a combination connecting board for connecting toll common return or grounded lines with the central energy lines. A new self-restoring magneto board was also shown. The exhibit was in charge of Mr. A. M Kellogg, assisted by W. N. Taylor and R. H. Manson, of the company's engineering department, and Messrs. A. J. Rousseau and H. B. Hanford, traveling representatives. The board used by the Columbus Citizens' Company is the product of this company's factory.

The National Automatic Telephone Company also had a system connected up, the automatic switchboard attracting much attention, particularly among managers from smaller exchanges, this being the class of trade which this company caters to especially. The company has several sub-exchanges in Ohio, and has recently closed a contract for a 100-telephone board, which will be tested by a leading operating concern. Mr. J. A. Russell, who was in charge of the exhibit, showed several interesting letters from managers in Western States, who are using the automatic system. As an example of the advantage of this board, Mr. Russell cites the case of a manager of a 100-telephone automatic exchange at Audubon, Iowa, who took a three-months' vacation in the busiest part of the year. During the entire time the exchange was closed and locked. On his return the manager learned of two cases of trouble, both of which were caused by aerial wires becoming crossed

Municipal Ownership Amenities.

The municipal ownership idea struck a snag in Frankfort, Ind., when it came to be put into practice. An Indiana correspondent tells us that the municipal electric light plant there has proven unsatisfactory. "Continuous trouble has been the lot since the construction of the plant, and the mischief at last forced a crisis. Superintendent Wells, of the plant, tendered his resignation, and the Council accepted it. The enthusiasm for municipal ownership has waned. The city was bonded and this brought on a lawsuit by parties who claimed the city had exceeded its limits of indebtedness. Contractors became alarmed, and progress was slow. The city won out in the courts, but more trouble came. The plant, when put in operation, was a failure, lights were miserable, jack-o'-lanterns were made of pumpkins, and the Council invited to see 'the new electric lights.' Open threats to tear down the poles were made unless the service was improved. The plant is not self-supporting. Those higher in authority than Superintendent Wells are now being charged with wrongdoing, and there is every indication of interesting developments in the near future."

The Institute Conversazione.

The conversazione to be given by the American Institute of Electrical Engineers at Columbia University on Friday, April 12, bids fair to be a great success, not only as to exhibits, but as to attendance. Secretary Pope informs us that up to Saturday last 800 invitations had gone out, and that on Monday about 100 more had already been applied for by members for themselves and friends. At the University Professor Crocker has rendered the committee all possible assistance, and during the week exhibitors have been busy getting ready for the function. The list of exhibitors at present is as follows:

Andrews, W. S.—Revolving High Frequency Spark: Luminous Aluminum Cell.

Baillard, E. V.—Faradmeter and Bridge.

Barker and Goodspeed.—Radiographs.

Clarke, C. L.—Synchronism and Phase Indicator.

Clift, A. F.—Telpherage System.

Crocker, F. B.—Magnetic Liquids.

Davis, H. P.—Alternation Meter, Phase Shifting Transformer, Power Factor Indicator, etc.

Entz, Justus B.—New types of chloride battery.

Geyer, William E.—Incandescent Lamp Experiments.

Hammer, W. J.—S. P. Langley's Bolometer and Aerodrome, Balloon and Air-Ship Photographs. European, Nernst and other Lamps. Poulsen Telephonograph Appurtenances.

Haskins, C. D.—Power Factor Indicator and Single Coil Astatic Instruments.

Hewitt, Cooper.—High Candle-Power Electric Lighting with hot gases in Operation.

Hubbard, A. S.—Gould Storage Battery.

Hutchison, M. R.—The Akouphone or Micro-Telephonic Apparatus for the Deaf, in operation.

Laws, F. A.—Radiographs of A. C. wave forms.

Louis, O. T.—Electric Furnace and Ohmmeter.

Palmer, H. R.—Fac-simile Picture Telegraph in operation.

Perret, Barrett and Meadowcroft.—Storage Battery.

Pupin, M. I.—Original apparatus used in developing recent invention for improvement of Long-Distance Land and Ocean Telephony.

Reber, Colonel Samuel.—Wireless Telegraph in operation. U. S. Army Telephone Outfit.

Robinson, L. T.—Wave Form Indicator and Frequency Indicator.

Rice, M. P.—New X-Ray Apparatus.

Ryan, H. J.—Radiographing of A. C. waves.

Sanville, H. F.—Copper Splicing Machine.

Schoonmaker, E. T.—Floating Magnetic Field, etc.

Tesla, Nikola.—High Frequency Phenomena.

Thomson, Elihu.—New Dynamo Static Machine, Electric Gyroscope and Bohnenberger Sphere.

Townsend, Fitzhugh.—A. C. Wave Trailer.

The Engineering and Chemical Buildings of Columbia University, their museums and laboratories, will be open for inspection. There will be music during the evening, and a collation will be served.

Montreal Electric Combination Effected.

The Montreal Light, Heat & Power combine was formally organized at Montreal, Quebec, in April. The meeting of the promotors, shareholders and directors of the amalgamated companies resulted in the election of the following board of directors: Mr. H. H. Holt, president; James Ross, first vice-president; Rodolphe Forget, second vice-president; Hon. L. J. Forget, Hon. Robert Mackay, Hon. H. B. Rainville, H. Montague Allan, Lieutenant-Colonel F. C. Henshaw and Charles E. L. Porteous. Mr. H. H. Henshaw was made secretary-treasurer of the new company, which is thus formally and officially launched with a capital of $17,000,000.

When the announcement of the directorate was made, it was generally accepted as a strong combination of moneyed interests, and attention was called to the fact that four of the directors are also directors of the Montreal Electric Street Railway Company. Mr. Forget, being asked the meaning of this close affinity, said he did not know except that perhaps "coming events cast their shadows before." Mr. Holt, the president-elect of the company, was president of the Montreal Gas Company. Mr. James Ross is the well-known millionaire street railway magnate, who is heavily interested in the Montreal and Toronto street railway companies. Mr. Forget was the president of the Royal Electric Company. All the other directors are among the leading capitalists of Montreal. The president's salary will be probably placed at $25,000 per annum.

It is announced that the holders of the Royal Electric and the Gas companies stock will receive 2½ of the new company's shares for each one formerly held, while the holders of the Montreal & St. Lawrence Light & Power, formerly the Chambly, will receive share per share. The Montreal Gas Company has 75,000 shares; the Royal Electric Company, 22,500, and the Chambly Company, 30,000, forming 170,000 shares of the new stock at $100 per share, or a total capital of $17,000,000.

Testing an Automatic Telephone Exchange.

In view of the general interest in the subject of automatic telephony, the following report made by Haskins & Sells, the well-known Chicago accountants, on the operation of the plant of the Augusta, Ga., Telephone & Electric Company, will be timely reading. They say:

In making the physical test of the service of the "Strowger system," two methods were adopted: First, by making 1021 calls over the telephone, noting (a) the time taken for each call, when a reply was received, (b) the number of times a wire was busy, and (c) the number of times no answer was received. These calls were made during the usual business hours, and in the ordinary manner, extending through a period covering five days, care being taken not to call up any subscriber more than once on any particular day. By "time taken for each call" is meant the time that elapsed from the instant the telephone was removed from the hook until a reply was received.

The total number of calls made was 1021, a brief summary of which is here annexed:

Calls made.		Per cent.
114	"Wire busy," or.............	11.16
75	"No answer," or.............	7.35
832	"Reply received," or.........	81.49
1021		100.00

The total time elapsed in making the 832 calls from which a reply was received, was 13,398 seconds, or an average of 16.10 seconds per call.

Twenty-eight different call stations were used in making these calls, and 443 different stations were called up. It will be noted that the number of stations called up is 82.96 per cent of the total number of subscribers of the company.

Second, by making a "competitive test" of 50 calls each over the "Strowger system" and the "Bell system," from and to identical stations, having as far as possible, the same conditions surround each competitive call so as to make the test as uniform and equitable as possible. Not more than five calls were made over any one telephone. The total elapsed time for the 50 "Strowger" calls was 899 seconds, or an average of 18 seconds per call, while the "Bell" calls show a total elapsed time for the 50 calls of 1518 seconds, or an average of 30.4 seconds per call. The total difference in elapsed time for the 50 calls is 619 seconds, in favor of the "Strowger," or an average of 12.4 seconds per call.

The company keeps a record of complaints of service in a book called "trouble calls," entering each complaint of a subscriber as it arises, giving nature of complaint, cause, etc. This book shows that for the year ended Dec. 31, 1900, 2545 "trouble calls" were made, or an average of seven complaints per day. Taking the average number of subscribers for the year as 523 it will give one "trouble call" for each subscriber in a fraction of over 75 days.

Electric Combination in Cincinnati.

A dispatch from Cincinnati states that the combination of all the big lighting companies of Cincinnati is now assured, as the directors of the various companies have formally accepted the terms submitted from the North American Company through the Board of Arbitrators. The companies entering into the combine and the percentages allotted them by the arbitrators are as follows: Per cent, the Cincinnati Gas Light & Coke Company, 68.80; the Cincinnati Edison Electric Company, 27.65; the Jones Brothers Electric Company, 3.20; the Brush Electric Light Company, .05; the First Cincinnati Edison Electric Company, .30; total, 100.

In monetary value the amounts are: Cincinnati Gas Company, $19,264,000; Cincinnati Edison Company, $7,742,000; Jones Brothers Company, $896,000; Brush Electric Company, $14,000; First Cincinnati Edison Company, $84,000; total, $28,000,000.

To the Foot of Mont Blanc by Trolley.

Mr. L. H. Washington, United States Consul at Geneva, Switzerland, writes the State Department as follows: "It will be of interest to those who intend traveling in Europe this summer to know that an electric tram line will bring Chamouni—heretofore only to be reached by diligence or the more expensive luxury of a carriage—within easy reach from Geneva at a moderate cost. The line has been built at great expense by the Paris, Lyons & Mediterranean Company from Fayet-St. Gervais, a station two hours by rail from Geneva and a trifle longer from Aix les Bains. During the summer season, it is intended to operate six trains daily between Geneva and Chamouni, the time of the run being, according to train, three and one-half to four hours. From Paris to Chamouni will take about 14 hours.

"The electric line from Fayet-St. Gervais to Chamouni is 20 kilometers (12½ miles) long, double tracks separated 1 meter (39⅓ inches). For 3.6 kilometers (2¼ miles), the cars will ascend on cogs, the steepest slopes having a grade of 9 centimeters to the meter (3.54 inches to 39⅓ inches). The line is expected to be in operation by June or July at the latest, and will have a first and second class service. The fare, second class, from Le Fayet to Chamouni will be 1.95 francs (about 38 cents). The first-class fare has not yet been decided. While many will, of course, continue to make the journey to Chamouni over the picturesque mountain passes, the simple, comfortable tram connection for even one way of the trip will prove a great convenience; and for the many hundreds of tourists of small means and restricted time, this line will make the mountain scenery of Chamouni an item in an itinerary that otherwise would have to be omitted."

CURRENT NEWS AND NOTES.

AUTOMOBILE FOR ROYALTY.—A London dispatch states that King Edward of England has purchased a 9-hp Gardner-Serpollet automobile phaeton.

ROENTGEN RAYS.—A dispatch from Paris states that M. Naudon has found means for producing Roentgen rays without electricity, by exposing a metal plate to the rays of the violet end of the spectrum.

TO PROHIBIT ELECTRIC COMBINATIONS.—A bill has been introduced in the Massachusetts Legislature to prohibit combinations between gas and electric light companies and leases of electric light corporations, on the ground that they are against good public policy. This measure appears to carry into effect a recommendation of the Board of Gas and Electric Light Commissioners, and it is stated that it is likely to become a law.

TRAIN LIGHTING.—The New York Central Railroad placed in service on April 3 four new trains for the "Lake Shore Limited." The cars of these trains represent the highest development in railway-car construction and fitting. The trains are lighted throughtout by electricity. An engine and dynamo, carried in the baggage car, generate the current, each center lamp has four 16-cp incandescent lamps. In the sleeping cars each section is provided with a reading lamp, which enables patrons to read, after retiring, if they so desire. In the smoking and observation rooms, side reading lamps are placed in convenient locations, and side lamps are also placed over each table in the dining cars. Ladies will especially appreciate the convenience of the commodious dressing rooms, which include an electric curling iron heater.

LONG-DISTANCE WIRELESS TELEGRAPHY.—It is stated that the steamer Ophir, with the Duke and Duchess of Cornwall and York on board, is almost constantly in touch with the shore by means of wireless telegraphy. Thursday last she sent a message to the Island of Malta, 185 miles distant, and passing 100 miles south of the Island of Crete the Duke of Cornwall and York telegraphed to his cousin, Prince George, of Greece, the Commissioner of the Powers on that island, and received a reply. When the Ophir was too far from land the attending cruisers took messages toward the land stations until the wireless calls were answered.

MANUFACTURERS' CONVENTION.—President Theodore C. Search, of the National Association of Manufacturers, announces that the executive committee has selected the dates of June 4, 5 and 6 for the holding of the sixth annual convention of the association, which will meet in Detroit. These dates were chosen after consultation with the citizens of Detroit, who have manifested a great deal of interest in the coming convention, and who propose to make it one of the most notable gatherings that has ever been seen in that city. Mr. George H. Barbour, of Detroit, the Michigan vice-president of the association, is in charge of the arrangements in Detroit. The opening of the Pan-American Exposition in Buffalo a few weeks prior to the dates fixed for the convention will enable manufacturers to arrange for a trip which will take in both points of interest.

LIQUID AIR FOR FUEL COMBUSTION.—A German engineer named Hempel is credited by the London *Engineer* with an invention for the employment of liquid air in the combustion of fuel. At some distance from the boiler room a vessel containing liquid air is placed, the contents of which naturally evaporate gradually. The first gases, rich in nitrogen and thereby impeding the process of the burning of the fuel, are allowed to escape; the later gases, however, are led under the grate "of a peculiar furnace" and cause a lively fire. The note has the naive conclusion that "the practical employment of this ingenious process depends upon the local price of liquid air." As 12 tons of liquid air would be required to consume one ton of coal, and as in ordinary furnaces the air for combustion is obtained without charge from the atmosphere, it is to be regretted that the inventor has not given specific details as to the economic value of the process.

AMERICAN CHEMICAL SOCIETY.—The twenty-fifth anniversary of the organization of the American Chemical Society will be celebrated by a general meeting in this city on Friday and Saturday, April 12 and 13. A number of guests representing officially other scientific societies will be present. The programme as outlined it will consist of a luncheon at the Chemists' Club, 108 West Fifty-fifth Street, on Friday, followed by a session of the society at 2.30 p. m. An evening session for more formal addresses will be held at 8.30 p. m. The following day will be devoted to visits and excursions, followed by a supscription dinner in the evening. The first president of the society was Dr. John W. Draper, of this city. The present officers are: President, F. W. Clarke, chief chemist of the United States Geological Survey; vice-presidents, the presiding officers of the various sections; secretary, Albert Hale, of Brooklyn; treasurer, Albert P. Hallock, of New York. The society has about 1800 members. Sections are situated in all the large cities of the United States.

ELECTRIC CANAL TRACTION is discussed rather vigorously by the London *Daily Express*, which says: The stupidity that appears to be the inevitable associate of our conduct in some departments of our public affairs has hardly ever been more signally demonstrated than in the case of English canals, which have been allowed to pass to a large extent into the hands of the railway companies, whose only object, of course, is to kill off, so far as possible, every source of competitive traffic. These idle waterways could easily be made the means of economical transit for slow-carriage goods if they were once freed from the paralyzing grip of the railway companies. Canal traction by horse, of course, is doomed, and no one would pretend to revive it; but it has been proved abundantly—not in England, of course, but in France, Germany and the United States—that electric traction for canal haulage is one of the best and most economical ways in which that beautiful power can be exerted. Surely something could be done. A small generating plant would be sufficient to propel a whole fleet of canalboats, either from the towpath or from a trolley motor overhead. These are times when we must utilize all our sources, and to suffer a great avenue of trade and traffic to lie stagnant as we are doing is not merely bad policy, but an economical iniquity.

AMERICAN PHYSICAL SOCIETY will hold a regular meeting in New York City on April 27. The programme committee is Messrs. J. S. Ames, M. I. Pupin and Ernest Merritt.

WIRELESS TELEGRAPHY IN HAWAII.—A San Francisco correspondent states that the wireless telegraph system in the Hawaiian Islands is reported to be working satisfactorily between the islands of Oahu, Molokai and Maui. Commercial business and press dispatches are promptly attended to between the points named.

FRANCO-CHINESE CABLE.—A special dispatch of April 6, from Hong Kong, says: The foreign residents of Amoy are puzzled by the odd procedure of the French cable ship Diolabah, which last Wednesday laid a cable from Amoy out to sea without consulting the local authorities, who did not interfere with the progress of the work, supposing the Diolabah to be a transport. It was reported that a second cable ship was waiting outside for the purpose of connecting with the cable laid by the Diolabah. The direction of these cables is unknown. To-day the Diolabah returned off Amoy and cut the cable she had laid, taking the end aboard.

FRENCH WATER POWERS are now attracting more attention on account of the enhanced cost of fuel. The *Annales de Géographie* recently announced that there are now in the French Alps 48 factories whose power is electrically supplied to them from mountain streams. These factories have 250,000 horse-power brought to them by electricity generated from water power. Engineers estimate that at least 3,000,000 horse-power is now running to waste among the streams of the Alps which might be harnessed in the service of many industries and thus reduce the importation of coal. Several important projects are now under way. Work is in progress for the development of 10,000 horse-power near Bellegarde. A French engineer named Souleyre proposes to transform the lower Rhone into a "gigantic hydraulic stairway" by which industry and agriculture will largely profit. A committee of engineers appointed by the Ministry of Public Works and Agriculture is studying the project with a view to deciding upon its feasibility.

CURRENT RECTIFIER.—Among the difficulties to be overcome in rectifying alternating current is the sparking, which takes place on change of load, and that due to the "hunting" of the driving motor. A patent issued April 2 to Professor Elihu Thomson has for its purpose to meet these difficulties without having recourse to adjustment of the rectifier brushes. In one arrangement described, a two-phase synchronous motor is employed to drive a rectifier for three-phase currents. In this case one of the two motor-field circuits is connected directly to the supply line, and the other phase to the secondary circuit supplying the rectifier. The consequence of this arrangement is that as the load on the rectifier circuit, and, therefore, that on the secondary windings of the transformer system, vary, there are corresponding variations in the magnitude and phase of the current supplied to the motor from the secondary system, thus shifting the motor armature to bring the polar line into proper position with respect to the exciting field, and thereby adjusting the point of commutation of the rectifier to secure minimum sparking. To prevent hunting, the shaft of the rectifier is flexibly connected to the shaft of the driving motor by means of a helical spring. The rectifier shaft also carries a flywheel which stores up and restores energy due to the flexure of the spring. If the spring is so designed as to have a period of oscillation different from that of the period of oscillation of the motor, these two periods will so far fail to combine as to produce a nearly uniform degree of rotation of the apparatus driven through the medium of the spring.

METER PATENTS.—The budget of patents for April 2 contains five relating to electric meters. Two of these were issued to E. J. King and describe a meter for accurately registering the actual energy consumed on both inductive and non-inductive loads, and which at the same time is capable of adjusting for various amounts of meter friction without affecting the accuracy of the registration. Means are also provided whereby a meter may be adjusted for different frequencies. The armature is of the cup type, with the series coils located outside and the shunt coils inside. The latter are mounted adjustably in order that a torque sufficient to compensate for the friction of the heater may be obtained, this being done without disturbing the phase displacement of the shunt as a whole. In general there are two shunt coils in connection with an impedance coil exterior to the meter mechanism. One of the shunt coils is connected across the mains in series with the impedance coil, and the other shunt coil is connected across a portion of the turns of the impedance coil. In the operation of the meter the first shunt coil produces a magnetic field which lags in the neighborhood of 90 degs. behind the e. m. f. of the circuit, while the second shunt coil produces a field lagging by more than 90 degs. behind the impressed e. m. f. The resultant of these two e. m. f.'s may, by proper adjustment, be made to give a magnetic field lagging substantially 90 degs. behind the impressed e. m. f., and, therefore, differing by 90 degs. from the series field. To adjust for different frequencies, a third and adjustable winding is supplied which acts in opposition to the second shunt winding above mentioned, and which is in circuit on a high-frequency circuit and short circuited on a low-frequency circuit. A multiple rate system of metering is the subject of two patents granted to W. C. Fish. The distributing system has an additional wire with branches at the various consuming stations. Each of these branches leads through a solenoid which controls means for cutting in or out a resistance in series with the meter armature. During the hours of heavy load, current flows through the auxiliary wire, and acting upon the solenoidal switch, causes the above-mentioned resistance to be kept out of circuit on the two-rate meter, and at the same time throws into circuit a maximum rate meter. As the load goes off from the station, current is cut off from the auxiliary wire, the result of which is to throw the additional resistance into the two-rate meter, and at the same time throw out of circuit the maximum meter. This arrangement will encourage the customer to use as little current as possible at the peak of the load, and avoid taking a heavy load for even a short time during heavy station load. On the other hand, he will be encouraged to use current freely at the times when the station is best able to furnish it. A patent granted to C. S. Jameson is on the form of an armature for electrical measuring instruments, the object of which is to increase the torque of the instrument and to provide for an open reading scale. The armature consists of oblong disks of magnetic material mounted on the axis of the instrument in such a manner that their planes lie at an angle to each other; or a pair of disks be so arranged that one of them will enter the field behind the other. The plane of the coil furnishing the field for the armature is at an angle with the axis to which the latter disks are secured.

LETTERS TO THE EDITORS.

The Skinkle Telephone.

To the Editors of Electrical World and Engineer:

Sirs:—In your edition of March 23 a description of a "practical" telephone, invented by Mr. Skinkle, was noted by Mr. R. W. Vickery and myself. The practicability of the transmitter was doubted by us, as to whether it would properly articulate speech, so we decided to construct one in our laboratory, to satisfy our curiosity.

With different membranes, including paper, as a diaphragm, we were unable to distinguish more than the ordinary key or note of the voice, in a receiver. No word or letter could be produced.

I do not see how it can be called a practical speech transmitter, as it acts in the receiver similarly to the different tensions of a spring. It certainly does not produce articulated speech properly.

City Island, N. Y. E. J. Williams.

The Dolbear-Marconi Litigation.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of March 23, an article entitled "Marconi Wireless Telegraph Patents Sustained," contains some erroneous statements, and to which latter I trust I may be pardoned for calling your attention.

In the first place, in the suit of Professor Dolbear's assignee, Learned vs. Marconi, no patents of Marconi were involved in any way. The suit was one brought upon the two Dolbear patents of December, 1882, and Oct. 5, 1886, which were alleged to be infringed by the apparatus used by Marconi.

In the next place, the dismissal of the complaint in this suit was not after a hearing upon the merits, and would, therefore, be no bar to a new suit upon the same patents. The suit was dismissed because the plaintiff did not appear when the case was called, and this may have been because he abandoned his case, but also, and what is more likely, may have been because some arrangement was made between plaintiff and defendant by which the former agreed to drop the suit for reasons unknown to the public. There was, therefore, no determination upon the merits that the Marconi apparatus did not infringe the Dolbear patents, and so the matter stands to-day. It is also of interest to note that the testimony of both sides has been withdrawn from the files of the Court, a most unusual proceeding, and for which no reasonable solution can be offered, except that this testimony was of such a character as to seriously threaten the interests of some one, should they remain a public record, and between the two the interests of defendant are much more likely to be important. Clifford E. Dunn.

New York.

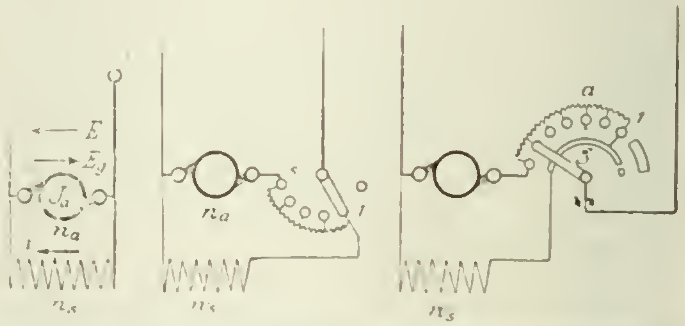
DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Friction and Hysteresis Losses in Three-Phase Induction Motors.—Hissink.—A paper read before the Elektrotechnical Society, of Berlin. He called attention to the very great differences often found between the measured and the calculated hysteresis losses in induction motors, while in transformers the calculated iron losses are generally in good agreement with the measurements. He says that those differences cannot be explained by a "rotary hysteresis." He calls attention to the fact that in tests the friction losses are usually assumed to be independent of the voltage. This would, however, be correct only for an ideal motor with no eccentricity. In induction motors, however, as built at present with a very small air-gap, a small amount of eccentricity causes a large mechanical force and the friction loss increases considerably with the voltage. The same is the case with the hysteresis loss. He divides the no-load losses of a motor into four parts: Friction loss for an ideal motor, additional friction loss due to eccentricity, hysteresis loss for an ideal motor, additional hysteresis loss due to eccentricity. He also gives the results of some tests. In the discussion which followed, Georges remarked that another cause of the increased hysteresis loss is the following: He assumes that the stator has open slots and that a tooth of the motor is not as broad as a slot of the stator. If six slots are assumed for a pole, 12 slots correspond to a pair of poles, hence in the time of a period the tooth of the rotor is magnetized and demagnetized 12 times, synchronism being assumed. The slip diminishes the number a little. It is evident that with open slots in the stator there must result a very considerably additional hysteresis loss in the teeth of the rotor. With closed slots, this loss is smaller.—*Elek. Zeit.*, March 7.

Measuring the Slip of Induction Motors.—Seibt.—A description of simple methods for measuring the slip. With an armature with slip rings, the armature current itself gives a convenient means of measuring the slip. If an ammeter is connected between two slip rings, the needle oscillates around the average value at which it would rest at higher frequency, and for the same effective current. If these oscillations are counted for a certain time, the slip is found. It is equal to the number of complete oscillations, divided by the double product of the time and the frequency of the primary current. Another simpler method which may be used also for squirrel cage armatures, is the following, in which an artificial alternating current is made which has the same frequency as the armature current. To understand the principle suppose that in the circuit of an incandescent lamp supplied from the same voltage as the motor, there is a switch which is opened and closed in synchronism with the frequency of the alternating current. In this case the lamp will burn continually with a certain luminosity or will be entirely dark, depending on whether the time during which the circuit is closed, is while the voltage is at the maximum or at the zero point. As a switch the Joubert contact maker can be used. But if this switch is fixed on the axle of the motor under test, the closing and opening of the contact is not in synchronism with the alternating current of supply, on account of the slip. Assume as a starting point, that corresponding to the moment the circuit is closed and the voltage is maximum, then at the moment of the next contact the voltage is smaller, etc. The starting point is reached again, when the motor is lagging by 1/p revolutions, when p is the number of pairs of poles. During this time the incandescent lamp is supplied with an often interrupted alternating current of the frequency of the armature current; hence the lagging of the motor by 1/p revolutions corresponds to lighting of the lamp twice. If the oscillations of the light of the lamp are counted per minute, the slip is found by a very simple formula. Instead of the lamp, a voltmeter or a Morse writing apparatus may be used to advantage.—*Elek. Zeit.*, Feb. 28.

Sparkless Disconnection of Shunt Motors.—Krause.—An article in which he discusses mathematically the conditions under which the disconnection of a shunt motor occurs without sparks. This is possible by a quick opening of the switch A, in Fig. 1. In this case it is necessary, however, that the motor runs at normal speed, so that the armature is under the full supply pressure. No part of the pressure must be consumed in the starting resistance, otherwise sparks will occur. By the rapid opening of the switch A the counter e. m. f. of the revolving armature is connected to the field, and the armature acts as generator on account of its kinetic energy. Fig. 2 shows an arrangement of Fischer-Hinnen, which explains itself. It will be seen that at normal speed the lever of the switch is at the point s, so that the starting resistance is in series with the field, but as its resistance is not more than 5 per cent of the resistance of the field winding, an increase in the speed of the motor of much less than 5 per cent results, which is negligible. The arrangement shown in Fig. 3 has been proposed by Menges. It is not as good as that in Fig. 2 for larger motors, while for smaller motors in workshops the disconnection is made sparkless just as well by the arrangement of Fischer-Hinnen, which has the advantage that the rod S is unnecessary.—*Elek. Zeit.*, March 14.



Figs. 1, 2 and 3.—Sparkless Disconnection of Shunt Motors.

References.

Theory of Three-Phase Alternators.—Niethammer.—A brief mathematical article, illustrated by diagrams, in which he shows how to calculate the voltage drop of three-phase alternators.—*Elek. Zeit.*, March 21.

Measuring the Slip of Induction Motors.—Rosenberg.—A communication referring to article of Seibt (see above). He calls attention to older methods, described in the Digest several years ago, of measuring the slip with an induction coil and a telephone.—*Elek. Zeit.*, March 14.

Short-Circuited Armature.—Fischer-Hinnen.—A communication referring to the article of Osnos (Digest, March 23). He corrects a misprint in a formula in one of his older papers and shows that it is in agreement with a formula of Roessler.—*Elek. Zeit.*, March 14.

Lights and Lighting.

Efficiency of Electric Lamps and the Electrolyte Arc Light.—Nernst.—An article in which he criticizes several points in the article of Rasch (Digest, March 9). Rasch gives the energy consumptions per Hefner candle at 1.5 to 1.6 watt for the Nernst lamp and at 0.5 watt for the direct-current arc lamp. Nernst remarks that there is a misunderstanding in so far as such numbers can be compared only if they are reduced to spherical candle-power. He gives some calculations based upon tests of arc lamps made by Wedding. With a 9-ampere alternating-current arc lamp Wedding finds 1.38 watt per candle from the average candle-power in the space below the horizontal. As with alternating-current arc lamps the distribution of light is symmetrical above and below the horizontal, the value 1.38 watt per candle also represents the spherical candle-power. With a 9-ampere direct-current lamp, Wedding found about 0.5 watt per candle for the space below the horizontal; but as direct-current lamps do not send much light upwards, Nernst multiplies this value by 2, to get the average spherical candle-power in the room. Under consideration of the necessary resistances in series, he finds the energy consumption of an alternating-current arc lamp to be 1.9 watt per candle, and that of a direct-current arc lamp 1.37 watt. For the Nernst lamp, under consideration of the necessary resistance in series, he gives 1.9 watt per candle, from measurements of the spherical candle-power with a life of 150 or 300 hours. He remarks that with a life of 10 to 20 hours he could get a better efficiency than that of alternating and direct current arc lamps; but in practice long life is more important than high efficiency. He remarks that the efficiency of arc lamps is further reduced by the absorption in the globes. He says there are often exaggerated ideas of the efficiency of arc lamps. While one speaks of 0.5 watt lamps, in practice, 2 watts in the best case and often more are consumed. Regarding the electrolyte arc light of Rasch he says that he has made experiments in the same direction. When the incandescent filament of a Nernst lamp becomes faulty in the central part, an arc is often formed. Nernst also found that at the ends of the arc there are enormous temperatures and a corresponding development of light, but regarding the practical application he has arrived at a conclusion different from that of Rasch. Nernst found a very rapid vaporization of the ends, and contrary to the facts in the direct-current carbon arc, in this case the negative pole was consumed more rapidly. He thinks that this fact might become of importance for the theory of the arc light. He found that when he used the same incandescent materials as in his incandescent lamp, the poles were consumed so rapidly that the life of such a lamp is much too short for the requirements of practice. Nernst also says that Rasch's numerical values of the efficiency of his electrolyte arc light must be "corrected very considerably on account of the reduction to spherical candle-power." He remarks, however, that he can judge only from his own experience, and that his negative results do not mean that some one else may not get positive results.—*Elek. Zeit.*, March 21.

Arc Lighting.—An illustrated article on the arc lighting of the Fulham corporation. The alternating-circuits are passed through Ferranti rectifiers, which supply two arc lamp circuits with rectified current. The arc lamps are arranged 44 in series—alternate lamps on each circuit. The lamps are of the 12-ampere, 32-hour double-carbon type. The controlling solenoids are differentially wound, and are extra powerful, so as to be practically independent of the friction of the working parts of the lamp. The feed is controlled by racks cut on the negative slide rods, geared up to escapements and balance sheets which are not affected by tilting the lamp. The movements of the balance wheels, and consequently of the carbons, are controlled by spring catches, which exert a very slight pressure, so that a feed can be started and stopped with a minimum expenditure of energy, and consequently a small variation in the length of the arc. This arrangement stands any amount of vibration without letting the carbons run together, and also ensures constant "feeding points." There is no periodic changing over of the arc from one pair of carbons to the other, and there are no parts that can suffer from the wear and tear of trimming. The movement of the lever, which is operated by the two plunger cores, is normally very small, owing to the good regulation of the lamp mechanism. Should, however, the voltage get too high, owing to the lamp failing to act, or the carbons being both burned out, the shunt coil pulls its core down, and the current is shunted by a special contact through a small resistance and a third terminal, thus releasing an automatic switch, and putting on two in candescent lamps which are on the private lighting mains. This cut-out arrangement cannot be opened if the carbons are burnt out, or if no carbons are in the lamp. It comes into operation when the lamp is only 5 or 6 volts above normal pressure. The weight of the holder of the first burnt-out carbon is always part of that of the mechanism. There is, therefore, no alteration of voltage when the second carbon comes in. The weight on the mechanism is always constant.—Lond. *Elec. Rev.*, March 22.

Traction.

Polyphase Electric Railways.—Cardew.—An abstract of the second of his Cantor lectures on electric railways. He dealt mainly with the Ganz system of polyphase traction, as proposed for the Inner Circle in London. The pressure proposed is 3000 volts. He considers this can be rendered safer even than with 500 volts on a third rail near the ground, because the polyphase conductors can be placed overhead and they can readily be protected by short-circuit devices in the event of their falling. On the train, the engine driver and other persons are protected from the high voltage by the use of compressed air for working all the regulating gear. Thus the trolley is raised or lowered, the switches are regulated for varying speeds and the resistances are adjusted, all by means of pneumatic controllers. Gearing is dispensed with, thought not at the sacrifice of spring suspension. The motor shaft is hollow, its inner diameter being much larger than the wheel axle passing through it. Flexibly connected links convey the power from the rotor to the driving wheels. By this arrangement considerable lateral movement is possible in the rotor without interfering with its driving rate.—Lond. *Elec., Elec. Eng.*, March 22.

Conduit and Trolley.—An editorial on a paper read by Connett before the Brit. Inst. Mech. Eng. on "Combined trolley and conduit surface systems." This combination is particularly adapted to cases where the tramway or light railway passes, over a portion of its route, through crowded city thoroughfares, and over the remaining portion, through less crowded suburbs or rural districts. The chief problem related to the junction between the two systems, at which point cars passing in either direction would have to undergo some effective and rapid process of conversion from one system to the other. "The Washington system of conversion is clumsy and costly, while the ingenious system of almost automatic conversion used in Berlin is not adapted to conduits having narrow slots" (such as are required in Great Britain). The question is then raised, Why such a complication is needed at all? The slotted conduit system cannot be extended into rural portions of the tramway as it would not pay, but why exclude the trolley system from the principal streets of cities and large towns? Alleged æsthetic defects and the danger of fatal accidents from falling trolley wires are said to be poor objections. The one outstanding objection against the trolley system is said to be the electrolytic corrosion of water and gas pipes from stray return currents. Attention is called again to a system of insulated return surface-contacts which would entirely obviate this difficulty, and at far less cost than a slotted conduit. Nevertheless, where the volume of traffic is sufficiently large and steady to justify the extra capital outlay, the slotted conduit provides an admirable method of equipping city tramways."—Lond. *Elec.*, March 22. The first part of a long illustrated abstract of Connett's paper in Lond. *Elec. Rev.*, March 22.

REFERENCES.

Huddersfield.—A well illustrated description of the municipal tramways of Huddersfield, England, which have recently been changed from steam to the trolley system. There are two over-compounded dynamos giving 500 volts at no-load and 550 volts at 375 kilowatts.—Lond. *Elec.*, March 22.

Basel.—Perkins.—An illustrated description of the new railway power plant at Basel, Switzerland.—*West. Elec.*, March 30.

Current Supply to Long Roads.—Sieber.—A reply to Rasch's last communication. He maintains that the conclusions of Rasch cannot be correct for general cases.—*Elek. Zeit.*, Feb. 28.

Installations, Systems and Appliances.

REFERENCES.

Central Station Records.—Farrer-white.—The first part of an illustrated article on "The card system applied to central electric supply stations." It is doubted if books are really adapted to central station record, and a card system is recommended instead. An outline of such a system is given. This card deals with the consumers' department and the meter department.—Lond. *Elec. Rev.*, March 22.

Charging for Energy.—De Fodor.—A communication in which he says that the maximum demand system is sometimes unfair. He suggests a different method of charging, in which three different percentages of discount are allowed at different times of the year.—*Elek. Zeit.*, Feb. 21.

Wires, Wiring and Conduits.

Insulation on Cables.—O'Gorman.—A continuation of his very long Brit. Inst. Elec. Eng. paper, the first part of which was abstracted in the Digest last week. He refers briefly to the methods of finding the specific capacity of any one quality of insulation, and calls attention to the fact that across a composite insulation the potential gradient divides itself inversely as the specific capacity of the various separate layers. Substances of dissimilar specific capacities can be utilized in much the same way as those of dissimilar conductivities for "grading" the layers of insulation and obtaining a uniform stress in all parts of the coating of a cable under alternating pressures. If an insulation is assumed to be made up of elementary condensers in series, and if the specific capacity of every layer of the insulation is arranged so that the elementary condensers have, in spite of the difference of area, the same capacity, then when they are all given the same charge they will have the same difference of pressure between their two sides, i. e., the stress in every part of the dielectric is uniform. As now made, cables are often inversely "graded." A large class of fibre cables are given their final impregnation by immersing them in their entirety in a tank full of a mixture of an oil and some solid hydro-carbon, which, as in the case of resin, frequently has a higher specific capacity than the oil and paper, as well as a greater disruptive strength. During the progress of this impregnation, the fibres of the outer layers have the effect of filtering the solute from the solvent, and although the oil reaches and fills up all the pores of the innermost layers of paper, the solid is filtered away and only reaches the outer portion of the dielectric which consequently has the greater dielectric strength and capacity where they are not wanted. That the dielectric strength should be greater in this particular portion is of little consequence, but that the capacity should be greater is a danger, because it tends to make the potential gradient steeper even than it would be in a homogeneous insulation close to the conductor. On the other hand, it would be worth trying to utilize this fact to graduate the conductivity or capacity by choosing the oil and solid so as to have a suitable viscosity at the temperature of the impregnating tank. A similar faulty arrangement is met with in ordinary vaulcanized rubber cables. It might be possible to grade paper cables by "loading" the paper with barytes, clay, gypsum, etc. He briefly refers to the calculation of the capacity of a three-wire cable and of a two-wire cable, and begins to discuss the radial depth of dielectric, which is practically the foundation of the power-cable makers' art. The paper is to be concluded.—Lond. *Elec.*, March 22.

REFERENCE.

Aluminum Welding.—Some brief notes on a process of Cowper-Coles. Some specimens of welds made by this method were shown at a recent meeting of the Royal Institute. No details of the method are given, but it is said that it is not electric in nature, and that no flux or solder of any kind is used. The results are said to be satisfactory.—*The Electrochem. and Met.*, March.

Electro-Physics and Magnetism.

Elementary Quantities of Matter and Electricity.—Planck.—From his own electromagnetic theory of radiation, in combination with a result of Boltzmann's mechanical theory of heat, he arrives at the following interesting results for a monatomic gas. The weight of the atom is 1.64×10^{-24} gram; the number of gas molecules in 1 cc. at 0 degs. and 1 atmosphere, 2.76×10^{19}; the mean kinetic energy of an atom at absolute temperature, 1 deg., 2.02×10^{-16}; the charge of a positive monovalent electron, 4.69×10^{-10} electrostatic units. If the theory holds good at all, these values are very much more definite than anything yet given. *Ann. der Physik*, No. 3; abstracted in Lond. *Elec.*, March 22.

Deformation of a Dielectric in an Electrostatic Field.—Sacerdote.—An article in which he criticizes the paper of More (Digest, Sept. 8), who had found experimentally that the stress occurring in the ether when a dielectric is electrostatically charged, causes no mechanical deformation of the substance. The present author shows that this conclusion is not justified, as the ararngement of More's experiments was such that no deformation could have been detected.—*L'Eclairage Elec.*, March 2.

Propagation of Electric Waves in Water.—Gutton.—When the electric and magnetic properties of an insulator depend only upon its dielectric constant, the wave-length of a resonator remains the same when measured first in air and then in the insulating medium. This proposition was deduced by Blondlot from considerations of homogeneity, and verified in the cases of castor oil and ice. If the medium is magnetic, or conducting, or if it shows considerable absorption for electric waves, its properties are no longer completely defined by the dielectric constant, and the equality of wave-lengths of a resonator in air and in the medium, cannot be certain. This is the case with ordinary spring water, which shows a decided conductivity and absorption of electric waves. The present author therefore measured the wave-length of a simple resonator in air and in water, and found that they were practically the same when the resonator and the wires were either out in the air or immersed in water. He also found that the path traversed by the waves during one period of the resonator oscillating in air is 8.3 times smaller in water than in air. This implies that when a resonator is plunged into water its period of oscillation becomes 8.3 times greater than in air.—*Comptes Rendus*, March 4; abstracted in Lond. *Elec.*, March 22.

Electric Effluvium.—Leduc.—A description of some remarkable properties of the silent electric discharges, produced by rapidly charging a condenser consisting of a metallic sphere on the one hand, and a sheet of aluminum with a central perforation on the other hand, separarted by a plate of glass or celluloid. The central portion of the plate is on both its faces the origin of violet and ultra-violet rays, which can be concentrated by a quartz lens. These rays produce an intense fluorescence on a platino-cyanide screen without concentrating the beam. Photographic effects are obtained which surpass in intensity those produced by sunlight. The rays are particularly valuable for Finsen's treatment of anæmic tissues. These are compressed by means of a quartz plate contained in an ebonite frame, which directly adjoins the aluminum sheet forming one armature of the condenser. The diseased tissue is thus exposed to rays which have only to traverse a thin plate of quartz. The apparatus may be worked with an induction coil or an influence machine.—*Comptes Rendus*, March 4; abstracted in Lond. *Elec.*, March 22.

Secondary Radium Rays.—Curie and Debierne.—An account of an investigation of the phenomenon that any substance placed in the neighborhood of a radium preparation becomes radio-active itself and also retains its radio-activity. It appears that only the most easily absorbed rays enter into this phenomenon. They are absorbed by the air, and in the process of absorption, they impart some property to the air which is diffused by convection, and eventually reaches the body exposed. They suspect a close connection between magnetic deviation and the absorption of rays.—*Comptes Rendus*, March 4; abstracted in Lond. *Elec.*, March 22.

REFERENCES.

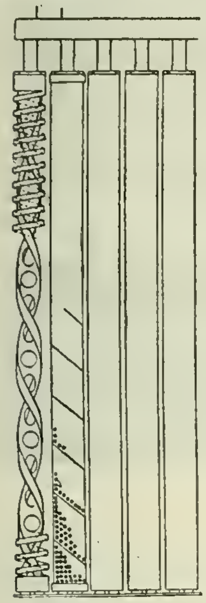
Losses in Sheet Iron.—Benischke.—A communication in which he criticizes some remarks of Kamps on the separation of the iron losses according to a well known formula, and on the influence of a surface layer of oxide on sheet-iron.—*Elek. Zeit.*, Feb. 21.

Theory of Permanent Magnets.—Burch.—For the most important application of permanent magnets, for instance, in measuring instruments like the Weston, and in electric meters, the knowledge of the number of lines of induction in the useful air-gap is necessary. He describes a method which enables one to calculate the magnetic flux if the magnetization curve of that quality of steel is known.—*Elek. Zeit.*, March 14.

Terrestrial Magnetism.—The December issue of this journal contains a long illustrated summary of magnetic observations made chiefly by the United States Coast and Geodetic Survey on the day of the total solar eclipse, May 28, 1900. An appeal, by Bauer, for international co-operation in magnetic and allied observatories during the total solar eclipse, May 17, 1901. The first part of a summary by Exner, of the results of recent investigations in atmospheric electricity, this part dealing with the annual and the daily variation. The first part of an article, by Littlehales, giving the results of some recent magnetic investigations in Italy, this part dealing with researches into the causes of local magnetic action in regions adjudged by their geological formation, to be non-perturbing. Also a good reproduction of a photograph of the later Hermann von Helmholtz, taken while delivering one of his lectures on mathematical physics.—*Terr. Magnetism*, Dec.

Electro-Chemistry and Batteries.

Storage Batteries.—West.—The first part of an illustrated article on recent progress in accumulator manufacture. The greatest defect is the disintegration of the active material in the positive plates. This causes a diminution of capacity and may lead to short circuits. If the pellets in the cellular apertures or grooves of a grid become loose, so that there is a space between them and the grid, a layer of sulphate forms in that space, and practically insulates them, thus enormously reducing the capacity of the cell. The causes which produce this loosening are mechanical vibrations, and variations in the volume of the active material relative to that of the recesses in the supporting grid. There are two ways of meeting this diffijculty. One is to so shut in the paste over both surfaces of the plate that it is practically supported at all its parts. The other method is to make the metallic support contract and expand with the active material. In the last direction the Blot and the Sherrin accumulators are said to have probably succeeded best. In the Blot cell corrugated ribbons of rolled lead are wound round a hard-lead former to which they are soldered at each end. The bundle of ribbons is then sawn in half and suspended in a light frame by the soldered ends, the other ends being left absolutely free to expand both longitudinally and laterally. The weak point in this construction would appear to be that in time the ribbons which are only 0.5 mm. thick must be eaten through and become extremely brittle. In the Sherrin cells the positive plates are built up of a number of rods consisting of a helical core of I-section pasted so as to form a cylinder. A helix cut from an ebonite tube is passed over this core to increase the thickness of the layer of paste and to help support it. The adjoining figure shows a plate in elevation. The slight twisting and untwisting of the core and the ebonite helix provides londitudinal contraction and expansion, and holes drilled at intervals through the web of the core give lateral springiness. This battery was very successful in the Automobile Club's competition. It was the only one which did not fall below the specified voltage (1.7 volts per cell) more than three times during the whole competition. It also gave the highest mean energy efficiency of any, namely, 70 per cent.—*The Electrochem. and Met.*, March.



STORAGE BATTERY PLATE.

Tanning by Electricity.—An article in which it is said that the slowness of the old process of tanning is largely due to the difficulty with which the tannin penetrates into the hide. As the penetration progresses, the outer part of the hide becomes converted into leather and is thereby made impervious, consequently the rate of penetration decreases. Groth's process has been found to shorten the time of tanning to a quarter of that necessary when no current is used, and the leather is said to be unexceptionable. His apparatus is designed to hasten tanning by circulation of the tan liquor as well as by the use of electricity. The tan liquor is contained in a tank in which is a frame carrying hides, and capable of being moved to and fro or rotated so as to bring the hides continuously into contact with fresh liquor. Copper electrodes are placed at the side of the tank. For a vat holding 1500 gallons a current of not more than 4 amperes is used. Another process, consisting essentially in passing a current of 12 amperes at 60 volts between electrodes of nickel-plated copper through a bath in which tanning liquor was continually circulated by a pump, proved to be capable of tanning heavy leather in about six days, the product being not inferior to that prepared by the old process in 12 months.—*The Electrochem. and Met.*, March.

REFERENCES.

Electrolysis of Organic Compounds.—Hewitt.—A continuation of his article. In this part he begins to discuss the application of electrolytic methods upon the organic compounds of the fatty series, and starts with hydrocarbons.—*The Electrochem. and Met.*, March.

Estimation of Metals by Electrolysis.—Nathan.—A continuation of his article. After some general remarks he gives brief descriptions of methods of estimating copper, cadmium, bismuth, manganese, lead, silver, mercury, gold, platinum, antimony, tin, arsenic, iron, zinc, nickel and cobalt.—*The Elektrochem. and Met.*, March.

Electrolysis and Color.—An anonymous article on electrical methods of pigment making and dyeing.—*The Electrochem. and Met.*, March.

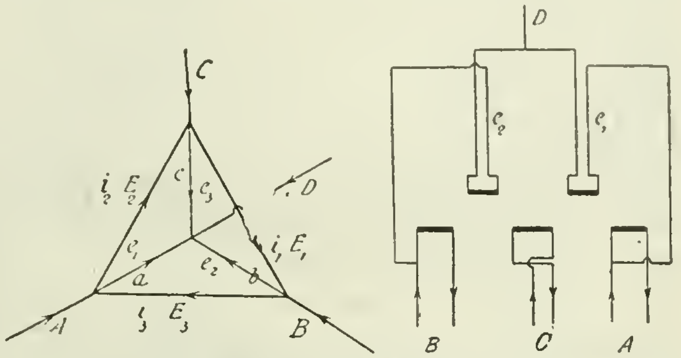
Manufacture of Parabolic Searchlight Reflectors.—Cowper-Coles.—The first part of a very long illustrated article on his electrolytic process for the manufacture of parabolic reflectors for searchlights and locomotive headlights.—*The Electrochem. and Met.*, March.

Units, Measurements and Instruments.

Meter for Four-Wire Three-Phase Systems.—Aron.—An illustrated description of a meter for such systems, which reads correctly for star as well as for delta connection, and is independent of the differences in the load on the three phases. In the adjoining figure, let A, B, C be the currents in the feeders of the three phases, and $E_1\, E_2\, E_3$ the ring e. m. f.'s, $e_1\, e_2\, e_3$ the star e. m. f.'s, in a combined star and delta connection as indicated in the adjoining figure, he shows that in the general case the power may be expressed by the formula

$$W = A\, e_1 + B\, e - C\, (e_1 + e_2)$$

This formula is applied in his meter, the arrangement of which is indicated in the second diagram. There are three coils, placed side by side and supplied with the three currents A, B, C, respectively. Two pendulums, bearing voltage coils, are oscillating above the three-current coils so that each pendulum is acted upon by two of the current coils. The voltage coil, which is acted upon by the currents A and C, is under the pressure e_1; i. e., the pressure between the phase A and the "neutral wire.' The voltage coil, which is acted upon by the currents B and C, is under the pressure e_2. A modification of this arrangement is also described.—*Elek. Zeit.*, March 7.



FIGS. 1 AND 2.—METER.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—An illustrated article on Guarini's wireless telegraph experiments in Belgium. Having satisfied himself that successful wireless telegraphic communication could be maintained between Malines and Brussels on the one hand, and between Malines and Antwerp on the other, Guarini has now tested his repeater with the object of retransmitting automatically to Antwerp the signals received at Malines from Brussels. Unfortunately, this trial has not been eminently successful. Individual letters and signals were received, but some failed to actuate the repeater at Malines, and others, although received at Malines, did not register themselves at Brussels, so that the transmission of actual messages was found to be absolutely impossible. The apparatus used by Guarini is briefly described. There is also a communication by Poncelet on some details of the experiments and especially on disturbing influences of atmospheric electricity.—Lond. *Elec.*, March 22.

Wireless Telephony.—Ruhmer.—An article in which he describes a new transmitter and a new receiver for wireless telephony. After pointing out that a small current intensity in the "speaking arc" is bad for acoustic effects, but very good for the fluctuations of luminous intensity used for transmission, he proceeds to dispense with the arc altogether, and substitutes for it a chalk or zircon block mounted on the telephone diaphragm itself and heated in the usual way by means of an oxy-hydrogen flame. The slight vibrations of the telephone disk suffice to alter the position of the luminous body in the flame, and thus to vary its luminosity in a way which is suitable for the transmission of speech. At the receiving station the high resistance of selenium cells has hitherto presented a difficulty. He gets rid of it by substituting for the selenium cell a "radio-microphone," a kind of carbon coherer mounted in the focal line of a parabolic mirror. The differences in temperature produced by the impact of the light upon the carbon are sufficient to actuate a telephone receiver. He also suggests a bolometer as receiver.—*Phys. Zeit.*, March 2; abstracted in Lond. *Elec.*, March 15.

REFERENCE.

Block Signals.—Ehrenfest.—A long illustrated description of the system of automatic electric block signals used on the Southern R'y of Hungary.—*Elek. Zeit.*, March 7.

MISCELLANEOUS.

Magnalium.—Kaempfer.—An article on alloys of aluminum and magnesium, especially Mach's magnalium, which has been repeatedly referred to in the Digest. The article deals mainly with the mechanical properties of magnalium, which is very hard and strong, and can be easily treated with tools, as already noticed. It is also said that the electric properties of magnalium are now being studied. It has been found that its conductivity is considerably higher than that of pure aluminum. The specific gravity of magnalium is less than one-third that of brass. The prices of equal volumes of brass and magnalium are in the proportion of 2 to 3 for large pieces and 1 to 2 for small pieces. This difference in the price is due to the high price of magnesium, which is at present $4.50 per kgr. It is, however, hoped that the price of pure magnesium will decrease considerably when the demand increases.—*Phys. Zeit.*, March 2.

REFERENCES.

Magnetic Separation.—Smits.—An illustrated translation in abstract of his paper on some applications of the Wetherill process of magnetic separation. Descriptions are given of the treatment of the tailings of the dressing works of Broken Hill, containing a mixture of galena, blende and garnet, also of the installation at Lohmannsfeld, Germany, where a deposit of ore consisting of galena, siderite and blende, with a gangue of quartz and quartzite is worked. The siderite contains up to 12 per cent of manganese.—*Eng. and Min. Jour.*, March 30.

Reyval.—Illustrated descriptions of a 350-kw direct-current dynamo of Mather & Platt; also of a 270-kilovoltamp three-phase alternator of the Allmanna Svenska Elektriska Aktiebolaget de Vesteras, Sweden.—*L'Eclairage Elec.*, March 16.

New Books.

BOOKS RECEIVED.

Hanbuch der Elektrischen Beleuchtung. Von Joseph Herzog und Clarence Feldmann. Second edition. Berlin: Julius Springer. 619 pages, 517 illustration, 5 plates. Price, 16 marks.

Elektro Ingenieur Kalender, 1901. Von Arthur H. Hirsch und Franz Wilking. Berlin: Oscar Coblentz. 173 pages, illustrated, with detachable notebook. Price, 2.50 marks.

A Novel Electric Sign.

By Orrin E. Dunlap.

Paul M. Lincoln, of the Niagara Falls Power Company, has been experimenting with an electric sign which is the invention of Mr. C. E. Skinner, insulation expert of the Westinghouse Electric & Manufacturing Company. This sign has been installed in the transformer station of the Niagara Falls Power Company, and promises to prove an attractive and weird electrical feature at the Falls.

There is a very good prospect that visitors to the Pan-American Exposition will have opportunity of inspecting it in the full glory of its operation, and if so they will view an excellent representation of thunder and lightning. Though the invention is classed as an electric sign, it also makes thunder and lightning in close competition with natural forces, and to hear it and see it is to make a person feel like seeking shelter from a storm about to break. Even a change in the atmosphere is noticeable, and as the lightning plays in all kinds of forms about the letters of the sign and the detonations of the discharges occur, it is hard to understand that the electric current that is feeding the display is controlled in its frightful fierceness by the hand of man.

The invention is suitable for almost any size of sign display, and the spectacle at various stages of the operation is well portrayed in the accompanying illustrations. The lightning flashes and the peals of thunder are produced by means of large glass condensers charged with high-voltage alternating currents. As the current is turned on at low potential the sign begins to glow and each letter is surrounded by a violet fringe. Then as the voltage is increased the lightning begins to shoot out in root-like formations, twisting, twirling, wriggling all about the letters, each of the serpent-like streaks being about a foot long. With the full voltage applied a different spectacle is presented, for it is then that the full discharges take place, as shown by the long flashes so well pictured about the word "Niagara."

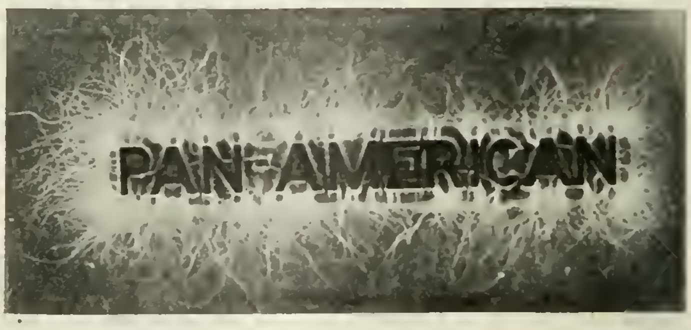


FIG. 1.—HIGH-VOLTAGE ELECTRIC SIGN.

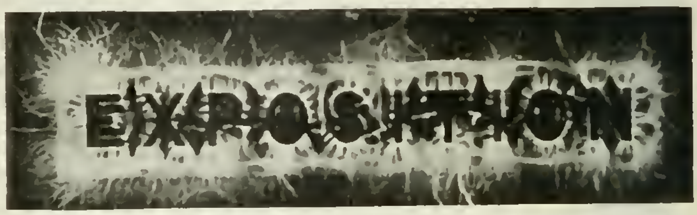


FIG. 2.—HIGH-VOLTAGE ELECTRIC SIGN.

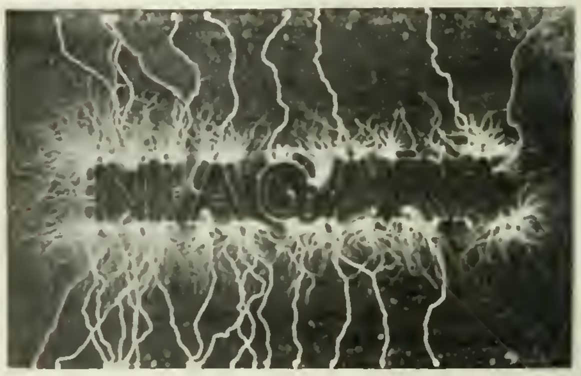


FIG. 3.—HIGH-VOLTAGE ELECTRIC SIGN.

As each of these full discharges occurs it is accompanied by a report that gives the thunder feature to the display, and the roar is truly ideal. A more perfect idea of the activity of the display can be gained from the statement that when the sign is receiving the full voltage, which is 40,000 to 50,000 volts, there are 250 complete discharges every second, each of which, as stated, is accompanied by a report that is thunder-like.

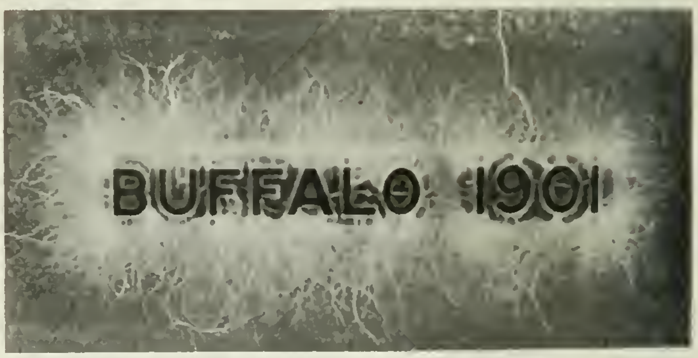
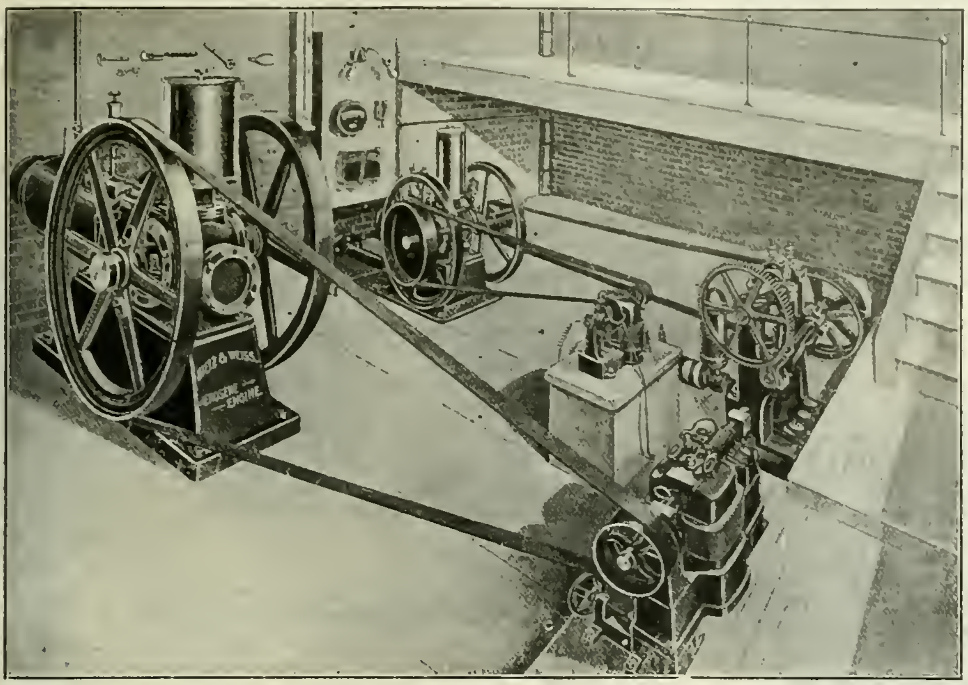


FIG. 4.—HIGH-VOLTAGE ELECTRIC SIGN.

A Residential Lighting Plant on Long Island.



RESIDENTIAL LIGHTING PLANT.

The illustration herewith shows a complete and well equipped power house for a large Long Island country house. Mr. G. A. Barker, the owner of this plant, used a small engine of the Mietz & Weiss system for some time for charging storage batteries, running fans and pumping, before the present larger installment was made. The new engine illustrated is a 10-hp belted to a 120-light generator. The smaller engine is a 2-hp belted to a triple pump of a capacity of 2000 gallons per hour, pumping water from a number of driven wells to a tank located in the tower of the power house about 100 ft. high. This engine has also a second pulley belted to a small dynamo.

The charging of storage batteries is a feature of great importance in many cases, as it introduces the electric carriage and electric launch. The fuel used in these engines is the ordinary grade of lamp oil or kerosene, of legal standard test, and the consumption amounts to three-fourths of a pint per actual horse-power per hour. This makes it at once a cheap and safe power. The self-ignition in the Mietz & Weiss engine, and its well-known constructional simplicity assure its reliability even in the hands of untrained attendants. These engines are fitted with automatic lubrication, an oil well at the side of the cylinder connected by copper pipe to sight feeds for the cylinder and connecting rod; by the suction of every turn of the shaft a small quantity is drawn in through the sight feeds when the engine is in motion. The main shaft bearings are provided with oil rings, carrying the oil from a well below the phospher bronze bushing to the shaft and returning again, thus furnishing a constant and economical system of oiling. These engines are manufactured in sizes from 1 to 40 horse-power by Aug. Mietz, 128 Mott Street, New York City.

Electric Propeller Fans.

The accompanying illustrations shows two styles of electrically-driven propeller fans manufactured by the B. F. Sturtevant Company, Boston, Mass. This type of fan is employed for the movement of large volumes of air under low pressures. The blades are so formed as to pick up the air at the inner edge at slow velocity, to move it forward in an axial direction, and when well under the influence of the blade to discharge it at the maximum velocity. These fans are driven either by engines direct connected, belted or direct-connected electric motors.

Fig. 1 shows a 42-inch fan driven by a direct-connected electric motor. The motor in the small and medium sizes is of the enclosed type, and rigidly held within a tripod support, the fan being carried upon the extended motor shaft. The motor is of the standard Sturtevant make, designed for continuous operation at high speed without overheating. It is of the enclosed type and dust proof. All the motors used for these fans can be wound for 115 and 230-type circuits, and some of them for 500 volts.

Fig. 2 shows a 72-inch fan driven by a direct-connected 8-pole motor. Motors of this design are usually installed upon an independent pedestal, as shown in the cut. They may, however, be installed in a manner similar to that shown in Fig. 1.

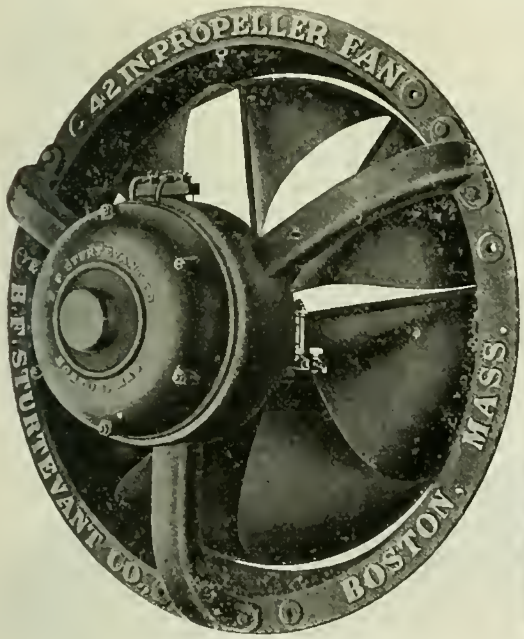


FIG. 1.—DIRECT-CONNECTED 42-INCH PROPELLER FAN.

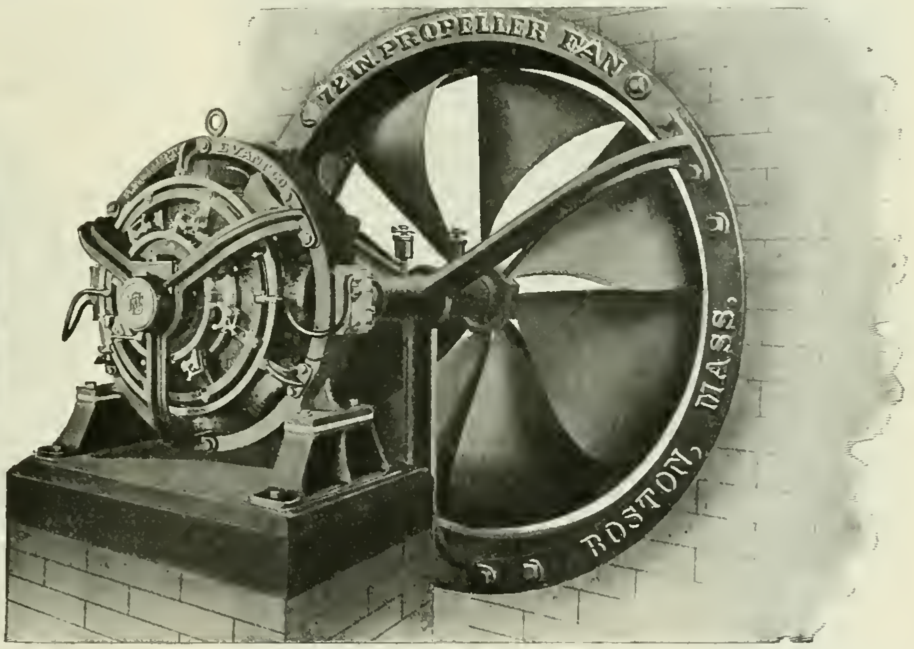
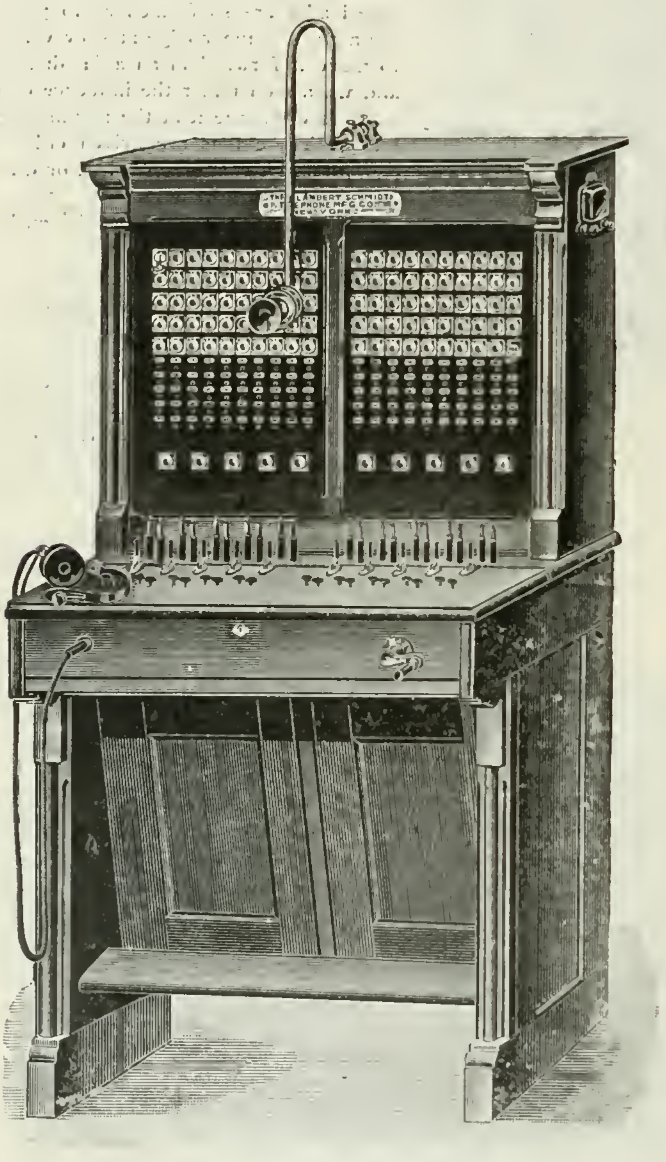


FIG. 2.—DIRECT-CONNECTED 72-INCH PROPELLER FAN.

Telephone System in a New York Hotel.

The new Manhattan Hotel, Forty-second Street and Madison Avenue, New York City, is unexcelled in elaborate and modern labor and time-saving devices, and unquestionably one of the most valuable accessories to the service is the telephone switchboard system, consisting of a 100-drop board and telephone. This plant was manufactured and installed by the Lambert Schmidt Telephone Manufacturing Company, of 325 Broadway, New York. This system is common battery with induction coils in the talking circuit. The method of calling from the telephone is by removing the receiver from the hook at the telephone station, which automatically raises the line drop at the switchboard, this drop staying in that position until the operator at the central inserts an answering plug in the proper line jack, when it immediately restores. The operator then throws down the listening cam, ascertains the connection desired, inserts the calling plug in the jack of that number, throws down the ringing key connected with this calling plug, and signals the telephone. When through talking, the hanging up of the receiver at either station raises the clearing-out drop corresponding with the pair of plugs in use, and this drop stays in that position until the correct pair of plugs are withdrawn. By this method, the operator's mistakes are reduced to a minimum and the handling of the calls becomes extremely rapid.

In the basement is located the battery closet supplying current for the entire telephone system and also an alternating-current motor generator for use in signaling the telephone stations from the switchboard. The wall telephones are small and compact, consisting merely of transmitter, double pole receiver, polarized ringer and automatic switch hook, mounted in a neat hardwood box. The desk telephones are of the all-metal portable type. A cut of the 100-drop switchboard is shown on this page.



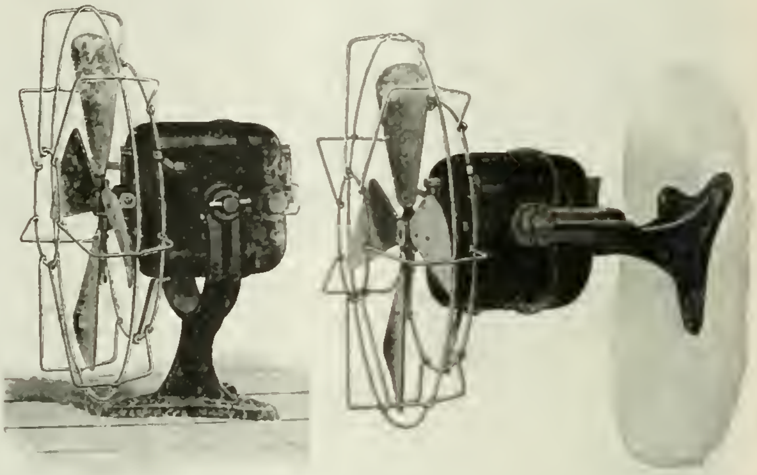
HOTEL TELEPHONE SWITCHBOARD.

Dayton, Ohio, Lighting Bonds.

N. W. Harris & Co., of New York, offer $400,000 first mortgage 5 per cent gold bonds of the Dayton Electric Light Company, of Dayton, Ohio, interest payable semi-annually; redeemable at 107½ and interest after March 1, 1906, Illinois Trust & Savings Bank, Chicago, trustee. These bonds are issued to refund an old issue of 6 per cent, and are part of the entire issue of $500,000, secured by a closed mortgage, and are of first lien on the entire property of the company.

Telephone Booth Fan.

The accompanying illustrations represent a fan designed by the Diehl Manufacturing Company, Elizabethport, N. J., for use in telephone booths and other places where space is limited. The fan can be adjusted to blow in any direction by means of a setscrew on the side of the trunnion. The machine can be fastened to the side wall or ceiling, or can be used as a desk fan. All that is necessary in any case is to fasten the base to the surface, whether the surface be horizontal or vertical. These fans are furnished with 9-inch blades and guard, and their compactness eminently fits them for the uses for which they are intended.



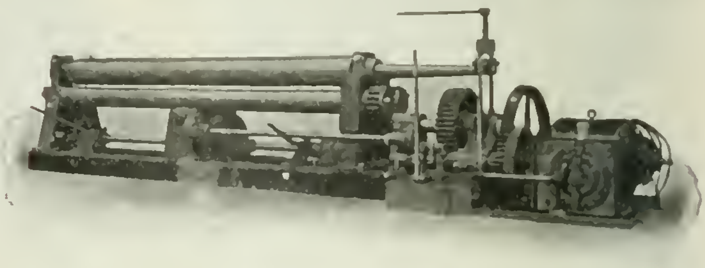
FIGS. 1 AND 2.—TELEPHONE BOOTH FAN.

Electrically Driven Bending Rolls.

The rolls of the electrically-driven bending machine shown in the accompanying illustration, are solid wrought-iron forgings, arranged in pyramid form, and have a capacity for bending plates up to 12 inches in width and ⅝ of an inch thick.

The lower rolls are geared together while the upper or bending rolls is revolved by the friction of the plate in passing through. It is adjustable by power to suit the thickness of the plate and the radius to which it is to be bent. It has a hinged bearing at one end which may be turned down out of the way, while the other end has a long shank extending to a third support, which retains the roll in position for the removal of rings or flues. This will be found a great advantage in boiler and other shops where plates are to be bent to a complete circle.

Midway between the housings a set of supporting rollers are placed to give additional stiffness to the lower rolls. For very long machines additional sets of rollers are added.



BENDING ROLLS DRIVEN BY ELECTRIC MOTOR.

The machine is firmly tied together by a heavy cast-iron soleplate. It is very strongly geared, and all parts are made stiff and substantial. Suitable levers and clutches are conveniently placed for the quick and easy control of all the operations. The machine is driven by an 18-hp reversible, constant-speed Bullock motor. For controlling the motor, an automatic rheostat is used to prevent the operator from throwing on the full current too quickly and burning out the motor.

The field consists of a circular yoke of special steel. While particular attention has been given to a reduction in weight, it has not been at the sacrifice of efficiency. The pole pieces, built up from soft sheet steel of the highest magnetic quality, are securely bolted to the yoke. The shape of the punchings are such as to produce a saturated pole face, and this feature, coupled with carefully proportioned windings, is largely responsible for the sparkless operation of the motor, and is a feature greatly appreciated by engineers.

The field coils are machine wound and carefully insulated. The shunt and series coils of compound wound machines are separately wound. The coils are slipped over the pole before it is bolted to the yoke, and, should it be necessary, are readily removed. The armature core is built up from thin, carefully annealed sheet steel, possessing a high magnetic permeability. These disks are again annealed and then japanned. They are mounted upon the shaft and held firmly together by malleable iron end plates.

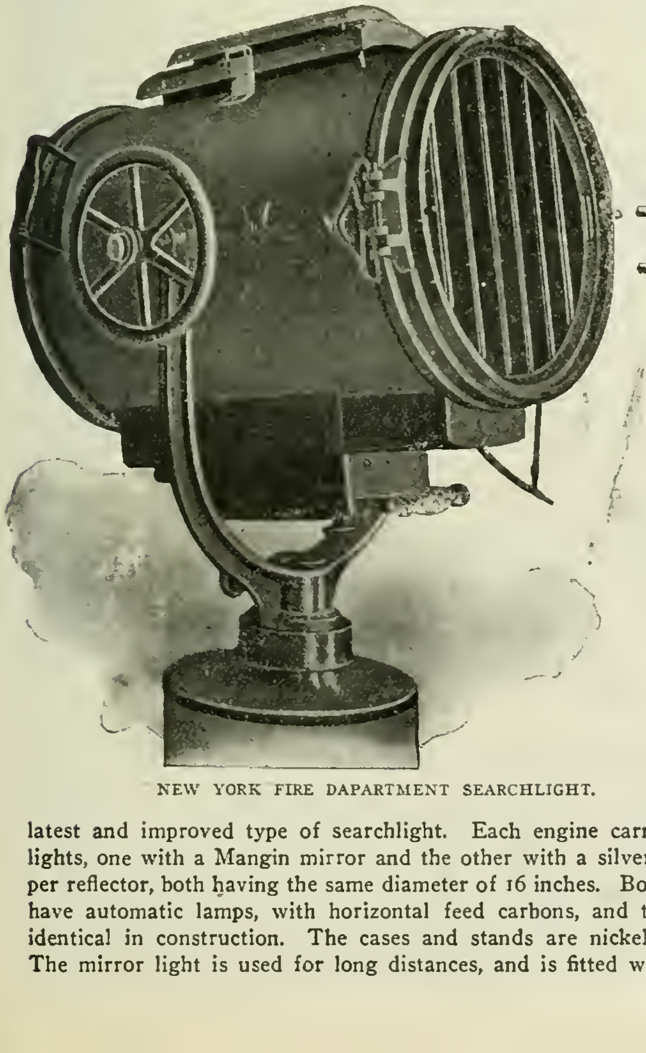
The windings, which are let into slots provided in the periphery of the armature core, are made of either copper bars or wire as best suits the requirements. The coils are machine formed, and after being formed are thoroughly insulated with mica and other high-grade insulations. They are then baked in steam-heated forms while under pressure, which removes all moisture and produces a perfect and very compact coil. The result is a coil that is less liable to be injured than when produced by the ordinary method and one which requires no further insulation when placed in position on the core. The coils of armatures are held in position by wedges of hard, thoroughly dried wood, driven into notches provided near the top of the slots.

The commutators are built from drop-forged bars of pure lake copper, with selected mica insulation. They possess great durability and have an exceptionally even wearing surface for the brushes.

The brush holder is simple and highly efficient. It is of the reaction type; no adjustment of the brushes is necessary, and when they are once set the motor will operate in either direction without sparking and under all variations of load.

Searchlights in the New York Fire Department.

The New York Fire Department has been for some time past experimenting with powerful searchlights, as aids to fighting fires. Two engines at the Marion Street Station are now equipped with the latest and improved type of searchlight. Each engine carries two lights, one with a Mangin mirror and the other with a silvered copper reflector, both having the same diameter of 16 inches. Both types have automatic lamps, with horizontal feed carbons, and they are identical in construction. The cases and stands are nickel plated. The mirror light is used for long distances, and is fitted with a 30 deg. divergent lens, so arranged that the beam may be spread vertically or horizontally, as required. The reflector light throws a spreading beam for use at a short range. Each engine carries an extra standard, which can be placed on the street or at any point where the light is wanted. Either of the lights on the engine can be unshipped and placed on this standard, and the light is immediately available for use. The current required by the two searchlights is about 70 amperes, and is generated by a very compact electric plant carried by each engine.



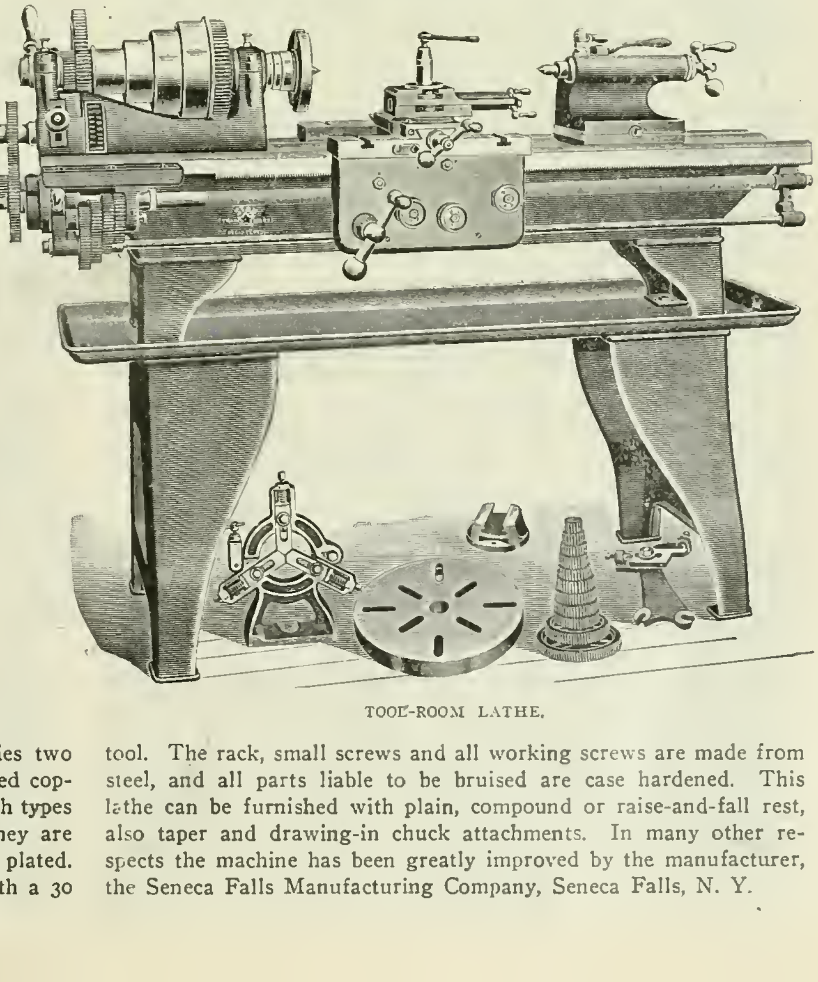
NEW YORK FIRE DAPARTMENT SEARCHLIGHT.

These new searchlight fire engines were given their first trial at practical fire fighting on the evening of April 1. Chief Croker says, as a result of the tests, that they are much better than the earlier examples. They give a more powerful and steady light, are more to be depended on, and the men find them much easier to manipulate.

The accompanying cut shows the apparatus. The engines were built by the La France Engine Company, Elmira, New York. The electric plants were constructed by the Bullock Electric Manufacturing Company, and the searchlights were from the works of Charles J. Bogue, 213 Center Street, New York.

Tool-Room Lathe.

The accompanying illustration represents a 13-inch "Star" tool-room lathe with power cross feed. The head stock is the improved web pattern, with hollow spindle made from crucible steel forging, and has phosphor bronze bearings. The centers are of standard taper, ½ inch to the foot, and the cone pulleys give eight changes of speed. The tail stock is of an improved curved pattern, which will allow the combined rest to swing around parallel with the ways and over the base of the tail stock with room to operate a feed screw handle. It is provided with an adjustable side movement for turning tapers and is locked in position in such a manner as to render it stiff and rigid. The carriage is provided with "T" slots for bolting on the angle plates, etc., and has a long bearing on the ways. It has a cam-locking device for locking it to the bed when using the cross feed. The power is transmitted from the spindle to the feed rod by gears, and is arranged with three different changes of speed, which changes can be instantly effected without stopping the machine. Both cross and longitudinal feeds can be operated independently or in combination, as desired. The improved tool post excludes all dirt and chips and admits of a quick, easy and secure adjustment of the tool. The rack, small screws and all working screws are made from steel, and all parts liable to be bruised are case hardened. This lathe can be furnished with plain, compound or raise-and-fall rest, also taper and drawing-in chuck attachments. In many other respects the machine has been greatly improved by the manufacturer, the Seneca Falls Manufacturing Company, Seneca Falls, N. Y.



TOOL-ROOM LATHE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 2½@3 per cent. Time money was easy and abundant at 3½ per cent for 30 to 90 days, and 3½@4 per cent for longer periods. A feature of the week was the willingness of lenders to accept the new United States Steel stocks as collateral. The Stock Exchange was closed on Friday and Saturday on account of the Easter holidays. During the four business days, however, there was great activity and sensational advances, in which the granger railroad shares and the stocks of the new United States Steel company figured prominently. The volume of trade was phenomenal, the aggregate number of shares sold being 7,190,336, and the speculative spirit seemed to run to extremes. The presence of the public as buyers of securities was on a larger scale than for years past, but, on the other hand, the manipulation was of a most open kind and conducted with a degree of skill that has never been equaled. The new steel stocks, which were admitted to the Exchange week before last have been skillfully handled, and on Monday and Tuesday 400,000 shares or more changed hands with an advance in quotations to 97½ for preferred and 49½ for the common. The other steel stocks were all strong. There were no important changes in prices of electric or traction securities, excepting Western Union, which closed with a net loss of 3 points. The share transactions were about the normal, being 35,800 for the week. General Electric was quiet and little attention was given to the stock, which closed with a net loss of ¾ points; the total number of shares sold was 4000. Business in the two main traction stocks was somewhat diminished as compared with that of the previous week, the sales of Metropolitan being 44,380 shares. The price of the latter, however, was firmly maintained and the closing quotation was ¾ of a point higher than that of the week before. Brooklyn Rapid Transit lost ¼ of a point, the number of shares sold being 91,000. American Telegraph & Cable gained 2 points, and Commercial Cable attracted unusual attention, closing the week at 175½, a net gain of 8¾ points since the last quotation. In the market for outside securities American Bridge showed considerable strength toward the close of the short business week, which, however, subsided at the end, the common closing at 49½, and the preferred at 105½. Copper stocks were moderately active. Electric Boat broke sharply at the close, when 500 shares sold at 23 and later 500 at 22. Following are the closing quotations on the four principal exchanges at the close on Thursday, April 4:

NEW YORK.

	Mar. 30.	April 6.		Mar. 30.	April 6.
General Electric	217	216¼	Electric Vehicle	13	10
Brooklyn Rapid Transit	83	82¾	Electric Vehicle, pfd	25	20
Metropolitan Street Ry	166¼	167	General Car	2	—
American Tel. & Cable	97	99	Illinois Elec. Veh. Tran.	1	1⅛
Western Union Tel	96	93	Hudson River Tel	120	120
American Dist. Tel	—	36	N. E. Elec. Veh. Tran.	2¾	—
Commercial Cable	—	175½	N. Y. Elec. Veh. Tran.	3¾	4
Electric Boat	24	20	Tel. & Tel. Co. of Am.	6	6
Electric Boat, pfd	51	50	N. Y. & N. J. Tel	178	170
Electric Lead Reduc'n	4⅞	4¾			

BOSTON.

	Mar. 30.	April 6.		Mar. 30.	April 6.
New England Telephone	—	141	Erie Telephone	49½	50
Mexican Telephone	3¼	3⅛	General Electric, pfd	—	—
Westinghouse Electric	62½	62*	Am. Tel. & Tel	167½	170
Westinghouse Elec., pfd.	—	—	Boston Electric Light	—	250*

PHILADELPHIA.

	Mar. 30.	April 6.		Mar. 30.	April 6.
Electric Storage Battery	72	69	Philadelphia Electric	5¾	6¼
Elec. Storage Bat., pfd.	74	70	Pa. Electric Vehicle	½	¾
Elec. Co. of America	8¼	8½	Pa. Elec. Veh. pfd	½	¾*
General Electric Auto	—	—	Am. Railways	39½	41

CHICAGO.

	Mar. 30.	April 6.		Mar. 30.	April 6.
Chicago Edison	154	154	Chicago Telep. Co	220	220
Chicago City Ry	260	260	Union Traction	16	16
National Carbon	15¾	15¾	Union Traction, pfd	56	56
National Carbon, pfd	82	83	Northwest Elev. Com.	40	40½

* Asked.

A McMILLIN CONSOLIDATION.—A circular was issued by Emerson McMillin & Co. this week to the stockholders of the Western Gas Company, of Milwaukee, the Grand Rapids Gas Light Company, of Michigan, the Madison Gas Light Company, of Wisconsin, and the St. Joseph Gas Company, of Missouri, inviting them to consolidate their interests by exchanging their shares for the common and preferred stock of a new company, which may be known as the American Light & Traction Company. The circular was signed by Emerson McMillin, who was a prominent stockholder in the East River Gas Company, now a part of the Consolidated Gas Company; Anton G. Hodenpyl, Philip Lehman, George P. Sheldon, Willard E. Case, Warren W. Foster, S. R. Bertron and W. F. Douthirt. The Trust Company of America has been named as a depository of the stock certificates. The consolidation plan, however, contemplates the ultimate absorption of a number of other gas companies, including the Binghamton Gas Works, the Columbus Edison Company, the Detroit City Gas Company, the Jackson Gas Company, of Michigan; the Laclede Gas Company, the Denver Gas & Electric Company, the Southern Light & Traction Company, of San Antonio; the Consolidated Gas Company, of New Jersey; the Jacques Cartier Water Power Company, of Quebec, and the Winnebago Traction Company, of Oshkosh. The circular issued to stockholders of the four companies to form the new company states that the plan will include only such stock as is deposited before April 30, and after that date acceptance of stock will be made at the discretion of the committee.

CHICAGO ELEVATED BONDS.—Extension bonds to the amount of $5,000,000 were authorized at a special meeting of stockholders of the Metropolitan Elevated Railroad on April 8. The bonds will bear 4 per cent interest, be dated Feb. 1, 1901, and run until Aug. 1, 1938, expiring the same time as the first mortgage bonds. The new issue is a first lien on the extensions which may be made from time to time, and a second lien upon all the other property of the company. The issue was authorized by a vote of 136,073 shares out of a total of 165,000 outstanding, the vote being unanimous. The new bonds will be subject to redemption at 105 on any interest day, Feb. 1 or Aug. 1, on four weeks' notice. It is proposed to issue approximately $1,500,000 to pay for the two extensions in immediate contemplation. These are extensions of the Garfield Park line from West Forty-eighth Avenue to West Fifty-second Avenue, distance one-half mile, and on the Douglas Park branch from the present terminus to West Fortieth Avenue, 1.85 miles. The balance will be reserved for further extensions which may be settled on from time to time.

CINCINNATI LIGHTING CONSOLIDATION.—It is understood that the consolidation of the various lighting companies of Cincinnati will be on the basis of the earning capacity of the companies, and the new stock will be calculated upon as a 4 per cent dividend security. The present capital of the Cincinnati Gas Company is $9,500,000, and it is paying 8 per cent. and believed to be earning a little in excess of that. Then the stockholders of the Cincinnati Gas Company will receive two shares of the new stock for one of the old. The earnings of the Edison Company are estimated at 6 per cent. and the present stockholders will receive 1½ shares of the new stock for one of the old. The capital of the new company is expected to be $30,000,000, the additional capital being used to purchase the smaller lighting plants distributed over the city.

NEW YORK ELECTRIC VEHICLE TRANSPORTATION.—At the stockholders' meeting of the New York Electric Vehicle Transportation Company the retiring board of directors was re-elected, with the exception of Robert McAllister Lloyd, who was replaced by G. Herbert Condict. No financial statement was issued. The board of directors will meet soon. It is expected that the present officials will be re-elected.

GENERAL ELECTRIC.—It is persistently rumored that an offer will be made to General Electric preferred stockholders allowing them to convert their stock into common stock at par. This will be done before the restitution of capital (the 40 per cent by which capital was cut down in 1898) is made. Both operations, however, will be carried through in the near future. This week General Electric has gone above 230.

TELEPHONE STOCK INCREASE.—The Central New York Telephone & Telegraph Company, of Utica, N. Y., has filed with the Secretary of State a certificate of increase of its capital stock from $800,000 to $1,000,000. The company has a paid-in capital of $800,000 and debts and liabilities of $210,961.

DIVIDENDS.—The Cincinnati Edison Electric Company has declared the regular quarterly dividend of 1¼ per cent, payable April 1.

Commercial Intelligence.

WEEK IN TRADE.—In trade circles last week there were no particularly noteworthy activities in evidence. Reports, however, indicated continued improvement. Spring trade has been good, although the weather has not been altogether helpful. In discussing the general situation, *Bradstreet's* says that the testimony as to expected great activity in building this year is well-nigh unanimous, and the strength of building materials is a natural reflection thereof. The textile trades continue a source of some discouragement to manufacturers. The iron and steel trade conditions are very satisfactory, from the standpoint of the seller; the demand is large; prices are strong and in raw and finished lines the outlook is regarded as very satisfactory. Mills are accepting contracts for the closing months of the year, and there is every indication that 1901 will surpass all records in the quantity of pig iron consumed by the manufacturers. As regards the cereal crops, reports indicate that the weather conditions, except in the Northwest, have been rather unfavorable to planting and to ground preparation. This is particularly true in the South, where cotton planting is retarded. *Bradstreet's* reports the number of failures for the week as 188, against 189 the week previous and 182 in the same week last year. Only twice in 19 years have the failures for the first quarter of the year been smaller in number than they are this year. However, while failures are more numerous this year in the first quarter than for two years past, the damage resulting therefrom—in other words, the liabilities of failing traders—are considerably smaller. Assets show a rather similar shrinkage, but it is worth mention that they are the smallest reported in a like period since 1882, 19 years ago. The unfavorable side to the latter showing, however, is that the percentage of assets to liabilities—in other words, the salvage—is only 45.3 per cent this year, against 49.7 per cent in 1900, 46 per cent in 1899, and 53.8 per cent in 1898, this pointing, on the one hand, to a steadily decreasing margin of possible recoveries, and, on the other, to the fact that this year more than for many years past the failure reported is really and absolutely a failure.

VICKERS SON & MAXIM.—At the annual meeting of this company at Sheffield, the chairman (Mr. T. E. Vickers) presiding, in moving the adoption of the report, referred to the statements which had been made as to a supposed amalgamation with certain American companies, and stated that they had never any intention of proposing any amalgamation whatever. They had, however, been in negotiation with some American firms with a view to getting the company's system of ordnance manufactured there on a scale commensurate with its importance. So far, the terms offered had not been such as they could accept, but they had not abandoned their intentions. They had acquired, on favorable terms, the sole European rights for the train-lighting system of the Consolidated Railway Electric Lighting & Equipment Company, and for the Holland submarine boat. The construction of five of these boats for the British Government was far advanced at the Barrow works. The dividend was 20 per cent. At an extraordinary general meeting of the company subsequently held, the capital was increased to £3,700,000 by the creation and issue of 200,000 new ordinary shares of £1 each, ranking for dividend from the 1st of January last. It was agreed that the new shares be offered in the first instance to the shareholders at the rate of one new share for every ten old shares held, the price of issue being 50s. per share.

THE NEW YORK GLUCOSE COMPANY has just let some additional contracts for the equipment of its plant at Shady Side. The most important contracts have been awarded to the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, through its New York office. The corn oil machinery recently ordered from the Ohio concern called for equipment having a daily capacity of 20,000 bushels. This installation is to be increased so as to be capable of handling 40,000 bushels a day. The pump contract has also been alloted to the Stilwell-Bierce Company. The contract requires no fewer than 75 pumps, principally triplex equipments, varying in capacity from 5000 gallons to 3,000,000 gallons a day. This order, which is valued at upwards of $50,000, is said to be one of the largest ever given for this type of pump. The contracts pertaining to the electrical equipment of the Glucose plant will be decided upon within the next few days. It is anticipated that fully $150,000 will be expended.

A BIG WIRE PLANT.—It is announced that the largest insulated copper wire plant in the United States is to be established in Newark by a company which is being organized with a capital of $10,000,000. The works are to employ between 3500 and 3600 persons, and are to be somewhere along the Passaic River. "By a new process that is to be used wire is to be made that will carry as high as 100,000 volts. The present limit, under existing processes, is 25,000 volts." Much secrecy is maintained as to the identity of the promoters of the new enterprise, but it is said their names will be known in a few days. Three of the principals, it is said, are interested in the United States Steel Corporation.

S. OSHIMA, the Director-General of the Japanese Government Steel Works at Tokio, has returned to Japan after placing initial contracts aggregating some $70,000 for various labor-saving devices manufactured in this country. The contract calls for rail drillers, punchers, rivetters, lathes, drill presses and other machine tools. It was secured by Manning, Maxwell & Moore. All this machinery is to be operated by electricity. The electrical contract, valued at nearly $250,000, and comprising a large number of motors, generators, turbine wheels, etc., was awarded to the Siemens-Halske Company, of Berlin. Very shortly after Mr. Oshima's arrival in Japan several other substantial contracts for machinery, etc., will be given out.

BELL TELEPHONE OUTPUT.—The American Telephone instrument statement for the month ended March 20 shows:

	1901.	1900.	1899.	1898.
Gross output	76,751	65,878	67,033	28,909
Returned	37,517	20,664	13,530	15,737
Net output	39,234	45,214	53,503	13,172
Since Dec. 20:				
Gross output	216,109	183,003	162,844	80,667
Returned	89,427	63,004	41,725	38,568
Net output	126,682	119,959	121,119	42,099
Total outstanding ...	2,079,498.	1,700,464	1,246,365	961,220

THE CASTNER ELECTROLYTIC ALKALI COMPANY, of Niagara Falls, N. Y., has given the contract for the construction of the proposed addition, to Wentworth & Taylor, of Niagara Falls. This extension will be built to the east of the present alkali works, and will occupy a large space. There will be two brick buildings, each 200 ft. long by 300 ft. wide, separated by an alleyway. These buildings will be three stories high, and of mill construction. When completed the plant will be the largest on the lands of the Niagara Falls Power Company. The cost will be about $250,000. It is expected to have the new plant in operation the latter part of the year.

ENGLISH CONSOLIDATION.—By a cable dispatch from London of April 3, the formation is announced of an electrical engineering combination, comprising the Thames Iron Works, Siemens, Mather & Platt and Brush companies, which the authority was convinced would hold its own against German and American combinations. They had prepared designs for the electrical equipment of the Metropolitan district, the Great Northern and the City railways. They had schemes in hand for railways from Northeast London to London Bridge, and from London Bridge to Piccadilly.

THE NATIONAL CONDUIT & CABLE COMPANY, of New York City, has secured a contract from Robert W. Blackwell & Co., Limited, of London, for the furnishing of several million pounds of copper wire, which will be utilized by various English traction companies for whose equipments the Blackwell concern have been allotted the contracts. The wire will be manufactured at the National Company's new plant at Hastings-on-Hudson, some particulars of which recently appeared in the Electrical World and Engineer.

BALL ENGINE ORDERS.—Among recent installations by the Ball Engine Company, Erie, Pa., of engines for electrical purposes, are the following: Pennsylvania Railroad shops, Altoona. Pa., one 450-hp engine, direct connected to alternating generator, running in parallel; George Wiedemann Brewing Company, Newport, Ky.; two 90-hp direct-connected engines; the County Hospital, Denver, Colo., one 150-hp direct-connected engine.

MARINETTE IRON WORKS, of Marinette, Wis., have lately supplied a 125-hp engine for direct connection to a Western Electric generator in the Bennett Building, Pittsburg; also one for the Press Publishing Company, of 100 horse-power. They have also received recently an order for two 125-hp engines from the Gazette Publishing Company, of Pittsburg.

WORK IN NEW ZEALAND.—Mr. R. M. Macdonald, managing director of the Christchurch Tramway Company, Limited, New Zealand, states that they are getting estimates for an electrical power transmission plant for that city. The generating plant will be distant about 30 miles. The head works provide for 90 ft. fall and up to 1000 cubic feet per second of water in the head race.

THE THRESHER ELECTRIC COMPANY, of Dayton, Ohio, has been incorporated under the laws of the State of West Virginia, with an authorized capital of $600,000, for the manufacture and sale of all kinds of electrical machinery and appliances. Plans are being prepared for extensive shops, with a complete equipment, affording the most approved facilities for manufacturing and testing.

BIDS WANTED.—The Bloomfield, Ind., Electric Light, Heat & Power Company is inviting private bids for a complete electric light equipment and steam plant, to be filed on or before April 12. The company calls for two boilers, boiler feeder, feed-water heater, one 200-hp engine, belting, dynamo, alternator and a complete line equipment. Messrs. E. H. Duggan and J. E. Meredeth may be addressed.

SKINNER ELECTRIC SIGN.—A company has been formed to promote the Skinner electric sign, a description of which appears in another part of this issue. The officers are Paul M. Lincoln, president; C. E. Skinner, vice-president, and W. E. Skinner, secretary, treasurer and manager.

THE RUSSELL-TOMLINSON ELECTRIC COMPANY, manufacturers of telephone apparatus, is removing its entire plant to Danbury, Conn., where it will have a factory capacity about twice the size of its present facilities at Milford.

THE AMERICAN BRIDGE COMPANY will furnish the crown agents for the colonies of Great Britain the steel work for two deck plate girder spans, and for strengthening two other bridges on the Jamaica Government Railway, West Indies.

General News.

THE TELEPHONE.

OTTAWA, ONT.—A movement is on foot to connect Bala, Port Carling and Bracebridge, Ont., by telephone.

HILLSBORO, OHIO.—The Hillsboro Telephone Company has been incorporated with $10,000 capital stock.

BELLEVILLE, ILL.—The Farmers' Telephone Company has applied for a franchise to do business in St. Claire County.

SOUTH MILWAUKEE, WIS.—The Southwestern Telephone Company has been refused a franchise to install an exchange.

ROME, GA.—A telephone ordinance has been passed and extensive improvements will be inaugurated by the Southern Bell.

DAVILLA, TEX.—The Davilla Telephone & Improvement Company is extending its toll lines throughout this section of the State.

JACKSON, OHIO.—The Jackson County Telephone Company has been incorporated to build an exchange with toll lines in this county. Capital stock, $50,000.

JEFFERSON CITY, MO.—Statement of increase of capital stock from $2,000,000 to $4,000,000 was filed by the Bell Telephone Company of Missouri last week.

CHARLOTTE, N. C.—The Wilson & Tarboro Telephone Company, of North Carolina, W. P. Mercer president, has applied for an increase in capital stock from $10,000 to $25,000.

THIBODEAUX, LA.—There is an excellent field for a telephone system in this section. Further information on this subject may be obtained by addressing Mr. L. H. Lancaster, of this place.

SPARTANSBURG, S. C.—The city council has decided to grant a franchise to the American Bell Telephone Company to place its wires and poles in the city, thus giving long distance connections.

WARSAW, IND.—The Commercial Telephone Company, of this city, will extend its lines throughout the county and give the farmers the same service as is given to the city people and at the same rental.

ATHENS, OHIO.—The Union Telephone Company, of this place, has increased its capital stock from $15,000 to $50,000. The system will be improved. A. B. Allen is president and D. Edwards secretary.

BLACK RIVER FALLS, WIS.—At the annual meeting of the Central Wisconsin Telephone Company, H. A. Bright was elected president; Charles Sichler, vice-president; E. A. Miller, treasurer, and M. F. Smith, secretary.

CLEVELAND, OHIO.—General Manager Mark Davis, of the Cuyahoga Telephone Company, has offered positions to striking linemen of the Bell Company at Wheeling, W. Va. The local concern has an immense amount of construction work on hand.

PORTLAND, ORE.—The Western Union Telegraph Company recently withdrew its opposition to the business license imposed by the city of Portland, and through its local manager, paid into the city treasury the amount due for the past six months.

PITTSBURG, PA.—The Hotel Schenley, of this city, has recently installed the telephone call system, and now 300 telephones are in daily use between the guests and the hotel clerk. A similar system is shortly to be adopted by the Hotel Henry.

MINNNEAPOLIS, MINN.—The local telephone exchange of New Paynesville, Minn., with thirty or forty telephones in service, was sold on March 30 to Mr. D. N. Tollman, of Willmas, Minn. The exchange was put in and owned by Mr. A. F. Knebel.

CHARLOTTE, N. C.—The sale of the Queen City Telephone plant at Charlotte to the Curtis Syndicate of Newark, N. J., has been confirmed legally and Mr. J. E. Taylor has been appointed manager. The Curtis Syndicate pays $23,000 for the plant.

CINCINNATI, OHIO.—The employees of the Cincinnati & Suburban Telegraph Association have presented the family of the late Captain George N. Stone a handsome memorial tablet. The tablet bears a portrait of the late general manager with an appropriate inscription.

SAN FRANCISCO, CALIF.—The Moulton Automatic Telephone Company was recently incorporated, with Sonora, Tuolumne county, Calif., as the principal place of business. Directors: W. O. Doxie, P. M. Keefe, M. S. Sanford, W. S. Griffith and J. P. O'Brien. Capital stock, $50,000.

LIBERTY, NEB.—The Liberty Independent Telephone Company has organized with a capital stock of $5,000. Sixty telephones have been let and the routes laid. The officers are: President, George Sutter; Vice-President, C. D. Matthews; Secretary, R. T. Moore; Treasurer, G. L. Meissner.

PORTLAND, ME.—The Dirigo Telephone Company has obtained permission from the Board of Aldermen to do business in this city. For three years this company has been trying to get a foothold in Portland, but its endeavor has heretofore been defeated by the New England Telephone Company.

ELKHART, IND.—The Home Telephone Company, of this city, has been compelled to order a new switchboard. The present capacity of the old board has been exceeded by over 30 orders. This company under present management is furnishing one of the most efficient independent services in the State.

CORYDON, IND.—The Independent Telephone & Telegraph Company, which was granted a right of way over the public highways of Harrison township, has commenced work. It will build a long distance toll line between Corydon and Louisville to connect with the new long distance line to Indianapolis.

ROCHESTER, IND.—Arrangements have been made whereby Charles R. Stevenson, of this city, has obtained possession of the telephone toll line to Momenee and Kankakee, Ill. This will form the nucleus of a system covering Wabash and adjoining counties, thus giving a through independent line to Chicago.

NEW PRAGUE, MINN.—The New Prague Telephone Company is making preparations for the addition of twenty new subscribers to its system. It now has seventy-two subscribers and a switchboard capacity of 100 drops, using the Stromberg-Carlson central energy system. Mr. S. A. Vopatek is president of the company.

NORWALK, OHIO.—The Huron County Telephone Company, which does business in Huron, Sandusky, Seneca, Crawford and Erie counties, operating 600 telephones and 50 miles of toll wire, has been sold to T. H. Knapp and C. R. Callaghan, of Bellevue. The new owners will make many improvements and extensions.

LEBANON, IND.—As previously announced, the Independent Telephone Company, of this city, has granted the Co-operative people free service. The franchise that forbids the consolidation of the two Thorntown companies has been adjusted. Patrons of the Lebanon company now have free communication with all the surrounding towns.

MT. VERNON, ILL.—At a meeting of the stockholders in the Tricounty Telephone Exchange Company, held in Tamaroa, Ills., last week, J. M. Dycus, of Blissville; J. D. Norris, of Bald Hill; William Ellis, of Elk Prairie, and Charles H. Judd, of Moore's Prairie, were elected directors to represent Jefferson county on the board. It was voted to increase the capital stock of the company from $10,000 to $15,000.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has received the first contract from the department of public safety of the local municipality for the installation of a number of telephones to be used by the police and fire alarm system. This is considered quite a victory for the new company, and it shows that it is gradually gaining a firmer footing as a competitor of the Bell company.

PITTSBURG, PA.—The United Telephone & Telegraph system of Philadelphia has completed the purchase of the Altoona Phoenix Telephone Company. The latter will be immediately connected with the lines of the companies in Montgomery, Chester, Delaware, Lancaster, Lebanon, Northumberland, Montour, Columbia, Union and Lycoming counties, which also belong to the Philadelphia syndicate.

MARION, IND.—The Indiana Pipe Line, which operates a private telephone line between its pumping stations in Indiana and Ohio, has offered a large reward for the arrest and conviction of the parties who stole several miles of wire from its line near Warren. Wire thieves robbed the Long Distance Independent Line near Wabash of nearly a mile of copper wire about three weeks ago, and a reward is out against them also.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company a few days ago purchased the stock of the Home Telephone Company, and it is now connecting its local lines with the Home Company's systems at Wilkinsburg, Verona, New Kensington, Oakmont and Parnassus. This is the first step the Pittsburg & Allegheny Company has been able to take in the direction of getting control of some of the independent lines outside of the city, which has long been recognized as a necessity for its success.

WABASH, IND.—The United Telephone Company has bought the copper wire for its extension from Huntington to this city eighteen miles, and Dr. Blont, president of the Home Company, this city, has closed a contract with the New Telephone Company, of Indianapolis, for a new copper metallic circuit from Wabash to Marion. This will make the third line of the company between this city and Indianapolis, the two lines now in service being overcrowded. The new line will be devoted to Indianapolis business exclusively.

WABASH, IND.—The competition which has prevailed for years between the Bell and the local Independent Telephone Company has taken an unexpected turn. Notices were served by the members of the Merchants' Association on the Bell Company to remove their instruments by April 1. The tradesmen say they cannot afford to support two exchanges and want one to withdraw. They have agreed to support the home company. The Bell Company officials say that this movement makes no difference, as they will remain in the field.

FRANKFORT, IND.—The complications of the Central Energy Telephone Company, of this city, and the financial difficulties were somewhat added to during the week by the filing of labor liens against the plant by workmen. Mr. Murphy had succeeded in staving off the suit brought by the Chicago company, and was not expecting a strike by his workmen. An effort is being made to secure money and discharge the debt. It is said the Bell Company has reduced the rate so low that the Central Energy Company has little chance to make expenses.

CLEVELAND, OHIO.—Judge James M. Thomas, president of the Independent Telephone Association, and general manager of the United States Telephone Company, has for some months been conducting negotiations with the city council of Kansas City, Mo., with a view to establishing an independent exchange in that city. The city authorities demanded that a cash guarantee of $50,000 be put up as security that the plant will be built. This has been agreed to by Judge Thomas and his associates. It was also demanded that the promoters guarantee not to sell out to the existing company, and this has also been agreed to. The independent people also agree to reduce existing rates 50%, and there is every reason to believe the franchise will be granted in the near future. It is stated that J. J. Heim, of Kansas City, will be the largest stockholder in the company and that A. M. Kellogg, the Chicago telephone manufacturer, will also be interested. The other stockholders will be Cleveland, New York and Chicago capitalists.

ELECTRIC LIGHT AND POWER.

GONZALES, TEX.—The new Gonzales cotton mills at Gonzales will receive sealed proposals for a power plant for a new mill until April 16.

OTTAWA, ONT.—Mr. J. M. Harris, of the Recco mine, Sandon, British Columbia, purposes establishing an electric light and power plant at Three Forks, B. C.

CLEVELAND, OHIO.—M. A. Bradley is preparing plans for a seven-story power building for the business section of the city. It will have an independent power plant.

OTTAWA, ONT.—The City Council of Vancouver, British Columbia, has decided to grant a franchise to the Stave Lake Power Company to supply light and power within the city.

CHARLOTTE, N. C.—The D. A. Tompkins Company, of this place, has installed a 1,500-light dynamo and 125-hp automatic engine for the Monahan Cotton Mills, Greenville, S. C.

GALION, OHIO.—The first annual report of the Galion municipal lighting plant is a pleasant surprise. During the past year the actual cost of maintaining lights was $23.57 each per year.

NORFOLK, VA.—The board of electrical control has practically decided that the city shall own the subways for underground wires, and that the subways should be leased to the users.

SAN FRANCISCO, CALIF.—The Chainman Company, of Ely, White Pine county, Nev., recently sold out all of its holdings to the Chainman Mining & Electric Company for the sum of $150,000.

STRASBURG, OHIO.—The Strasburg Electric Company has been incorporated by Thomas Kempt, E. P. Hopizky, G. A. Meyers, Jacob Denzer, Jacob Boyer and J. C. Schultzbach. Capital stock, $10,000.

OTTAWA, ONT.—The Legislature of Nova Scotia will be asked to give the town of Yarmouth, N. S., authority to borrow $10,000 for the purpose of installing an electric light plant to be operated and owned by the municipality.

PARIS, TEX.—Negotiations have been perfected by which the newly organized street railway company becomes the purchaser of the electric light plant of this city. Ffity thousand dollars' worth of improvements will be made on the electric light plant at once.

INDIANAPOLIS, IND.—Contracts have been let for a new electric power plant in this city in the new "Century Building." The building will cover a quarter of a square, and be seven stories high. The purpose is to supply small and large manufacturers with space and power. The Schmidt Bros. are the owners of the plant.

CINCINNATI, O.—The Edwards Railroad Electric Light Company has been formed to make and sell new electric lighting apparatus for locomotives, etc. Mr. Edgar A. Edwards is president; S. O. Bayless, vice-president; W. E. Cole, secretary and treasurer; C. W. Adams, manager. The company is about to build and equip its own factory.

COVINGTON, LA.—R. S. Stearnes & Co., New Orleans, were recently awarded the contract to install a complete electric lighting plant here, including General Electric apparatus. A. M. Lockett & Co. will furnish the Ball & Wood engines and the plant will be modern in every particular. It is to be in operation by June 1. The St. Tammany Ice Company has just completed a new building to house a plant producing ten tons daily, and the town shows many other improvements.

COLUMBUS, OHIO.—Bids for arc lights for city lighting have been submitted as follows: Fort Wayne Electric Works, $83 and $105 per lamp, contract to begin Sept. 25, 1902; Columbus Edison Electric Light Company, arc lights, $85 per year; Columbus Electric Company, $86.30 and $103.50 per year. The present contract price is $74.50 for ordinary arc lamps on a moonlight schedule which is unsatisfactory. The bids are for ordinary arc lights and the latest improved enclosed arc lamps for all night service the year around.

THE ELECTRIC RAILWAY.

CLEVELAND, OHIO.—The Cleveland City Railway Company paid a dividend of 1 per cent on April 5.

PARIS, TEX.—A St. Louis syndicate has purchased the street railway system here, and will install electric service.

CLEVELAND, OHIO.—The Lorain & Cleveland Railway Company paid a quarterly dividend of ¾ per cent. on April 5.

CHICAGO, ILL.—The Chicago City Railway Company has secured two extensions of franchises for its Southern suburban lines.

CINCINNATI, OHIO.—The Cincinnati & Eastern Electric Railway Company has increased its capital stock from $10,000 to $500,000.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway Company has applied to the commissioners of Franklin county for a franchise for a road over the National pike.

TIFFIN, OHIO.—The Tiffin & Norfolk Electric Railway Company, not yet incorporated, is securing a private right of way between this place and Monroeville by the way of Republic.

AKRON, OHIO.—The Northern Ohio Traction Company, which is building a new line from this city to Canton, is considering the advisability of extending it from Canton to New Philadelphia.

CHESTER, VT.—A consolidation of the existing electric street railway lines in Vermont and the extension of several of them at points on the western edge of the State is reported to be on foot.

SPARTANSBURG, S. C.—The Gas, Electric Light & Railway Company, of this place, will construct five additional miles of electric railway. F. D. McEowen is president of the company.

LOCKLAND, OHIO.—The village council has granted a franchise to the Millcreek Valley Electric Railway Company, which is building from Cincinnati to Hamilton, thus completing the entire right of way.

RICHMOND, VA.—The big plant of the Virginia Electrical Railway & Development Company has been set in motion. Power will be supplied and the water power of the James River near Richmond utilized.

BLOOMDALE, OHIO.—At a mass-meeting of citizens, held a few days ago, a committee was appointed to secure right of way for an electric railway, which is to be turned over to some company willing to build a road.

CHARLOTTE, N. C.—A route is being surveyed for an electric road between Elkin and Sparta, N. C., the charter having been granted by the last Legislature. Hugh Chatham and others are the incorporators.

ELECTRICITY ON THE BROOKLYN ELEVATED.—It is stated that unless some unforeseen delay occurs the Brooklyn Rapid Transit Company will have all the elevated roads in that borough electrically equipped by July 1 next.

CLEVELAND, OHIO.—It is reported that a new company, to be known as the Southern Electric Railway Company, will shortly be incorporated with $500,000 capital stock, by local people, to build a line from the city limits at South Brooklyn to Hinckley, Parma, Royalton and Strongsville. Later it will be extended to Akron.

CLEVELAND, OHIO.—A banking syndicate headed by M. J. Mandelbaum & Co., of Cleveland, and composed of fourteen Cleveland banking and trust companies, besides banking companies at Cincinnati, Hamilton and Akron, Ohio, has been formed to underwrite the securities of the Aurora, Wheaton & Chicago Railway Company, to the sum of $3,000,000.

CLEVELAND, OHIO.—The Cleveland & Warren Electric Railway Company, which proposes to build a direct line from this city to Warren, has secured about twenty miles of a private right of way in Cuyahoga and Geauga counties, and grading has been started at several points.

EAST LIVERPOOL, OHIO.—Residents of this city and Calcutta have arranged for the organization of a new company, and have asked the city to revoke the franchise of the East Liverpool Street Railway Company for its line to Calcutta. Because of a number of serious accidents on a steep hill on this line, the company has not operated cars for several weeks.

ROCHESTER, N. Y.—The Batavia, Albion & Lake Ontario Railway has been organized, stock subscribed, and consent of the property owners has been obtained to build a line twenty-seven miles long, from Batavia to the east side of Oak Orchard Harbor, known as Point Breeze. The capital stock is $350,000, and the directors include George W. Aldridge, John H. Gregory, and John F. Kinney, of Rochester.

NEW INDUSTRIAL COMPANIES.

THE AMUSEMENT ELECTRICAL COMPANY, of Brooklyn, has been incorporated. Capital, $4,000. Directors: G. W. Woods, H. C. Bolton and A. J. Moore, New York.

THE W. N. THAYER COMPANY, of New York City, has been incorporated to manufacture electrical machinery. Capital, $5,000. Directors: W. N. Thayer and G. N. Warner, New York City; E. G. Bernard, Troy.

THE NATIONAL BATTERY COMPANY, capital, $500,000, has been incorporated in New Jersey. Incorporators: W. B. Greely, C. A. Wendall, R. S. Nichols, Francis P. McManus and John M. Scobel, New York.

THE MERRITT & LOCKWOOD (INCORPORATED), of New York City, has been incorporated to deal in electrical goods. Capital, $10,000. Directors: T. F. Merritt, New York City; E. F. Lockwood and Elizabeth M. Lockwood, Mount Vernon.

LEGAL.

DELIVERY OF TELEPHONE MESSAGES.—That a telephone company is not bound to deliver a message was settled by the local court at Franklin, Ind., in dismissing a suit for damages. Plaintiff left a message with the Central Union Company's operator to be telephoned, but the operator failed to do so. The company took the position that the undertaking to deliver was a personal one with the operator, and was not binding on the company. The court sustained this view.

CONTROL OF THE COLUMBIA INCANDESCENT LAMP COMPANY.—The Garrison-Rex fight for control of the Columbia Incandescent Lamp Company, of St. Louis, was carried beyond the confines of the Circuit Court last week by a decision handed down, in which the temporary injunction asked for by the Garrison faction was dissolved and the plaintiffs' bill dismissed. The court held that the grounds of contention were substantially the same as those embodied in a former suit which embraces an application for a receiver, and which is now in the Supreme Court of Missouri.

OBITUARY.

MR. ULRICH EBERHARDT, president of Gould & Eberhardt, Newark, N. J., died at his home in that city on March 31. Mr. Eberhardt was born in Switzerland in 1841. A widow and five children survive him.

MR. CARL. J. SCHLESINGER, vice-president of the Alden Electric Company, of Chicago, who represented the concern in Illinois territory, died at his parents' home at La Salle, Ill., on March 30, after an illness of two months' duration. His death is deeply regretted by all who knew him.

PERSONAL.

MR. C. T. YERKES has sailed from England for this country.

MR. R. LESTER THAYER, of Peoria, is on a business trip in Chicago this week.

MR. ROBERT L. McOUAT, of Indianapolis, Ind., is visiting Chicago on business.

MR. TOM L. JOHNSON has been elected Mayor of Cleveland. One of the planks in his municipal programme is lower street railway fares.

MR. JOHN W. GATES will probably soon retire from the office of chairman of the American Steel & Wire Company and take a long trip abroad.

MR. T. D. BOYLES, of the General Electric Company, presented a paper on Switchboards at the April meeting of the Cleveland Electric Club, held on April 3.

MR. T. A. EDISON is quoted by the New York *Journal* as saying that the capital stock for his new storage battery has been subscribed by the presidents of three trunk line railroads.

MR. ADALBERT BENICKE.—An inquiry from Germany reaches us with regard to Mr. A. Benicke, and we shall be greatly obliged if any one can inform us of his whereabouts.

MR. JAMES GEARY, 2236 South Robertson Street, New Orleans, La., has retired from the firm of Wilcox & Geary, architects, and will hereafter be engaged in the business of general contracting.

MR. CHARLES BRANDEIS, E. E., a member of the electrical engineering staff of the Lachine Rapids Company at Montreal, is on a trip to this country, and visited New York city during the week.

MR. C. H. DUELL.—To Charles H. Duell, of New York, who recently resigned as Commissioner of Patents, has been presented a magnificent loving cup for which every employee of the Patent Office subscribed.

MR. V. C. GRAU, who has formerly travelled in Ohio for Robert L. McOuat, is now in Chicago representing J. Jones & Son, New York, and Queen & Company, of Philadelphia. He is located at 934 Monadnock Building.

MR. J. W. MARSH, vice-president and general manager of the Standard Underground Cable Company, has been lecturing recently on cable manufacture, a subject to which he has given special attention for many years past.

Mr. H. C. SPALDING has been placed in charge of the New England business of the American Stoker Company and will be pleased to meet his old friends and make new ones at his office, No. 176 Federal Street, Boston, Mass.

WILLIAM H. CHAPMAN, the consulting electrician and manufacturer of voltage regulators, etc., at Portland, Me., has removed to new and more commodious quarters at 109 Middle Street, that city. His regulators are built for alternating or direct current and are becoming quite well known.

MR. H. L. DOHERTY has just been elected president of the Ohio Gas Light Association, an honor that has been well earned. Mr. Doherty was for two terms president of the Northwestern Electrical Association, and has an enviable reputation in both the fields of gas and of electric lighting.

MR. MARCONI.—It is reported by Commander W. H. Beehler, U. S. Naval Attaché at Rome, that, speaking recently of wireless telegraphy, the King of Italy said to him: "Marconi will soon have to do military service, but we shall arrange to assign him to a vessel upon which he can continue his experiments while fulfilling his military duties."

MR. W. S. BARSTOW, manager of the Edison Electric Illuminating Company, of Brooklyn, and president of the electrical section of the Brooklyn Institute, lectured last week before the department on the new electrical developments of the twentieth century. It was an interesting review of recent improvements and inventions and breathed throughout a strong spirit of hopefulness.

MR. STEPHEN L. COLES, the managing editor of the *Electrical Review*, of this city, has resigned his connection with that estimable journal and will engage in commercial enterprises in the electrical field. For a dozen years past Mr. Coles has been doing excellent work in the technical newspaper field—with occasional ventures in other literary work—and he has won a host of good friends, who will all, like ourselves, be deeply interested in his newer pursuits and will wish him most abundant success.

MR. H. B. FULLERTON, a well known official of the Long Island Railroad, and an enthusiastic champion of improved highways, gave a most interesting lecture before the Automobile Club of America on April 9 on "Good Roads." It was profusely illustrated with lantern slides of good roads in Europe, and such bad roads in the United States as to make every American shed tears of disgust and indignation. Mr. Fullerton's running lecture and comment was full of pertinent points and dry humor, and was immensely enjoyed by members and their friends.

MR. CHARLES A. MUNSON, manager of the Chicago office of the Fort Wayne Electric Works, died at the Mercy Hospital at Chicago, April 5, as the result of a surgical operation. Mr. Munson was born at Fort Wayne, Ind., March 27, 1842. He fought in the navy through the civil war, the latter part of the war being lieutenant of a boat on the lower Mississippi. He was prominent in Indiana politics for a number of years, and then became connected with the Chicago office of the Fort Wayne Electric Works, of which he later became manager. The funeral was conducted by the Masons, Knights of Pythias and Templars, at Fort Wayne, April 7.

MR. J. J. SWANN.—The Brooklyn Engineers' Club held a meeting on the evening of April 4 at the Liberty Building, Brooklyn, N. Y., to discuss the subject of "Compressed Air and its Uses." The matter was introduced by Mr. J. J. Swann, of the Ingersoll-Sergeant Drill Company, and in the course of discussion the questions of production, transmission and use were gone over and figures were given showing the cost of each of these three stages forming the cycle of a compressed air installation. A number of stereopticon views were shown to illustrate the points involved and to show the various types of machines used in actual practice.

EDUCATIONAL.

MANHATTAN COLLEGE LECTURES.—Because of a recent decision from Rome, the Brothers of the Christian schools have been obliged to eliminate the teaching of the classics in their colleges and academies. This decision has stimulated the Brothers to renewed efforts in the teaching of the sciences. Desiring to further develop and equip this department of Manhattan College, New York City, they have called to their aid the services of men eminent in the various departments of science, and as a result a subscription course of lectures at Carnegie Lyceum, Fifty-seventh Street and Seventh Avenue, will be held on the following dates: April 10, "Meteors and Meteorites," by Brother Potamian, D. Sc., London University, Manhattan College; April 16, "The Development of Artillery in the Nineteenth Century," by Captain Edmund L. Zalinski, United States Army (retired); April 22, "Submarine Boats," by John P. Holland, inventor of the Holland; April 25, "The Steam Engine and Its Rivals," by Professor Robert H. Thurston, LL. D., doctor of engineering, director of Sibley College, Cornell University, and April 30, "Electrical Wave Transmission," by Professor Michael I. Pupin, Ph. D., Columbia University. The lectures will begin at 8 p. m., and will be illustrated by experiments and lantern slides.

Trade Notes.

BRIDGE CONTRACT.—The Chicago & Alton Railroad has placed a contract with the American Bridge Company for 4000 tons of bridge work.

THE ST. LOUIS AUTOMOBILE AND SUPPLY COMPANY, St. Louis, Mo., has disposed of its business to the Scott Automobile Company, of the same city.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising as its "Big Four" Packard lamps, Packard transformers, A. B. arc lamps and Gutmann wattmeters.

THE SARGENT & LUNDY COMPANY writes us that on and after May 1 its address will be 1000-46 East Van Buren Street, Chicago. It is at present in the Monadnock Block, that city.

OIL FILTER.—The Deep Leeds Transmission Company, of Australia, recently installed a Cross oil filter, made by the Burt Manufacturing Company, Akron, Ohio, in its electrical power station.

TUERK'S ELECTRIC CEILING FANS, of both the alternating and direct current types, are briefly described and illustrated in a little pamphlet just issued by the Hunter Fan & Motor Company, Fulton, N. Y. Price lists of the various styles of fans are given, together with a telegraph code.

WARREN TRANSFORMERS.—The Warren Electric Manufacturing Company, Sandusky, Ohio, in Bulletin No. 15, just issued, describes and illustrates the Warren transformer, which has been designed to meet the demands of the most advanced central station practice. The mechanical construction of these transformers is simple.

MR. A. O. SCHOONMAKER, 158 William Street, New York city, reports an increasing demand for his mica washers. For some time he has made a specialty of this class of goods, and is prepared to furnish washers, bushings and tubing, to any size and thickness. He will be pleased to forward samples and quotations on request.

THE GARVIN MACHINE COMPANY, Spring, corner Varick Streets, New York, is reported to be quite busy in its regular lines of machines. This company has recently brought out several important improvements on its "Universal" milling machines, also on its profiling machines. Its trade in lathes, planers, shapers, drill presses, tapping machines, screw and monitor lathes is reported to be very good.

THE FALCON ELECTRIC MANUFACTURING COMPANY, 432 East Seventy-first Street, New York City, has issued a set of four cards, on which are given illustrations and prices of "Falcon" all-copper switch panel boards, "Falcon" attaching plug and flush receptacle, "Falcon" 1901 direct-current combination desk and bracket fans with three speeds, and Falcon direct-current arc lamps.

TELEPHONE SUPPPLIES.—A complete line of telephone apparatus and supplies is manufactured by the Farr Telephone & Construction Supply Company, Chicago. In a recent pamphlet its products are illustrated and concisely described. The company on March 1 moved its factory to the corner of Jackson Boulevard West and Desplaines Street, where it has larger and better equipment, which will greatly aid it in filling its orders more promptly.

A DIVISION OF LABOR.—The Lackawanna Lubricator & Manufacturing Company announces that it has appointed the Vallee Brothers Electrical Company, Philadelphia, sole agent for its goods in the territory, including Massachusetts, Rhode Island, Canada, New York, New Jersey, Pennsylvania, Maryland, Virginia, West Virginia and South Carolina. All orders and inquiries for Lackawanna lubricators, grease cups and lubricating compounds will be referred to the selling agent.

BUSINESS CHANGE.—Mr. A. L. Dyke, who was formerly manager of the St. Louis Automobile and Supply Company, has embarked in business for himself and will supply the trade with his new running gear, engines, carburetters and other parts. He also carries a full line of automobile supplies. Mr. Dyke started the Automobile Supply Company nearly two years ago. Those interested in building their own machine or who desire a gasoline machine will do well to write Mr. Dyke and get his new 16-page catalogue.

NEW WIRE FACTORY.—Alfred F. Moore, 200 North Third Street, Philadelphia, is sending out an illustration of his new building which has been in course of construction during the past ten months. New and improved machinery has been installed in the factory, which is said to be one of the largest and best equipped in the country, devoted exclusively to the manufacture of insulated wires. It will be remembered that fire completely destroyed Mr. Moore's plant over a year ago. With his present facilities Mr. Moore is now able to make prompt shipments of all regular goods.

THE HAINES & NOYES COMPANY, manufacturer of guaranteed telephone apparatus for every possible use, announces that it has now consolidated its sales department and factory at 118-132 West Jackson Boulevard, Chicago, and that it is prepared to fill all orders, large and small, very promptly. The increased space will permit the company to manufacture telephone apparatus in large quantities, and it states that it will have a large stock on hand at all times. It informs us that it is adding many improvements to its instruments. It will be glad to send its latest bulletins to parties desiring the same.

MODERN HEAT.—A catalogue and price list of the electric heating apparatus manufactured by the American Electric Heater Company, 195 River Street, Detroit, Mich., has been issued. The devices illustrated include soldering irons, laundry and pressing irons, electric disk heaters or portable stoves, air heaters, curling irons, broilers, etc. The list of goods is a very extensive one and will be a surprise to those who are not familiar with the development in this branch of electrical industry. The company is improving its apparatus all the time, and makes the claim that its heating devices have greater durability than ever before and are easier of repair. They have also been improved in design.

WINDOW REFLECTORS.—The adoption of the Frink patented window reflector for show windows is evidence of the popularity which this fixture has gained with progressive merchants in all parts of the country. Contracting engineers who install it for the first time in a city soon place further orders, for competitors are quick to recognize the advantage a house with perfectly lighted windows has over them in drawing trade through the increased effectiveness of show window displays. The finer the quality of the goods a store carries, the greater the necessity for perfect lighting, for the differences in quality are only brought out by showing them to the best possible advantage. Full information will be given on request by the manufacturer, I. P. Frink, 551 Pearl Street, New York.

"TO WIN THEE FAVOR."—The North Electric Company, Cleveland, Ohio, is sending out some attractive literature concerning its telephone apparatus. A circular calls attention to an operatic libretto issued by the company, the title of the new opera being, "To Win Thee Favor." It depicts the downfall of the telephone imp. The cast includes such celebrities as Mr. "F" Desk Set, "Compact and Complete," Mlle. Type "E," "Smallest and Prettiest Magneto Call Wall Set in the World," Mr. Twin Set, "With Hosts of Admirers," and "His Majesty, the Telephone Imp Now at Large." There is a full chorus consisting of beautiful and attractive specialities needed in every telephone exchange or toll line system. According to the announcement, becoming a charter member in this international movement will help to raise the standard of success for independent telephone companies.

CENTRAL STATION HEATING.—An interesting pamphlet has just been issued by the American District Steam Company, of Lockport, N. Y., in which is given a complete description, illustrated, of the company's system of heating from central stations. It gives a brief sketch of the early work of Mr. Holly, and the Holly Steam Combination Company, of which the American District Steam Company is the successor. The various improvements of the system are pointed out, and the essential mechanical features described and illustrated. Among the illustrations are those of two large modern office buildings which are heated by this system. By the Holly system direct and exhaust steam is distributed in cities and villages for heating and power. The pamphlet contains three maps of sections of three cities in which the system is installed, showing the extent of the area served.

THE O. C. WHITE COMPANY, Worcester, Mass., is preparing an elaborate exhibition of its adjustable electric light fixtures for the Pan-American Exposition. Its space is in the northeast corner of the Electricity Building. It has an eighteen-foot frontage, and will be very handsomely furnished with quartered oak casings, counters and side wall shelving. Besides the many styles of fixtures which are already well known and have made its high reputation, it will show between thirty and forty entirely new styles never before exhibited. These include some ingenious and conveniently adjustable combination gas and electric fixtures for ceiling, sidewall and bench use, a new floor stand for Crookes tubes in X-ray apparatus, and some large fixtures for very high ceilings. The O. C. White Company's space will undoubtedly be a prominent feature of the electrical exhibits.

THE E. W. BLISS COMPANY AT THE PAN-AMERICAN.—One of the most interesting exhibits in the Machinery Hall at the Pan-American Exposition will be that of the E. W. Bliss Company, of Brooklyn, N. Y. Most of our readers are acquainted with this concern and its products, and know that it is perhaps the largest manufacturer in the world of presses, dies, shears and other sheet metal working tools. This company was the only American manufacturer in its particular line of machinery to receive the "Grand Prize" at Paris. While the Bliss exhibit at Buffalo will not be so large as the one at Paris, it will contain many automatic machines and a complete plant for making harness oil cans automatically. In addition to these machines there will also be several sizes of the well-known Bliss inclinable power press, a Stiles power punching press, a Bliss patent toggle drawing press, a Bliss improved double action press, a "Stiles" automatic drop hammer, a new type Bliss automatic notching press for armature disks and a number of other tools. The exhibit will be in charge of one of the Bliss Company's consulting engineers, who has had a large experience in tools for the manufacture of sheet metal goods. The Bliss Company will be pleased to meet at its exhibit, or at its main office in Brooklyn, all who are looking for information regarding the most economical method of manufacturing various sheet metal articles.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 2, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

670,927. INCANDESCENT ELECTRIC LAMP; C. R. Campbell, Huguenot, N. Y. App. filed July 12, 1900. A multi-filament lamp having a socket switch for throwing any number of the filaments into circuit at once.

670,931. THERMOSTAT; C. B. Garrett and W. S. W. Blake, Minneapolis, Minn. App. filed Feb. 6, 1900. A plunger acted upon by a spring is released to close a circuit when fusible material is melted.

670,952. POTENTIAL REGULATOR; A. R. Everest, Lynn, Mass. App. filed Sept. 24, 1897. The invention in general comprises a transformer having a primary winding connected through a reversing switch across the supply mains, with a secondary winding arranged in section and adapted to be connected wholly or partially in series with one of the supply mains.

670,964. TELEGRAPHY; D. Murray, New York, N. Y. App filed Jan. 17, 1901. An improvement on the invention described in patent No. 653,936, and relates especially to the disposition of the pins designed to pass through the holes in the perforated tape.

670,980. TELEGRAPHIC INSTRUMENT; A. S. Bissell, New York, N. Y. App. filed Sept. 4, 1900. Details of an instrument in which a tape is perforated with Morse characters in the receiving instrument.

670,986. AUTOMATIC PROTECTING AND DETECTING DEVICE FOR ELECTRIC LIGHT CIRCUITS; H. Etheridge, McKeesport, Pa. App. filed June 19, 1899. Automatic device for closing a shunt around the lamps in case the lamps become inoperative.

670,994. ELECTRIC LIGHTING SYSTEM; J. A. Mesiroff, Milwaukee, Wis. App. filed April 30, 1900. Means controlled through the medium of the secondary circuit conductors of a transformer for closing or breaking the primary circuit in correspondence respectively with the use or non-use of the lamps at the station, without increasing the resistance of the lighting circuit.

670,999. PRESSURE GAUGE; A. J. Purinton and L. W. Sweet, Waterbury, Conn. App. filed Jan. 8, 1900. Details of a gauge adapted to close an alarm circuit when the pressure reaches a predetermined point.

671,008. APPARATUS FOR PRODUCING CALCIUM CARBID; J. Zimmerman and Isadore S. Prenner, of Chicago, Ill. App. filed March 13, 1899. Mechanism is provided for feeding the mixture of lime and carbon continuously in position between the arc and from below the arc.

671,009. BONDING PIN; L. S. Bacon, Washington, D. C. App. filed Nov. 19, 1900. A bonding pin tapered throughout and having an open lengthwise side channel.

671,032. CONTROLLING APPARATUS FOR SIGNAL OPERATING SYSTEMS FOR RAILWAYS; B. C. Rowell, Chicago, Ill. App. filed Feb. 13, 1899. Mechanism for controlling the power machine of a signal operating device, in which a shaft under tension is provided with two lugs, and two stops for the lugs; magnets are arranged to shift the stops so that when one magnet disengages one stop it will move the other into position to engage with its lug.

671,046. TELEGRAPH RECORDER; G. L. Foote, Brooklyn, N. Y. App. filed Jan. 29, 1898. A device whereby the recorded dots and dashes will respectively be of uniform length regardless of the duration of the current producing them.

671,079. CONTACT FINGER FOR ELECTRIC MOTOR CONTROLLERS; F. W. Garrett, Johnstown, Pa. App. filed July 24, 1900. The object is to provide for adjusting the fingers with respect to the contact, when necessary by reason of wear, without altering the original tension of the springs acting on the fingers.

671,080. TROLLEY; H. S. Goughnour, Johnstown, Pa. App. filed June 8, 1900. The spring which forces the trolley upward is disconnected when the wheel leaves the wire.

671,084. ELECTRIC WELDING APPARATUS; H. F. A. Kleinschmidt, Johnstown, Pa. App. filed April 24, 1900. By a peculiar arrangement of the clamps it is possible to apply pressure and current to different parts of the joint, so as to uniformly heat the same.

671,093. SWITCH AND OUTLET BOX; M. Robinson, Newton, Mass. App. filed Jan. 31, 1901. Details of construction.

671,106. AUTOMATIC STOP FOR ELECTRIC ELEVATORS; A. Cowperthwait, New York, N. Y. App. filed Feb. 4, 1901. When the elevator reaches the top or bottom of the shaft the device automatically opens a local circuit controlling the motor circuit, and if this does not stop the elevator, the further movement thereof opens the main motor circuit.

671,139. ELECTRIC HEATER; A. R. Leask, London, Eng. App. filed Dec. 13, 1900. A heating apparatus which can be bodily placed into any suitable vessel for heating the water therein.

671,179. TROLLEY CAR; L. A. Brod, Brooklyn, N. Y. App. filed Aug. 15, 1900. Details.

671,232. ATTACHMENT FOR NOTCHED QUADRANTS; W. B. Potter, Schenectady, N. Y. App. filed Dec. 28, 1900. A notched rack co-acting with a latch and means for automatically supporting the latch when raised out of the notch, until the handle is turned to bring the latch over the next notch.

671,235. MEANS FOR ATTACHING POLE PIECES; H. G. Reist, Schenectady, N. Y. App. filed Jan. 29, 1900. The attachment is made by means of a dove-tailed connection which is held secure by a key.

671,244. AIR PUMP GOVERNOR; S. B. Stewart, Jr., Schenectady, N. Y. App. filed Jan. 21, 1901. The governor comprises a pressure operated device for opening and closing the circuit of the motor, a spring resisting the movement of the device, an auxiliary spring strained by such movement, and a tripping device for the controller operated by the switch.

671,249. RECTIFIER; E. Thomson, Swampscott, Mass. App. filed Jan. 9, 1900. (See Current Newa and Notes.)

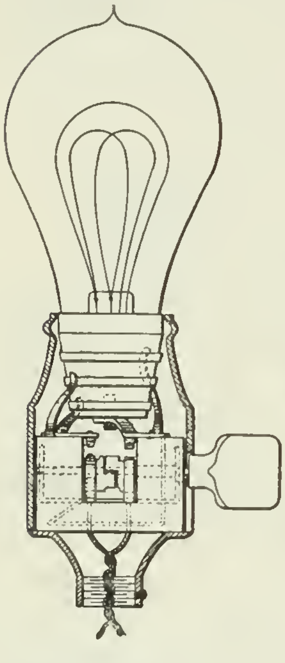
671,258. ATTACHMENT FOR CONTROLLER HANDLES; A. H. Armstrong, Schenectady, N. Y. App. filed Jan. 22, 1901. This invention is applicable to any shaft of a controller, on which a loose handle is mounted, which it is desirable to retain, yielding in a predetermined angular position with reference to the shaft.

671,259. SYSTEM OF MOTOR CONTROL; C. F. Barry, Schenectady, N. Y. App. filed Jan. 29, 1900. Improvement in the multiple unit system of control.

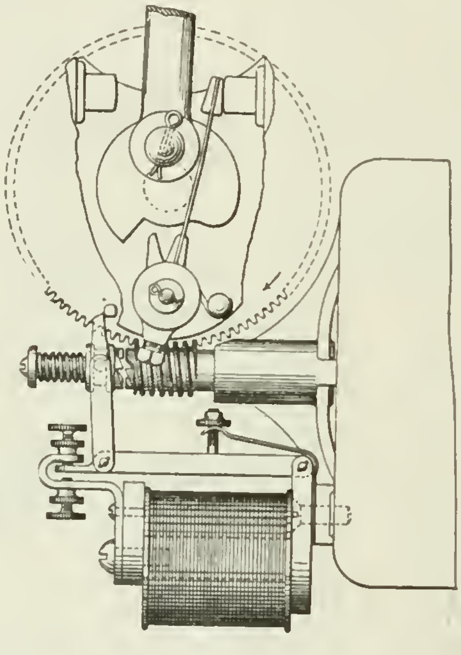
671,265. ELECTRIC RECORDING INSTRUMENT; Frank P. Cox, of Lynn, Mass. App. filed July 9, 1900. An electrodynamometer is resiliently connected with a disc which revolves between the poles of two opposite magnets, which are attached to the shaft of a small electric motor. As the motor revolves it imparts a torque to the friction disk, which torque acts opposite to that of the dynamometer. A pinion on the shaft of the disk acts on a rack carrying at its end a pencil, which records on a paper on a revolving drum.

671,270. MEANS FOR EQUALIZING THE SPEED OF SHAFTS; W. L. R. Emmet, of Schenectady, N. Y. App. filed Jan. 9, 1900. A fly-wheel is loosely mounted on a shaft and its rotation restrained by means of springs connected by an arm keyed to the shaft. This arm, as well as a similar one on the opposite side of the shaft, has flaring sides which are in close proximity to magnets carried by the fly-wheel. In case of a sudden change of speed the magnets on one or either side of these arms are energized and thus tend to restore the arms to their normal relative position, and the pull thereby exerted checks the forward or backward impulse of the shaft and tends to bring it back to its normal speed.

671,271. ELECTRIC FUSE; W. L. R. Emmet, of Schenectady, N. Y. App. filed Jan. 27, 1900. An insulating handle is attached to an enclosed fuse for entering the same into the clips of its support. The clips are within a bell-shaped receptacle, which affords a full vent to the gases when the fuse blows.



679,927—Incandescent Electric Lamp.



671,278—Electrically Controlled Switch.

671,272. ELECTRIC METERING SYSTEM; W. C. Fish, Lynn, Mass. App. filed Jan. 18, 1899. (See Current News and Notes.)

671,273. METERING ELECTRIC ENERGY; W. C. Fish, Lynn, Mass. App. filed Jan. 26, 1901. (See Current News and Notes.)

671,278. ELECTRICALLY CONTROLLED SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Dec. 30, 1898. Details of a power switch.

671,279. MEASURING INSTRUMENT; C. S. Jameson, Swampscott, Mass. App. filed Dec. 23, 1898. (See Current News and Notes.)

671,282. ELECTRIC METER; E. J. King, Fort Wayne, Ind. App. filed Jan. 20, 1900. (See Current News and Notes.)

671,283. ELECTRIC METER; E. J. King, Fort Wayne, Ind. App. filed Jan. 31, 1901. (See Current News and Notes.)

671,287. END PLAY DEVICE; Alexander D. Lunt, of Schenectady, N. Y. App. filed Feb. 9, 1900. The longitudinal movement of a shaft acts upon a device, which opens or closes the circuit of a magnetizing coil in inductive relation to the end of the shaft.

671,289. CONTROLLING ROTARY CONVERTERS; S. W. Manger, Schenectady, N. Y. App. filed Jan. 16, 1901. A system of electrical distribution comprising a plurality of motor-generators or rotary converters, independent circuits fed thereby, a common supply circuit, and starting switches for interconnecting any pair of machines on their direct-current sides.

671,311. TELEPHONE CALL BOX; W. Decker, Owego, N. Y. App. filed April 20, 1898. Details.

671,334. CONSTRUCTION OF MORSE'S REGISTERING TELEGRAPHIC INSTRUMENTS; E. Ducretet, Paris, France. App. filed July 29, 1898. Details.

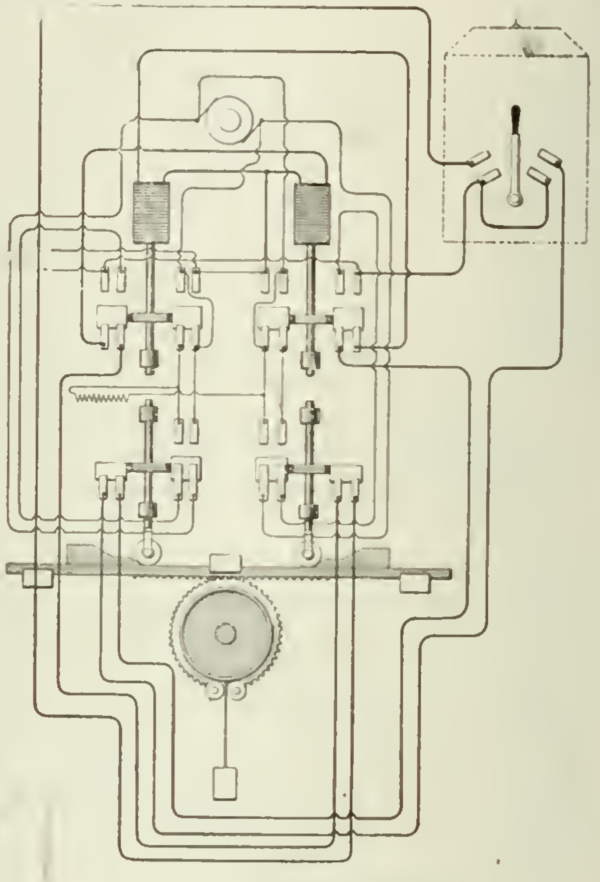
671,338. CONDUCTOR AND CONTACT FOR ELECTRICAL GLOW LAMPS; J. A. Halford, Bayswater, England. App. filed Sept. 10, 1900. The conductor is made up of bunched wires and the connection is made from the lamp to the conductor by sharp spikes which penetrate the conductor.

671,349. ELECTRIC SIGNALING APPARATUS; W. H. McClure and D. E. Healy, Worcester, Mass. App. filed Dec. 8, 1899. Details.

671,350. ALARM SYSTEM; J. H. McCracken, Washington, D. C. App. filed Nov. 23, 1900. Relates to the particular construction of a door mat containing circuit closers.

671,388. DEVICE FOR PROTECTING SAFES AGAINST BURGLARS; A. P. Prichard, Tacoma, Wash. App. filed Feb. 6, 1900. Details.

671,403. WIRELESS TELEGRAPH SYSTEM; Harry Shoemaker, of Philadelphia, Pa. App. filed Nov. 26, 1900. The aerial conductor is made shorter than usual; at the upper end it is connected, at the transmitting side with a stand consisting of a series of parallel circular plates, and at the receiving side with a stand consisting of a series of concentric cylinders. The sparking system of the induction coil consists of two larger end spheres and two smaller intermediate spheres, the latter being connected to a condenser. For decohering there is a soft iron ring above a hollow containing the filings; a magnet exterior to the tube surrounds this ring, and when magnetized causes the ring to attract the filings, thereby decohering the same.



671,106.—Automatic Stop for Electric Elevators.

671,404. ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS; H. Shoemaker, Philadelphia, Pa. App. filed Nov. 26, 1900. The track is divided into sections and relays located at the ends thereof are controlled by the movement of the train to operate the signals.

671,405. TELEGRAPH; H. Shoemaker, Philadelphia, Pa. App. filed Jan. 12, 1901. Details.

671,406. WIRELESS TELEGRAPH; H. Shoemaker, of Philadelphia, Pa. App. filed Jan. 17, 1901. The sparking balls of the transmitter are contained in a tube filled with an inert gas under high pressure. Decohering is effected by means of a ball within the coherer tube over the filing pocket; when an exterior magnet extracts the ball it strikes the tube and decoheres the filings. The coherer circuit contains an auxiliary relay which responds to the impulses of the transmitter in the aggregate, thereby producing as a short forward stroke of the armature the dot corresponding to a series of impulses, and as a prolonged forward stroke, the dash which results from a relatively greater number of impulses.

671,407. WIRELESS TELEGRAPHY; H. Shoemaker, of Philadelphia, Pa. App. filed Jan. 22, 1901. The decohering magnet is below the coherer tube and has the axis of its poles at right angles to the axis of the tube and opposite to the pocket containing the filings.

671,420. ELECTROTHERAPEUTIC SPECTACLES; A. F. Humphrey, Allegheny, Pa. App. filed Jan. 11, 1901. The temple wires of the spectacles are composed of different metals and batteries are attached to each end thereof.

671,426. ELECTROMAGNETIC BRAKE; P. F. L. R. H. K. Voigt and W. C. Kusterer, Ilmenau, Germany. App. filed Oct. 12, 1899. Details.

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RAPID TELEPHONIC GROWTH.

The fact that the Pacific Coast has witnessed an extremely rapid development of the telephone is well known, but the causes for such growth have not hitherto been discussed. We are glad, therefore, to present in this issue an interesting article on the subject by a staff correspondent, who has just been over the ground and made a careful study of the work on the spot. The present article will be followed by one or two others, discussing various technical and popular aspects of the telephonic situation on the Pacific Coast. It would seem that the policy of Mr. Sabin and his associates presents many points for imitation, and some which, if not imitated, will furnish food for thought. His goal is that at which all telephonists are aiming—the greatest possible profitable use of the system by the public.

THE INSTITUTE CONVERSAZIONE.

The Conversazione at Columbia University on the evening of April 12 formed the occasion of an interesting and successful meeting. Such functions are necessarily of a social character, and they are agreeable substitutes for dinners in that while a dinner is an interesting excuse for bringing a number of men together who are interested in different aspects and branches of the same art or science, yet at a dinner one's social environment is frequently limited almost entirely by one's right-hand and left-hand companion. At a conversazione the excuse for a social gathering is the collection of exhibits, and one's social environment is unbounded.

The first difficulty with a conversazione lies in securing such attractive features as shall ensure its success by reason of sufficient attendance, and the second difficulty is usually to prevent the success from being a failure by reason of overcrowding. The only solution of the difficulty from overcrowding lies in providing sufficient space for the guests in a sufficiently spacious hall. Conversaziones of scientific societies have on several occasions ended disastrously by unscientific management of apparently unimportant particulars, such as the care and checking of hats and coats. It is not so long since the guests of a heavily thronged conversazione in Europe had to go home hatless and coatless after a long, free fight in the vestibule over garments which were thrown into disorder by insufficient attention and provision for so numerous a gathering. It is to be hoped that in view of the success attending last week's Conversazione, each year may see one of these gatherings of the members of the A. I. E. E. in addition to or as an alternative to the annual dinner and the annual convention.

Those who attended the conversazione—some 1200 people—must have been impressed, as were all with whom we have talked over the affair, with the ease and smoothness with which the arrangements throughout met all the conditions, and next, with the unusually high average of the exhibits. Such demonstrations as those of Professor Thomson, Peter Cooper Hewitt and Nikola Tesla are necessarily not made very often, and on this occasion they were but three out of thirty displays of the best class, with all mere advertising rigorously excluded and with strong emphasis on the scientific side. The latest phenomena, the newest instruments, the novel applications were all there, and the only drawback was that they all had to be seen and studied in the space of about three hours. But each individual could concentrate on the things of most personal interest, and this in itself helped to scatter the crowd and keep it in circulation. On the whole, the Conversazione must be declared a brilliant success, gratifying to all whose efforts contributed to that end and creating a warmer and stronger interest than ever in the Institute, for whose growth and welfare it was projected.

Chemical Formulae and the Theory of Invariants.

The theory of invariants has hitherto remained a branch of quantics and, therefore, a branch of pure higher mathematics. It has been so pure that no shadow of utility seems to have perturbed its serenity. It is of comparatively recent origin, and before Boole and Cayley, invariants and covariants were not. In the report of a recent meeting of the Physico-Medical Society at Erlanger, is a paper by Messrs. P. Gordon and W. Alexejeff, setting forth an analogy appearing to exist between groups of chemical compounds of definite atomic relationship, and groups of invariants obtained by the algebraical methods of transformation and substitution.

If the theory propounded is found to be correct, we might expect it to lead to some modification of ideas on the classification of chemical compounds. At present it is recognized that there is no limit to the structural complexity of molecules, and that there is no limit to the number of possible chemical compounds or unions between atoms. The number of possible groupings and resulting compounds up to a certain range of complexity is so great that it is hopeless to attempt an enumeration of them.

If, however, the invariant theory should be found tenable, then owing to the labors of pure mathematicians already garnered, the numbers of substitution products in algebra up to and including a given range of complexity can be applied immediately to substitution products in chemistry, and products may be found capable of classification on a purely algebraical basis. But whether the theory of invariants, as applied to chemical formulæ, be reliable or not, it is evident that we may expect to find no field of mathematics so pure or remote from application but that the applied scientist will seek to lay hold of it. It would seem, in fact, as though the time and hope of the old philosopher were passing away, when he thanked Providence that he had hit upon a line of mathematical study for which no utilization was possible.

Expert Testimony.

We never look over the reports of a technical case involving the consideration of much expert testimony without wishing for radical changes in the present course of practice. We shall not here enter into the ethical consideration of the matter, assuming that so far as electrical cases are concerned the experts are acting in entire good faith and telling the truth as they understand it. Electrical science has advanced far enough to put its essential principles beyond dispute, but nevertheless there is left ample opportunity for wrangling over their application. In interpreting the technical features of a patent, for instance, two entirely conscientious and thoroughly trained experts may take points of view radically different, and arrive at utterly diverse conclusions. For patent specifications are seldom—we might almost say never—so drawn as to make the inventor's real understanding of the case fully evident. They are, as a rule, drawn by attorneys who are anxious to get the patent in as good legal shape as possible for the defence of their client's interests, and it very often happens that the objections of the examiner are met by purely verbal changes, which, while satisfying his formal requirements also serve to cloud the original clear expression of the inventor's intentions. When such a patent is put in litigation, it becomes, particularly if the art has been rapidly advancing, almost impossible to tell how fully the principles involved were in the inventor's mind and how completely his disclosures have anticipated the work of others. Instances of this kind lead to radical difference of opinion among experts, and derision of expert testimony on the part of the unthinking public. And the complete freedom allowed attorneys and experts in the ordinary course of testimony before an examiner tends to produce constant thrust and parry, shifty questions and elusive answers that put the expert in still worse repute when perhaps he is merely trying to avoid an ingenious attempt to extract from him an answer which, while verbally true, can be twisted in the coming brief to mean something entirely different.

In cases before referees, auditors and juries the plight of the expert witness is even worse. There are no well determined rules of expert testimony, and it often happens that hours are taken up in wrangling over the admission of some bit of technical evidence which all the parties concerned know perfectly well to be pertinent and important. We do not wish to cast aspersions on our friends the lawyers, but it certainly appears to the layman that a large part of their time is taken up in court with strenuous endeavors to prevent the whole truth from reaching the ears of the jury. Any one with the most rudimentary knowledge of technical matters knows that many questions, even when asked in perfectly good faith, cannot be answered categorically without stating half truths, and yet the Court often compels an expert witness to answer thus or say he cannot so answer, when it is perfectly evident that either alternative really conceals the facts. In cross examination the questions are frequently deliberately ambiguous or intentionally misleading, and there is at present no adequate means for checking this tendency. Nor is there usually any tendency on the part of the Court to restrain blackguardly attorneys, of whom the courts are never entirely rid, from miscellaneous abuse of the witness in an attempt to blacken his professional character and discredit his testimony. In patent practice the witness can at least defend himself, but in court work he is absolutely at the mercy of any pettifogger who is bent upon defeating justice. Even on direct examination hypothetical questions can be, and often are, put in such terms that an absolutely truthful answer will of necessity convey a false impression to the hearers. If in addition the expert is disposed to strain a point, there is almost no limit to the deception that can be practiced without deliberate falsehood on the part of any one. In such a state of affairs it is small wonder that expert testimony is sometimes looked upon with suspicion.

It seems to us that the remedy is to be sought in the formulation of definite rules of expert testimony, which is essentially different from ordinary fact testimony, and in an extension of the applied powers of the Court. In the first place, the qualification of the witness should be made once for all by the Court and in the most rigorous manner, and when his competence is so determined he should be protected from attack upon his qualifications. If such was the practice neither side would dare to put on an improperly qualified man and risk the effect of his being excluded by the court, nor would such a man venture to appear as a witness. In the next place, there should be a definite place given to expect testimony. At present, in patent practice, the witness is allowed unhindered to testify to fact and hypothesis at his own sweet will, while in court practice he is usually cross examined on the theory that his professional qualifications are of no value, and that data not obtained by his own personal experiments are to be classified as heresay evidence and excluded. The former course is absurdly loose, while the latter practically denies the existence of expert testimony as such. Some common ground should be formed between these two extreme positions and so defined that there should be uniformity in all legal proceedings. Finally, it would be a very desirable thing if the Court were permitted to retain expert assistance at its discretion or at the request of either party to the litigation, for the obvious purpose of sifting the technical evidence into such form that the Court can utilize it. The average judge has a great deal more acute appreciation of technical matters than he is popularly credited with, but it takes real expert knowledge of the details of a subject to get to the bottom of disingenuous hypothetical questions and evasive technicalities. For this purpose an expert retained by the Court, or, still better, permanently attached to it, would promote the ends of justice to no small degree.

Aluminium for Lines.

The present and continuing high price of copper has created a strong tendency to replace it with aluminum wire whenever feasible as a measure of economy. Of course, one cannot predict the future of the copper market, influenced, as it is, by pools, corners and combinations of various sorts, by the exploitation and possible operation of new mines, and by the chance for the development of new mining regions. It seems tolerably evident, however, that the demand is so great that the tendency of the market is decidedly upwards from the low plane of a few years ago. In view of this fact, the introduction of aluminum as a serious competitor has come about naturally enough, and we have from time to time noted in our columns the erection of a goodly number of aluminum transmission lines, some of them on a very large scale. On the whole, such lines have been successful, but some recent experiments abroad have tended to throw not a little doubt on their probable endurance. The matter is a very important one industrially, and there is real need for a thorough investigation of it. As in most mooted questions there are many pros and cons to be discussed.

The fundamental facts regarding aluminum are as follows: The white metal when pure has, weight for weight, just double the conductivity of copper; that is, of two lines of equal conductivity, the aluminum one will have just half the weight of the copper one. The cross-section of the former, however, will be about 1.64 times that of the latter, and its diameter about 1.27 times greater. The tensile strength of the aluminum line would be about 62 per cent that of the copper, supposing the latter to be hard drawn; but the copper in addition is perceptibly the tougher of the two. Its elastic limit is also somewhat higher, the aluminum taking permanent set very easily indeed. The linear expansion for each degree of rise in temperature is 1.4 times greater for aluminum than for copper, and while the former melts at 600 degs. to 700 degs. C., the latter becomes fluid only at 1000 degs. to 1100 degs. C. At present it is far easier to get pure copper than pure aluminum, since the latter is very hard to rid of the last traces of certain impurities, notably iron, and is produced by a process which presents some difficulties in the way of getting a uniform product. Chemically, the copper is far more stable as regards atmospheric influences. In the electrochemical series aluminum stands near the electro-positive end of the list, being followed only by such metals as magnesium, calcium and the like, so that when in electrolytic combination with any of the common metals, even iron and zinc, it is the aluminum that suffers. It is especially susceptible to salt water in every form. And, finally, while copper can be joined with solder very readily, aluminum is soldered only with great difficulty, and joints so made are of very dubious strength and permanence. This list of properties appears at first sight unfavorable to the use of aluminum, but there is more than one side to the question when put on an economic basis.

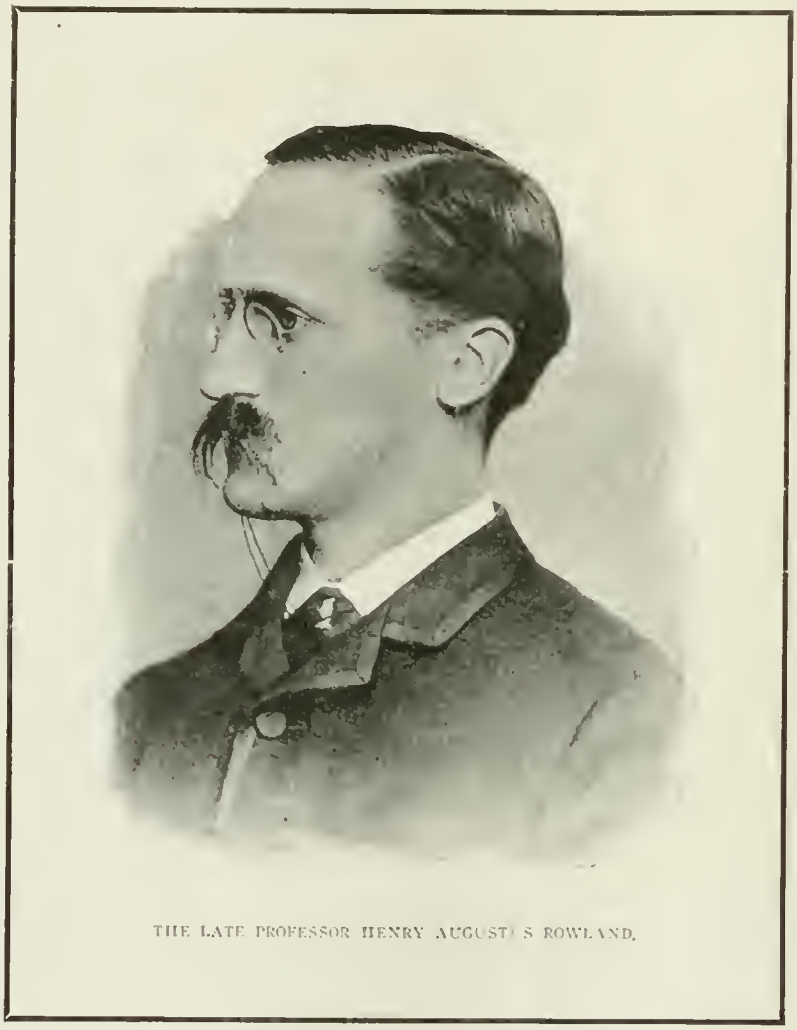
In the first place, the fact stands out conspicuously that in the first cost of material aluminum at even 30 cents per pound is as cheap as copper at 15 cents, and at 20 cents becomes equivalent to 10-cent copper. Moreover, if as very frequently happens, particularly in power transmission work, freights are a serious item of expense, every dollar spent in freights on the aluminum line is a dollar saved over the transportation charges on the equivalent copper line. This gain extends to the whole matter of distribution and handling of the wire. Against it has to be set the extra labor in stringing the aluminum, arising from the extra care that has to be taken in spite of the lessened weight. The added pains arise in part on account of using a weaker material, but especially on account of its very much greater expansion with temperature than in the case of copper. This implies much caution in stringing the wire under uniform tension, and adjusting the tautness of the line very carefully with relation to the temperature. Systematic use of thermometer and tension dynamometer are precautions somewhat novel in line construction of the ordinary sort; but, after all, the main thing is to get the line foreman into the knack of working thus, and the real added cost in dollars and cents is not so large as would appear at first thought. Joints are a far more serious problem. Soldering in the ordinary sense is practically out of the question at present, and the best results seem to have been reached by slipping the wires tightly into an aluminum sleeve and securing it by twisting. If such a joint could be air and water tight one could feel sure of its permanence, but in the case of salt fogs there is every reason to expect corrosion at a fairly rapid rate. The aluminum line has for the same conductivity as copper somewhat larger capacity and inductance, but the difference is not great enough to be material. It is also an easier victim in case of an accidental arc being established, but inasmuch as this is likely to be disastrous in any case, it is doubtful whether the lower fusing point of aluminum is practically of much account.

The improvement of methods of manufacture so as to ensure a homogeneous product of uniform quality and free from flaws, and the solution of the joint problem are the two things most important in the adaptation of aluminum to every-day use in line work. The other difficulties are of minor importance, and not to be seriously considered. If copper holds near its present price, it is safe to say that the incentive to use aluminum will be sufficient to ensure a thorough study of the case, and the presentation of remedies for the present difficulties. In much present and future work the cost of the line conductors is and will be so considerable an item in the total investment that even at present prices copper would hardly be in the game. A real stimulus to the aluminum industry would mean cheapening of production to a point at which even far cheaper copper than we now have could not successfully compete with it. In any case, it is safe to say that the genial theorists who consider a copper line in the jungle as a quick asset upon which securities can be successfully floated, may well stop and meditate a bit on the future of aluminum, and with them should commune the promoters who are opening low-grade copper mines on the strength of the present market. Copper, presumably, we shall have with us always, but at a pinch the electrical industries could get along on much less than at present.

Death of Prof. Henry A. Rowland.

As we go to press a dispatch announces the death of Professor Henry A. Rowland. Professor Rowland was born at Honesdale, Pa., Nov. 27, 1848, and was graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., in 1870. A year later began the career of scientific investigator and teacher which gave him such an enviable position among the American scientific names of the century.

His father, the Rev. H. A. Rowland, was a scholar of distinction and of old Connecticut Congregational stock, a graduate of Yale and Andover, and a pastor in the Presbyterian Church for nearly 30 years. It is evident that the genius of the boy soon found its object, for he determined on a scientific course and entered Rensselaer Polytechnic Institute at Troy, from which he was graduated as a civil engineer. The next year found him railroad surveying in Western New York, but his ability as a teacher was already recognized, and his services were called into requisition at Wooster University. In 1872 he returned to Rensselaer as instructor in physics, and in 1874 he became assistant professor.


THE LATE PROFESSOR HENRY AUGUSTUS ROWLAND.

In the meantime, he had completed his now widely known experiments on magnetic permeability, but at first he was unable to get them published. The scientific journals in America rejected his work, but, confident of its value, he sent his results to Clerk Maxwell, who at once had them published in the *Philosophical Magazine*. He was now becoming known, and when the authorities of the newly founded Johns Hopkins University, at Baltimore, cast about them for some one to fill the chair of physics and become director of the physical laboratory, Professor Rowland, with his already recognized ability, and with the countenance which Maxwell's recognition of his talents gave, was chosen for the place. This was a year before the University actually opened, and the interval he spent in Europe, working in Berlin with Helmholtz. Here he investigated the effect of static electricity in motion, and later offered the first proof of Maxwell's great hypothesis on the identity of electromagnetic and luminous undulatory transmission by demonstrating that a static charge moving with the velocity of light has the effect of a current. In accordance with an international agreement, Professor Rowland was selected by the United States Government to determine the absolute value of the ohm.

While the energies of Professor Rowland were largely devoted to exhaustive researches into the nature and phenomena of electricity and magnetism, his work took a broad sweep through pretty well the whole range of physics. He devised a very exact method for determining the mechanical equivalent of heat, and the valve obtained by him replaced that which had hitherto been accepted by science. To the public his name is probably even more familiar in connection with his large diffraction gratings, which are ruled by a method of his own directly on concave mirrors, the image of the solar spectrum being thus produced without the aid of lenses. In fact, the photographs of the spectrum obtained with the aid of these gratings far exceed anything else of the kind, and their exhibition before the National Academy of Sciences in 1883 was one of the leading scientific events of the year. Professor Rowland's friends claim for him the discovery of the phenomenon known as the Hall effect.

The well-earned degree of Ph.D. was conferred upon Professor Rowland by Johns Hopkins University in 1880. As a member of the Electrical Congress at Paris in 1881, and of the jury at the Electrical Exhibition at the same time and place, he received the order of a Chevalier of the Legion of Honor. In 1881 he was elected a member of the National Academy of Sciences. In 1883 he presided over the Physics Section of the American Association for the Advancement of Science, at Minneapolis, and read a memorable address, entitled "A Plea for Pure Science." In 1884, being appointed by the Government on the commission specially formed for the purpose, he presided over the deliberations of the National Conference of Electricians at Philadelphia, and delivered an address. During the same year he received from the American Academy, of which he is an associate, the Rumford medal for his researches in light and heat, and since then other well merited honors have fallen to his share. In 1893 he was elected presiding officer of the International Electrical Congress, sitting at Chicago. During the past eight years Professor Rowland has devoted much time to the perfection of a system of rapid telegraphy, a working exhibit of which formed perhaps the most interesting feature of the American Electrical section of the recent Paris Exposition.

Professor Rowland was the author of many papers of great importance, most of which relate to his far reaching researches into various scientific subjects. In addition to developing the resources of the physical and electrical laboratories at Johns Hopkins, where, in addition, an electrical testing bureau has been established by him, Professor Rowland in some manner continued to devote time to many other matters of importance. He was corresponding member of the British Association for the Advancement of Science, and of the Cambridge Philosophical Society; was one of the 12 foreign members of the Physical Society of London, and a permanent member of the International Commission for establishing electrical units. Quite recently Professor Rowland appeared before a Senate committee at Washington and delivered an argument in favor of the measure establishing the National Standardization Bureau. He was the first president of the American Physical Society.

As a teacher, Professor Rowland was a constant source of inspiration to students. As in the case of other great teachers of original cast of mind, his thoughts in the lecture room at times soared beyond the ken of the auditors, but none the less influenced their minds toward higher aims. A strong bond existed between the Professor and students, and the expression "A Rowland man," as applied to Johns Hopkins graduates, has come to have a significance even higher than that of a learned degree.

The Development of the Telephone on the Pacific Coast.

MORE telephones are used in proportion to the population in the Pacific Coast States than anywhere else in the United States. This condition of affairs makes the telephonic development in that territory a subject that is worth investigation by all interested in telephone work.

The Pacific States Telephone & Telegraph Company is the Bell organization which operates in the States of California, Oregon, Washington, Nevada and a part of Idaho. The independent telephone movement has not as yet assumed much importance in those States. Owing partly to its distance from Eastern examples and men, and partly to the capacity of the company's management for going ahead on original lines, the Pacific States Telephone & Telegraph Company has pursued lines of policy which differ considerably from the Eastern Bell companies. While many of the methods adopted have probably been looked at doubtfully by Eastern telephone managers who knew of them, the results in the way of a telephone development and usefulness exceeding that of any other portion of the United States, certainly speak for themselves. It is not easy to state in a few words, nor is it always easy to determine, the exact reasons for the success of a business undertaking. The men themselves who have been responsible for the success cannot always give the reasons for it, and often when they do their opinions do not agree. The writer has talked with many telephone men on the Pacific Coast and elsewhere in the endeavor to determine the real factors which have made the Pacific Coast telephone business what it is. A number of different explanations have been given. Probably no one of them covers the case entirely. Taken together, they explain the case rather fully. Perhaps the most comprehensive reason offered by any one was that given by the man who said "The reason for the success of the Pacific States Telephone & Telegraph Company is its president." To know the policy and personality of President John I. Sabin is to know much of the secret of the company's success. Mr. Sabin is a man of unlimited energy and push, the dominant spirit of the whole undertaking and one who stops at no radical move that gives promise of making the telephone more popular and useful and increasing the business.

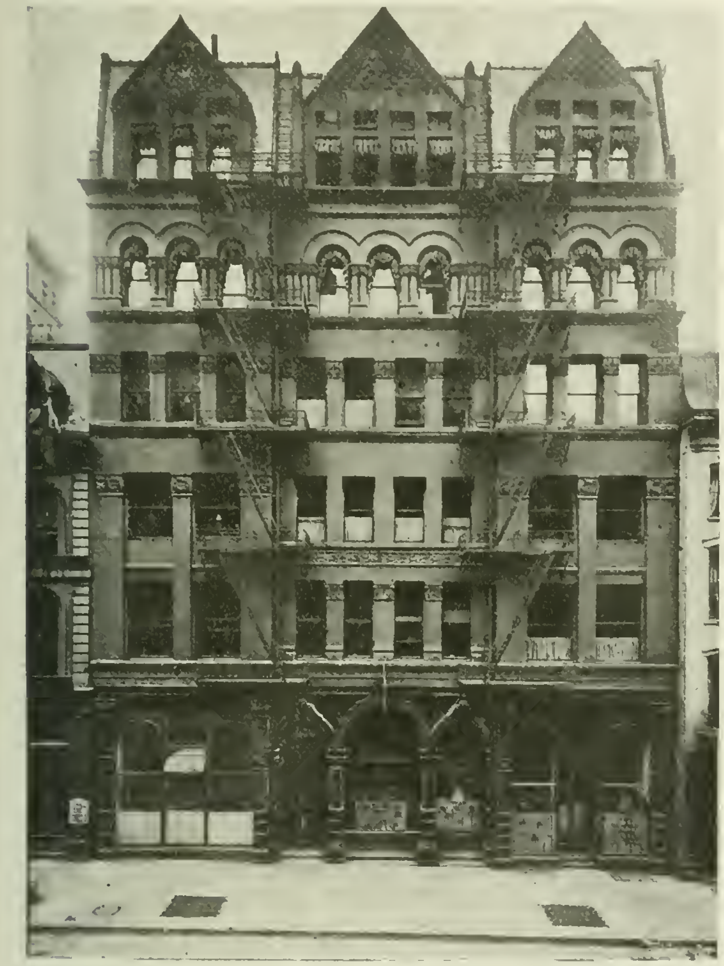


FIG. 1.—MAIN EXCHANGE, SAN FRANCISCO.

Going more into detail, the reasons for such a wonderful telephonic development as given by various people are as follows:

1. Faith in the unlimited possibilities and future of the telephone by the company, rather than the conservative belief that the developmentment possible was limited, that formerly prevailed in the East.
2. Giving the different classes of patrons, both local and long distance, various classes of service, suited to their needs.
3. The nickel-in-the-slot party-line telephone suited to the use of a large class of people.
4. Constant, active pushing for new business by solicitors and by advertising.
5. The use of exchange apparatus and methods suited to the enlargement of the business without great complication and expense.

The meaning of these reasons will be better understood later on when the methods pursued are taken up in detail.

SUBSCRIBERS AND POPULATION.

Statistics are apt to be dry, but in view of the high percentage of telephone subscribers to population most of the following figures will be of considerable interest to those familiar with similar figures on the use of the telephone elsewhere. The population and percentage of subscribers to population is shown in the following table:

PERCENTAGE OF TELEPHONES TO POPULATION, ACCORDING TO CENSUS OF 1900, IN EXCHANGES OF 300 OR MORE SUBSCRIBERS, AS AT DEC. 31, 1900.

Exchange.	Population.	Subscribers.	Percentage of subscribers to population.
SanFrancisco	342,742	21,324	6.22
Los Angeles	102,479	7,830	7.64
Oakland	96,638	6,560	6.78
Portland	90,426	6,445	7.12
Seattle	80,671	4,337	5.37
Tacoma	37,714	2,558	6.78
Spokane	36,848	3,618	9.81
Sacramento	29,282	2,257	7.70
San Jose	25,150	3,069	12.20
San Diego	17,700	1,359	7.67
Stockton	17,500	1,581	9.03
Fresno	12,470	1,405	11.26
Walla Walla	10,049	598	5.95
Pasadena	9,117	600	6.58
Astoria	8,381	363	4.33
Riverside	7,973	376	4.71
Everett	7,838	449	5.72
Tucson	7,531	352	4.67
Eureka	7,327	582	7.94
Whatcom	6,833	432	6.32
Santa Rosa	6,673	347	5.20
Baker City	6,663	408	6.12
San Bernardino	6,150	315	5.12
Santa Barbara	6,587	412	6.25
Santa Cruz	5,659	367	6.48
Phoenix	5,544	457	8.24
Bakersfield	4,836	656	13.56
Marysville	3,397	311	9.15

The two exchanges having the highest percentages are those at San Jose and Bakersfield. The figures in those cases are perhaps rather deceiving, however, for neighboring towns and suburban line subscribers are connected on the main exchanges. In the case of Bakersfield also the oil boom which is there in full force has something to do with the large number of subscribers. Aside from these considerations, however, the percentage is very high not only in those two towns, but in all the others. Independent exchanges are

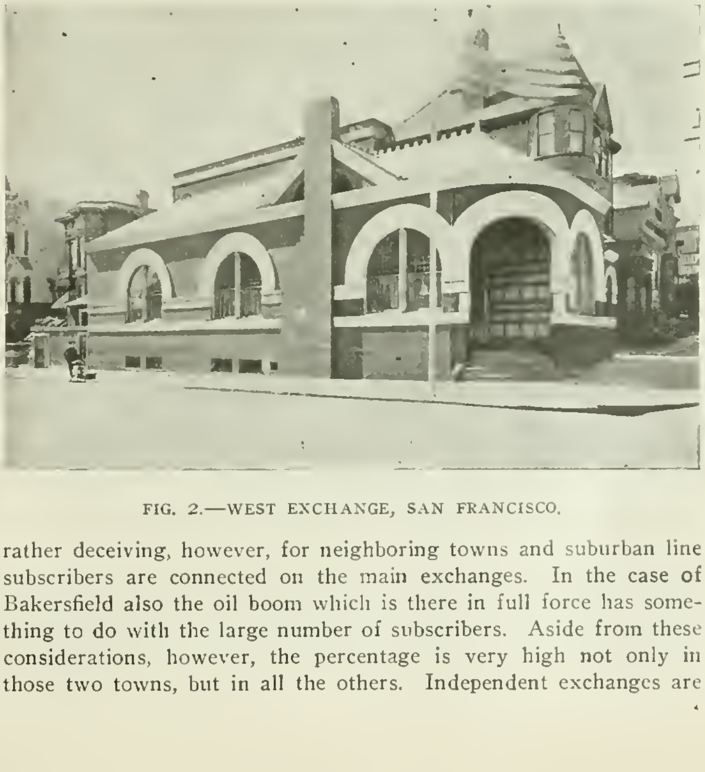


FIG. 2.—WEST EXCHANGE, SAN FRANCISCO.

in operation at Portland and Sacramento, and there was one formerly at San Jose.

The growth of the business in the company's territory from 1895 to 1900 was as follows:

Dec. 31.	Number subscribers.	Increase over previous year.
1895	20,053	....
1896	24,961	4,908
1897	34,511	9,550
1898	44,985	10,474
1899	64,538	19,553
1900	85,744	21,206

FIG. 3.—SUPPLY DEPARTMENT, LOS ANGELES.

In the city of San Francisco (the largest exchange) the same figures for the five years were as follows:

Dec. 31.	Number subscribers.	Increase over previous year
1895	6,372	....
1896	7,810	1,438
1897	11,374	3,564
1898	13,053	1,679
1899	16,817	3,764
1900	21,324	4,507

On Jan. 31 there were 21,755 subscribers in San Francisco.

CLASSES OF SERVICE OFFERED AND RATES.

The kinds of service offered to the public have an important bearing on the telephone growth in these States. The policy of this company is to suit the service offered as nearly as possible to the needs of all classes of possible subscribers rather than force all subscribers to adapt themselves to one or two classes of service. The idea is to get something that will suit every one's pocketbook and requirements, rather than to try to convince a prospective customer that he wants something he does not need. The importance of suiting the service to the subscriber rather than the subscriber to the service is often not sufficiently realized by companies operating in other parts of the United States. There has been a conservative fear about adopting anything new because of the complications involved, or a fear that it would result in unsatisfactory service. The officers of the Pacific States Company have never hesitated to make a move on this account, and while the quality of service may have suffered sometimes as a result for short periods, the business has certainly been wonderfully built up. Then, too, the switchboard construction universally used on the Pacific Coast permits additions and changes to be made more easily than the multiple board construction which is common in the East. Of this aspect of the case more will be said later in connection with exchange equipment.

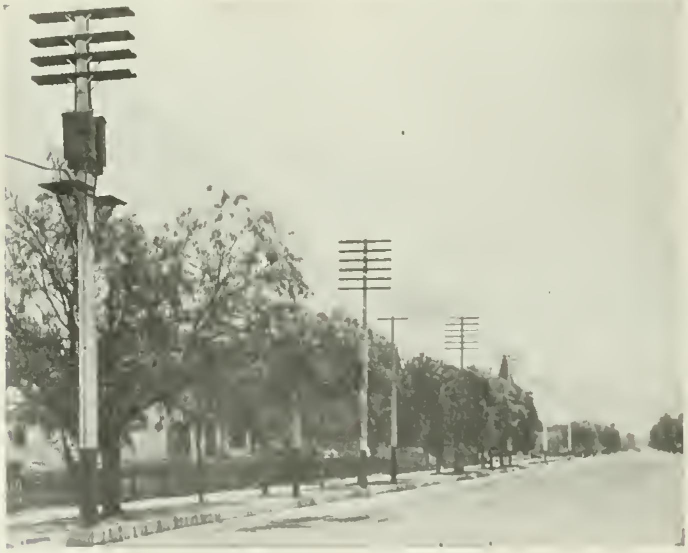


FIG. 4.—POLE LINE, LOS ANGELES.

In the city of San Francisco the number of different classes of service offered make a rather formidable list. In the other cities the variety is not so great. The rate for a business or professional individual metallic circuit is $7.50 per month. Measured service on individual metallic circuit is offered by the following schedule:

Switches, or less, Per Month.	Per Month.	Extra Switches, each.
83	$2.50	4c.
166	5.00	3c.
250	7.00	2c.
416	10.00	1½c.
583	12.50	1c.

Nickel-in-the-slot telephones on a two-party line are put in upon a guarantee of 20 cents per day for business or professional use. If the earnings of the instrument in nickels falls below an average of 20 cents per day the subscriber makes up the deficiency. Nickel-in-the-slot telephones on 10-party lines for business or professional use are put in on a guarantee of 5 cents per day. Ten-party business telephones are put in on a rental of $2.50 per month, 40 switches free and 5 cents each above 40 switches.

FIG. 5.—LOS ANGELES EXCHANGE.

Residence telephones on individual metallic circuits, unlimited switching, are $5.50 per month, and on a two-party line $5 per month. Nickel-in-the-slot instruments on two-party lines are put in residences upon a guarantee of 10 cents a day and on 10-party lines are put in upon a guarantee of 5 cents a day.

Of the 21,324 subscribers in the San Francisco exchanges, Dec 31, 1900, there were 9,969 nickel-in-the-slot telephones of the various classes connected. While the nickel-in-the-slot 10-party line service is not suited to any one having much business over the telephone on account of the liability of frequently finding the line busy, it meets the needs of a large class of people and at the same time educates people to the use of the telephone, so that in case the 10-party service is not sufficient they take something better. Of the 9,969 nickel telephones, 482 were on two-party lines with 20 cents a day guarantee; 1134 were on two-party lines, with 10 cents a day guarantee; 3781 were on 10-party business lines, with 5 cents a day guarantee, and 4572 were on 10-party residence lines with 5 cents a day guarantee.

The nickel-in-the-slot service went into effect on the Pacific Coast first about April 1893, and the express system was introduced first about December, 1892.

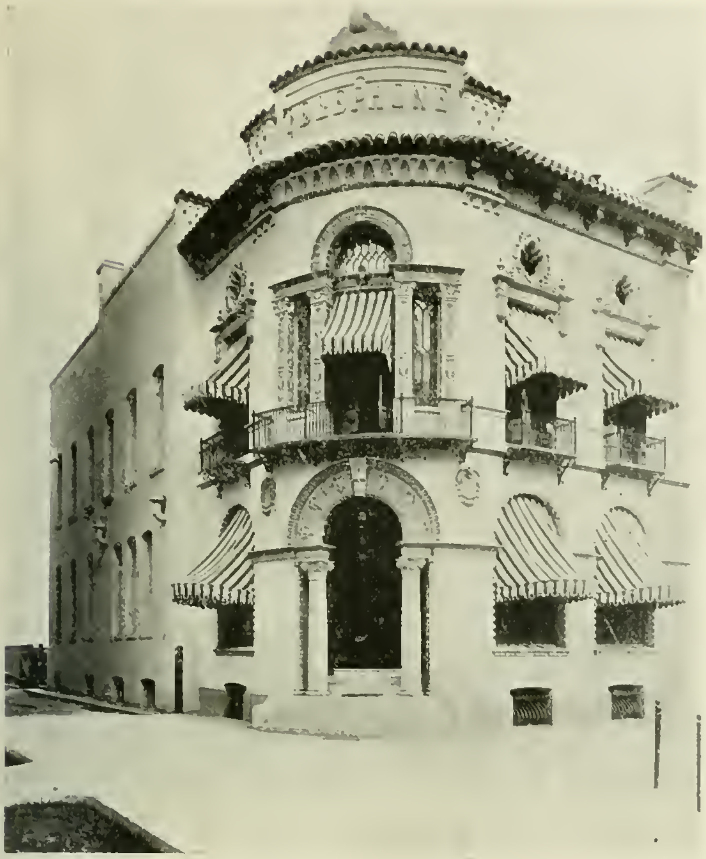


FIG. 6.—SAN JOSE EXCHANGE.

In some of the fairly representative cities outside of San Francisco the rates are as shown by the following table. The population and number of subscribers in the towns on this list can be obtained from the table previously given:

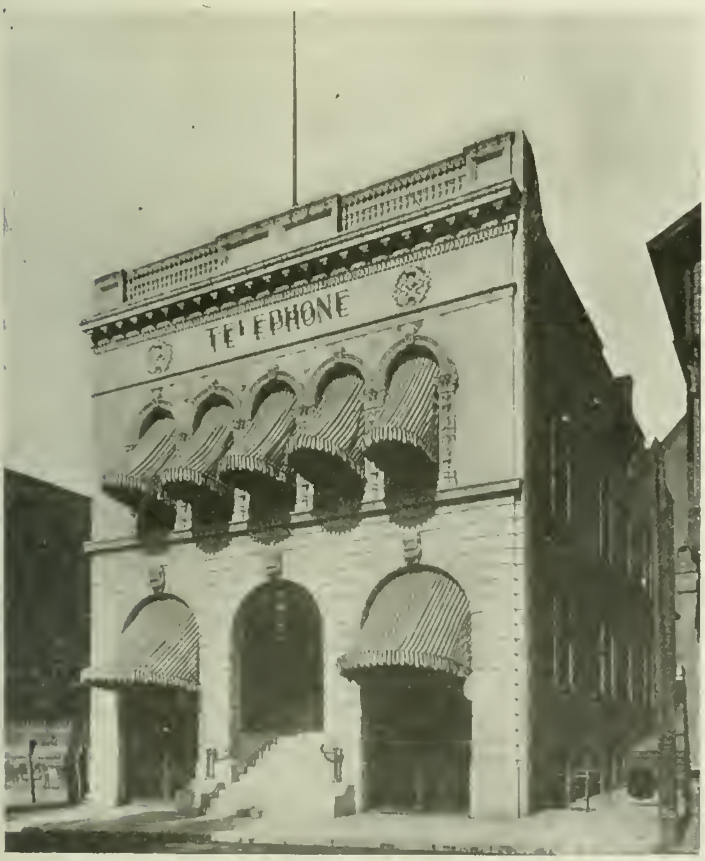


FIG. 7.—SEATTLE EXCHANGE.

BUSINESS RATES.

	Individual.			Two Party.		Ten Party.
	Unlimited.	*100 Calls.	*40 Calls.	Unlimited.	*40 Calls.	*40 Calls.
Los Angeles	8.00	6.00	5.00	5.00	3.50	2.50
Fresno	5.00	....	....	3.50	....	2.00†
San Jose	6.00	5.00	4.50	3.50	....	2.00†
Bakersfield	4.00	....	....	3.00	....	1.50†
Stockton	6.00	5.00	4.50	3.50	....	2.00†
Portland	8.00	6.00	5.00	5.00	"X"	"V"

RESIDENCE RATES.

	Individual. Unlimited.	Two Party. Unlimited.	Ten Party. Unlimited.
Los Angeles	4.50	2.50	1.25
Fresno	4.50	2.50	1.25
San Jose	4.50	2.50	1.25
Bakersfield	4.00	2.50	1.25
Stockton	4.50	2.50	1.25
Portland	4.50	2.50	1.25

Outside of San Francisco, coin attachment or nickel-in-the-slot instruments are not used to any large extent, although there are 1879 in Los Angeles and 1498 in Portland.

A special class of service called "Business Exchange" has been installed in San Francisco and Los Angeles. This will be described under exchange equipment and operation.

LONG-DISTANCE RATES.

The main difference between this company's practice in regard to long-distance tariffs and others is the introduction of low rates for very short conversations. Connections will be made for anything from one-quarter minute up. Time is kept with a stop watch by the long-distance operator. The rates for various lengths of conversation are shown by the accompanying rate table. The rate numbers refer to a certain list of towns, and the rates are from San Francisco to those towns. The one-quarter-minute rate to Portland from San Francisco is 75 cents, and the rate to Los Angeles 50 cents. Portland is 772 miles by rail and Los Angeles 482. The short conversation rates catch much business that would otherwise go by telegraph.

LONG DISTANCE TELEPHONE TARIFFS.

Rate	¼ Min.	½ Min.	¾ Min.	1 Min.	3 Min.	†5 cents each add'l.	REMARKS.
1	....	....	....	....	.25	30 Sec.	
2	....	....	....	.25	....	30 "	†The additional 5-cent or 10-cent rate applies only after the longest period for which rate is given in previous columns.
3	....	.25	....	.40	....	30 "	
4	....	....	....	.40	....	30 "	
5	....	....	....	.50	....	30 "	
6	....	....	....	.50	....	20 "	
7	....	....	....	.50	....	15 "	
8	....	....	....	.50	....	10 "	
9	....	.40	....	.75	....	15 "	
10	....	.50	....	1.00	....	15 "	
11	....	.50	.75	1.00	....	10 "	
12	.50	.75	1.00	1.25	....	10 "	
13	.50	.75	1.00	1.25	....	5 "	
14	.50	1.00	1.25	1.50	....	3 "	
15	.50	1.00	1.50	1.75	....	3 "	
16	.50	1.00	1.50	2.00	....	3 "	
17	....	1.25	1.75	2.25	....	2 "	
18	....	....	....	....	.10	60 "	
19	....	....	....	....	.15	60 "	
20	....	....	....	....	.50	30 "	
21	....	....	....	.15	....	60 "	
22	....	....	....	....	.25	60 "	
23	....	....	....	.20	....	60 "	
24	....	....	....	.25	....	60 "	
25	....	.25	....	.30	.40	30 "	..2 Min. 35 Cts.
26	....	.25	....	.35	....	30 "	
27	....	.25	....	.40	....	30 "	40 Sec. 30 Cts. 50 Sec. 35 Cts.
28	....	.25	....	....	....	30 "	
29	.25	.35	....	....	....	30 "	
30	....	.50	.75	1.00	....	5 "	
31	....	....	....	.75	....	15 "	
32	.50	.75	1.00	1.25	....	4 "	
33	.75	1.25	1.75	2.25	....	2 "	
34	.75	1.50	2.00	2.50	....	2 "	
35	1.00	1.75	2.50	3.00	....	2 "	
36	1.25	2.00	2.75	3.50	....	....	10 Cts. for each additional 3 Sec.
37	1.50	2.00	2.75	3.50	....	....	10 Cts. for each additional 3 Sec.
38	1.75	2.50	3.25	4.00	....	....	10 Cts for each additional 3 Sec.
39	....	....	....	.10	....	60 "	
40	....	.50	.75	1.00	....	....	10 Cts. for each additional 15 Sec
105	....	.25	....	.50	....	30 "	
106	....	.25	....	.50	....	20 "	
107	.25	.35	....	.50	....	15 "	
109	.25	.40	....	.75	....	15 "	
110	.25	.50	....	1.00	....	15 "	
111	.25	.50	.75	1.00	....	10 "	

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*Excess switching at rate of 2c. each.
†No nickel machines connected; practically have unlimited service.
X.—No rental; 5c. a switch, subscriber guarantees 10c. a day.
V.—No rental; 5c. a switch, subscriber guarantees 5c. a day.

Introducing the Trolley at Huddersfield, England.

ALTHOUGH activity in planning for trolley development was seen in England a year or two ago, it was predicted by many observers that the work would be very slowly done, owing to the natural and artificial obstacles thrown in the way of the promoters. This has not been the case, however, one reason being that the municipal authorities who are usually prompt with obstructions have themselves taken up the trolley movement or have been constrained by public opinion into adoption of the new system. One of the progressive municipal bodies is the corporation of Huddersfield, which beginning with horses in 1882, on 10 miles of track, changed to steam in 1893, and with a system of 28 miles in 1898 has now developed a borough and rural network of over 50 miles. We are glad to have the opportunity to illustrate the system, exemplifying, as it does, a combination of the best English and American ideas and materials. In the power plant, which is illustrated herewith, the boiler room is 157 by 59 ft. and 23 ft. high, providing space for 8 boilers, of which 3 of the Lancashire type have already been installed. The furnaces are fitted with Vicar's stokers, with special clinkering nozzles that enable the clinker to be broken while the boilers are working. The conveying and feeding mechanism is run by a Greenwood & Batley 10-hp motor. Each boiler is fitted with a Green economizer, and a Musgrave superheater, and there are two Blake & Knowles pumps, each capable of supplying 3000 gallons per hour. All the steam piping is in duplicate. Adjoining the boiler house is the engine room, 130 by 42.6 ft. and 35 ft. high in the body. There are also large car sheds, built entirely of steel.

There are now installed two vertical inverted cross-compound condensing engines, manufactured by Musgrave & Sons, of Bolton. The high-pressure cylinder is 17½ inches in diameter, the low-pressure 35 inches, with 3-ft. stroke. The engines are rated for 520 ihp, with a maximum of 650 ihp at 90 r. p. m. and 150 lbs. steam pressure. They are fitted with Musgrave automatic cut-off gear, and are designed for working condensing or non-condensing. They are provided with adjustable forced lubrication, and all the parts are supplied by two ram pumps on each side of the engine. One pump is coupled to the neck and eccentric rings, the other to the crank-pin, crosshead-pin and side block; but, if necessary, both pumps can be coupled to pump the oil through one main pipe to the various parts. The valves are of the Corliss type, double ported, the high pressure only being coupled to the governor, which can be regulated to vary the speed while running. The flywheel is 18 ft. diameter, with 10 tons of metal in the rim. On starting up, an auxiliary engine is employed to "bar it round," the barring engine making 1055 revolutions to one of the main engine, and is fitted with automatic throw-off gear. The air-pump is 24 inches in diameter, with 14-inch stroke, the suction pipe dipping into an open culvert which runs the full length of the engine house in the basement. The condensers are of the injector type, giving a vacuum of from 26 to 27 inches, and the injection water return pipes are laid alongside of the exhaust steam pipes at the top of the culvert, and discharge to the Colne River at a lower level than the intake, the whole arrangement being made sufficiently large for a total flow of 3000 gallons per minute when the station is completed

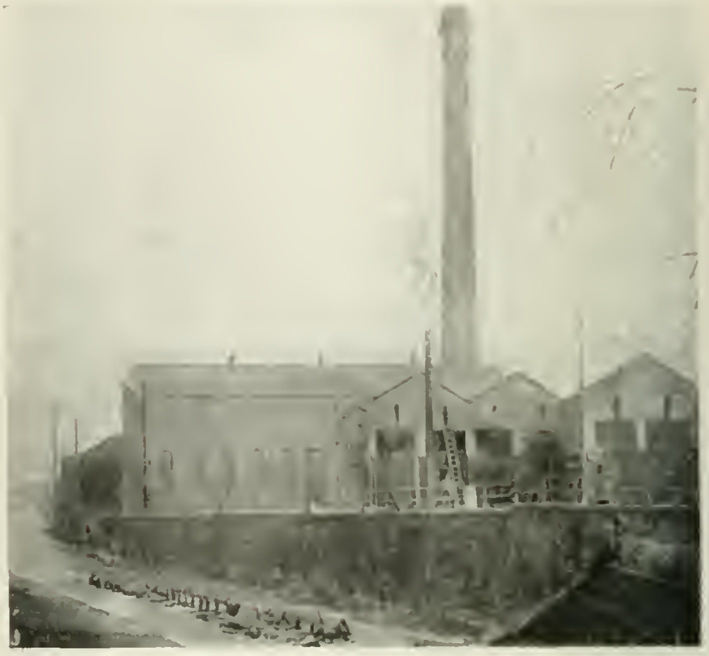

FIG. 2.—POWER HOUSE ON THE COLNE

The dynamos are Greenwood & Batley multipolars, over-compounded, the pressure being 500 volts at no load and 550 at 375 kilowatts. The armatures have slotted cores, and are internally ventila-

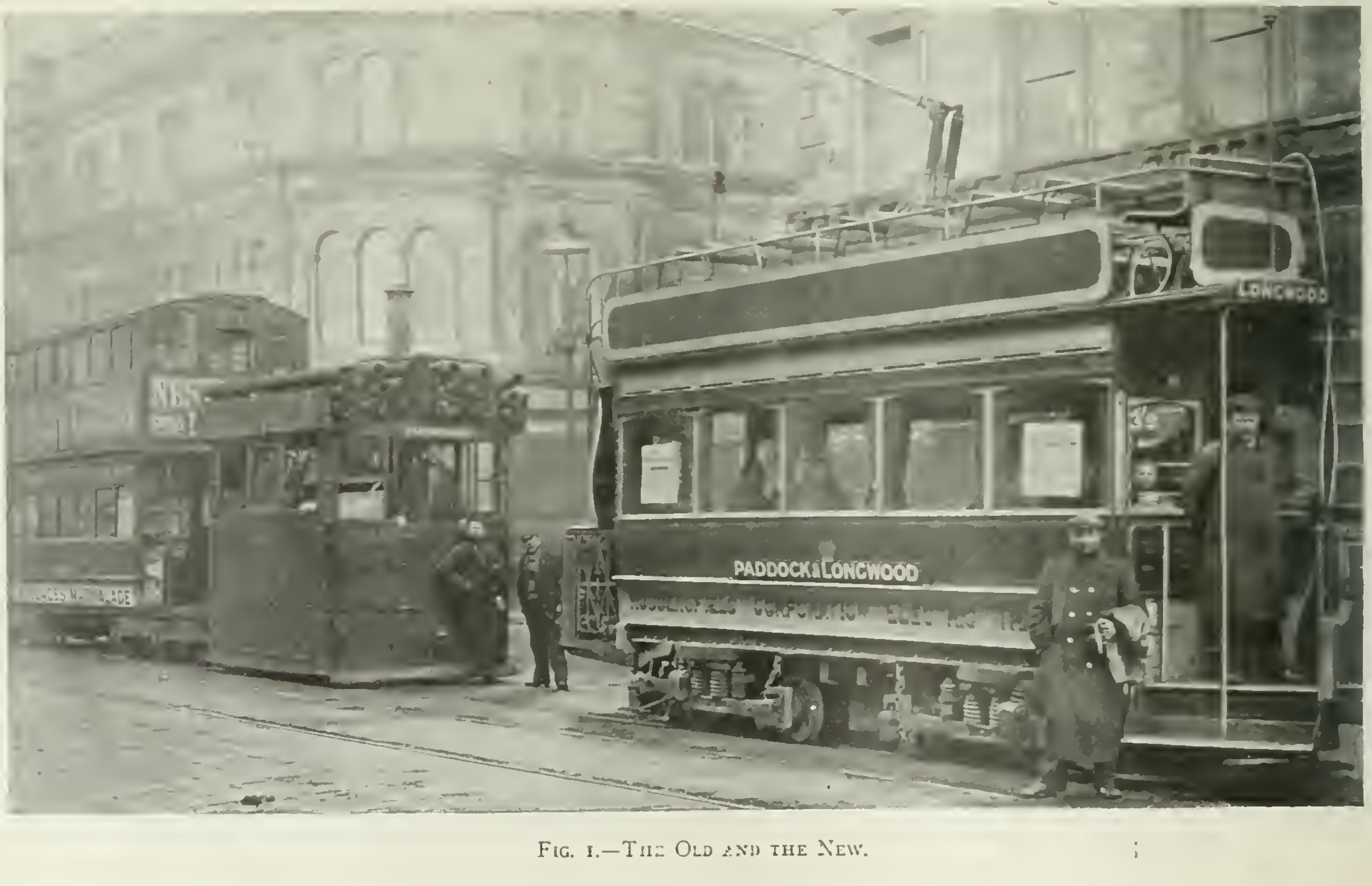

Fig. 1.—The Old and the New.

ted, with barrel winding, in parallel, the conductors being laid in slots with micanite trough protection. The armature is mounted directly on the engine shaft, the armature hub being bolted direct to the flywheel. There is also a General Electric 25-kw direct-coupled set, supplied by the British Thomson-Houston Company, used for the station lighting and for shunting around the car barn.

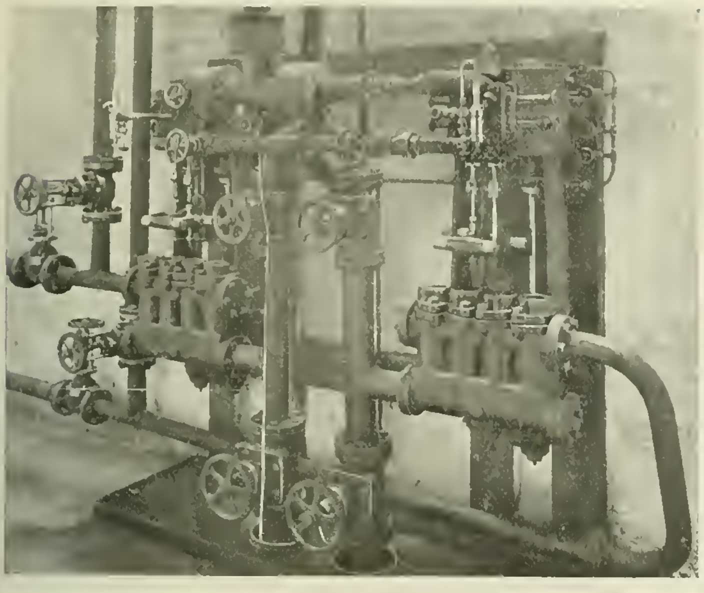

FIG. 3.—POWER PLANT FEED PUMP.

The switchboard, built by the British Thomson-Houston Company, is situated in a gallery which connects on the upper decks of the engines. The board comprises two generator panels, three feeder panels, a Board of Trade and a station lighting panel, and is made of enameled slate.

The line material was furnished by the British Thomson-Houston Company and Robert W. Blackwell & Co. The trolley wire is No. 00 B. & S., and the poles are tubular steel. Paper insulated feeders are used, and they are laid in earthenware conduit bedded in cement, all being of English manufacture. The track is jointed with double 0000 Felten & Guilleaume bonds. The maximum drop between feeding points and the furthest point on the line is not more than 20 volts. The maximum drop on the rails in the town is about 3½ volts, and on the outlying routes not quite 5 volts, the leakage current being about one-fifth of an ampere. Section boxes are fixed about half a mile apart, with switches for cutting out any section, and two main switches for disconnecting rail and line feeder. Telephone cables are brought up to cast-iron boxes fixed to the feeder pillar, and each motorman carries a telephone of Western Electric make. The cars number 25, of which 16 are at present running. They were built by Messrs. G. F. Milnes & Co., of Hadley, and are mounted upon Brill maximum traction trucks. They are 29 ft. in total length, and carry 24 passengers inside and 33 outside. They carry each two G. E. 58 motors. The service in the town is every 10 minutes, and outside every 20 minutes. The postal authorities pay $1,500 a year for the privilege of using the cars for postmen and telegraph messengers.

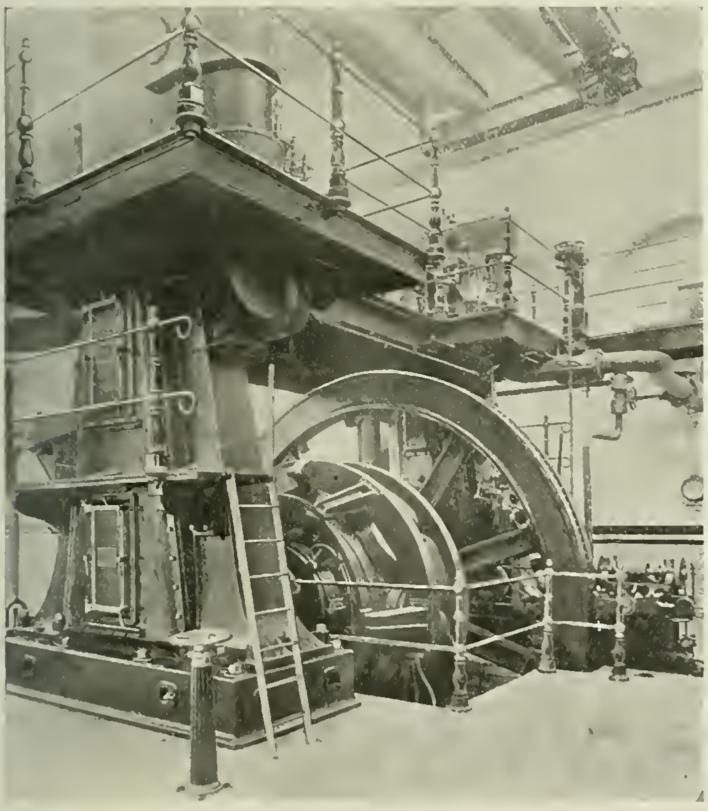

FIG. 4.—GENERATING UNIT, HUDDERSFIELD.

Mechanical Equivalent of Light.

By Carl Hering.

EXPERIMENTS recently made with an arc light which departs entirely from the principles common to all those heretofore used, are claimed to have shown an efficiency of 100 per cent in the conversion of electric energy into light; that is, all the energy of current is claimed to have been converted into light.[1] That this cannot be correct, and that certain unallowable assumptions were made, will appear to those who have followed the description of the experiments, but it again brings up the question of the mechanical equivalent of light, what it is, and how it is determined. In view, therefore, of the fact that this novel, efficient and interesting lamp, although still of doubtful commercial value, may be experimented with by others, it may be of interest here to discuss the determinations of this mechanical equivalent of light made some years ago by Tumlirz and by Thomsen, and to reduce them to more convenient terms.

This mechanical equivalent of light, that is, the energy which is required to produce a unit quantity of light rays, is a figure not found in text books, and has heretofore been of comparatively little interest, for the reason that the best efficiencies which have been obtained in commercial lights have been so very low, that it was of little consequence to know how near the maximum possible efficiency they were. It sufficed to know that a really efficient commercial light was still unknown.

Another reason why this figure is not generally stated may be that it does not exist. There is no doubt that light is energy, since it is a form of vibration; if proof is necessary, it is found in the fact that light may be and often is converted into heat, as shown, for instance, by laying a black cloth in the sunlight, which will change the light into heat and get much warmer than a white cloth, which reflects it. Much and perhaps all of the heat we receive from the sun is conveyed to us as light or something similar, which is then converted into heat on or around the earth. Moreover, light is known to be nothing more than electromagnetic waves, precisely of the same kind as the Hertzian waves used in wireless telegraphy, the only difference being that the wave lengths are very much shorter than those of the latter. The shortest electromagnetic waves of the Hertzian order which it has been possible to produce, are a few centimeters long, while the lengths of the light rays are only one or two hundred-thousandths of an inch. According to Lord Kelvin, the period of vibration, or frequency, as we now term it, of light waves is between one four million-millionths of a second and one eight hundred million-millionths of a second. That Hertzian electromagnetic waves are a form of energy was shown by Hertz himself in an experiment in which he absorbed these waves by an apparatus in which they were converted into heat, which then manifested itself in the form of a deflection of the instrument, thereby indicating the presence of these invisible waves. Further proof is, therefore, not needed to show that light is a form of energy; nevertheless, there may not be a single mechanical equivalent of light, as there is for heat, because it may depend greatly on the color or composition of the light, that is, on the wave length, and there may, therefore, be a large number of different mechanical equivalents of light.

Nevertheless, it may be possible to determine an average value for the standard of light ordinarily used, and this is what Tumlirz endeavored to do. His experiments and those of Thomsen are the only determinations of this constant that the writer has been able to find in a hasty search. The former are described in three very long papers published in the Transactions of the Vienna Academy of Sciences in 1888 and 1889.[2]

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[1] Digest, March 9, p. 413.

In the first one he describes experiments with a platinum wire heated to a white heat by means of an electric current. He measured the radiation by means of an air thermometer especially constructed for this purpose, and also the total input of energy, from which he calculated the energy of the light. Taking the Hefner amylacetate lamp as a basis, he found that for the unit candle-power there is radiated per second as light, an amount of energy equal to 0.00326 gram-calories, or about 140 gram-centimeters, which reduced to electrical terms is about 0.0135 watt. He admits, however, that this is only a very rough approximation, and merely gives a general idea of this constant. His other determinations are better.

In the second paper he calculated a value of this mechanical equivalent of light from some earlier experiments of Julius Thomsen.[3] These are based on a unit of light consisting of a spermaceti candle consuming 8.2 grams of spermaceti per hour. The action of the light on a thermopile was compared with that of a glass sphere filled with water at 50 degs. C., the radiation from which was calculated by Thomsen according to the Dulong formula. The result of Tumlirz's calculation was as follows: The amount of energy in the form of light which falls per second on a vertical surface of 1 square centimeter at a horizontal distance of 1 meter from the center of this flame, is equal to 5.6×10^{-7} gram-calories. This reduced to electrical terms is 2.32×10^{-8} watts. Or in units of work, 0.024 gram-centimeters per second, or 2.4×10^{-7} kilogram-meters per second. These data will be discussed below, in connection with the reference to the original paper of Thomsen.

The third part of the Tumlirz article is the more interesting as it gives the results in definite and well-known terms. In this determination he measured, by means of a specially constructed air thermometer, the total radiation from a Hefner amyl-acetate lamp, including both heat and light, and then by means of a thermopile, the relation between the light rays and the total rays. From these two he determined the mechanical equivalent of light and obtained the figure 0.00361 gram-calories per second, for the energy of the light emitted in a unit solid angle in a horizontal direction. The exact definition which he gives is somewhat encumbered by mathematical expressions and conceptions, but such accuracy in definition is hardly warranted by the possible accuracy of the experimental determination. The above is what he means, and it agrees with the results in the next paragraph.

He furthermore states that the amount of energy in the form of light which falls per second on a vertical surface 1 square centimeter at a horizontal distance of 1 meter from the center of the flame, is equal to 361×10^{-9} gram-calories, or "(1 226 milliamperes)$^2 \times 1$ ohm." Assuming that a unit solid angle is one which at unit radius subtends a unit surface, and which, therefore, at one meter radius would subtend 10,000 square centimeters, the latter figure agrees with the statement in the preceding paragraph.

These figures may be reduced to the following forms, some of which may be more convenient than those given by Tumlirz. They are all based on the Hefner amylacetate lamp as the unit of candle-power, and should there be a difference in the mechanical equivalents of light for sources of different color, then the present figures are limited to the color of that particular flame. Attention may here be called to the fact that while the mechanical equivalent of heat is expressed in terms of units of work, such as foot-pounds or joules, the mechanical equivalent of light is expressed in units of power, such as horse-power or watts. Either may be, of course, reduced to the other by introducing a limited time.

The amount of energy in the form of light which falls on a vertical surface of 1 square centimeter at a horizontal distance of 1 meter from the center of the flame, being taken, according to Tumlirz, as 361×10^{-9} gram-calories in each second, then, if expressed in units of power, as it should be, it is equal to 2.01×10^{-9} horse-power (English), or 1.50×10^{-6} watts. Or, if expressed in units of heat or work in a limited time, it is equal per second to 3.61×10^{-10} kilogram-calories, or 1.53×10^{-7} kilogram-meters, or 1.105×10^{-6} foot-pounds, or 1.50×10^{-9} joules.

An illumination of a meter-candle is that produced on a surface normal to the rays, by a standard candle at the distance of one meter. The above figures, therefore, also represent the power in the light per square centimeter on an illuminated surface for each meter-candle of illumination. A room 12 × 15 × 9 ft., which is lighted so that the illumination which reaches the walls, ceiling, floor, is equal to about 10 meter-candles—which is quite a bright illumination and enables fine print to be read with ease—would, therefore, require only 11.8 watts for light, if the efficiency were 100 per cent, or less than a quarter of the power in a single ordinary 16-cp electric lamp. There is, therefore, room for improvement if the basis of these figures is correct.

All the above figures refer to the surface which is illuminated, and not to the source of light. To calculate all the power which emanates as light from a source, it is necessary to know the mean spherical candle-power of the source, or the relation of this to the candle-power in the direction in which the light was measured. The figure can, however, be determined as follows for a unit spherical candle-power—that is, for a source which emits one candle-power in every direction, or whose average spherical candle-power is unity.

The original data were based on the amount of light in a un[illegible] angle. If this unit is the solid angle subtended by the unit surface at unit radius, then a complete sphere measures 4π or 12.57 solid angles in terms of that unit. This, multiplied by Tumlirz's figure for the unit solid angle, .00361 gives .0454 gram-calories per second per spherical candle. This is equal to 2.52×10^{-4} horse-power, or 0.188 watts; or, in terms of units of heat or work per second, to 4.54×10^{-5} kilogram-calories, or 0.0193 kilogram-meters, or 0.139 foot-pounds, or 0.188 joules. One horse-power could, therefore, produce about 4000 spherical candle-power, or 8000 hemispherical candle-power.

According to these figures (if the Tumlirz constant is correct), the maximum light efficiency obtainable would be about 0.188 watts per spherical candle, which corresponds to about 5.3 candles per watt, and in this form the mechanical equivalent of light given by Tumlirz may be compared directly with our present way of stating the efficiency of electric lights. If we assume the mean spherical candle-power of an arc lamp to be 1 watt per candle, the light efficiency based on the Tumlirz constant would be about 19 per cent. That of the Nernst lamp at 1.5 watts per candle would be about 13 per cent; that of incandescent lamps at 2.5 watts per candle about 7.5 per cent, or at 3 watts per candle about 6.3 per cent.

Tumlirz made a deduction from his determination which, though of no utility, is at least interesting. If one looks at a standard candle from a distance of 1 meter, and if the pupil has a diameter of 3 mm, the energy entering the eye per second as light is so small, that it would require 1 year and 89 days to heat one gram of water 1 deg. C. A more interesting figure would have been the power in watts or horse-power which is consumed in the eye when one looks directly at the sun.

Unfortunately, the Tumlirz determination was based on taking the difference or the ratio of two measured quantities which are nearly alike. This is a method which should not be resorted to unless there is no better way, because a very slight error in either of the two measurements produces a very great error in the calculated quantity sought. His results are, therefore, probably not very accurate. A better way to determine this constant, or constants if there are several, would seem to be to use a source of cold light, such as that produced by phosphorescence or vacuum tubes, convert a known part of it into heat and then measure this heat. Or, to use an ordinary source of light and filter out the heat rays (if any means for complete filtration exist), and then convert the cold light rays into heat which can be measured, as Thomsen did. The quantity desired will then be measured as a whole, and not as a difference between two measurements which are nearly alike, and the error would then be much less if no new sources of inaccuracy are introduced thereby.

Very little seems to have been published on this subject of the mechanical equivalent of light, but it may be of interest to compare a few other figures which have come to the notice of the writer.

The *Philosophical Magazine* of 1865, vol. 30, series 4, p. 429, contains an article by Julius Thomsen on the mechanical equivalent of light, and it appears to be the same one to which Tumlirz referred in his second paper. The method used was to measure by means of a thermopile the total radiation (heat and light) from a spermaceti candle burning 8.2 grams per hour (this measurement does not seem to enter into the calculation); he then measured that part due to the light alone, by absorbing the heat rays in a layer of 20 cm of water, which he says completely absorbed them. The readings of the thermopile were calibrated by using a bulb of warm water in place of the lamp, the heat radiation of which could be calculated from Dulong's law. He thus finds that 1 kilogram-meter in a second is equal to 34.9 times the energy of the luminous rays from a spermaceti candle burning 8.2 grams per hour. He adds, "This is the maximum of the mechanical equivalent of light, and it may possibly still be somewhat reduced by subsequent experiments."

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[2] Tumlirz Sitzungsbericht der Wiener Akademie der Wissenschaften, 1888, XCVII, II, p. 1523; same volume, p. 1627; and 1889, XCVIII, II, p. 826.

[3] *Poggendorf Annalen*, 125, p. 348.

Thomsen refers to this as the "radiation" from such a flame, and gives no limiting boundaries. It may, therefore, be assumed that this figure is for the total radiation in all directions, if this radiation in every direction is equal to that in the direction in which he measured it. In other words, the result then refers to a unit spherical candle-power, whether the ratio of the spherical to the horizontal for that flame was unity or not. Tumlirz in his deductions from Thomsen's figures makes this same assumption, as calculations will show.

With this assumption, about which there is little doubt, these figures may be compared directly with those of Tumlirz. The candle used by Thomsen was apparently the British standard, which consumes 120 grains, while 8.2 grams would be 126.5 grains. Correcting for this increased consumption, and for the ratio of the Hefner to the British unit, makes the Hefner unit equal to 0.83 of that used by Thomsen. Thomsen's mechanical equivalent reduced to spherical Hefner units then equals 0.236 watt as the power for one spherical Hefner candle. Tumlirz's corresponding figure is 0.188, showing a very fair agreement, considering the difficulties involved in the measurements, especially as Thomsen merely claims his figure to be the maximum value.

Professor Ebert, a well-known German physicist, is reported to have stated that a single horse-power would be sufficient to operate 46,000,000 Puluj lamps of 16 candle-power. This means 7.36×10^8 candles per horse-power. As that lamp consists of a piece of mica painted with sulphide of calcium and subjected to the action of cathode rays in a vacuum, it would not be correct to assume that this is expressed in spherical candle-powers. Let us suppose the spherical candle-power was only a tenth of the horizontal, which is surely favorable to his figure, it would then reduce to 7.36×10^7 spherical candles, while, according to Tumlirz, it would be only 4×10^3, which is only about one twenty-thousandth of Ebert's figure. The discrepancy is rather large, and if Ebert's figures are at all reliable, Tumlirz's mechanical equivalent of light is far too large.

H. Ebert, presumably the same physicist, in an article on Light from Electric Oscillations (see *Electrical World*, Nov. 3, 1894, p. 467), describes a "luminescent lamp," which gave one-thirtieth to one-fortieth of a Hefner candle and consumed about one-millionth of a watt, the latter being calculated, as he says it was too difficult to measure it directly. If this referred to spherical candle-power the mechanical equivalent for a spherical candle would be 0.00003 to 0.00004 watt, as compared with Tumlirz's figure, 0.188. The difference is again very great. Judging from the illustration of that lamp the spherical candle-power may have been about one-eighth of the horizontal, which would make his figure 0.00024 to 0.00032 watt.

Dr. Lodge, the distinguished English physicist, is reported to have said that at 100 per cent efficiency one man turning a crank could develop sufficient energy to light a whole city. Assuming a man-power to be one-eighth of a horse-power, he would, according to Tumlirz's figures, generate about 500 spherical candles, or 1000 hemispherical, which would not be a very brilliant illumination for a city. According to this, the Tumlirz equivalent is again much too great.

The new arc lamp referred to at the beginning of these notes is one recently described by Rasch,[4] in which the arc is produced between two electrodes of magnesia, or other similar material, usually an oxide, including some of those of the rare earths, which is rendered conducting by heat, as an electrolyte, like in the Nernst lamp. He found that the efficiency increased with the input, reaching a maximum at 5.21 Hefner amylacetate candles per watt, after which it diminished again, the electrodes then becoming liquid. This figure approaches very closely to the corresponding equivalent determined by Tumlirz, namely 5.3 candles per watt, which would indicate an efficiency of very nearly 100 per cent. The latter figure is, however, based on spherical candles, while Rasch seems to base his figure on the horizontal candle-power. The necessary correction might diminish this efficiency by nearly 50 per cent. The ideal lamp of 100 per cent efficiency has, therefore, not been reached by him, as he claims, although even when corrected his efficiency seems to be far above that of commercial lights, and his experiment is, therefore, of interest. Whether his lamp can be made commercial seems still very doubtful. But even if not, it may be of considerable scientific interest in connection with the theory of the arc lamp. That the efficiency could not be 100 per cent as claimed, is also evident from the fact that energy must be spent in volatilizing the electrodes, which are consumed, and considerable free heat is also developed, not only in the arc but in the electrodes as well. This must reduce the efficiency very greatly, for even if the Tumlirz equivalent is only approximate, it shows what has been generally known—that the mechanical equivalent of light is very small, or, in other words, that a small amount of heat or work corresponds to a large amount of light. Any light approaching an efficiency of 100 per cent must, therefore, be cool, if not very nearly at the surrounding temperature, and if it is not so, one may be sure even without a knowledge of the exact value of the mechanical equivalent of light, that the ultimate has not been reached.

The Development of the Incandescent Light to 1880.

By A. E. Fay.

POSSIBLY a few words in addition to Mr. Hammer's recent article with the above title may be of interest. As he described some platinum lamps, it seems that some of the experimenters in this line who came before Starr (1845), where Mr. Hammer's history begins, should be given some attention. It also seems that the attempts made by the early experimenters to find the proper medium with which to surround the incandescent body, and the results of their experiments, should form a part of a history of this subject.

The first to produce an electric light of any kind in vacuo was Hawkesbee, but as his was produced by induction, the best means at his disposal at that time, 1705, it has no bearing upon the modern light. As Mr. Hammer says, Davy first produced a brilliant light, in 1810, or earlier, by heating a piece of charcoal or a platinum wire by means of his great battery, and at he same time he discovered the fundamental principle of the arc light, and was the first to use a vacuum in connection with it, his purpose being merely to increase the length of the spark. The next step was to employ it to retard the combustion of the carbon electrodes, which was suggested by Meinake in 1821 (Colburn's "Practical Economy"), and was practiced by Deleuil and Archereau from 1841 to 1844.

The third and final step, that of placing the continuous conductor in vacuo, seems to have been invented by Starr, but de Changy has claimed that it was first suggested by Jobart, of Brussels, in 1838 (*La Lumiere Electrique*). His contentions regarding his and Jobart's early work in this line are open to grave doubts, however.

A peculiar lamp was invented by Frederick de Moleyns, of Cheltenham, England, in 1841, in which a helix of platinum wire was placed in contact at the end with a knob or a second helix in vacuo. The helix was heated to incandescence, and then the contact was broken, forming an arc. The brilliancy was to be increased by means of a stream of finely powdered carbon descending upon the arc. Although this was meant for an arc lamp, the fact that part of the light was caused by the incandescence of the platinum wire might make it an anticipation of that part of Starr's invention in which he used a strip of platinum in vacuo; but his carbon lamp was new and, as Mr. Hammer says, that was the real beginning of the history of the modern lamp.

A few months before the date of de Moleyns' invention, Prof. W. R. Grove had produced a steady light by the incandescence of a spiral of platinum wire in an enclosed, but not exhausted glass (*Phil. Mag.*, 1847); and Prof. Draper was engaged in experiments along this line at the time of Starr's invention (*Silliman's Journal*, 1847).

As to other media, Davy had found that ether, alcohol, oils, and water allowed his platinum wire to become only white hot with the same power that would fuse it in air (*Phil. Trans.*, 1821), while Grove found that if a platinum wire were heated to incandescence in air, it was apparently extinguished when enclosed in hydrogen, but that oxygen and nitrogen did not produce this effect (*Phil. Mag.*, 1845). He tried the effect of various gases and liquids, including the common hydro-carbons, on both platinum and iron wires (*Phil. Trans.*, 1848). About 1860 nitrogen, carbon dioxide, oxygen and carburetted and phosphoretted hydrogen were tried in this way, not as mere scientific experiments, but in actual lamps.

The first incandescent lamp to be patented in this country was that of Gardiner and Blossom, brought out in 1858. It was the simplest form of the platinum helical coil lamp, and was designed for a marine signal lamp. No references were cited against the broad claim by the patent officials.

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[4] Electrical World and Engineer, March 9, 1901, p. 391. *Elektrotechnische Zeitschrift*, Feb. 14, 1901, p. 155. See also the reply of Nernst, same journal, March 21, p. 256.

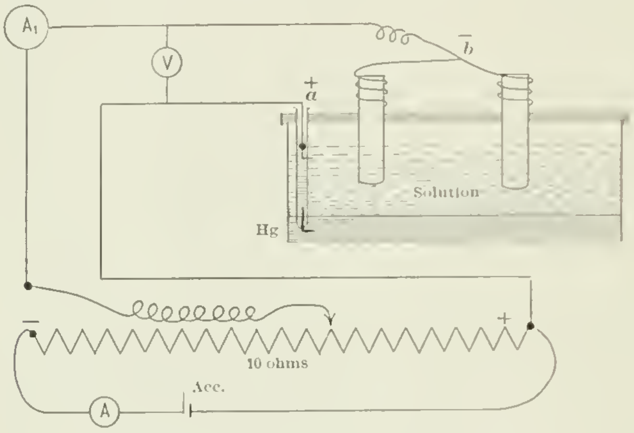
The Electrolytic Purification of Mercury.

By Woolsey McA. Johnson.

SOMETIME ago, while making an electro-chemical investigation at the Jarvis Physical Laboratory of Trinity College, Hartford, I had occasion to need some reliably pure mercury. As the distilling apparatus was not in order, I thought that it was a good occasion to put into execution a plan I had had in mind for some time for clearing mercury by electro-chemical means.

When we consider that the Ostwald process only depends on the fact that the "electrolytic solution pressure," or ionizing pressure of hydrogen is less than that of the impurities and greater than that of mercury, it seems very possible to assist the impurities into the solution of acid by the use of an electric current. By the proper arrangement of electric potential or voltage and the opposing pressure due to the changes produced in the solution by the current (variable at will by changing the resistance or the solution) we can regulate the process.

In order to regulate the drop, an accumulator of about 20 ampere-hour capacity was closed through a 10-ohm circuit. By a sliding contact, a shunt of varying ratio allows the voltage at the terminals *a*, *b* of the "purification-cell" to be varied at will. As the resistance of the cell was very small, any e. m. f. larger than the "polarization e. m. f." of the cell would shunt a current through the cell. For example, we will call this counter e. m. f. 1 volt, and the resistance of the cell 0.05 ohm. Then, if we place the shunt at 5 ohms corresponding to 0.975 volt (5/10 1.95 or ½ the accumulator voltage), no current will flow through the cell. When, however, the potential exceeds 1 volt, the current will shunt through the cell. At direct connection with the poles of the accumulator, the effective voltage is $1.95 - 1.00 = 0.95$, and the current will be



ELECTROLYTIC PURIFICATION OF MERCURY.

$$\frac{0.95}{.05\,X} \quad \left(X = \begin{array}{c}\text{the resistance of}\\ \text{the accumulator}\end{array}\right)$$

if we neglect the fact that there is always a second or even a third "polarization point" to any cell.

The mercury was of the usual purity and originally came in iron jars. It tarnished on exposure to the air and left a black smudge on porcelain. About a kilogram of this was poured into a flat crystallizing dish of 15 cm diameter, and covered with 500 ccs of a solution KNO_3 4 per cent HNO_3 17 per cent. Connection was made to the mercury as anode by a sealed platinum wire in a glass tube. The cathodes were two carbon rods, around which wire was wound to make a good connection. The scheme of connections was as described above. A voltmeter (*V*) and two ammeters, one (*a*) in the main and one *a* in the derived circuit, enabled the chemical actions to be diagnosed. At first we have a very large current due to the fact that the purifier is at first a cell of considerable e. m. f., and works with the current from the accumulator. But immediately a counter e. m. f. is set up. As long as the voltage is kept below 0.75 very little mercury will leave the anode, but the current rises as its carriers the pure active ions of Fn, Cd. Pb, Cu, etc. On the cathode, of course, hydrogen is evolved. To the voltage of polarization must be added the "casparische überspannung," or the pressure necessary to push the hydrogen ions through the pores of the carbon.

A glance at the Values of Wilsmore[1] for the "electrolytic potential"

$Zn \quad + 0.770$

$cd = + 0.420$

$P6 = + 0.148$

$H = + 0.0$

$cu = - 0.329$

$as > - 0.293$

$Bi > - 0.391$

$sb > - 0.466$

$Hg - 6.750$

$ag = - 0.771$

shows that for normal concentrations of the ions, all the ions of the strong metals and of all the weak metals excepting the noble metals would be pushed out into the solution easier than the mercury ions. The fact that the ionic concentration is low in the cell is balanced by the "casparische uberspannung." Instead of the voltage of 0.75 a voltage of 1.00 can be used without sending very much mercury into the solution. After changing the solution several times the current can be broken and the solution poured off and the mercury dried.

As a result of the current going for six hours the mercury was very mobile and left no discoloration on porcelain. Long times and small currents (about .03 ampere) gave the best results. If there had been any suspicions of silver as an impurity the addition of 0.1 per cent K Cl would have reduced the concentration of the + *bg* ions to such an extent that the mercury could be purified of the silver. As a matter of fact, traces of the noble metals (and their value assumes that only traces have been left), do not injure mercury at all for electro-chemical purposes.

I think that for laboratories, where a steady source of current is at hand, this method will give better results than the old method of allowing the mercury to drop through a long tube full of HNO_3. The apparatus is just as simple as the instruments could be dispensed with. At any rate, it is interesting from a scientific point of view, less wasteful of mercury and more efficient in the purification. An interesting extension of this would be the investigation of the rate at which amalgams of known composition are purified under varying condition of voltage, solution and temperature.

In conclusion, I would like to express my thanks to Dr. Riggs and Dr. Robb for their kindness in allowing me the use of apparatus and facilities of their laboratories in this and other experiments.

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Power Transmission at Mexico City.

By C. R. Mundinger.

WHILE we in the United States are making rapid progress in power transmission work, our neighbor, the Latin American Republic, is by no means idle in this respect. It is a well-known fact that Mexico possesses many favorable locations for water-power plants, being generally very mountainous and having some very good water supplies; but not often can as perfect a location be had as that of the "Compania Explotodora la fuersa hydro-electrica de San Ildefonso," which company's five generating stations are strung out among the mountains from 12 to 30 kilometers to the northwest of Mexico City. Mexico, owing to the fact that the poorest grade of coal costs $22 and upward per ton there, is an ideal city for this kind of power. All the stations are now completed and in operation, except one. The machinery consists altogether of 19 waterwheels, made by Picard & Pictet, of Geneva, direct connected to as many 225-kw, two-phase, 50-cycle Westinghouse alternators. Step-up transformers change the 440 volts, two-phase, as it comes from the alternators, to 22,000 volts, three-phase, by means of the well-known "main and teaser" arrangement, commonly known as the Scott two-phase-three-phase system. Each plant is provided with two 125-volt exciters driven by Pelton wheels.

From Madin station (the nearest to the city) to Veronica station, the receiving station, a distance of about 12 kilometers, extend a wood and an iron pole line, each carrying three insulated wires. Here it may be stated that transmission lines in Mexico do not, as is the custom in the United States, employ bare copper wire, for the simple reason that the excess of duty on bare over insulated copper wire, somewhat exceeds the difference in first cost of the two. At Veronica station, which is situated in the western edge of

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[1] *Zeit f. Phys. Chem.*, *xxxv* 3, p. 318.

Mexico City, the 22,000 volts is lowered to 2500 volts, at which pressure it is distributed about the city.

In the other direction from Madin station extend two iron pole lines, each carrying two sets of wires, viz., six in all. One takes a southwest direction, while the other extends almost due west. The end of the former is at Alameda station, where there are four generating units. The most interesting feature of this system lies in the fact that on both of these branches the same water is made to do its work three times before it is released. After the water at Alameda, which descends from the top of a mountain about 560 ft. above the station, through a 42-inch tube 1500 ft. long, passes through the wheels, it is conducted through a canal about 3½ ft. wide by 3½ ft. deep, which winds around the mountain sides (crossing intersecting ridges by means of tunnels, and ravines by bridges and iron "V" tubes, thereby avoiding the necessity of so much canal construction that would be needed to get around these objects) to Chiluca station, a distance of about 5 kilometers.

While at the start, at Alameda, the canal and river, or natural watercourse, are on a level, the canal is, because of its small drop and great drop of the river above, 250 ft. above the latter at Chiluca, where it drives three units. After meeting the river once more, the water is immediately caught up by another canal and by the same scheme of canal construction is at Madin station, 4 kilometers northeast, again about 145 ft. above the river. At Madin station are only two units. Here it is, after being used three times, turned loose in the natural course, and after flowing for a few miles to the northeast is mostly used up for irrigating purposes.

At Villada, about 18 kilometers west of Madin, on the other line, is a station equipped with five units working under a head of 430 ft. When discharged here, the water flows east for about 6 kilometers to Aquacaliente (this name is taken from two Spanish words, "aqua," meaning water, and caliente, meaning hot, there being a small hot spring there) where five more units are worked under a 395-ft. head. This is now all the stations which contribute to the Mexico City power, but when discharged here the water goes to Tlilan, where is another plant of two more units of 225 kilowatts, driven by Pelton wheels. The current from this station is sent to a large woolen mill about 5 kilometers away. The volume of water in this canal is somewhat greater than in the first mentioned, but in either the volume is very small; yet, owing to the comparatively high pressure at three of these stations, and taking advantage of the slope by using the water over so many times, it all goes to make more power than would be expected of such small rivers.

It is needless to say that all 19 alternators are run in parallel. The synchronizing is effected by means of the usual "dark lamp," and is done on the low-tension or generator switchboards. Some little trouble is occasionally experienced from short circuits, due to some mischievous natives who, for the want of better amusement, toss upon the line large green stalks of the soppy and green maguey plant, which is better fit to produce a sap from which pulque, mescal and other bad Mexican drinks are made, than to ornament a 22,000-volt transmission line. However, the sword-shaped leaves usually burn off in a short time, leaving the line clear. Natives, called "celadors," patrol these lines every day. On account of its quietness and apparent innocence it was difficult to impress upon the natives the extreme danger of the high-tension line, until, unfortunately, some were sent to the next world through its agency. The object lesson proved very beneficial to their more fortunate associates, and now they use every precaution that an "Americano" would when working near it.

This system will be reinforced by a most modern steam plant of 1500 horse-power situated on the site of the receiving station, as the water is more scarce during the extreme dry season. At the same place there will be a storage battery plant, which will help to equalize the load on the water power stations by being charged by means of "rotaries," at those hours of the day when the demand is small.

The switchboard apparatus is similar to that used in other plants of this kind, including time element circuit breakers and wood fuse circuit breakers for the high-tension boards. These are made of two pieces of wood. The shorter length is hinged at the center of the longer, which extends down about 3 ft. below the bottom clip to form a handle. The short length, which is the blade, is held against the action of a spring at the hinge by means of the fuse at the upper end, which, on melting, allows the shorter stick to swing on its hinge, thereby opening the circuit some 6 ft. The switches are detachable from the marble tablet on which are mounted the clips, 3 ft. apart, and must be fused before inserting, thereby avoiding all danger to the attendant.

The six stations, with dwelling houses attached for the attendants, are built of "tate tapa," a common building material in Mexico, with corrugated steel ceilings and granitard or cement roofs as flat as any pavement.

The system is equipped with a good telephone system connected upon the bridging principle. It is absolutely inter-communicating, and Madin, Chiluca and Alameda may converse over three different lines. The instruments are of the "Ericsson Swedish" type.

All electrical apparatus, machines, instruments, switchboards, etc., are of the Westinghouse make. The attendants of these stations are Americans, Mexicans and Spaniards. The installing of all the machinery was done by Bailey & Lawrence, a local contracting firm.

Telephone Service Ideals.

By G. F. Jenks.

When the original Bell patents expired some years ago some of the Bell companies sold Bell telephones; that is, Bell receivers. This was done in a quiet way without advertising, and in some cases, although sales were made, the Bell companies would not make deliveries, but the buyers were obliged to carry home the receivers themselves. There was a comparatively slight demand for these telephones, largely because a receiver is ordinarily of no use without a transmitter, but some of these Bell receivers were used in connection with independent battery transmitters, and others were rigged up in pairs, so that one receiver would be used as a magneto transmitter. These lines, of course, were effective only over short distances and under the most favorable conditions, but such arrangements were used until recently, and some may still be in use on private lines.

At the time the receivers were sold, other equipment, such as magneto ringers and extension bells, could be procured from the Bell companies for use on private lines; but this has been mostly done away with, and in general the Bell companies have insisted on leasing all apparatus for private line work as well as for exchange service, although in private line work the "subscribers" are at liberty to provide their own wires. All this was while the Bell interests were preserving the fiction that they controlled all "battery" transmitters through the Berliner patent. Now that this theory is swept away, it may be profitable to speculate on what their position will be in the future.

The telephone ideal will only be reached when every business man has a telephone on his desk, when every house has a telephone in every room, and when all these telephones can readily communicate with each other. This ideal is approached in certain offices and hotels nowadays. Some of the installations are of Bell instruments and some are independent, but the Bell installations usually approach more nearly to the ideal because they are parts of the great Bell system which covers the whole country, while all of the independent installations are limited to a greater or less extent in the territory they cover, and many of them do not reach beyond the building in which they are installed and its immediate vicinity. It is a great disappointment when you have a telephone in your room in a hotel to find that it communicates only with the office, and that to make an engagement in town or get a report from your home office you must go down stairs and wait for your turn at the "pay station."

It is noticeable, too, that the quality of service in such isolated independent systems is frequently not reliable. This is especially the case when the telephones are bought outright, and is natural enough, for the average electrician of a hotel or business building can hardly be expected to inspect and care for a telephone system as well as the employees of a regular telephone company can. In the larger cities, then, the Bell companies are coming nearer the telephone ideal than are the independents.

In the smaller towns and in the country, matters are frequently reversed. The independents manage somehow to get a telephone into every house while the Bell telephones are used only where long-distance service is a necessity, and frequently are installed side by side with the independent telephones, for if you do not have the independent you cannot reach the neighbors. Here you are not so certain to get superior service from the Bell telephone as the instruments are so sparsely scattered through the country that they cannot receive the constant attention necessary for good telephone service. There is present, too, a great waste in the duplication of wires and telephones, and that in parts of the country where such waste can be least afforded.

It may be said, then, that the nearest approach to the telephone ideal is given by the Bell companies in the largest cities, and the next approach is that of the independent companies in the rural communities, where "every one has a telephone," while the worst state is in the parts of the country where the Bell and the independents are in violent competition.

I have cited above the fact that when their first great patent ran out the Bell companies for a time made a great break with their traditions and sold telephone receivers. I cite this not to intimate that they may now be willing to sell telephone transmitters, but simply as an indication that it is possible that they may under present circumstances make a violent but shrewd reversal of their present policy if there is a prospect of their gaining by it. It seems possible that matters may be so handled that it may now be to the Bell companies' interest to help the public to reach the telephone ideal. That can hardly be attained by the selling of telephones as long as the majority of us do not know how to repair telephones and lines and to maintain telephone batteries, but if the Bell people will only consent to the shattering of another of their idols, a long step can be made.

This quickest step toward the ideal is to connect up Bell and independent systems by trunk wires, charging a proper toll for the use of these trunks. This is the system that works successfully in the City of Mexico. It is, to be sure, rather a question if it would work successfully here if too indiscriminately applied, as many independent transmitters are not adapted to long-distance service. They work successfully in local service with two or three volts, but they can hardly stand up in competition with the Bell solid-back that will not heat under a normal voltage of four to six running up to over twenty in central energy systems. This is a disadvantage in independent telephoning which has been pressed by the Bell interests for perhaps more than it is worth, for there are a numbr of independent transmitters in existence which compare favorably with the Bell even in such work, and if there were a demand for them, more could readily be developed. Further, there are few independent transmitters which are so hard to keep in adjustment or so bad for long-distance work as the old Blake transmitters which the Bell companies still supply for certain classes of service.

The independent companies would then have to provide suitable and well-cared for transmitters if they were allowed to connect with the Bell system of wires and telephones.

It is true that if the Bell companies agreed to such connection they would lose their detached subscribers in the territory "captured" by the independents, but the rates and divisions of the tolls could readily be so arranged that they would gain enough in tolls on calls interchanged with the independent systems to recoup their losses. They would also be saved entirely the expense which must be considerable, of keeping up the care and inspection of a large number of these unremunerative scattered wires and instruments. Indeed, it seems quite possible that they could enforce a standard of efficiency upon the independent companies which they do not always maintain themselves in their "thin" territories.

Questions of sentiment and the memories of old fights will doubtless delay any settlement on these lines, and possibly we must wait a community of interest which may secure the same result. Local considerations, too, may stand in the way, as it is possible that such a policy, while it would certainly benefit the Bell interests as a whole, might be fatal to some of the smaller Bell companies. The fact remains that we shall not approach perfection in telephone arrangements until every telephone in this country can be connected with every other.

Edison Ore Milling in Europe.

Mr. J. Laurence, president of the Edison Ore Milling Syndicate in England, whom we quoted recently as to the subject, makes the following statement of their hopes and plans:

"The most promising deposit of low-grade iron ore that our expert geologists came across was the vast deposit of iron on the Dunderland River, in Norway, which has been known to metallurgists for a number of years to be the greatest anywhere in Europe. The chief of our scientific staff, Dr. Theodor Lehmann, of Freiberg University, one of the best metallurgists in Europe (who had been conducting similar explorations for some years), made elaborate borings, cross trenches and assays and shipped a large quantity of ore from Dunderland to Mr. Edison for treatment. This deposit had hitherto been commercially unwerkable, as being a trifle too lean for shipping direct to the blast furnace, although very rich for the purpose of crushing and concentrating. Another element that had formerly barred its utilization for separating purposes was the existence of a large proportion of specular hematite combined with magnetite. It has only been within the last eight months that our co-director Mr. Edison has been able to solve the problem of separating specular hematite; and as soon as we were satisfied by reports and subsequent personal observations in America that this could be accomplished and at a commercial profit, we at once exercised our option and finally acquired the Norwegian property. We are now enabled to take two tons of this low-grade non-Bessemer ore and, by the combined Edison processes, produce from it over one ton of high-grade Bessemer ore averaging 65 per cent of metallic iron. We have proved already on a portion of the property the existence of over 80,000,000 tons of iron ore, and there is reasonable hope for believing that other parts of this property may turn out proportionately good. It is our intention at present to erect works and ship this ore exclusively to British ironmasters, there being already a market for it at a superior price."

Grottoes at the Pan-American Exposition.

By Orrin E. Dunlap.

The pleasure of the electric launch trip on the canals of the Pan-American Exposition grounds is to be materially intensified by the remarkable experience passengers will have in passing through the subterranean grottoes under the Triumphal Bridge. These grottoes are modeled after the famous Buttes des Chaumont, of Paris. The Triumphal Bridge under which they are located is one of the finest, ornamental structures of the kind It spans the canals and lakes at the south of the Esplanade, near the southern entrance to the Exposition grounds. It swings from four monumental piers, each 100 ft. in height, each pier being surmounted by a sculptured group. Mr. Rudolph Ulrich is the landscape architect of the Exposition, and in these grottoes he has developed a creation that is thoroughly novel and of unusual size. Beneath the bridge there are two channels, each of which is 400 ft. long, extending in a winding manner through caves and recesses, where the formation is weird in the extreme. Unusual rock forms are all about. Huge branches of coral shape are imitated with surprising truthfulness, and from the roof huge stalactites hang. Rising to meet them at some points are stalagmites, as though about to join in supporting the roof of the strange cavern. Cascades break from the sides.

One of the channels will be wholly illuminated in dark green, and the other with a pink effect. Boats passing to the east will go through the green grotto, while those going westward will make the trip through the pink grotto. The lightng will be done by incandescent lamps deftly concealed. In accomplishing these lighting results Mr. Henry Rustin, chief of the mechanical and electrical bureau, has carried out the conception with a thoroughness that is destined to make the grotto trip famous. Even the ceiling has its incrustation so true to Nature's caverns that one will easily fancy himself far down in the earth in a place resembling the Mammoth Cave of Kentucky.

The Situation in Erie Telephone.

The Erie Telephone situation is becoming interesting, as there are rumors, according to the Boston News Bureau, of a possible contest for control. The Telephone, Telegraph & Cable Company bought in February, 1900, a controlling interest in the stock, 50,001 shares at $115 per share. Later, to secure financial assistance for Erie it parted with 29,000 shares of the stock of the company at $100 per share, retaining 21,000 shares, which now stand at an average cost of $137.38 per share. Soon after the transfer of the 29,000 shares to the Eastern people the stock was raided down to $48 per share for the purpose of compelling the owners of the 21,000 shares and the holders of the 29,000 shares to throw over their stock. Various rumors came to the front, one to the effect that the American Bell Telephone Company proposed to buy Erie at its own price.

After the decline to $48 there was a quick rally to $66, and persons friendly to Bell interests are credited with buying 15,000 shares. Indications now are that the Cable Company is endeavoring to average up its holdings with a view to again securing control, and the new interests at present owning 15,000 shares may try to secure the control in the interests of the Bell Company. If the Bell again loses its control of Erie and it passes into the hands of the independents who, it is said, have already arranged with a large trust company to finance Erie on a broad and liberal basis, all stock purchased under par by the Cable Company will reduce the cost of their present 21,000 shares. The holders of the 29,000 shares are very familiar with the earning power of the company and will be slow to part with their holdings under par and the stock for control must come from the 1800 stockholders.

Gas and Electricity in England.

Mr. Charles Wood, F. C. S., of Bradford, was recently elected president of the Manchester District Institution of Gas Engineers at the meeting held in Manchester, and in his inaugural address to the members dwelt on several questions of special interest to gas engineers. It was often asked, he said, what effect had the supply of electricity on the sales of gas? In the domain of public street lighting they have nothing whatever to fear from electricity, if they availed themselves to the utmost of the possibilities of the incandescent gas burner. In Bradford all the gas lamps had been converted into incandescent; and they were now getting more than twice the amount of light obtained under the old system, and at a slightly less total cost. The alteration had given general satisfaction to the public, and it had been decided not to erect any additional arc lamps at present. Whilst speaking of electrical matters, the possibility of serious injury to gas mains and services from electrolysis suggests itself. In America this has become a grave trouble for gas companies, and he was told by a gentleman, who only returned from New York a fortnight ago, that he had seen in that city alone, miles of gas and water pipes which had been taken up, having been destroyed by electricity escaping from tramway circuits. Electric tramways were now being rapidly extended in almost every town in the country; so that this new danger was a matter for the consideration of every one. There had been in Bradford several miles of electric tramway in operation for two and half years; but so far he had not been able to detect, with certainty, any damage to the pipes from electrolysis, although they had one pipe entirely melted by electricity which had escaped from a faulty cable. This immunity may be accounted for by the fact that nearly all their gas mains were laid under the footpaths; and hence any escaping electricity would have to travel a considerable distance to reach the pipes. This plan should always be adopted in streets where tramways had been or were likely to be placed. One very important feature in connection with the matter, and which unfortunately added considerably to its danger, was the insidious nature of this electrolytic action. The existence of any injury would, in all probability, not be apparent until a whole length of main was completely destroyed.

It is needless to add that Mr. Wood has been grotesquely misinformed as to the effects of electrolytic action in New York. The gentleman just returned from New York has been telling him fairy tales.

Long Distance Telephone Transmission.

Mr. D. M. Therrell, wire chief Southern Bell Telephone & Telegraph Company, writes us from Atlanta, Ga., as follows in regard to work of his about which we have been in correspondence with him for some time:

For the past six years I have been studying the problem of long-distance transmission, and have made numerous experiments along various lines, most of which were without result, though here and there interesting and promising results were obtained, but with perpetual exceptions, generally in regard to articulation, or the transmission of the upper partials or "overtones," so-called.

During the early part of the present year I have, however, been enabled to obviate this difficulty, and have succeeded in scoring some rather remarkable results. I now claim to be able to transmit the upper partials as far as the prime or fundamental. With my apparatus I have successfully talked over circuits 2300 miles long, including 13 miles of cable. As you are aware, the present long-distance limit falls closely around 1300 miles, or, as we put it, 1350 miles. I also talked successfully with the same equipment over 646 miles of No. 12 copper wire with 15 local stations and 6 exchanges in circuit, a result, if anything, more remarkable than the former.

Important Telephone Consolidation in Pittsburg.

The absorption by the United Telephone & Telegraph Company of the Maryland Telephone & Telegraph Company, the Pittsburg & Allegheny Telephone Company, and certain other telephone properties, is announced. The consolidation includes the following-named properties:

"Maryland Telephone & Telegraph Company, capital, $1,000,000; Pittsburg & Allegheny Telephone Company, capital, $1,500,000; West Pennsylvania Long-Distance Telephone Company, capital, $1,000,000; Home Telephone & Electrical Company, capital, $200,000; Allegheny County Telephone Company, capital, $200,000; Harford County Telephone Company, capital, $10,000. In all about 50,000 telephones will go into the combination. The United Company obtains a strong position in Pittsburg territory by the interests absorbed there. This territory is regarded from a Bell viewpoint as the third best in the United States for local service and second only to New York for long distance business. The West Pennsylvania Long-Distance Telephone Company owns the line from Pittsburg to Beaver, Pa., where connection is made with the United States Long-Distance Company, that will give service into Cleveland and other Ohio and Indiana points. Over 167,000 telephones will be connected by this line with the Pittsburg and Allegheny plant. The West Pennsylvania Company is building toward Harrisburg, where it is to meet the proposed long-distance line from Baltimore." Apparently the local Pittsburg reporter was long on ciphers when this item was dictated, for the recorded capitalization of the West Penn Telephone Company is only $10,000, and that of the Home Telephone Company $100,000. Then there is no telephone line from Pittsburg to Beaver, except the Bell circuit, and no connection is made at Beaver with the United States Telephone Company, as the latter company has neither built across Beaver County nor even to the Ohio line. And if the West Penn Company is building east from Pittsburg towards Harrisburg, it must be news to the telephone fraternity in Pittsburg, unless reference is made to the long lines the Federal Company is building in Westmoreland County.

Three months is a very short time to accomplish much building. Hence it is generally surmised that the Federal Company is on the inside in some present negotiations. The press dispatch further states: "It is expected within the next three months to have about 27 towns around Pittsburg connected with the Pittsburg & Allegheny Telephone Company, which will give the United Telephone & Telegraph Company about 20,000 telephones in that section." Outside of the Federal Company's plants, there are not a thousand independent telephones in all of Allegheny County outside of the cities of Pittsburg and Allegheny.

No lines have been completed, and the indications are that before the work is a success some other plans will have to be adopted than those of trespassing on the right-of-way of other companies, or of attaching wires to the poles of other companies without permission.

On April 5 the statement appeared in the *Dispatch* that "the Pittsburg & Allegheny Telephone Company owns a franchise in Washington, D. C., and plans are now formulating for a connection from that point to this city. A line to Cleveland is about completed." The press dispatch more accurately stated that the company "had been at work to secure a franchise from Congress for the City of Washington. This is expected to be granted at the next session." The facts are that in its closing hours the United States Senate sat down on the measure, voting adversely to granting such a franchise. Commenting on this announcement, the local Pittsburg *Dispatch* editorially states that "all of the companies named were organized by practically the same people and for convenience of operation and efficiency of service are now brought under one management. As may be seen from the data relating to territory covered and number of instruments installed the United is a quite formidable system. The public is friendly to it because it has brought the benefits of competition into the telephone field, but wisdom dictates that future franchises granted to it shall contain the same limitations of charges and prohibition of transfers of property that were incorporated in the original grants, merely as a guarantee that competition shall continue."

The Conversazione of the American Institute of Electrical Engineers.

JUDGED by any and all of the standards of success, the Conversazione of the American Institute of Electrical Engineers at Columbia University, on April 12, must be rated very high. The exhibits were on a high plane of unusual excellence, the arrangements, made with great care, all worked out smoothly, and a beautiful night after a week of bad weather enabled 1200 people to attain with comfort the crest of Moringside Heights from which the great new buildings of the University look down over the whole Island of Manhattan. To the flattering success achieved, several causes contributed, of which note will be made, but the original incentive came from abroad. While the Institute was in Europe last year, its officers and members participated in several functions, one of the most notable of which was a reception given in Paris by Prince Roland Bonaparte, at which the combination of hospitality with features of scientific interest was so great that it was at once determined by Messrs. Hering, Mailloux and others to try the same thing on the return home. During the winter the matter was referred by the Council to the Committee on Papers and Meetings, and an appropriation was made from general funds in the belief that the resultant good to the society would be considerable. The chief difficulty was to secure a building adequate to the purpose, but this was met through the activity of Professor Crocker, past president, who secured from President Low permission for the use of the Engineering Building. This privilege was in itself an enormous boon, for it not only furnished the best surroundings, but gave many members for the first time an opportunity to see the University itself. As the work of preparation advanced, it was found that the building named would not be sufficient to accommodate all the exhibits and guests, and Havemeyer Building was added, as well as the Engineering and Mechanical Laboratories, thus providing for a separation of the exhibits and free circulation for the hundreds of visitors. The next elements of success may be found in the untiring energy of the committee of arrangements, and the readiness with which members came forward with offers of interesting exhibits. As will be seen from the subjoined report in detail, over 30 distinct exhibits were selected, each of which possessed features of importance beyond the ordinary, and many of which were of the greatest novelty and attractiveness. And it may properly be noted that the desire to cooperate was not confined to the rank and file, but was manifested in equal degree by the leaders in the profession, Mr. Edison returning from his Southern holiday in time to be present, and such men as Professor Elihu Thomson and Mr. Nikola Tesla furnishing personal exhibits of the greatest interest. In fact, of the reception committee consisting of 32 members, 24 were in attendance, as follows, and of those absent none are residents of New York: President Hering W. S. Barstow, Elihu Thomson, F. J. Sprague, W. A. Anthony, J. W. Lieb, Jr., C. F. Scott, L. B. Stillwell, Herbert Lloyd, T. C. Martin, F. B. Crocker, G. F. Sever, S. Sheldon, W. J. Hammer, E. Caldwell, R. W. Pope, G. S. Dunn, C. P. Steinmetz, W. D. Weaver, C. W. Rice, R. D. Mershon, R. T. E. Lozier, C. O. Mailloux, M. I. Pupin.

No fewer than a dozen rooms were occupied for the purposes of the Conversazione, with the laboratories, cloak rooms, etc., in addition. Entrance was effected through Havemeyer Hall, over whose door an electric sign, "A. I. E. E.," was hung, and over a hundred feet of awning, illuminated with incandescent lamps, connected the hall with the Engineering Building. The large lecture room in Havemeyer was devoted to Mr. Tesla's experiments, for which several tons of apparatus had to be installed in less than 12 hours after regular lectures in the morning, while a special high-voltage circuit was run up to the college by the New York Gas & Electric Light, Heat & Power Company. All the other exhibits were practically concentrated in the Engineering Building, except that of telpherage, which requiring a long stretch, was run the length of the mechanical laboratory, where the big locomotive was also in operation with a crew of students. On the ground floor, Professor Thomson and Mr. Peter Cooper Hewitt each had a large room to themselves, and the other exhibits were grouped by subject or the exigencies of space. A band of music was located on one of the upper floors, and in another large lecture room there Mazzetti served an admirable collation to over 1000 people, without any trouble or confusion whatever. Each exhibitor was allowed three assistants, while Professors Crocker, Sever and Townsend organized a corps of some 50 students as ushers and aides, the young men being most obliging and useful. Much care was given to details. A special insurance of $15,000 was taken out on the exhibits, policemen and firemen were in attendance by request, and the Metropolitan Street Railway Company had a special provision of cars to bring people up from downtown, or to connect with convenient stations on the elevated road. All admission to the Conversazione was by ticket, each member receiving two if applied for, and being allowed to subscribe by name for friends up to a certain number. For all this endless work the committee of arrangements, comprising Messrs. W. S. Barstow, chairman; Caldwell, Hammer, Crocker, Martin, Rice, Lozier and Sever divided up, and it must be heartily congratulated on the results obtained. One of the most praiseworthy things it did was to provide a handsome 16-page pamphlet, in which all the exhibits were described in detail, with their location, this being supplemented by brochures furnished by the United States Government, from the Smithsonian Institution, in regard to the exhibits relating to Professor Langley's bolometer and aerodrome.

The attendance was quite remarkable not only as to its size, but in the matter of quality, and included judges of the various courts, officers of the army and navy, the clergy, professors and many well-known members of New York society. Among the officials of Columbia were President Low, Dean Woodward and Professors Hutton, Laudy and Hallock, the first named being accompanied by the German Ambassador, Baron von Holleben, with Herr P. Glasenapp, the engineer attaché of the Imperial Embassy. There were also present several of the foreign consuls in New York, and last, but by no means least, a party of students in physics from Vassar College, in charge of Misses Stone and Cooley, professors in that department. The visitors were all in constant circulation in the museums and laboratories, in the Rontgen ray rooms, in the Elihu Thomson and Cooper Hewitt exhibits, studying Mr. Hammer's wonderful series of balloon pictures, crowding into Mr. Tesla's demonstration, trying to understand Dr. Pupin's apparatus for long distance telephony, listening to the akouphone, delighting at the sparkle of Mr. Andrews' aluminum cell, learning about alternating-current waves from Professors Ryan, Townsend and others, and marveling at the "miles of talk" reeled off in the Poulsen telephonograph. It was midnight before all the resources of the entertainment had been exhausted and the first Conversazione of the Institute had passed into history.

The press notices in regard to the affair have been most generous and extensive, and their general tenor is best represented by the following extract from a leading editorial article in the New York *Tribune:* "The American Institute of Electrical Engineers is to be congratulated upon the attractiveness of its Conversazione on Friday evening. In Europe the combination of an exhibition showing recent advances in science with an evening reception is a familiar occurrence; but in America it is something of an innovation. Moreover, an undertaking of this sort involves a large investment of time, trouble and tact on the part of both the exhibitors and the committee of arrangements. But such a venture yields a handsome return in educational results. And those who contributed, by material or service to this particular one have reason for just pride over its success."

OSCILLATOR EXPERIMENTS.

The fact that Mr. Nikola Tesla is most busily occupied with his preparatory work for signaling by wireless telegraphy across the Atlantic was in itself sufficient reason why that distinguished inventor should not be able to participate in the proceedings at the Conversazione, but yielding to the urgent request of the committee of arrangements, Mr. Tesla, to whom the Institute is already indebted for more than one brilliant demonstration, went to considerable pains and trouble to contribute to the exercises of the evening. With the assistance of Mr. Lozier, he transported several tons of apparatus from his laboratory downtown up to the big lecture room in Havemeyer Hall the afternoon of Friday, as the room could not be occupied before that time. Within the brief space of 6 or 8 hours the whole of the apparatus, including the converters, oscillators and temporary circuits connecting with the outside lines brought to the building by Mr. Calvin Rice through the courtesy of the New York Gas & Electric Light, Heat & Power Company, was set up, tested and put in operation. The hall, which ordinarily accommodates about 350 people sitting, will perhaps provide for 400 to 500 when crowded, and it had been arranged to give not less than two demonstrations. The first went off most successfully, and the extraordinarily brilliant effects obtained by Mr. Tesla with vacuum tubes, special coils of wire and free ends of wire in air, were given to the intense delight and satisfaction of the largest audience the room would accommodate. So profuse were the discharges in free air from the apparatus, the audience had to retire somewhat precipitately from the front three or four benches, leaving Mr. Tesla a clear space of 8 or 10 ft. around the apparatus, and even then in the darkness the discharges were of a most weird and awe-inspiring character. It was found at the close of the first performance that the converter supplied temporarily for Mr. Tesla's use instead of the one used by him in his laboratory had become so overheated as to be incapable of further service, and as no other was obtainable at that late hour of the night, it was found impossible to give a repetition of the display, to the intense chagrin of hundreds of people who were waiting. Mr. Tesla, however, apologized for this disappointment in a very charming manner, and volunteered his readiness to give a further demonstration before the members of the Institute at such time as might be found suitable and convenient. The display, while not particularly novel to those who have seen Mr. Tesla's previous work, was certainly one of the great features of the Conversazione, and Mr. Tesla is entitled to warm thanks of the Institute for the inconvenience to which he put himself in order to take part in the affair.

ANALYSIS OF HIGH-FREQUENCY SPARK.

An interesting apparatus was shown by Mr. W. S. Andrews, which had been devised to study the high-frequency spark. The appartus was very simple, consisting merely of a glass tube of small bore mounted as a radius on a revolvable disk. As installed, the apparatus was connected with an alternating-current circuit of 118 volts and 58 cycles. The current was conducted into the tube, which had a bore of only .25 mm, by wires inserted in the ends, there being an air-gap about 5 inches long inside the tube. The tube was revolved while illumined by the discharge, the optical effect being a circle of bright radial lines. Under these conditions, the number of primary radii is obviously determined by the ratio between the alternations and the speed of rotation, but the characteristics of the primary radii may be changed by manipulation of the apparatus.

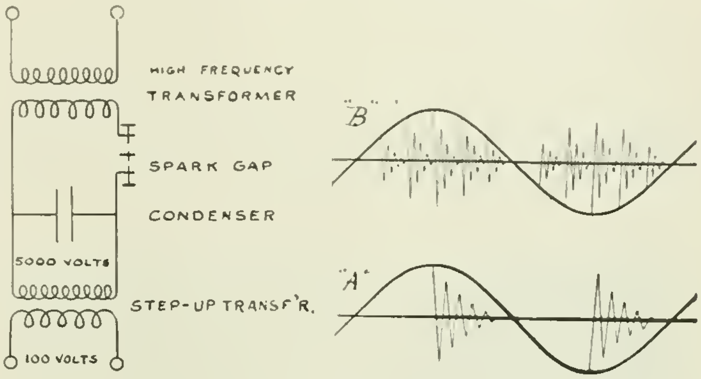
Referring to the diagram of high-frequency apparatus shown in Fig. 1, when the spark-gap is set at a certain length and the potential of the transformers adjusted so that the condenser discharge will only just arc across it, the radii will appear as single lines, indicating that the condenser discharges only once during a half wave (see "A," Fig. 2).

If the primary potential is now increased, or if the spark-gap is shortened, the single radii will be seen to open out like a fan into two or more lines, thus indicating a corresponding number of condenser discharges during each half wave (see "B," Fig. 2).

To obtain permanent records of the different effects, photographs were taken from which the prints of Figs. 3, 4 and 5 have been made. Figs. 3 and 4 show snap exposure of the high-frequency sparks during two and three half-waves, respectively.

Fig. 5 shows a star produced when the tube was revolved at 430 r. p. m. During each half revolution eight compound radii were formed in each half of the circle, corresponding to eight half waves in a 58 cycle current.

It would be difficult, if not impossible, to record any purely high-frequency oscillations by the present method, as a sufficiently high speed of rotation could not be attained. The results here described, however, appear to present a clear proof that each half-wave may be the source of a number of groups of high-frequency oscillations. It therefore follows that an arc across a high-potential circuit containing inductance and capacity ruptures itself instantly, so that, if the voltage is high enough it can occur repeatedly during each half-wave.



FIGS. 1 AND 2.—ANDREWS' EXHIBIT.

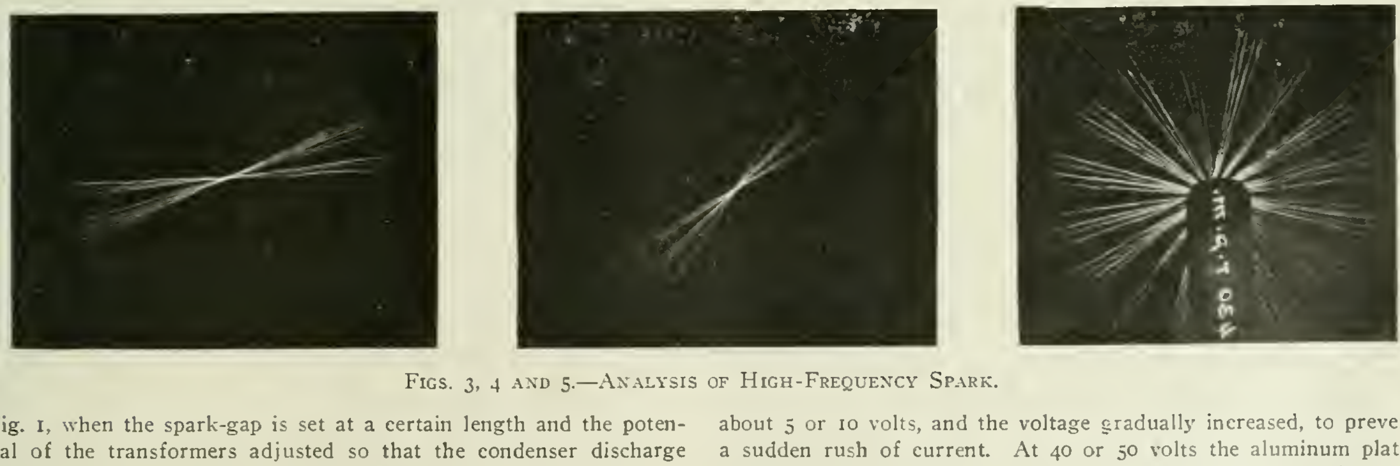
LUMINOUS ALUMINUM CELL.

Another exhibit by Mr. Andrews consisted of a luminous aluminum cell. This cell is composed of a plate of aluminum and a plate of carbon suspended in a saturated solution of Rochelle salts (double tartrate of potash and soda).

The peculiar property of the aluminum cell in retarding a flow of current in one direction is well known. There is practically no resistance to the passage of current through the electrolyte from the carbon to the aluminum, but a high resistance is encountered in the opposite direction. Many attempts have been made to use these cells for rectifying alternating current, and changing it into a pulsating unidirectional current, but their low efficiency is a serious bar to any commercial application.

When two of these cells are connected in opposition to each other across an alternating current, the e. m. f. of which can be controlled from zero to about 200 volts, a very interesting phenomenon may be observed, the experiment being performed in a darkened room. With two newly charged cells the current should be connected at about 5 or 10 volts, and the voltage gradually increased, to prevent a sudden rush of current. At 40 or 50 volts the aluminum plates will be seen to glow with a faint phosphorescence, which will grow brighter as the voltage is raised. Little stars will then appear on the luminous surface, and these will increase in number and brightness until finally the aluminum plates will become glowing fields of beautiful scintillations, each point of light continually changing in position and brilliancy.

The phosphorescence and scintillations on the surface of the plates will extend for a short distance above the level of the liquid, and



Figs. 3, 4 and 5.—Analysis of High-Frequency Spark.

a pretty effect may be produced by slightly tipping the cells so as to momentarily wet a larger surface of the plates.

The voltage necessary to produce these results will vary with the size and condition of the plates and the density of the solution. It will, however, be always safe to begin at a low voltage and gradually work upwards.

The high resistance of these cells to the passage of current in one direction is probably due to the formation of a film of non-conducting oxide on the aluminum, through which a great number of minute disruptive discharges may produce the appearance of scintillations and phosphorescence.

SYNCHRONISM AND PHASE INDICATOR.

An apparatus which attracted the particular attention of technical visitors was exhibited by Mr. Charles L. Clarke, and is illustrated below. This consists of an instrument for indicating when the frequency and phase relation of alternating-current generators are such as properly to permit them to be connected in parallel. The instrument is shown on the left of the illustration, the apparatus on the right having been installed to demonstrate its practical operation.

In the case are two 12-pole single-phase synchronous motors, which respectively rotate two blackened aluminum disks in opposite directions. The motor shafts are axially in line, so that the disks carried by them are one directly behind the other, and located as close together as practicable. Six narrow slots, extending radially inward, are cut in the circumference of each disk at equal distances apart. A brilliantly lighted white screen is located behind the disks. The stroboscopic effect of viewing the screen through the slots in the disks as they rotate appears in the form of an image, consisting of a series of bright, narrow radial lines arranged circumferentially upon a black background. The number and distance apart of the lines and whether or not they move, or are stationary, depends upon the relative speed of the disks.

SYNCHRONISM AND PHASE INDICATOR.

At the circumference of, and in the same plane as, the front disk is located a scale, which reads to 180 degs. on each side of a zero line, and embraces one-twelfth of the circumference of the disk. Directly behind this scale, and in the plane of the rear disk, is located another similar scale. The two scales together constitute a single scale for avoiding error due to parallax. The scales are fixed together, and, as a whole, are capable of a certain amount of motion about the disks for adjustment.

When the disks rotate at or near the same speed and, therefore, the motors are at or near synchronism, the characteristic image appears, in which case 12 lines at equal distances apart (360 degs. apart as measured on the scale) are seen. These lines will be stationary if the motors are in synchronism, or slowly rotate if the motors are nearly in synchronism, the direction of motion depending upon which motor is going the faster.

To adjust the scale both motors are connected with the same source of e. m. f., with the necessary result that they run in synchronism, and, therefore, the characteristic image appears, and its lines are stationary and assume the position for zero difference of phase. The scale is then adjusted to bring its zero line opposite a line of the image.

No further explanation is necessary to make it apparent that with the two motors respectively operated by two generators, the appearance of the characteristic image will indicate, if its lines are stationary, that then the generators are in synchronism; or, if the lines are rotating in either direction, which generator has the greater rotary speed. The position of a line on one or the other side of the zero line of the scale (only one line of the characteristic image can be inside the limits of the scale at the same time) will indicate the lead or lag, respectively, of the e. m. f. of one generator relative to that of the other.

The construction above described relates to an indicator operated by 12-pole motors. In general, with motors having *n* poles the disks should each have ½ *n* slots, and the scale embrace the *n*th part of the circumference of the disks. The characteristic image will have *n* lines.

The indicator exhibited had single-phase motors, as before stated, and naturally had to be started in operation by mechanical means, which was easily and simply accomplished by twirling knobs on the armature shafts. By use of split phase, or polyphase motors the indicator is self starting. But the construction is much simplified by using single-phase motors, and the apparatus is in every way just as accurate and applicable to practical use.

Besides its use for the connecting-in of generators, as before described, this indicator is also applicable for showing the phase relations of a current and an e. m. f., or two currents of the same frequency.

BOLOMETER.

Professor S. P. Langley, director of the Smithsonian Institute, showed a bolometer of the form which he devised for conducting his researches on heat, and since has employed in studies on the solar and lunar spectra. The salient feature of the apparatus consists in a wire, or rather a "tape" of platinum, of a length of 10 mm or less, a width of a tenth of a millimeter or less, and a thickness of less than one one-hundredth of a millimeter. This is made one of the arms of a Wheatstone bridge, the other arm being shielded from the radiation of the object under examination. The action rests on the principle that the heating of an ordinary metallic conductor increases its resistance. The application of it here carries us into what may be almost called the "physical infinitesimal" in which the principle is still found to hold good for an almost infinitely small change of resistance. Through the two arms of the bridge flow currents from a battery. This battery current, which may be roughly taken at a tenth of an ampere, is equally divided between the bridge arms, until the heat (by causing a change of temperature which may be less than one one-thousand millionth of a degree in the exposed arm) induces an increase of resistance and a consequent flow through the galvanometer, represented by a current which need not be more than 0.000,000,000,001 of an ampere, a deflection of 1 mm on the scale of a special reflecting galvanometer (not here described) corresponding to a change of temperature on the bridge of nearly 0.000,000,001 of a degree centigrade.

The bolometer would evidently be comparatively useless if any accidental heat radiations reached it which were not connected with the object under immediate examination. Accordingly, it is kept free from external temperature variations by a case surrounded by a water-jacket and by other aids. It is used in a chamber of constant temperature, where the heat is automatically controlled so as to be the same in summer and winter and in day and night.

Accompanying the bolomoter case were shown several types of bolometers made for special purposes, in all of which, however, strips or "tapes" of platinum are employed as one of the minute arms of the enclosed "bridge." A drawing was exhibited showing in detail the construction of the bolometer and the balancing coils combined within one water jacket, and also a diagram showing the electrical connections of the apparatus and illustrating the principles of its action.

ELECTRIC LIGHT FROM VAPOR TUBES.

Without doubt the exhibit which attracted the most attention was that of Mr. Peter Cooper Hewitt, consisting of mercury vapor tubes for the production of light upon the passage of a current through the tube. Various forms of these tubes are shown in the cuts below. The simplest form consists of a plain cylinder having a bulb at one end containing mercury. Before sealing, the tube is partly exhausted. The amount of exhaustion was not stated, but it was said that no tube was exhausted below a pressure corresponding to 1 mm. of mercury when running.

In Figs. 3, 4 and 5 are represented different sizes of tubes, each accompanied by data, a comparison with which gives the relation of voltage to the length and diameter of the tube. Fig. 2 shows a lamp in which the tube is coiled. In starting up a higher voltage than normal was used to start the discharge through the tube, but it was stated that tubes could be put in operation without having recourse to a high starting voltage.

A number of sheets of curves were exhibited, showing the variations of efficiency under different conditions and with currents of different value. Engravings of these curves will be printed in an early issue. One of the curves referred to a tube 54½ inches long with an inside diameter of one inch, which at 74 volts and 3 amperes gave a candle-power of 700. As a calculation will show, this corresponds to .32 watt per candle. The photometric value was determined by measurement at right angles to the axis of the tube, and, therefore, does not correspond to the basis upon which candle-power of incandescent and arc lamps is determined. The illumination afforded by a single tube was, however, very large, lighting brilliantly a room which normally is lighted by two enclosed arc lamps.

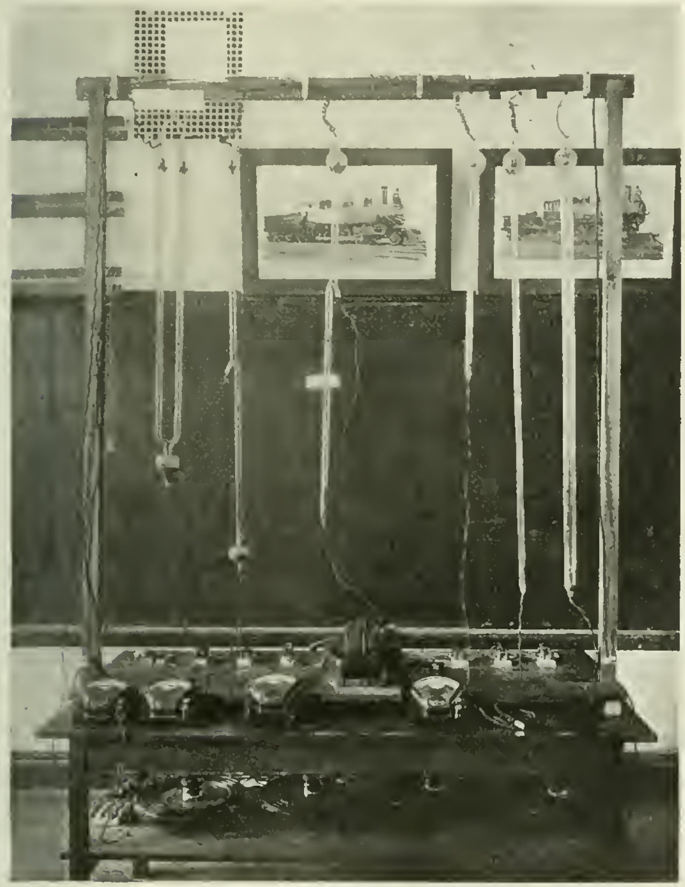


FIG. 1.—GENERAL VIEW OF VAPOR TUBE EXHIBIT.

INCANDESCENT LAMP EXPERIMENTS. PHASE INDICATOR.

Professor W. E. Geyer showed an interesting arrangement to illustrate the properties of parallel alternating-current circuits containing inductance and capacity. One of the parallel circuits contained inductance in series with a lamp and the other parallel circuit a capacity, also in series with a lamp. In one of the legs connecting the parallel circuits to the source of e. m. f. was a third incandescent lamp. When current was turned on the third lamp glowed dimly, while the two lamps in parallel each glowed at full candle-power. The apparent paradox of a lamp burning dimly through which presumably the current for both of the brightly glowing lamps passed, was explained as being due to a storage of energy in the inductance and condenser of the parallel circuit, which caused a surging current in that circuit that did not appear in the circuit including the dimly

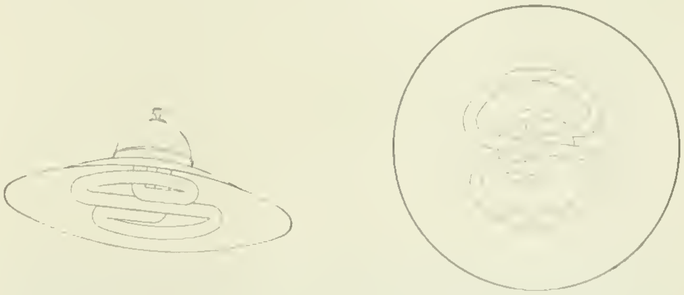
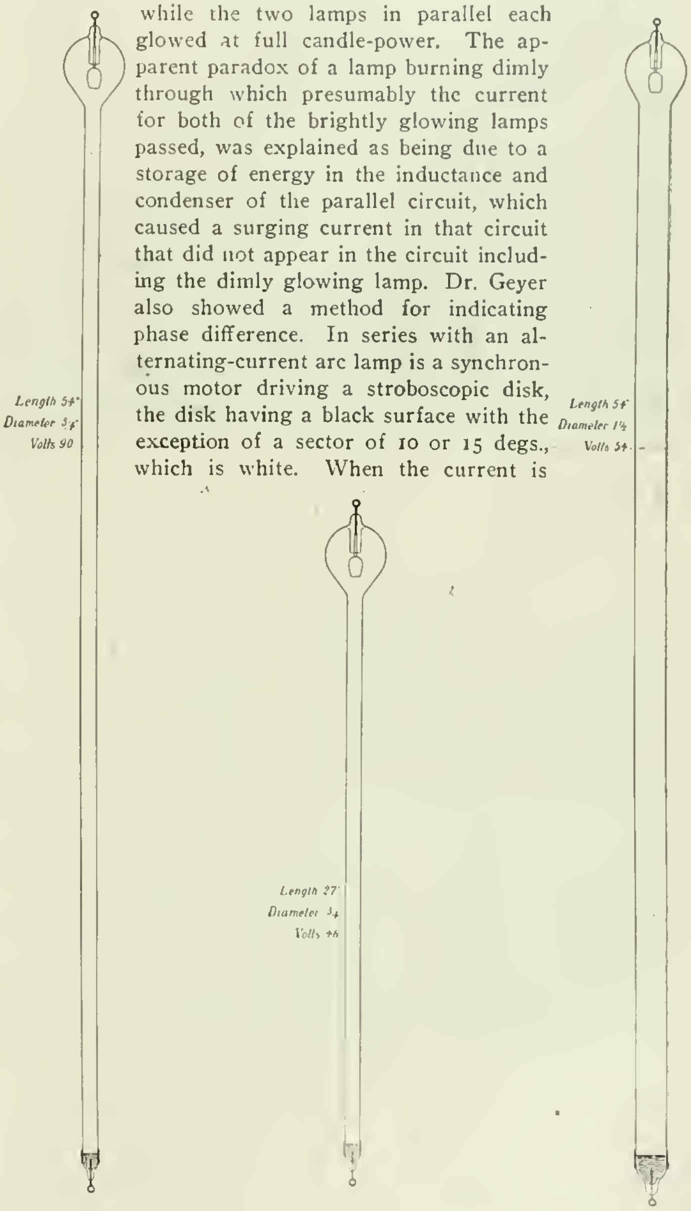


FIG. 2.—LAMP WITH COILED TUBE.

while the two lamps in parallel each glowed at full candle-power. The apparent paradox of a lamp burning dimly through which presumably the current for both of the brightly glowing lamps passed, was explained as being due to a storage of energy in the inductance and condenser of the parallel circuit, which caused a surging current in that circuit that did not appear in the circuit including the dimly

glowing lamp. Dr. Geyer also showed a method for indicating phase difference. In series with an alternating-current arc lamp is a synchronous motor driving a stroboscopic disk, the disk having a black surface with the exception of a sector of 10 or 15 degs., which is white. When the current is turned on, the position in space of this sector appears to be fixed since the eye is preponderatingly affected by the disk when the reflection of light is maximum, which maximum occurs when the current passing through the lamp, and consequently through the alternating-current motor driving the disk, is at a maximum. If the apparent position of the sector is vertical when it is on one leg of a two-phase circuit, it will be horizontal or 90 degs. distant when the arrangement is switched onto the other leg of the two-phase circuit.



FIGS. 3, 4 AND 5.—TUBES OF DIFFERENT SIZES.

EXHIBITS OF PROFESSOR ELIHU THOMSON.

One of the main attractions of visitors, both technical and lay, was the exhibits of Professor Elihu Thomson, which consisted of three items, two of which are shown in the cut below. One exhibit was an aluminum disk mounted on a vertical shaft free to rotate, and embraced by the two legs of an alternating-current electromagnet. The electromagnet is adjustable so that a greater or less portion of the disk can be embraced, and also to enable the magnet to be shifted in position so that the plane of its legs may make a different angle with a tangent to the disk. When current was turned on the electromagnet, the disk would remain stationary or move in one direction or the other, according to the position of the electromagnet with relation to the disk. Another exhibit was a rotary electrical apparatus (see above) consisting of an iron sphere heavily electroplated with copper and suspended on gimbles so that it may revolve in any axis or in any plane, there being two gimble rings. Surrounding this sphere are three coils at right angles to each other. By suitably energizing these coils with polyphase currents, the sphere was made to revolve on any axis or in any direction, so that it may be said the apparatus illustrates a three-dimension polyphase system and also the principles of the gyroscope and the Bohenberger sphere. The switching arrangement was such that current could be passed through any one or two or all of the coils, and in direct or reverse order.

EXHIBITS OF PROFESSOR ELIHU THOMSON.

The third exhibit was a dynamo-static machine which was an improved form of one shown about two years ago at a meeting of the New York Electrical Society. This machine contains a small direct-current motor, the windings of which are tapped and connected to two rings, giving a primary alternating current for the operation of a step-up transformer, which gives a secondary current that can be regulated through a range up to about 20,000 volts. The tops of alternating-current waves of high potential obtained from this secondary transformer are used to charge a number of glass plate condensers in parallel. The rotating frame synchronously driven with the motor makes connection to the condensers periodically and in synchronism with the alternating current. The connection by the rotating frame is alternately in parallel and in series; the condenser plates may thus be charged to 15,000 volts with 10 plates in parallel, giving 150,000 volts when connected in series. The machine thus furnished from low tension direct-current high-potential discharges of definite polarity at the machine terminals.

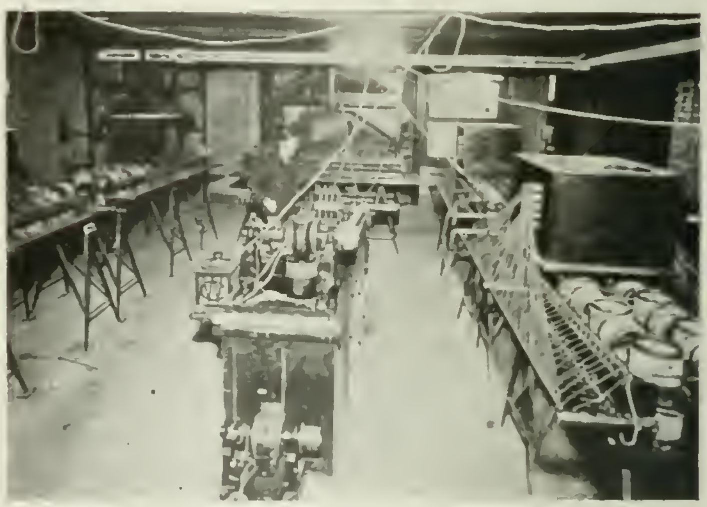
TELEPHONOGRAPH AND AERONAUTICAL PICTURES.

Mr. W. J. Hammer showed a collection of photographs, mostly taken by himself, of aeronautical subjects, comprising photographs of Professor S. P. Langley's aerodrome, Sir Hiram S. Maxim's flying machine, Santos-Dumont's dirigible air-ship and Count Zeppelin's balloon. Also photographs made from balloons during the Aeronautical Congress at the Paris Exposition of 1900, and by the Aero Club, of France.

Mr. Hammer also exhibited a Poulsen telephonograph. An illustrated description of this interesting apparatus appeared in our issue of April 21, 1900. Briefly, the apparatus consists of a brass drum, 11 × 5 inches, upon which is wound piano wire. Resting upon the wire is a tiny electromagnet, which is connected to a carbon telephone transmitter, a couple of cells of battery, and an induction coil in the usual manner. When the transmitter is spoken into the magnet transversely magnetizes the steel wire as the drum revolves, and the magnetic lines of force are permanently recorded therein. After the steel spiral is filled—which operation takes about 39 seconds, and permits the recording of 100 to 120 words—the tiny magnet is placed in its original position, and connected with a Bell receiving telephone; the cylinder is again revolved, and as the magnetized steel wire passes before the poles of the electromagnet, it forms a species of magnetoelectric generator, giving out currents of electricity of a strength and direction corresponding to the magnetization of the steel wire, which correspondingly affect a Bell telephone held to the ear, and reproduce the sounds and words originally spoken, with absolute fidelity. In addition, there was shown the band form of telephonograph and a dictation machine for office use.

PUPIN LONG-DISTANCE TELEPHONY EXHIBIT.

The cut below shows the exhibit of Dr. Pupin, consisting of an artificial telephone line which was constructed to test the mathematical deductions of Dr. Pupin relating to the reduction of the distortion and attenuation of telephone currents on long land overhead lines and in cables. The apparatus consists of such a distribution of capacity and resistance as corresponds with an actual line, and the connections are such that inductances may be plugged in at various intervals. During the Conversazione demonstrations were given, showing that if inductances are inserted in a certain definite relation with respect to the length of the line, telephonic communication is carried on with as much ease as if the line were but a few rods long, whereas the artificial circuit corresponded to a line some hundreds of miles in length; on the other hand, it was shown that if the same amount of inductance were plugged in without regard to the law discovered by Dr. Pupin, conversation was rendered impossible, and the same was true when the line contained no artificial inductance.



DR. PUPIN'S LONG-DISTANCE TELEPHONY EXHIBIT.

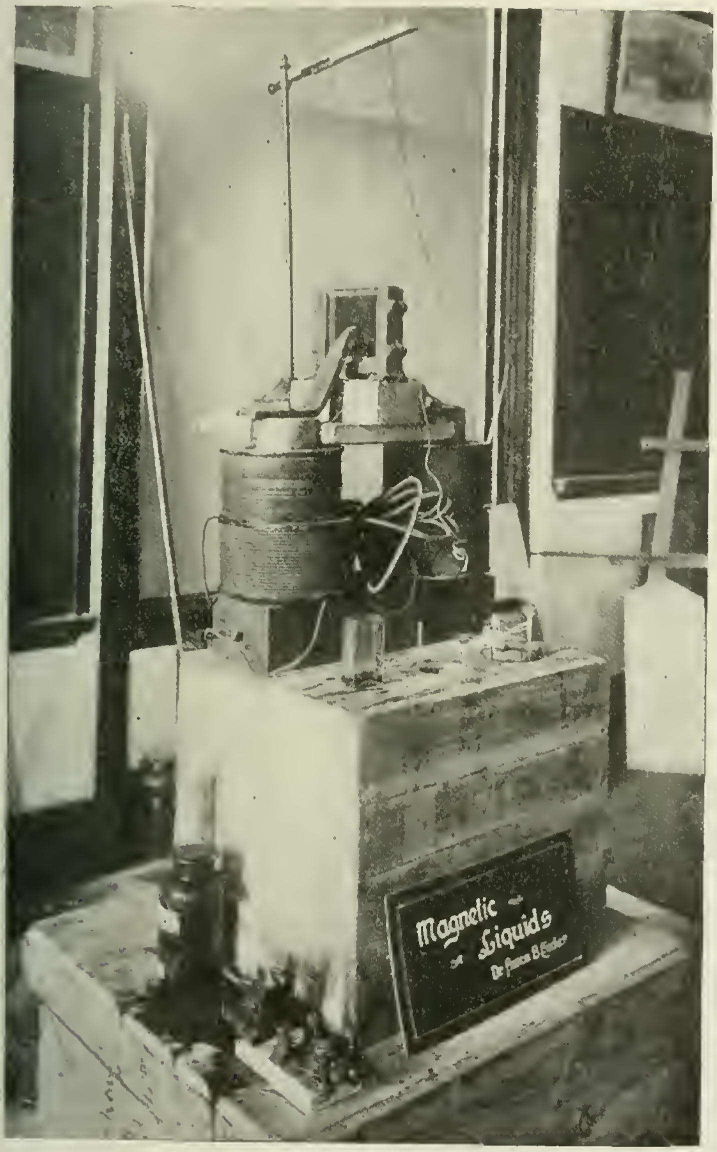
TELPHERAGE SYSTEM.

A very interesting exhibit of the new system of telpherage was made in the Mechanical Laboratory by the United Telpherage Company, which was represented by Mr. J. B. Wallace, C. W. McMullen, C. L. Riley, A. F. Clift and T. B. Peck, Jr. There was naturally considerable difficulty in securing long enough stretch of space to display this system to advantage, but it was found by running a cable for about 100 ft. above the tanks and steam pipes, etc., in the laboratory and securing the two ends by stout temporary supports, a demonstration could be made. The contact wire for the sleeve trolley was slung above and thus the telpher was able to travel up and down at a good rate of speed and display to advantage the handiness of this ingenious system for handling freight, mail, etc.

It was evident that to a great many of the visitors, including, be it said, not a few engineers, the idea of sending actual material along a wire electrically was wholly new, and the skill and ease with which the operation was effected elicited a great many warm commendations. Those who put up the temporary exhibit under the exacting conditions are to be congratulated upon the success achieved by their demonstration, which in itself illustrated admirably the manner in which such a method of transportation can be adapted to buildings whose floor space is congested with all kinds of apparatus, and where, therefore, the transportation of material is correspondingly troublesome.

ILLUSTRATION OF PARAMAGNETISM AND DIAMAGNETISM OF LIQUIDS.

The cut below shows an arrangement exhibited by Professor F. B. Crocker for illustrating the magnetic properties of liquids and for measuring their permeability. The liquids are contained in small phials immersed in another liquid and situated within a powerful magnetic field. As exhibited, one of the phials contained a paramagnetic liquid consisting of a salt of iron, and the other contained a diamagnetic liquid. When the field was established the former tended to move toward the strongest part of the field, while the latter tended to move toward the weakest part of the field.



PROFESSOR CROCKER'S MAGNETIC LIQUID EXHIBIT.

U. S. SIGNAL CORPS EXHIBIT.

One of the most extensive exhibits was that of the U. S. Signal Corps, which was collected and installed under the supervision of Colonel Samuel Reber, U. S. A. The wireless telegraphy apparatus was of particular interest, as it embodies a number of improvements suggested by experiments on a practical scale; in fact, the Signal Corps has perfected a complete system of its own, which is the first practically operated in this country, and by means of which regular communication has for some time been established between stations in the harbors of New York and San Francisco.

The receiving apparatus is shown in Fig. 1, and consists of a specially constructed relay; the coherer and decoherer, the former containing nickel and silver filings and being adjustable; a telegraph printer, and two two-point switches, one for testing the decoherer and the other for testing the printer. All of these instruments are mounted on a base which contains the various connecting wires, coils, etc. The whole device is covered by a neatly polished box, and when ready for shipment measures 38 × 18 × 14 inches.

The sending apparatus consists simply of a large induction coil and an ordinary telegraph key, a four-cell storage battery furnishing the current; 7.5 amperes at 10 volts is used in the primary, and with a spark 1½ inches in length, about 12 words can be transmitted per minute. By means of two split plugs and receptacles for the same on the base of the receiving apparatus and the two ends of the secondary of the sending coil, the operator can quickly change over from receiving to sending, and vice versa.

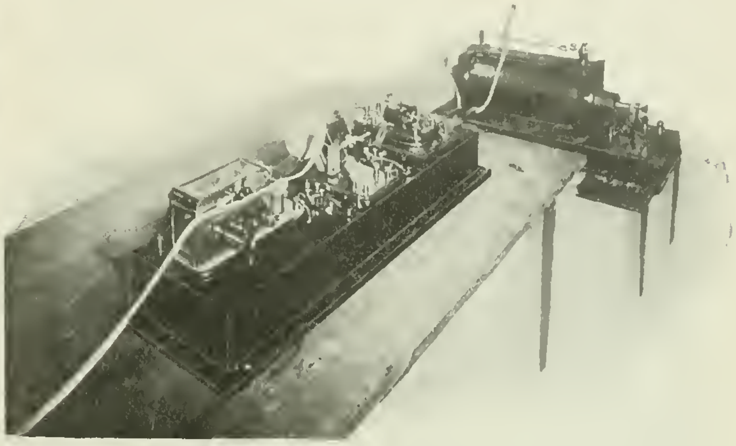


FIG. 1.—WIRELESS TELEGRAPH RECEIVING APPARATUS.

Another series of apparatus shown, which has been developed to a point of great efficiency, are the field telegraph and telephone kits and portable switchboards. Three of these are shown in Fig. 2. The device on the extreme left is known as "Type C" kit, and is a combination telegraph, telephone and phonoplex. By means of a switch the operator can cut out his own receiver, so as to avoid annoyance, and by eliminating the back stroke there is no click in the receiver. By the use of a reed, the pitch of which may be varied, the operator is enabled to work through wires located in swamps and circuits which have actually been severed. The battery is inside the leather case, and the size of the whole outfit is 7 × 7 × 7 inches. In the center of the illustration is shown the "Type D" kit, which is a combination telegraph and telephone outfit. It has a buzzer only, and the whole kit measures 8 × 5 × 4 inches. On the right of the figure is shown a cordless field switchboard, which is built to take from 1 up to 10 circuits. It contains the necessary battery, night signal and drops, which are wired to the lines ahead of cross-connecting keys, of which there are three rows. Any cir-

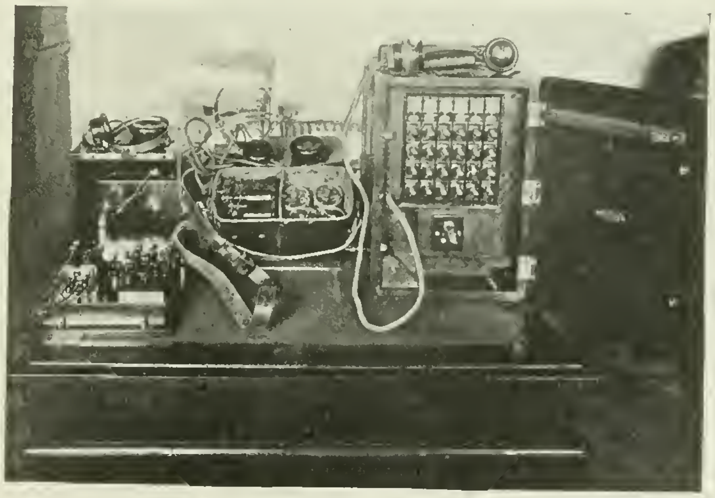


FIG. 2.—FIELD OUTFIT.

cuit may be connected with any other circuit by a simple arrangement. The board is substantially constructed, so as to stand field usage, and a 10-drop board measures only 10½ × 9⅛ × 16⅛ inches.

Another very interesting contrivance designed and constructed on lines indicated by a board of Signal Corps officers is the portable field electrical signal light, which was also on exhibition. In addition to its primary use as a signal light it also serves as a searchlight. The lines of construction are such as to insure efficiency of action, economy of power and readiness of transportation, all essential qualities for campaigning. A number of these outfits are now in the Philippines, and can be readily transported. It can be easily mounted at any point so that it can be used for searching battlefields for dead and wounded, or as a screen for intrenching operations at night, or for reconnoitering purposes on armored trains, or for columns in the field. One carriage carries the boiler, engine and dynamo, while the other carries the light proper.

ELECTRIC FURNACE.

An electric furnace exhibited by Mr. Otto T. Louis, consisted of several terra cotta cylinders about 2 inches in diameter and ½ inch thick, around which is wound platinum wire of No. 22 B. & S. gauge. The wire is put on in four circuits, so that as the resistance increases with the heat, the circuits may be thrown from series to parallel. The cylinders have longitudinal and vertical motors, and are held in position by clamps.

ELECTRIC FURNACE.

WAVE FORM INDICATORS.

Mr. L. T. Robinson showed a wave-form indicator, consisting of a small synchronous motor in connection with suitable commutating devices used for determinng the wave shapes of alternating current. An alternating-current tracer shown by Mr. Fitzhugh Townsend differs from the usual instantaneous contact device in that the contact is made during one-half the period.

FLOATING MAGNETIC FIELD.

Mr. E. T. Schoonmaker showed one of the remarkable magnetic phantoms of which he has devised a number of beautiful forms. In this case there are several phantoms on parallel panes of glass which are illuminated from below. The effect is that of a field in space, the particles of iron appearing to be in radial suspension about the pole.

TELEPHONE TO ASSIST HEARING.

Mr. M. R. Hutchison exhibited a form of telephone for the use of persons of defective hearing, consisting of a combined receiver and transmitter to which current is supplied by a small storage battery of a convenient form for being concealed on the person. The sounds received are intensified by the transmitter and the vibrations therefrom conducted to the ear through tubing.

RADIOGRAPHING ALTERNATING-CURRENT WAVES.

Professors H. J. Ryan and J. A. Phelon exhibited an apparatus for securing stationary and continuous diagrams of cards of alternating-current waves. The waves are conveniently recorded by means of a simple form of pantagraph which is run over a luminous diagram and operates a lead pencil.

COPPER SPLICING MACHINE.

Mr. H. F. Sanville showed a portable and self-contained splicing press with independent pump and flexible hose, used for making a solderless splice in wires and cables in the form of a cold weld. The machine has a pressure capacity of 20 tons per square inch in the weld.

FARADMETER AND RESISTANCE BRIDGE.

. Mr. E. V. Baillard exhibited a bridge for measuring low resistance and a faradmeter. The latter instrument embodies in practical form the well-known Wheatstone bridge method of comparing capacities. Instead of employing a galvanometer, a telephone in connection with a small vibrating make-and-break is used.

SWITCHBOARD PANELS.

Mr. H. P. Davis showed two switchboard panels containing a phase-shifting transformer, a power factor indicator, a synchronizer, an alternation meter and various new indicating and integrating instruments.

ELECTRICAL MEASURING INSTRUMENTS.

An exhibit by Mr. Caryl D. Haskins consisted of a power-factor indicator, showing the relation between real and apparent energy in an alternating-current circuit; and a single-coil astatic instrument, which, instead of having four coils as usual, employs but a single coil. An ohmmeter was shown by Mr. Otto T. Louis, having a range from 10,000 to 10,000,000 volts.

STORAGE BATTERIES.

Several types of the chloride storage battery were shown by Mr. Herbert Lloyd, and also specimen plates. Included were cells for vehicle purposes, and a special form of cell designed for traction purposes as used on the Thirty-fourth Street Cross-Town Line, New York City.

Mr. A. I. Hubbard exhibited types of cells and plates of the Gould storage battery. The principal feature of this battery is the increase of superficial area of the plate obtained by spinning or grooving with rotary knives, which force the lead up between them, forming ribs and grooves of any desired dimensions. Each rib is made independent by tying the ends with the main cross-bars, and not depending on any center conductor or support, thus giving a low internal resistance. Positive and negative plates were shown, having small amounts of active material, which have gone through a series of charges and discharges, at half-hour and 20-minute rates; an automobile battery cell with a "spinning" giving 450 square inches of surface per pound of lead; a positive and negative plate of the automobile type of cell; and an unformed plate with delicate "spinning," giving 144 square inches per cubic inch of lead.

A storage battery made upon the unit system was exhibited by Messrs. Frank Perret, J. A. Barrett and W. H. Meadowcroft. Cells of different sizes are built up of standard units of definite capacity. The formation is purely Planté, no oxydizing agents being used, and nothing but pure sulphuric acid and water employed at every stage.

MISCELLANEOUS.

An electrolytic magnesia arc lamp on the Nernst principle, and operating at 1000 volts, was shown by Professor W. S. Franklin. Professor Frank A. Lows exhibited radiographs of alternating-current wave forms, made by the use of cathode ray tubes of the Braun pattern. Mr. H. R. Palmer showed in operation the fac-simile picture telegraph which was described in our issue of April 13. A Röntgen ray outfit was shown by Mr. Martin P. Rice, which included a modified form of Wehnelt interrupter. A 55-cm Wimshurst machine, shown by Mr. Otto T. Louis, was operated in connection with the exhibit of Professor H. J. Ryan. The American Institute of Electrical Engineers had on exhibition the handsomely engrossed resolutions, prepared for presentation to the British Institution of Electrical Engineers in recognition of numerous courtesies extended during the visit of the Institute last year to London.

General Electric Annual Report.

A forecast has already appeared in these pages of the annual report of the General Electric Company, which has now been confirmed. The report of the company for the fiscal year ended Jan. 31 shows profits, including $419,066 from the sale of securities, and after deducting all expenses and allowances for depreciation and losses, of $6,243,792. Dividends on the preferred and common stock and interest on debentures were $1,968,289, leaving a balance of $4,275,502, which has been carried to surplus account. The previous balance was $2,353,031, making the present surplus $6,628,533. The orders received during the year aggregate $27,969,541, against $26,323,626 the previous year and $11,170,319 in the year ended Jan. 31, 1897. The number of employees in all the works of the company is over 12,000. There were expended in the year for new patents, patent expenses and patent litigation, $360,259.

The patents and good will of the Siemens & Halske Electric Company of America, the Marks Enclosed Arc Lamp Company and various other manufacturing concerns were acquired at a cost of $604,672, making the total expended on this account $964,931. In the last previous annual report patents, franchises and good-will were carried at $2,000,000. The bookkeeping profit of the difference between the par of $3,763,000 debentures and $3,124,300 par of common stock issued therefor was credited to patents and good-will. The amount is $618,057. There was written off on the same account $346,874, a total of $964,931, leaving the patents, franchises and good-will standing on the books at the end of the year $2,000,000, the same as at the beginning of the year. The three plants of the company now occupy 180 acres, and the total factory floor space of the buildings is approximately 2,362,000 square feet. The book value of these plants is $1,858,044, which is less than 80 cents per square foot of all the manufacturing floor space.

The constantly increasing business of the company necessitates continuous large expenditures on its plants to increase manufacturing capacity. On Jan. 31, 1893, the book value of the three factory plants was $3,958,528, and in the eight years ended Jan. 31, 1900, additions of lands, buildings and machinery were made, at a total cost of $6,127,770, making total book cost of the plants $10,086,299. Within the same period there has been written off for depreciation $6,686,297, leaving their book value on Jan. 31, 1901, at $3,400,002. No change has been made in the book valuation of securities held since Jan. 31, 1897. Securities for which there was no special reason for holding permanently have been sold for $1,070,272. They had been carried on the books at $651,205, showing a profit of $419,066. The proceeds of the sales mentioned were used to protect and improve existing investments to the extent of $1,126,416.

An allowance of $404,131 has been made for possible losses on bills receivable. The amount of sales billed to customers during the year exceeded $28,000,000, and during the last three months they aggregated nearly $9,000,000. Of the 12,600 regular customers on the books of the company, there were debit balances against 4,900 at the close of the year. The cash collections exceeded $26,500,000. Notes and accounts receivable at the beginning of the year footed up $7,314,930, of which all but $516,429 have been settled. The allowance for possible losses on old debts was $228,888, and for the current year $175,243, a total of $404,131. In the balance sheet raw materials have been valued at the lowest price paid by the company during the last three months of the fiscal year. The market price on Jan. 31 last was used where it was lower than the price paid by the company during the previous three months.

The consolidated balance sheet as of Jan. 31, 1901, shows:

Assets—			
Cash			$2,373,683
Stocks and bonds		$6,012,300	
Real estate (other than factory plants)		522,453	
Notes and accounts receivable		9,596,940	
Work in progress		1,054,659	
		$17,186,352	
Merchandise inventories—			
At factories	$7,061,751		
At general and local offices	865,326		
Consignments	63,903		
		7,990,980	
			25,177,332
Factory plants		$3,400,002	
Patents, franchises and good-will		2,000,000	
			5,400,002
Total			$32,951,017
Liabilities—			
Five per cent gold coupon debentures		$1,534,000	
Accrued interest on debentures		12,783	
Accounts payable		820,450	
Unclaimed dividends		3,750	
			$2,370,983
Capital stock—			
Seven per cent cumulative preferred		$2,551,200	
Common		21,400,300	
			23,951,500
Surplus			6,628,534
Total			$32,951,017

The consolidated profit and loss account as of Jan. 31, 1901, shows:

Payments—		
Cost of sales		$23,585,860
Interest on debentures		240,040
Dividends paid—		
On preferred stock	$178,584	
On common stock	1,549,665	
		1,728,249
Surplus at commencement of year	$2,353,031	
Undivided earnings during the year now added to surplus	4,275,503	
Balance Jan. 31, 1901 (surplus)		6,628,534
Total		$32,182,683
Earnings—		
Balance Jan. 31, 1901 (surplus)		$2,353,031
Sales	$28,783,276	
Royalties and sundry profits	298,366	
		29,081,642
Dividends and interest received on stocks and bonds owned	$232,041	
Interest and discount	96,902	
		328,943
Profit on sales of stocks and bonds		419,067
Total		$32,182,683

The balance sheet shows that the company's cash on hand in excess of all liabilities, securities, real estate other than plants, notes and accounts receivable, work in progress and merchandise are $1,225,000 in excess of the capital stock outstanding. The company has no notes payable nor is there under discount any paper bearing the company's indorsement or guarantee. Since January, 1895, the company has not borrowed any money, nor at any time since that date has its credit been used either by issuing notes, indorsing customers' paper for discount or lending its name in any way; but by adhering to its established policy of maintaining sales on a basis of cash or short credit to desirable customers, all purchases have been paid for in cash. On Jan. 31, 1900, there were outstanding $5,300,000 debentures. There were purchased for cash (average price $1,270.83) during the year, $3,000, leaving $5,297,000. Surrendered and exchanged for common stock at $120, debentures at $100, $3,763,000, leaving debentures outstanding, $1,534,000.

CURRENT NEWS AND NOTES.

THE CUNARD COMPANY has, it is said, decided to install the Marconi wireless system of telegraphy on its steamers.

ISOLATED PLANTS IN BOSTON.—The Wire Department of Boston reports that at the end of last year there were 271 isolated plants in the city, in which there were 466 generators having an aggregate capacity of 18,205 kilowatts. These plants supply current to 714 motors, aggregating 6257 horse-power; to 193,091 incandescent lamps and 3297 arc lamps.

MR. G. MARCONI called upon the United States Navy Department in Washington last week and saw Secretary Long.

MORE FRENCH SUBMARINE BOATS.—The French Minister of Marine, M. de Lanessan, has ordered the construction of 20 additional submarine boats.

MINING LOCOMOTIVES.—It is stated that there are now more than 250 electric mining locomotives in regular operation in the State of Pennsylvania alone.

WIRELESS TELEGRAPHY IN CORSICA.—A recent Paris dispatch conveys the information that a system of wireless telegraphy has been established along the coast of Corsica for a distance of 124 miles. The masts used are 120 ft. high.

MR. ISAAC L. RICE, at the request of a large majority of the stockholders, has agreed to accept the presidency of the Consolidated Railway Lighting & Refrigerating Company, and John N. Abbott the position of vice-president and general manager.

NEW YORK ELECTRICAL SOCIETY.—The New York Electrical Society will hold its next meeting at Havemeyer Hall, Columbia University, Thursday, April 25, when Mr. C. F. Scott, chief electrician of the Westinghouse Electric & Manufacturing Company, will lecture on alternating-current motors.

LIGHTING ST. PETERS.—A special cable dispatch from Rome, speaking of Easter in the Eternal City, says: The newly installed electric lighting plant at St. Peter's was inaugurated this evening. The effect was most brilliant. There were 80,000 spectators present, including many tourists.

WIRELESS TELEGRAPHY IN HAWAII.—The steamer Upolu, a small interisland vessel, was reported recently on the reef at Puku, Hawaii. The news was sent to Honolulu by wireless telegraph from Maukona, which would imply that the system is now in regular working order in the Sandwich Islands.

CHICAGO TICKER SERVICE.—The contract between the Chicago Board of Trade, the Western Union and the Postal Telegraph companies provides that these two companies and the Cleveland Telegraph Company shall receive the quotations simultaneously by means of one Morse instrument on the floor of the exchange. The sum paid by the telegraph companies jointly for the quotations is $30,000 a year. The contract runs for one year and provides for the termination thereafter upon 60 days' notice by either party.

THE GROWTH OF THE TELEPHONE.—General Sabin, president of the Pacific States Telephone Company, which company holds the records for Bell telephone progress, wires as follows: "We will close March with 24,000 central stations in San Francisco, making a net gain of over 1500 for the month, in addition to which we have 500 unfilled orders. This telephone business needs, first, general consolidation, general enthusiasm, fewer high-class blue prints and more common, every-day arithmetic, fewer wheel horses to hold back in the traces and more broncos to put in the lead. For your information, a bronco is a wild Mexican horse that it takes 14 men to hitch up, and when once started he never goes at a walk until he dies."

APPOINTMENTS IN UNITED STATES SIGNAL CORPS.—The following appointments have been made in the Signal Corps, regular army, subject to a physical examination: To be captains, Edward B. Ives, Eugene O. Frecht, Gustav W. S. Stevens, Daniel J. Carr, Leonard D. Wildman, Charles McK. Saltzman, Otto A. Nesmith, Carl F. Hartmann, Benjamin F. Montgomery, Charles B. Hapburn. To be first lieutenants, Frank E. Lyman, Jr., George C. Burnell, Henry W. Stamford, Basil O. Lenoir, Charles S. Wallace, William Mitchell, Walter L. Clark, George S. Gibbs, Richard O. Rikard, Henry S. Hathaway, Alfred T. Clifton, Charles B. Rogan, Charles de F. Chandler, Mack K. Cunningham.

THE CABLE TO MANILA.—A special dispatch from Washington says: The report from Manila that the cable ship Burnside is to continue to lay cables in the Philippines, connecting the islands with Manila, revives interest in the protest made by the Eastern Extension Company, which controls the cable from Hong Kong to Manila, against the laying of cables in the islands. This protest was considered by the State, War and Justice departments of this Government, and it was determined, after an opinion by the Attorney General, that the reservation which the Spanish Government made when it granted to the Eastern Extension Company exclusive rights in cable construction allowed the United States Government to continue its cable construction. This reservation provided that the Spanish Government could lay cable for State purposes. As the cable being laid by the War Department was for the use of the military authorities in governing the islands it was the opinion that it meant the same as "State purposes" in the Spanish concession. The cable company concession was granted just before the American-Spanish war, and runs for 40 years.

FREQUENCY OR SPEED INDICATOR.—An instrument for indicating the speed of an electrical generator or the frequency of an alternating current, is the subject of a patent issued April 9 to R. D. Mershon. A voltmeter has its terminals connected to the terminals of a choke coil placed across the working circuit. The core of the choke coil has such a section that the iron will be worked at some point above saturation. In series with the choke coil is a resistance of such value that the drop between its terminals relative to that between the terminals of the choke coil is so great that the former substantially governs the amount of current which shall flow through the indicator circuit. In the case of a constant voltage the amount of current flowing through the choke coil and ohmic resistancies will be substantially constant, and the voltage across the terminals will vary approximately as the frequency of the current passing through it and, therefore, approximately as the speed of the generator; consequently, the voltmeter may be calibrated to indicate approximately the frequency or speed. To secure a still more accurate indication there may be included in series with the resistance the primary winding of a small transformer, the iron of which is worked not above, but below, saturation. The secondary coil of this transformer is so connected with one terminal of the choke coil and with one terminal of the voltmeter as to oppose the voltage which the voltmeter receives from the choke coil. This transformed voltage serves to change the voltage at the terminals of the voltmeter in such a manner that a curve thereof will approximate very closely to a straight line substantially parallel to the co-ordinate axis of current. It therefore follows that any variation in the voltage of the generator will produce substantially no effect upon the voltmeter, which will be influenced only by changes in frequency and speed.

MAINTAINING IN SYNCHRONISM ALTERNATORS IN PARALLEL.—It has been found in practice that when two or more alternators are driven by independent engines there is a tendency for the machines to get out of synchronism, particularly if the generators are of large size. To counteract this tendency C. I. Young, in a patent issued April 9, proposes to employ a combination of centrifugal and inertia governors in such manner that the former will tend to maintain the speed of its engine uniform without regard to the other units, and the latter will control variations from synchronism in speed. The first mentioned governor may be of the usual type which acts to shift the engine eccentric and thereby vary the valve lead. The eccentric strap connects to one arm of a bell crank, the other arm of which has a curved slot in which is mounted the pin of a connecting rod giving motion to the valve stem. On the shaft of the engine is also mounted an inertia governor, which acts upon a link, the outer end of the link being pivoted to the valve connecting rod. Assuming that there are two engines and two generators, if the machines start to go out of synchronism there is a succession of jerks forward on the slow machine and a corresponding succession of jerks backward on the faster machine. Now, the constant jerk forward on the slower machine will cause the weight of the inertia governor to act, the result of which will be to raise the valve connecting rod pin in the curved slot, thus increasing the lead of the valve motion and speeding up the engine. On the other hand, the jerk backward on the fast machine will through its governing means act oppositely on the valve rod of its engine, and thus decrease the lead of the valve motion and reduce the speed of the engine. As soon as the jerks stop, the inertia governors tend to move back to the former position slowly on account of the dashpots, and the main work of regulation is then taken care of by the centrifugal governors.

MR. THOMAS A. EDISON informs us, with regard to the cadmium-copper Edison storage battery illustrated and described recently in these pages, that his complete work in this direction, dealing with its latest developments, will be described by Dr. A. E. Kennelly before the American Institute of Electrical Engineers.

LONDON UNDERGROUND.—A cable dispatch from London of April 13 says: The *Globe* states that the deadlock between the Metropolitan and District Underground railways has been ended, and a contract for the introduction of electricity as motive power has just been signed. It is stated also that uniform fares will be introduced.

CALCUTTA DWELLINGS.—According to a report from Mr. F. R. Patterson, United States Consul-General, the situation in Calcutta demands either the creation of suburbs to be reached by trolley or the erection of modern roomy apartment buildings with American electric fans and elevators, and "all improvements," such as are known in New York.

GERMAN SUBMARINE BOAT.—A cable dispatch from Berlin of April 13 says: The German authorities have been making extensive trials and experiments since March 1 near Lindau, on Lake Constance, with a new type of submarine torpedo boat. The inventor, who is a civil engineer named Gurt, of the Navy Department, preserves silence concerning the result of the experiments, but it has been ascertained that the tests have so far been successful. The boat dives for a short time to a depth of 300 ft.

THE PARIS UNDERGROUND.—The *Figaro* asserts that the Metropolitan Railway has beaten the world's record for the number of passengers carried on any line. From Jan. 1 to March 31 it transported 11,315,700 persons, which, at the same rate for a year, would give a total of 32,000,000, an average of 4,000,000 per kilometer. It carried on Easter Sunday 182,216 passengers, which number was double the biggest day's total during the Exposition.

"INSURANCE ENGINEERING."—This is the title of a new monthly publication issued by the Insurance Press from its offices at 120 Liberty Street, New York City. It bids fair to be a very interesting and useful publication if the first number be taken as a criterion. It contains several valuable articles dealing with subjects of importance from the insurance standpoint, and discussing in each case the engineering features as related to the fire risk and casualty. As might be expected, there are articles dealing with the electrical side of the question, and these are written quietly and temperately, as befits the subject. In the overcrowded field of technical journalism it might seem difficult to strike out a new path, but *Insurance Engineering* may be said, with proper phrase, to have "blazed" one for itself. and we shall be glad to note our new contemporary's success. The editor is Mr. Harry D. Gue.

LETTER TO THE EDITORS.

The Development of Lighting Fixtures.

To the Editors of Electrical World and Engineer:

Sirs:—Although nearly all the veterans of the electric light and power industries have had something to say in the technical press relative to the early days of those useful arts, I have not seen anything on the subject of lighting fixtures, a business which has grown like Jonah's gourd. The output for last year was somewhat more than $2,000,000. In 1882, according to a set of tables, which have been gathered with care, the total output was not much more than $10,000. I can well remember that during the year when the first incandescent lighting plant was planned for New York, two gentlemen, now among the most prominent expert electrical engineers in the country, called upon me for the purpose of obtaining estimates for a few brackets and chandeliers for a downtown banking office. The estimate was accepted, and the goods ordered, and then trouble began for me. My uncle, who was the head of the firm, gave me "the rounds of the kitchen" in vigorous style and denounced the electric light as "a miserable circus humbug, that would never amount to anything." He ended by issuing positive orders that the next inquirers for electric light fixtures were to be most politely and firmly informed that our facilities were overtaxed for gas goods. As ill luck would have it, for me, the next man who turned up was a very warm friend who is now the head of a large corporation in Philadelphia. He, too, wanted some brackets, and I broke the rule and took the order. I made a blunder in the factory order for wiring, and as the goods were not suitable for the purpose for which they were ordered, my uncle "paid me off," as he said, by charging up the bill to my account. For six months thereafter all inquirers for electric fixtures were cordially told to go elsewhere.

During the next year the demand for fixtures began to mean something. I asked for 20 square feet of space for an electric fixture showroom, but was voted down at the directors' meeting. Other makers of gas fixtures were like minded with us, and refused to make electric goods. By 1886 we all began to see that electricity had "come to stay," and that it is was high time for us to wake out of sleep and go in for the good time a-coming. Still, we looked on the electric side of the business as a poor thing. For the gas showrooms we had velvet carpets, decorated walls and richly upholstered sofas and chairs. For the electric room we thought bare floors and painted walls good enough. Customers for gas goods were treated to 20-cent cigars and luncheon at Delmonico's. The electric fellows were treated to 10-cent straight cigars and a snack at the first lunchroom in sight. From time to time, we asked the opinions of the "gas barons" about electricity, and they told us that the electric light was merely a creature of speculators, and that it would never amount to much, except in shops and theaters. Most of the high-class architects for fine houses were then of the same way of thinking.

Finally, a day came when the late Richard Morris Hunt came into our place and said: "I want you to go to Newport to-morrow night and note down my ideas for electric fixtures for so-and-so's house." In three days we booked that order for $15,000. That set things a booming for fine electric fixtures. I spent the whole season with multi-millionaires who were bound to put in the electric light, and at the end of the season we put velvet carpets on our electric light fixture sample rooms, and fitted it up equal to the gas fixture rooms. So with our competitors. All embarked in the fixture business, until the business was overdone.

Fortunately, the business was started on right lines for the development of art in electric fixtures. Alexandre Sandier, then decorative artist for the architects of the William H. Vanderbilt mansion in Fifth Avenue, and now head of the Sevres National Porcelain Works, Paris, and Mr. Charles B. Atwood, afterward the architect of the Fine Arts Building at the Columbian Exposition at Chicago, made a number of magnificent designs for electroliers which set the form for fine electric fixtures in all countries. At that time, there were very few gentlemen in the electric light companies who knew how much money should be spent for fixtures by a man of large fortune. I remember that the late Frederick L. Ames, of Boston, sent to a local electrician to make an estimate for wiring and supplying fixtures for his palatial mansion, which was and is as fine as the finest mansion in Europe. My friend, the electrician, estimated the fixtures at $5,000. "Why," said I. "my dear boy, for a mansion of that sort $5,000 is very small for the lower floors." We finally put in more than $10,000 worth. I remember another case in New Orleans where an electrician figured on $250 for the entire house of a millionaire, where, after the owner had seen my drawings by Mr. Atwood, he paid $5,000 for the fixtures alone.

As the electricians were mostly bright young men of good mental attainments, it did not take them long to learn the fine art points of the fixture business, and by 1888, there were few electricians in the country who were not able to talk eloquently on the Louis XIV., Italian Renaissance, Empire and Adams schools of art in metal. More than this, a number of our leading electricians who are fertile in ideas have developed a school of art in fixtures which, while it has no name, is well recognized abroad as an example of the talent of Young America in dealing with new problems in the art world. I remember a hint dropped by a Boston customer for fine fixtures which led to many new ideas in fixtures. I took him to see a number of remarkably good things of the day—the Henri IV. banquet hall at the Plaza Hotel by Mr. Samuel Insull's company; the Empire Hotel, by Mr. Edward Caldwell, etc. After he had seen all these things he said: "You have shown me a lot of things called after men who have been dead for centuries, now show me something that is really American. I don't care a cuss for Henry IV. or Louis XIV. or Napoleon." To get at something really American, I took him over to see Mr. Meadowcroft, and the other gentlemen of the General Electric Lamp Works. He saw plenty of American ideas there, and placed his order.

When the work was put up I am sure it was the only genuinely American designed example of electric fixtures in the world. The effects made a sensation. All Boston wondered and came and saw. For months the owner stood a delighted spectator, and whenever I turned up he usually said: "I wonder what your back-number friends, Henry IV., Louis XIV. and old Napoleon, would say if they could rise up and see this outfit of fixtures." The good fellow has been long, I hope, in a better world than this. He certainly gave the spark to a thought that blazed into a school of decorative art in electric lighting which is daily growing more and more in favor, and is departing from the conventional forms of gas fixtures which once dominated the electric fixture field.

Newark, N. J. P. W. George.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Repairing a Generator Commutator.—Weeks.—An illustrated article giving directions on repairing and reconnecting a generator commutator.—*Amer. Elec.*, April.

Induction Motor Armature.—An explanatory article with diagrams showing the action of an induction motor armature or rotor, and giving formulæ for calculating the e. m. f., torque and frequency.—*Amer. Elec.*, April.

POWER.

Electrically-Driven Machine Tools.—A description of machine tools devised by Kodolitsche, the director of the Lloyd Arsenal in Austra. His boring drills are all modifications of a single type. An electric motor is mounted upon a revolvable vertical bearing, which is supported on a horizontal axis. Motion is transmitted from the motor to the working tool by means of a telescopic shaft universally jointed to permit of the tool being turned in any desired direction the tool itself may be fastened to the work by ordinary clamps or magnetically attached to the work by means of electromagnets. His riveting machines are constructed as follows: The driving electric motor carries an electromagnet around in its revolutions, and when current passes through this movable magnet it engages a metallic mass, which is placed in front of the electromagnet and by means of a screw provided with a traveling nut, the movement of this metallic mass results in operating the movable header of the riveter. At the precise moment when the contact with the rivet should take place the electromagnetic contact is automatically released, but the accumulated operative energy in the metallic mass is translated into a pressure upon the head of the riveter capable of producing the desired head on the rivet, whereupon the movable parts automatically replace themselves and the machine is ready to operate upon the next rivet.—*L'Etincelle Elec.; El'ty*, April 3.

Packing-House Power Equipment.—An illustrated article on the alternating-current power equipment of some packing houses. All the various factories are supplied from one central station. One of the stations supersedes 11 isolated steam plants formerly used to generate power for the 48-acre packing plant. Arc and incandescent lamps and induction motors are all supplied from a common generating source.—*Amer. Elec.*, April.

Electric Installation of a Glass Manufacturing Plant.—Farnham.—An illustrated description of the power plant of the Edward Ford Plate Glass Company, of Toledo, Ohio. All of the machinery for grinding and polishing the glass, and all the smaller auxiliary machinery is driven by electric motors. The power plant has a capacity of 5200 horse-power. In all there are 83 motors with an aggregate horse-power of 7043, 59 of these, including 18 of 200 horse-power each, and 24 of 100 horse-power each, and aggregating 6754 horse-power altogether, are of the three-phase induction type, and designed for a current of 580 volts, with a frequency of 80. The remaining 24 motors, with an aggregate horse-power of 289, use direct current at 120 volts; 15 of these are special crane motors.—*The Eng.*, April 1.

Speed Regulations of Electric Motors.—Wheeler.—A brief article in which he says that "the electric motor's regulation and control are the most valuable of all its good attributes. It is unique and remarkable in the accuracy, scope and adjustability of its regulation. It maintains a speed which is nearly constant, and is not deranged by great overloads. It may be adjusted to run with a constancy of speed within any limit of precision,and its action swings about this fixed speed as a center, its activity increasing as a motor if it is slowed down by heavy load and becoming that of a dynamo and reversing the demand for current if speeded up by the application of extra power. It achieves this remarkable regulation when made in the simplest form, and without any governor, valve or other apparatus."—*Cassier's Mag.*, April.

Diesel Engine.—Some editorial notes on the exhibition of the first Diesel engine, made in England. "The essence of the Diesel internal combustion engine is the Diesel cycle, and the essence of this cycle is—high compression. Everything else about the engine—whether in its Continental four-stroke or in its more recent Brtish two-stroke arrangement—is incidental to the realization of this high compression in an actual gas or oil engine."—Lond. *Elec.*, March 29.

REFERENCES.

Fan Motors.—A profusely illustrated article on the different fan motors for the year, with details of their construction.—*Amer. Elec.*, April.

Direct-Current Fan Motor.—An illustrated article with working drawings and directions for the construction of a direct-current fan motor.—*Amer. Elec.*, April.

Polyphase Sub-Station Machinery.—Eborall.—The first part of a Brit. Inst. Elec. Eng. paper, in which he gives "Some notes on polyphase sub-station machinery." In this part he deals with the general ideas underlying the equipment and operation of sub-stations for lighting or traction. He discusses at great length the use of asynchronous motor generators, synchronous motor generators and rotary converters.—Lond. *Elec.*, March 29.

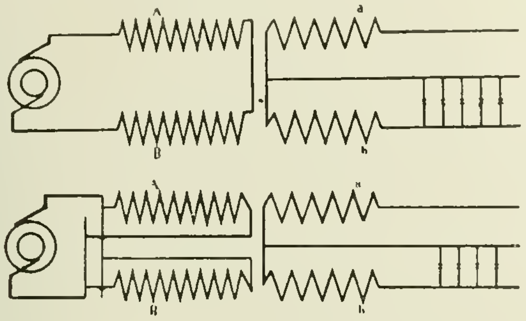
Drilling Machine.—An illustrated description of a new electrically-driven portable machine, made by a British firm, for drilling holes up to 2½ inches in diameter.—Lond. *Elec.*, March 29.

Steam Engine Efficiency.—Nagle.—A letter defending the use of the Mariotte expansion curve as a basis for comparison in determining the efficiency of an engine.—*Amer. Elec.*, April.

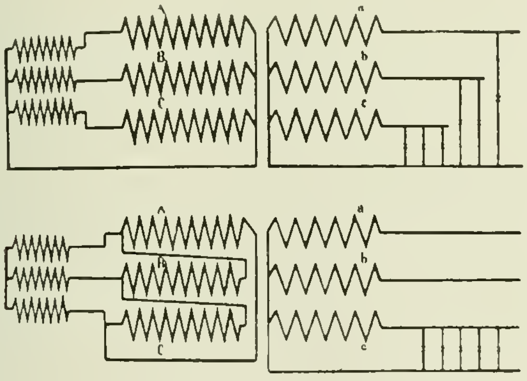
Water of Condensation.—Obert.—An illustrated article on the cause and dangers attached to water of condensation, together with methods of preventing its accumulation and withdrawing it.—*Amer. Elec.*, April.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Transformer Connections.—Dolivo-Dobrowolski.—A paper read before the Electrotechnical Society, of Berlin. In single-phase and three-phase systems, in which relatively few consumers on large areas are to be supplied with light, and in which one does not want to use too many small transformers, it is often desired to use a system similar to the three-wire direct-current system. This leads to the use of so-called "neutral" conductors. In the three-wire single-phase system there are some difficulties in the transformer connections. If there are two cores and the connections are made as in Fig. 1, a great difference of voltage occurs when the loads on the two halves of the system are unequal. For instance, if the load on coil *b* is greater, the current in the high-tension coil *B* ought to be larger also, but this current cannot be obtained in sufficient amount, as it would also flow through the coil *A*, which, however, has only a light load, hence we get an entirely unsymmetrical distribution of the magnetizing and demagnetizing forces, therefore also unsymmetrical straying. The result is that the voltage in *b* decreases and that in *a* increases. The differences of voltage if only one side is fully loaded, may attain 50 per cent or more. He recommends the following simple and interesting remedy, which he has used in installations of the Gen. Elec. Company, of Berlin. He calculates both high-tension coils for the full high-tension voltage, and connects them in parallel, as shown in Fig. 2. The load in the halves *a* and *b* may be entirely different, but the voltage drop is the same whether the load is only on one-half, or is symmetrical. He has found this to be correct in practice. A somewhat analogous arrangement can be used for three-phase currents. The system shown in Fig. 3, in which the lamps are connected between the three phases and the neutral wire, is well known, but it has generally been used only for low-voltage installations. For those of high voltage, with transformers, the consideration of the balance of the voltage required one to use a neutral wire, starting from the central station. This was a very great disadvantage. He shows that it is not necessary to let the neutral wire start from the central station. His arrangement is very similar to that for single-phase systems, described above, and is shown for three-phase systems in Fig. 4. This arrangement has been used by his company for 1½ years with good success. For all practical purposes it is sufficient to make the neutral wire half as thick as the outers, just as in the direct-current system. A transformer connection, in which one side has star connection, the other ring connection, is called by him a "fixed" connection, while one in which both sides are connected either in star or in ring, is called a "normal" connection. It is said to be necessary to use different names, as a transformer with mixed connection cannot work in parallel with a transformer with normal connection. Transformers with mixed connection can be connected in parallel among themselves, also transformers with normal connection among themselves. His company paints the transformers with normal connection with a different color than the transformers with mixed connections.—*Elek. Zeit.*, March 21.



FIGS. 1 AND 2.—TRANSFORMER CONNECTIONS.



FIGS. 3 AND 4.—TRANSFORMER CONNECTIONS.

REFERENCES.

Diagrams of Electrical Connections.—Diagrams showing the connections for storage batteries with modified compound and differential boosters.—*Amer. Elec.*, April.

Pan-American Exposition.—An illustrated article describing the fountains to be used and the method of their illumination, together with the general lighting plan to be carried out at the Pan-American Exposition at Buffalo.—*Amer. Elec.*, April.

Wires, Wiring and Conduits.

REFERENCE.

Interior Wiring.—Knox.—An article with plan drawings devoted to the consideration of the characteristic features of the electric light wiring of a modern hotel.—*Amer. Elec.*, April.

Electro-Physics and Magnetism.

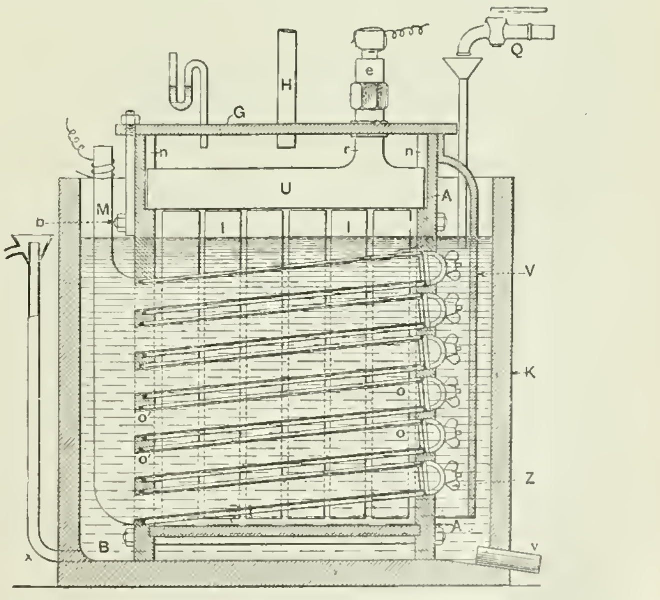
Distribution of Current Over Two Cathodes.—Wehnelt.—In exhausting cylindrical vacuum tubes containing circular cathodes nearly filling up the cross-section, the observation has been made that the cathode and canal rays which at high pressures fill up the whole tube, are gradually driven away from the walls until nothing remains but a thin pencil or rays along the axis of the tube. "This observation suggested to A. Wehnelt that a considerable diversity should exist in the current intensity traversing different parts of the same cathode, and to find whether this was the case he constructed composite cathodes consisting of a central plate and a guard ring round it. He found that in such cathodes the current only flows through the parts covered with visible rays. In the case of oscillating currents, it even happens that he guard-ring acts as an anode, while the central plate acts as a cathode. The cathode rays only proceed from those parts of a cathode from which luminous rays proceed also. When concave electrodes are used, the current density is the same on the inner and the outer surface. If two cathodes of equal area are contained in the same tube, the current flows mainly through the cathode, showing the least drop of potential. Impurities have a great disturbing effect, but unevenness of the cathode only at high pressures."—*Phys. Zeit.*, March 2; abstracted in Lond. *Elec.*, March 29.

REFERENCE.

Electromagnets and Solenoids.—An article with diagrams and tables giving the lifting power of magnets at different pole-face densities, together with a discussion on the various forms of solenoids. —*Amer. Elec.*, April.

Electro-Chemistry and Batteries.

Alkali Process.—Kershaw.—An illustrated description of the Outhenin-Chalandre electrolytic alkali process. It is for the production of alkalies and chlorine compounds by the electrolysis of solutions of sodium or potassium chloride, and belongs to the diaphragm class. It is in actual operation in Switzerland and France. The adjoining figure is a sectional elevation of the cell. It "consists of an outer vessel *K*, and of an inner vessel *A*, entirely closed and built of materials unacted upon by chlorine gas or its compounds. This inner vessel is filled with rows of porous-diaphragm tubes *o o*, open at each end to the outer chamber *K*, of the cell, and inclined at a slight angle, as shown in the figure. Each tube is hermetically sealed into the walls of the chamber *A* by a special device shown at *Z*, and contains an iron sheet cathode running the whole length of its interior. These sheet cathodes are joined to a common terminal at *M*, and each vertical row of diaphragm tubes is thus served with current by the one electrical



SECTIONAL VIEW OF CELL.

contact to the main supply. The anodes *I* are round rods of specially prepared carbon, fixed into the common lead head-piece *U*, and communicating at *e* with the negative terminal of the dynamo. They hang vertically in rows of seven between the rows of diaphragm tubes, and the chlorine evolved at their surface collects in the upper portion of the anode chamber, and is carried away by the outlet pipe *H*. The right-hand side of the inner cell is provided with a sheet-iron movable hood *V*, and outlet pipe not shown in the figure. This serves to collect and carry away the hydrogen liberated within the diaphragm tubes and facilitates its utilization for other purposes. The cell is operated in the following manner: The inner chamber *A* is nearly filled with a concentrated solution of sodium chloride, and the outer vessel with a dilute solution of sodium hydrate. The electrical connections are then made. The chlorine gas liberated within the chamber *A* passes off by the pipe *H*, and is used for the manufacture of bleaching powder or for some other purpose. The sodium liberated at the surface of the sheet-iron cathodes decomposes the water present, yielding hydrogen gas and a solution of sodium hydrate. The first travels up the tubes and escapes into the collecting chamber *V*, whence it passes to a gasholder for storage until required. The solution of sodium hydrate, owing to its higher specific gravity than the surrounding solution, travels down the tubes, and collects on the bottom of the outer chamber of the cell. Since the cell design permits the hydrogen to pass away with a minimum disturbance of the electrolyte in this outer chamber, fairly concentrated solutions of sodium hydrate can be obtained, and when required are run off by the outlet pipe *v*." The advantages of this cell are complete separation of the electrolyte in the anodic and cathodic compartments of the cell, and collection and utilization of the hydrogen liberated at the cathodes. The disadvantages are the high e. m. f. due to the diaphragm, and a very complicated structure. That the cell has been operating in the Swiss plant since 1899 with satisfactory results is proof that under certain conditons the advantages outweigh the disadvantages. A modification of the process is described, in which the liberation of oxygen and oxygen compounds with the chlorine at the anode is suppressed.—Lond. *Elec.*, March 29.

Aluminum Electrode.—BARTORELLI.—An investigation of the fact that an aluminum electrode in a voltmeter allows a much stronger current to pass when it acts as a cathode than when it acts as an anode. It is not yet certain whether this is due to a layer of silica or of aluminum oxide. His researches do not decide this question but give valuable information concerning the polarization and the internal resistance of the voltameter in terms of the current traversing it.—*Nuovo Cimento*, Feb.; abstracted in Lond. *Elec.*, March 29.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephonic Transmission.—WIEN.—If human speech is to be transmitted with complete clearness and distinctness, every constituent frequency must be reduced (attenuated) in the same proportion, if at all. "That the telephone does not do this is due to the fact that the effective resistance increases with the frequency, while the magnetic induction decreases. This has a serious effect upon distinctness, especially as the frequency of the constituent sounds of human speech vary between such wide limits as 16 and 10,000 vibrations per second. Another complication is introduced by the natural period of the telephone disk. According to Max Wien, a Bell telephone reinforces the notes of 1100, 2800 and 6500 vibrations per second, and several higher pitches as well. A Siemens telephone has two successive maxima at 5000 and 5400. The most characteristic notes of the human voice lie between 500 and 3000, and for these notes the telephones of Bell, Apel and Siemens are equally sensitive. For higher notes, the sensitiveness often shows remarkable differences. Thus a modern Siemens and Halske telephone will transmit the note 4000 nearly 100 times as loudly as a Bell telephone. The author used an alternate-current siren for these investigation." —*Ann der Physik*, No. 3; abstracted in Lond. *Elec.*, March 29.

Wireless Telegraphy.—GUARINI.—A brief communication on his experiments, noticed before in the Digest. He found "that the employment of alternating currents is preferable to the employment of Hertzian currents." There is also a brief note on a letter from Poncelet, who considers that the object of Guarini's experiments was actually attained, as signals transmitted from Brussels were successfully received at the repeater station and retransmitted by the apparatus to Antwerp. During the last days of the experiments the only failures occurred in the receiving part of the repeater.—Lond. *Elec.*, March 29.

REFERENCE.

Common Battery Telephone Switchboard Systems.—HENRY.—An article on common battery telephone switchboard systems, with diagrams of connections.—*Amer. Elec.*, April.

TRACTION.

The Ganz System in London.—An editorial commenting on the proposed equipment by Ganz & Co. of the present steam underground railway in London with alternating-current motors. The contract has not yet been awarded. The bid was said to be $1,000,000 lower than that proposed by American manufacturers, all of whom bid on direct-current motors, with rotary converters. The writer refers to the successful results, which are said to have been secured on small roads with alternating-current motors, and welcomes the introduction of the system on such a large scale as in London. If the results are satisfactory, it will mean quite a change in existing methods, while if unsatisfactory, the fact will be clearly determined. There seems to be no difficulty in taking current from working conductors at very high voltages or of winding induction motors for several thousand volts. This makes the polyphase system preferable so far as the cost of conductors is concerned. There are a number of problems yet to be worked out as regards the speed control of motors, but it should be remembered that the present series parallel system of controlling direct-current motors was originally very crude and was only brought to its present perfection by many years of careful and persistent work. One cannot be justified, therefore, in predicting failure for the proposed method of controlling the speed of polyphase motors. Other problems may arise, but can only be determined by actual experiment.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Electric Traction for Heavy Railroad Service.—BURCH.—A paper read before the Northwestern Railway Club. The writer quotes tests of tractive coefficients of the Baltimore & Ohio electric locomotives as showing 30.8 per cent as against 20.6 per cent for steam locomotives under the same conditions. A reduction in weight of 50 per cent of the electric locomotive over the steam locomotive can be made to secure the same service. The statistics of all the steam roads in the United States show the following operating expenses: For repairs of roadway, 10.72 per cent; for repairs and renewals of locomotives, 6.2 per cent; for water of locomotives, 0.62 per cent; for engine and roundhouse men, 9.69 per cent; for fuel for locomotives, 9.45 per cent. The first item will be largely reduced by electric locomotives, as the driving wheels are perfectly balanced. The second item will be reduced from 60 to 75 per cent by the use of electric locomotives. The third item will disappear entirely and a large reduction will be made in the fourth item. The writer then discusses the fifth item at considerable length, and concludes that here a saving of 65 per cent in coal used per horse-power generated, or 53 per cent in horse-power used for traction will be secured. In the discussion some figures as to the amount of coal used by steam locomotives showed it to vary from 900 lbs. to 1300 lbs. per 10,000-ton miles for freight service and 1500 lbs. to 2200 lbs. for passenger service. The locomotive under various severe service evaporates from 5¾ kg. to 8 kg. of water per kg. of coal.—*St. R'y Jour.*, March 9 and 30, and Int. Ed., April.

Electric Railways.—CARDEW.—An abstract of the last of his three Cantor lectures. He arrived at the conclusion that for the case of railway work on an extensive scale and necessitating transmission of electrical energy to a distance, polyphase generation and distribution are to be preferred. The points in favor of it are the simplification of the sub-stations, the possible use of much higher pressures (3000 volts) for the motors on the train. The currents to be carried being less at this high pressure, the sub-stations could be further apart, and the rail return would be replaced by a copper strip on fairly insulating supports. These and other advantages, including the simplification of the motors and the possibility of suspending their rotors entirely on springs, quite counterbalanced the advantages of direct current, such as the saving of one conductor, the reduction of plant capacity, by the use of storage batteries, the absence of idle currents, estimated as amounting to a waste of 15 per cent in polyphase working, and the wider permissible variations in speed. He gave the general design of an electric railway line extending 50 miles, with a large load traffic at one end and a small local traffic at the other. He explained an ingenious time table, in which slow trains traversing sections of the main line between the times of the half-hour express trains, resulted in an almost ideally quick and frequent service between all points.—Lond. *Elec.*, March 29.

New Method of Rating Street Railway Motors.—AMRSTRONG.—The writer first advocates the rating of motors by tests of actual operating conditions rather than under continuous loads. He then considers the current required to give different speeds, and shows some acceleration curves. The losses in watts in different parts of the motor are shown. In these the watt losses in the field are the same as those in the armature when the runs are very short. To properly rate a motor it is necessary to know the degrees of temperature rise per watt loss in the field and the armature, and these data are of value only when they are obtained under the conditions of ventilation found in practical operation. Thus, with the motor stationary while it is tested, the ratio of the heat produced in the armature to that of the field would be much greater than when the armature was ventilated by contact with a current of air, as when in service. The writer then criticizes the position taken by Storer in an article on motor rating in the January issue of that journal, and states that under different conditions of speed and operation, different ratings would be given to the same motor by the Storer method. In other words, he recommends that speed should always be considered.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Electric Railway at Georgetown, British Guiana.—The site of this town is on soft, blue clay, with only about 4 inches of hard surface, mostly the macadam of the streets. This makes it very difficult to construct foundations for heavy buildings and machinery such as are required in electric railway operation, and even the setting of poles is a difficult matter. The line in the town has recently been built by a Canadian syndicate, and as the telephone system in the city was owned by the Government, a number of difficulties were encountered. The telephone wires all had to be raised to clear the trolley wires, and fuses were required on each subscriber's line and at the exchange. The guard wires for the trolley system had to be earthed wherever the trolley wire passed the telephone wires. The company also supplies electric lighting, and for its railway equipment has one 200-kw and one 100-kw generator. The foundations are of concrete, and are carried down to a depth of about 5 ft., and the base of the foundations is extremely broad. In setting the poles a cone-shaped hole was dug about 2½ ft. in diameter at the top, 3½ ft. in diameter at the base and 5 ft. deep. The poles were then set on wooden blocks about 3 inches thick and 20 inches square. Concrete was then packed around the poles. Even under these conditions the poles sometimes become loose, and this can only be overcome by frequent tamping and guying. There are about 10 miles of track. The road is laid with a 64-kg. T-rail on metal ties.—*St. R'y Jour.*, April.

Street Railway System of Naples, Italy.—C. PIO.—There are only two short electric lines in Naples which have been in use for any length of time, the first section of the main line having been put in operation only on March 2 this year. Nearly all the lines are owned by one company, the power station of which has not yet been completed so that power is being bought from electric lighting companies. The feeders are laid underground. The two short lines first mentioned have an aggregate length of about 12 km. and a maximum grade of 7.9 per cent. The new power station will contain three horizontal compound condensing tandem engines, each directly connected to a 600-kw generator, and three smaller units, also four direct boosters and five converted boosters.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Michigan Traction Company.—This consists of two city systems, each with about 20 km. of track, and a line connecting the two cities about 44 km. in length. The latter line uses two trolley wires to avoid overhead switches, and a telephone signal system. Each car has a telephone which can be connected by plugs on every fifth pole, and in addition there are stationary telephones at each turn. The cars in the cities are about 18 ft. in length, and those on the interurban line about 45 ft. in length. Power is distributed from the three-phase system from a station about 22 miles distant from one city and 46 miles from the other city. This station has a capacity of 2800 horse-power. Power is distributed at 60 cycles, as considerable lighting is also done. The voltage on the transmission line is 25,000. Full particulars are given of the transmission line.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Philadelphia.—The Union Traction Company, of Philadelphia, has seven power stations, two of which are non-condensing and two use mechanical draft. A table shows the kilowatt output of these stations during 1900. The total is a little over 81,000,000 kilowatt hours. Another table shows the total number of men employed in the power stations. In addition to its power stations, the company has five storage battery stations connected to the main stations. Most of the stations are fitted with two positive bus-bars, one being at 550 volts and the other at about 675 volts. The switches of the outlying feeders can be connected to either the high or low-voltage bus-bars, as occasion requires. All the new cars of the company are now of the double truck type, with bodies 28 ft. long and all equipped with air brakes. The company has also installed some new track joints, which are shown.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Some Novelties on the New Haven Railway.—Some engravings show a tower car for construction purposes, in which the principal novel features is the fact that the tower is raised and lowered by hydraulic means. The hydraulic ram is located inside the car, and by it one man can easily raise the tower, even if there are three workmen on it. This allows the position of the tower to be changed while the men are working. Access to the roof is provided through a stairway in the car, and when the tower is down, the roof is no higher than that of an ordinary car, and the roof is also water tight. The maximum height to which platforms can be raised is 18 ft. The article also describes the method of testing motors, in which one motor is run as a generator and the other as a motor. The usual method is to mount the two motors in line and connect the pinions by a sleeve. Instead of this, the motors are mounted with the shafts parallel to each other 4 ft. apart, and are connected by a 5-inch wide belt running over pulleys 18 inches in diameter. The final engraving shows the method of dismounting motors. The bottom of the pit is provided with two tracks, one 18-inch gauge, the other 29-inch gauge. On the latter is an iron framed carriage, and on the former is a small hydraulic jack. To dismount the armature the carriage is run under the motor and the jack underneath the carriage. The lower field of the motor is then lowered by the jack and put at rest on the carriage, which is then slid out of the way and the jack is again run under the car to lower the armature.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Repair Shops.—A description of those of the Rhode Island Railway Company. They will contain a full equipment of electrically-driven tools distributed through a series of different departments which have a consecutive relation to each other. The cars are handled in the equipment department by a transfer table, and in the paintshop by a system of curves and switches. It is expected that the shops will be in operation by July 1.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Combined Trolley and Conduit Systems.—CONNETT.—A paper read before Inst. of Mechanical Engineers, of London. The writer first refers to the cities in which conduits are used and mentions Budapest, Berlin, Brussels and Paris as using the side-slot conduit, and Lyons, Nice, Bordeaux, New York and Washington as using the center-slot conduit. The chief trouble with the side slot is the switch, as shown. The slot here has to be made a certain width to accommodate the flange of the wheels, while with the center slot it can be made any width. The wheels also throw water and mud into the conduit and on the plow. The distance from the conductor bar to the bottom of the conduit, should be from 9 to 10 inches to allow room for water and dirt, but for short distances these clearances could be reduced to 4 inches. A shallow conduit used in Paris is shown, in which these clearances are 4 inches, and the total height is 17 inches. The switch is a critical feature of the entire construction. The construction of a switch for the center slot and for the side slot are shown. Where a mixed system is used arrangements must be made for disconnecting the plow from the car or raising it into the car. The writer discusses the relative advantages of these two methods and shows a method by which the slot is widened, so that the plow can be raised into the car. A cut shows the device on the car for this purpose. He then discusses the cost of conduit construction and gives the additional cost for a conduit road as between £4,500 and £5,600 per km. of track. He then gives some detailed figures from actual installations, and also some figures of estimated construction under different conditions.—*St. R'y Jour.*, April 6, and Int. Ed., April.

The New Conduit Proposed for Use in London.—A full description of the conduit which the London County Council has provisionally adopted for use in that city. The new conduit consists of a small yoke placed between the tracks, which rests upon a concrete bed. The traction rails are connected with the yoke by means of tie rods and rest upon a separate bed of concrete. The conductor rails are supported on brackets, which are fastened to insulators. These insulators are of the pedestal type, and are placed in recesses made in the concrete or cement. The yokes are made sufficiently rigid to hold the slot rails a fixed distance apart. An editorial is also published commenting at length upon the conduit.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Track Construction.—An illustration showing a type of joint used in Portland, Oregon, where electricity had replaced the cable. The cable yokes were 4 ft. 6 inches apart, and the rail was only 3 inches high, and weighed 36 lbs. per motor. As the company did not want to go to the expense of taking up its old cable conduit, and as a large rail could not be used in the yokes, the joint illustrated was designed. The rail supporting the joint is of the same size as the track rail, and is 40 inches long. Between it and the track rail are six cast-iron blocks ⅞ × 2 × 2¾ inches. The rails are held together by forged iron clips held by a ¾-inch bolt. The old fish plates are kept in place, and two of the steel clips are left short to allow for the fish plates. In the case of crossing, an I-beam 10½ inches high is carried under the joint and riveted to the base of the rail.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Automobiles vs. Tramways.—Adams.—An article on the possible competition in the future of electric automobiles with the present tramcars. In favor of the former are the low investment, flexibility of operation, and freedom from the street structures of the tramways. He finds that in the comparison of both systems there is an unbalanced advantage of transportation with battery vehicles, namely, a saving of about one-half of the entire first cost, and also of one-half of the annual interest charges of present tramcar systems.—*Cassier's Mag.*, April.

REFERENCES.

Third-Rail System Near Rome.—Engraving showing an insulator and third-rail to be employed for a line 26 km. in length between Rome and Frascati.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Power Station Figures at Trenton.—These figures give the power station expenses total and per car mile of the Trenton Street Railway Company. The station equipment consists of one 800-hp compound condensing, direct-connected unit, and two 400-hp belted engines of this same type. The average cost of coal delivered is $2.60 per ton.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Weak Fields and Grounded Armatures.—Berry.—An article on weak fields and grounded armatures, with directions showing how to guard against them in railway motors.—*Amer. Elec.*, April.

Notes from Germany.—The writer first gives a digest of the annual report of the Grosse Berliner Strassenbahn for the year 1900; then two tables showing the growth of the electric railway industry from 1891 to Sept. 1, 1900. He then refers to various accidents which have occurred in Vienna from the falling of telegraph and telephone wires on the trolley wire, in which several horses were killed, but no people were injured.—*St. R'y Jour.*, April 6, and Int. Ed., April.

How to Make Non-Paying Roads Pay.—Cooper.—A discussion of the collection of and registration of fares.—*St. R'y Jour.*, April 6, and Int. Ed., April.

MISCELLANEOUS.

Electricity in Agriculture.—A description of two electric plants for agricultural purposes in Austria and Hungary. The one is a 40-hp plant, in which three-phase current at 2000 volts is generated for transmission to different farms for power purposes and lighting. The other is a three-wire direct-current plant, water-power being utilized. In both cases the introduction of the electric service is said to have been a commercial success, as saving in the cost of operation and an increased output were obtained.—*Zeit. f. Elek.*, March 17.

Paris Exposition.—Feussner.—A paper read before the Elektrochemical Society, of Berlin, in which he gives a report on some instruments at the Paris Exposition. He discusses the rheograph of Abraham, which is an instrument for plotting the waveform of an alternating voltage, or of other quick electric phenomena by projected light curves, which may be used for photographs. He discussed at some length the advantages of the O'Keenan meter and gave an account of some tests of it made in the German Reichsanstalt. He also described Weissmann's experiments with incandescent lamps with thick carbon filaments for pressures of 12 and 22 volts. They were connected to the 110-volt circuit by means of transformers.—*Elek. Zeit.*, Feb. 28.

Reyval.—Long and well illustrated descriptions of machines, exhibited by the Societe Alsacienne de Constructions Mecaniques. A 750-kw and 200-kw direct-current dynamo, a 1340-kilovoltamp. three-phase alternator, and a 500-kw synchronous converter.—*L'Eclairage Elec.*, March 2.

Reyval.—A well illustrated description of two machines of Schuckert & Co., driven by the same steam engine. One is an 850-kilovoltamp three-phase alternator, the other a 900-kw direct-current dynamo; also an illustrated description of the Vulcain energy meter.—*L'Eclairage Elec.*, March 9.

Korda.—An illustrated article on three-phase machines of Ganz & Co.—*Elek. Zeit.*, March 14.

New Books.

BOOKS RECEIVED.

A Treatise on Electromagnetic Phenomena. By Commander T. A. Lyons, U. S. N. New York: John Wiley & Sons. 556 pages, 385 figures and plates. Price, $6.

The Principles and Practice of Linear Perspective. By Herman T. C. Kraus, C. E. New York: Norman W. Henley & Co. 53 pages, 11¼ by 15½ inches, and 14 plates of practical examples. Price, $2.50.

Saw-Filing and Management of Saws. By Robert Grimshaw, M. E. New edition, revised and enlarged. New York: Norman W. Henley & Co. 93 pages, 81 illustrations. Price, $1.

Reseaux Electriques. Nouvelle Methode Generale de Controle de l'Isolement et de Recherche des Defauts sur les Reseaux Electriques Pendant la Service. Par Paul Charpentier. Paris: Ch. Beranger. 23 pages, 6 illustrations. Price, 2.50 francs.

A Manual of Laboratory Physics. By H. M. Tory, M. A., and F. H. Pitcher, M. Sc. New York: John Wiley & Sons. 283 pages, 63 illustrations. Price, $2.

Electricity in a Modern Foundry.

A new building for foundry purposes was recently erected in Brooklyn, near the waterfront by the E. W. Bliss Company, the well-known manufacturers of punching presses and engines. It measures 100 by 200 ft., and is surmounted by a large skylight, which admits plenty of light and air in addition to that admitted through a large number of windows. Along the southern side of the building extends a gallery where the various machine and woodworking tools are located, as well as the pattern storage room. The moulding is done on the main floor and along the south side, in the center of the building are the two blast furnaces. In the southeast corner is the blower room, and in the cellar the engine and boiler rooms, as well as the coal bin and the storeroom for many tons of pig iron are located.

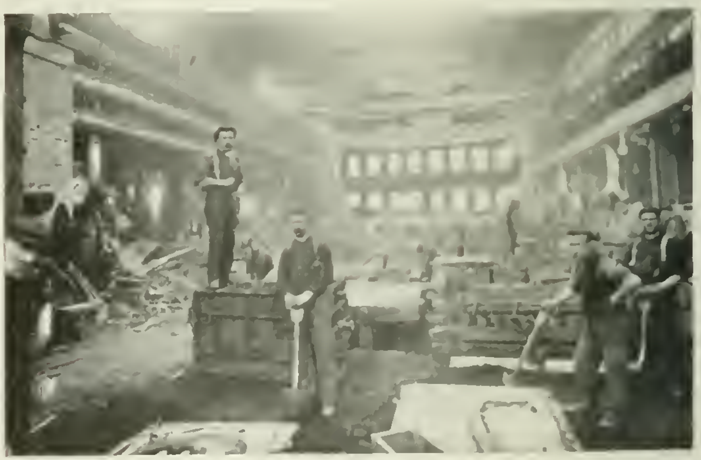


FIG. 1.—GENERAL VIEW OF FOUNDRY.

The plant affords a striking illustration of the advantages of using electric power in a foundry. Some idea of the extent of the plant may be gathered from the facts that about 150 men are constantly employed, that the plant is worked night and day, and that on an average of 20 tons of castings are turned out daily, the ultimate capacity of the plant being 50 tons.

As will be seen from Fig. 1, the foundry is equipped with two electric cranes, built by the Shaw Electric Crane Company, having a capacity of 30 tons and 10 tons, respectively. Mounted beneath the gallery at the southwest corner of the building, close to the office, is a 40-hp motor, which drives the machinery on the gallery floor and supplies power to the elevators which convey coal and iron to the furnaces. In the blower room, shown in Fig. 2, a 50-hp motor, attached to the ceiling, is belted to a Root blower, which supplies air for the blast furnaces. The motor was mounted on the ceiling, so as to be able to accommodate another similar outfit in the same room. There is in addition a 25-hp motor direct connected to a Sturtevant blower, which furnishes air for an indirect heating and ventilating system, hot air being supplied in winter and cold air in summer. This air is distributed by means of large galvanized iron pipes run along two sides of the building, which have a number of outlets radiating in different directions at every supporting pillar, as shown in the figure. There is a valve at each outlet, by means of which the amount of air is regulated.

The building is lighted by means of 40 Helios enclosed arc lamps, two being burned in series on a 220-volt circuit, which experience has shown ensures a short arc and in consequence a remarkably white light. There are, besides, 200 incandescent lamps distributed around the gallery, main floor and cellar. In connection with the use of these lamps a very ingenious device has been worked out by the engineer who has designed the entire equipment, Mr. E. R. Knowles, E. E. It consists of a plug outlet of special design attached to each pillar along the sides of the main floor. The workmen require lights while they chip the slugs and burrs from the castings as well as for the inspection of molds. For this purpose the lamps, which are surrounded by wire cages, are attached to long flexible cords having a plug at the other end. These may be inserted into any one of the numerous receptacles and a special wire hook on the latter prevents the workman from pulling the plug out of its socket while working around with the lamp.

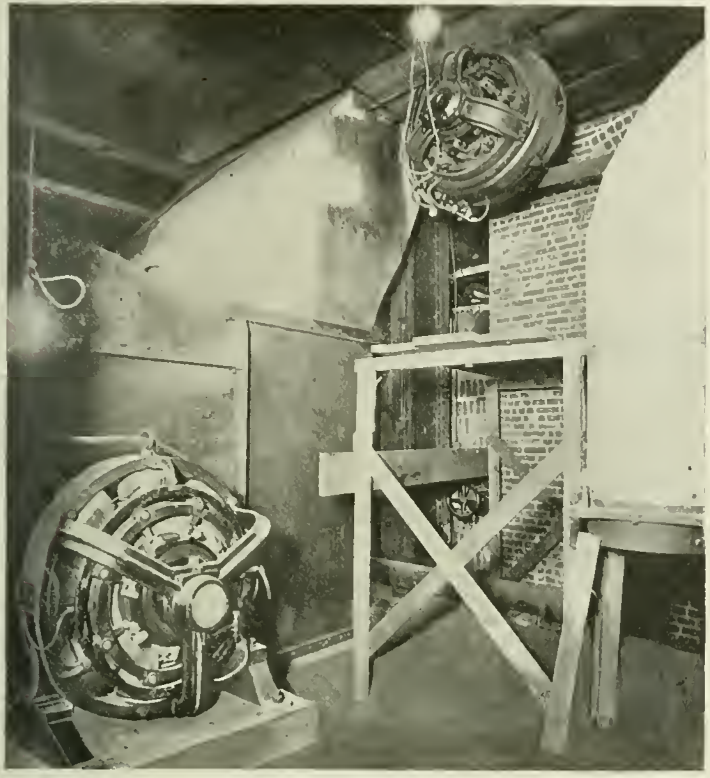


FIG. 2.—BLOWER ROOM.

The current is distributed from four junction boxes. This minimizes the danger of a complete breakdown of the electrical system by dividing the wiring into a number of sections, each being controlled from an independent junction box. Open wiring has been adopted, all wires being run along porcelain insulators, with the exception of the vertical risers which are all located in conduits. The very best material and workmanship have been employed on this part of the equipment, so as to have it harmonize with the rest of the installation.

In the engine room shown in Fig. 3 are located two direct-connected units, consisting of two Ball & Wood 150-hp engines connected to two 100-kw Sprague 6-pole dynamos, generating 230 volts at 250 r. p. m. To prevent the possibility of a breakdown a duplicate set of units has been installed, and each unit is capable of carrying the maximum load. The mains from these generators are carried beneath the floor to the switchboard, which is situated on a gallery reached by an iron stairway. The board, which was built for the Tucker Electric Construction Company, the contractors, by F. A. La Roche, after the designs of Mr. Knowles, consists of three panels, the center one being the main generator panel and the right and left ones the power and light panels, respectively. On the main panel are mounted two voltmeters and two ammeters of the Wagner switchboard type, with a horizontal pointer, one street service switch, two D. P. D. T. 500-ampere generator switches, two equalizer switches and a ground detector.

On the power panel are five Victor combination switch and circuit breakers and the field rheostats. On the light side are five 75-ampere Victor combination switch and circuit breakers. The average day load is about 300 amperes, and the average night load about 250 amperes. In addition to the machinery enumerated there is a 40-hp Ingersoll-Sergeant air compressor in the engine room, which furnishes compressed air at 80 lbs. pressure for the chipping tools and sandblast apparatus.

In the boiler room are two vertical Corliss boilers of 150 horsepower each. They are 16 ft. high and 6 ft. in diameter, and each boiler contains 164 2-inch tubes. The boilers are fed by No. 7 Monitor injectors. The auxiliary apparatus consists of an economizer and a 6 × 4 × 6 pump, which furnishes water for foundry purposes.

The equipment clearly shows with what diligence each problem has been studied out and how satisfactorily each difficulty has been overcome, all reflecting great credit on Mr. E. R. Knowles, the consulting engineer for the Bliss Company.

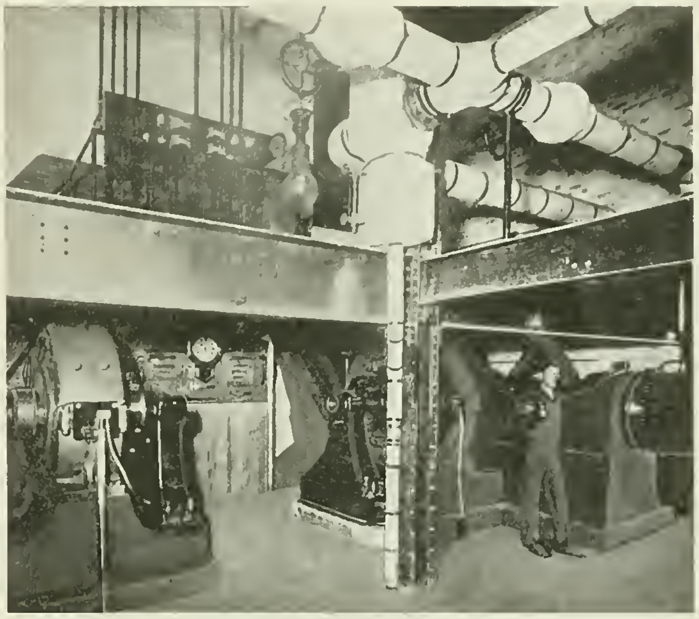


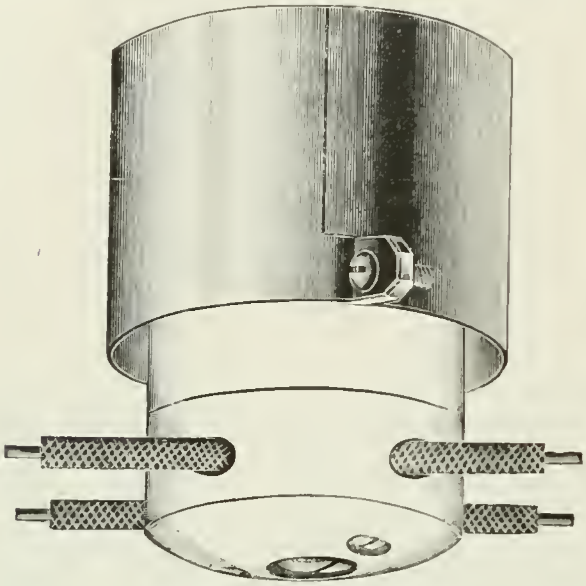
FIG. 3.—ENGINE ROOM.

A Bullock and Wagner Selling Arrangement.

The Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, have effected a combination of their selling organizations. By thus combining forces in the field, they are mutually benefited, inasmuch as the products of the two companies are totally different, and where the product of one is used, the other is likely to be necessary. The product of the Bullock Company consists of a complete line of direct and alternating current machines, from a ½-hp motor to a 10,000-kw generator, controllers of various types and rotary transformers. The Bullock "Teaser" power system for driving large daily newspaper presses has become world famous, and is to-day installed in the press rooms of many leading dailies in Europe and America. The product of the Wagner Electric Manufacturing Company covers a full line of static transformers of all types and of the largest sizes; ammeters, voltmeters, indicating wattmeters, switches, switchboards for all purposes and single-phase self-starting alternating-current motors. The entire absence of complicated starting mechanism especially adapts the Wagner single-phase motor to pumping plants and machinery of like character. Thus it will be seen that the two lines are admirably adapted to be sold by one organization, which will be under the management of Mr. E. H. Abadie, formerly sales manager of the Wagner Company.

Improved Sign Receptacles.

The device shown in the accompanying illustration, with its appliances, is designed to enable the quick making up of electric illuminated signs or decorations for the interior or front of buildings. The receptacles are linked together by S-shaped clamp hooks, which bind firmly about the receptacle, thus clamping the whole structure into a rigid outline of any design or proportion desired. For indoor use the receptacles may be readily wired, using the contacts projecting at the back of the main receptacle. For outdoor use, in an exposed position, where weatherproof construction is desirable, the wires are run through openings in the contact cap provided for that purpose. After replacing the contact cap of the receptacle proper, the interior space may be filled with weatherproof compound, a thoroughly weather tight and safe construction being thus obtained. Owing to the fact that the contact caps are spaced at regular intervals, the same contact caps and the same wiring may be readily used in connection with designs entirely different from the one for which they were originally made up, it not being necessary to change the wiring, except in rare instances. A metal rainguard is provided for additional protection to the lamp and socket when they are in use in exposed positions.

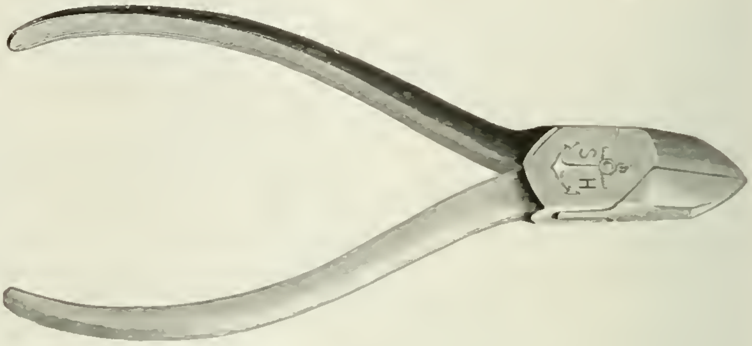


RECEPTACLE FOR SIGN LAMPS.

These devices, which are known as the Brewster universal sign receptacles and appliances, are manufactured by the Electric Motor & Equipment Company, 12 Beaver Street, Newark, N. J. They are recommended for the use of theaters, merchants and electric lighting companies, as a ready means of changing electric signs. They may also be used for electrical decorations, such as shields, stars, flags, festoons, etc., the same material being used in each instance.

Diagonal Electrical Plier.

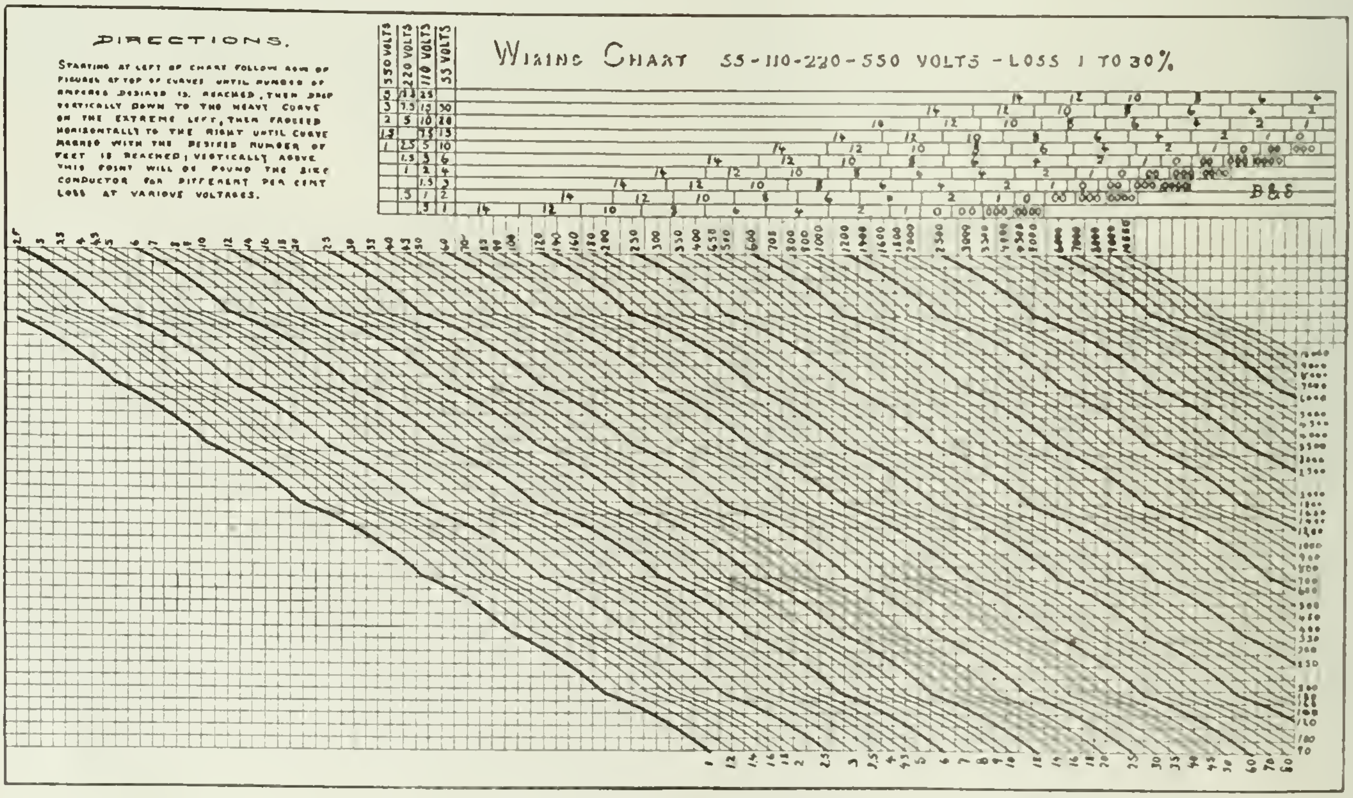
It has been noted by the Smith & Hemenway Company, 296 Broadway, New York City, that there has been a long-felt want in the trade for a first-class, tough, non-brittle, diagonal plier for electrical and telephonic purposes, and we now illustrate this company's Swedish diagonal plier, just brought out. The points of merit in this plier are that the jaws are parallel and will cut the finest insulation. At the same time, they are stiff enough to cut any kind of hardened copper wire or light steel or iron wire.



DIAGONAL PLIERS.

Wire Chart.

The accompanying chart, copyrighted by Geo. Ams Tower, of Richmond, Va., was prepared to provide a quick and convenient method of ascertaining the proper size conductor for any direct-current lighting or power circuit. The chart embraces a wide range of conditions, and should prove of value to those having use for a ready means of making such calculations.



DIRECTIONS.

STARTING AT LEFT OF CHART FOLLOW ROW OF FIGURES AT TOP OF CURVES UNTIL NUMBER OF AMPERES DESIRED IS REACHED, THEN DROP VERTICALLY DOWN TO THE HEAVY CURVE ON THE EXTREME LEFT, THEN PROCEED HORIZONTALLY TO THE RIGHT UNTIL CURVE MARKED WITH THE DESIRED NUMBER OF FEET IS REACHED; VERTICALLY ABOVE THIS POINT WILL BE FOUND THE SIZE CONDUCTOR FOR DIFFERENT PER CENT LOSS AT VARIOUS VOLTAGES.

DIRECT-CURRENT WIRING CHART.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 4½ per cent. nominally. Time money was freely offered during the week and the demand was fair. The rates were 4 per cent. for 30 to 60 days, 3½ for three, four, five and six months. There was little activity in mercantile paper, with a fair but limited demand. The rates are 3¾ a 4¼ per cent. for 60 to 90 days' endorsement, 4 a 4½ for choice four to six months single names and 5 a 6 for others. In the stock market there was considerable irregularity in price movements. Higher money rates—call loans rising to 6 per cent.—caused heavy realizing and renewed short selling. The market continues, however, to be very active and possesses the same strong undertone which has been a leading feature for some weeks past. In the electrical list General Electric exhibited great strength on the highly favorable character of its annual report and the intimations that a stock dividend would be declared to return to the shareholders the 40 per cent reduction of capital made some years ago. No fewer than 32,380 shares changed hands during the week, the highest price reached being 234 and the lowest 213, the closing quotation being 226½, a net gain of 10¼ points. The net gain in the price of this stock since Feb. 9 is 40 points. Western Union was quiet, closing with a net loss of ½ point. The street railway stocks continue in good demand and there was considerable activity in both Metropolitan and Brooklyn Rapid Transit. The sales of the former were 114,590 shares, the net gain for the week's business being 1½ points, and the sales of the latter were 100,070, the net gain being ¾ of a point. American Telegraph & Cable continued on the upward movement and closed with a net gain of 1 point. In the outside market a hopeful tone existed at the close. The net changes in quotations, however, as a rule were confined to fractions, being in a majority of instances advances. The gains, however, were not sufficiently great to overcome the losses suffered in the trading of the earlier part of the week; at the close the most of the active securities were below the firmer figures of the preceding week. American Bridge stocks were in good demand and closed at 49¾ for the common and 103¾ for the preferred. The transportation stocks were quiet, New York Transportation advancing 1½ points; General Carriage closed at 2. Following are the closing stock quotations at the four principal financial centres:

NEW YORK.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
General Electric	216¼	226½	Electric Vehicle	10	12
Brooklyn Rapid Transit	82¾	83½	Electric Vehicle, pfd	20	20
Metropolitan Street Ry	167	168½	General Car	—	2
American Tel. & Cable	99	100	Illinois Elec. Veh. Tran.	1⅛	⅞
Western Union Tel.	93	92½	Hudson River Tel.	120	120
American Dist. Tel.	36	36*	N. E. Elec. Veh. Tran.	—	2½
Commercial Cable	175½	170	N. Y. Elec. Veh. Tran.	4	5½
Electric Boat	20	21	Tel. & Tel. Co. of Am.	6	5
Electric Boat, pfd	50	50	N. Y. & N. J. Tel.	170	160
Electric Lead Reduc'n	4¾	4½			

BOSTON.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
New England Telephone	141	—	Erie Telephone	50	61½
Mexican Telephone	3⅛	3	General Electric, pfd	—	—
Westinghouse Electric	62*	—	Am. Tel & Tel.	170	171
Westinghouse Elec., pfd	—	—	Boston Electric Light	250*	—

PHILADELPHIA.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
Electric Storage Battery	69	75	Philadelphia Electric	6¼	6⅜
Elec. Storage Bat., pfd	70	75	Pa. Electric Vehicle	¾	1
Elec. Co. of America	8½	8¾	Pa. Elec. Veh. pfd	*¾	¾
General Electric Auto	—	—	Am. Railways	41	40

CHICAGO.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
Chicago Edison	154	155	Chicago Telep. Co.	220	230
Chicago City Ry	260	257	Union Traction	16	15
National Carbon	15¾	15¾	Union Traction, pfd	56	57
National Carbon, pfd	83	83	Northwest Elev. Com.	40½	40

*Asked.

ELECTRIC VEHICLE BONDS.—Official announcement was made last week of the issue of $1,675,000 of short term bonds by the Electric Vehicle Company. The conditions under which the bonds are to be issued and the purpose of the loan are explained in the following circular received by the stockholders: You are hereby notified that the Electric Vehicle Company, under action of its Board of Directors, has authorized the issue of $1,675,000 of bonds of the denomination of $1,000 each, bearing 6 per cent interest from May 1, 1901, payable on November 1 and May 1 in each year. These bonds mature on April 30, 1904, unless sooner retired by the sinking fund, or drawn for redemption and cancellation under the provisions of the Trust Deed, at par and accrued interest, at any time prior to maturity. These bonds have been underwritten at 90, as of May 1, 1901, by a syndicate who agree to take all which are not subscribed for by the shareholders of record at the close of business, April 22, 1901. Under the resolution of the Board and the terms of the agreement with the underwriting syndicate, these bonds are now offered to the shareholders of the Electric Vehicle Company upon exactly the same terms as they have been underwritten, namely, at a price of 90, as of May 1, 1901. You are entitled to subscribe at the price of 90 to a par value of these bonds equal to 9 per cent of the par value of the stock (both preferred and common), standing in your name upon the books of the company at the close of business, April 22, 1901. To cover cases where a subscription is for an amount less than $1,000, or greater than $1,000, without being a multiple thereof, it has been arranged for the issuance of scrip which can be exchanged into bonds when offered in amounts of $1,000 or multiples thereof. The sum to be realized from these bonds, namely, $1,507,500, will more than pay off all existing debt of the Electric Vehicle Company, and the surplus will be paid into the treasury to be used as working capital.

STATUS OF ERIE TELEPHONE.—Stone & Webster's report of the physical examination of the Erie Telephone properties covers a thorough examination of the entire system which has in operation nearly 300,000 miles of wire. Several experts have been engaged upon the work since December 1. The report is a large bound volume containing photographs of 60 exchange buildings owned by the subsidiary companies, with estimates of valuation of the various properties. Fully 90 per cent of the Erie's 95,000 miles of long distance wire system is constructed on or adjacent to railroad property giving the system clear and unobstructed right of way for its long distance wires, while far in excess of a majority of its subscribers lines in the large exchanges are underground. The report shows a large excess capacity of pole, cable, underground conduit and switchboards arranged for the rapidly increasing business and the classes of construction established during the past three years which has required an expenditure upon the plant in excess of $16,000,000. On the whole the report is favorable to the value and stability of the property.

GENERAL ELECTRIC CAPITAL.—It is stated that the General Electric Company is about ready to return the capital reduction made in 1898. It is understood that this will be done in the form of a 66 2-3 per cent dividend of stock, each holder of three shares getting two shares as a dividend. On the increased capital it is expected that 8 per cent dividends will be maintained as a minimum, and it is possible that dividends may be increased to a 10 per cent basis. At 230 three shares of General Electric would cost $690. This would then represent five shares of an 8 or possibly 10 per cent stock, worth say 160 as an 8 per cent stock or 200 as a 10 per cent stock in view of the company's ability to earn 20 per cent on the increased capital. Five shares at 160 would be worth $800 or $110 more than the present cost while at 200 they would be worth $310 more. In the one case this would mean a price of 266 for the present General Electric stock, and in the other it would represent 333. The stock is selling around 230.

RAILWAY $1,000,000 MORTGAGE.—The Delaware General Electric Railway Company has filed with the Recorder of Deeds for Kent county a mortgage for $1,000,000 given to the Knickerbocker Trust Company of New York City, for the construction of the Kent county trolley, work on which has been begun this week.

NEW YORK LIGHTING CONSOLIDATIONS.—There are indications that the lighting interests of Greater New York are drawing closer together, and it is rumored that the combined capitalization, gas and electric, may be put at just short of $300,000,000. Meanwhile all these securities are strong and rising.

DIVIDENDS.—The International Steam Pump Company has declared regular quarterly dividend 1½ per cent on preferred stock, payable May 1. H. R. Worthington, Inc., has declared a dividend of 3½ per cent. on the preferred stock, payable May 1.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies as to trade conditions were generally favorable and indicate continued improvement. The seat of greatest strength is in the iron and steel trade. Finished products are active, and most mills are sold ahead beyond July. Despite the drop in export trade, some orders are being received. The gross railway earnings by 100 systems for March aggregate $56,495,887, a gain of 7.4 per cent over

1900, and following a gain a year ago over 1899 in the same month of 12.5 per cent. The Granger roads alone show decreases. For the first three months of the year, earnings of 100 roads show a gain over the same period of last year of 6.7 per cent, following a gain of 16.2 per cent in 1900 over 1899. The failures for the week, as reported by *Bradstreet's,* numbered 225, against 188 the week previous and 152 the corresponding week last year. In the copper market, the developments of the week have strengthened the position of the producers, who are in control of the situation, and although there has been no change in quotations, the tone of the market is somewhat stronger. The quotations generally given in the trade are: Lake Superior ingot, 17 cents, and electrolytic 16⅝ cents. The exports of copper so far this month have amounted to 1,199 tons and the imports 1,164 tons.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, through its secretary, Mr. James Wilson Bullock, has acquired control of fifteen acres of land directly opposite the present plant at East Norwood, Ohio. Upon this tract the Norwood Foundry Company will erect a foundry building 200 feet long by 150 feet in width; a pattern storage house, fireproof construction, 50x150 feet, three stories high; and a modern office structure. All these buildings will be built of buff pressed brick with steel frames and trusses to conform to the present buildings of the Bullock Electric Manufacturing Company. The foundry will be equipped with three electric cranes, the largest of which will have a capacity of fifty tons. The side bays, which will be 25 feet in width, will be served by hand traveling and jib cranes. The plant will be of the most modern character, and electricity will be used for power and lighting throughout. While this foundry will be operated under the name of the Norwood Foundry Company, it will serve primarily the needs of the Bullock Electric Manufacturing Company. It will also be in position to handle outside orders in a satisfactory manner. That it will be operated successfully is guaranteed by the fact that it will be under the direction of Messrs. Hoffinghoff & Lane, of Cincinnati, a firm whose skill in handling foundry work is well known.

STEAM ENGINE CONSOLIDATION.—It was stated last week that the activity and strength of the stock of the International Power Company is, in anticipation of a combination of stationary steam engine companies, with a possible capitalization of $50,000,000. It is said that the combination or merger will be made through the International Power Company. This company's ownership of all the Green-Wheelock and Corliss patents, with these several large plants, it is asserted probably makes it the largest stationary engine manufacturing company in the world, but the Allis interests at Milwaukee are doubtless much larger. The International Power Company, which has three plants in Worcester, Mass., and Providence, R. I., has purchased a large tract of land at Paterson, N. J., on which it will immediately begin to erect a big plant where it will concentrate all its works. It expects to employ 2,500 workmen within a year. The company was attracted to Paterson during the negotiations for the sale of the Rogers Locomotive Works. It manufactures locomotives, stationary engines and auto-trucks

BRITISH TELEPHONE CONTRACT.—The Western Electric Company has received a large contract for telephone apparatus from the British Government, and there have been charges that British firms did not have a fair chance to compete. The London manager is reported by cable to have said: "Our contract does not reach anything like £1,000,000. The cables we are installing were made by British labor at our works in Woolwich. Only materials which are absolutely unsecurable here are being imported from America. The British Post Office authorities and all persons connected with telephonic construction in Great Britain and on the Continent admit that these are far ahead of any made on this side. The greater part of the appropriation of £2,000,000 will be spent in breaking up roads and similar work. The British firms had a fair show, and it was only when it was found that they were unable to provide the materials that the Post Office here dealt with an American firm."

STURTEVANT FIRE.—We record with regret the following special dispatch from Boston of April 14: The main building of the extensive blower works of the B. F. Sturtevant Company, in the Jamaica Plain district, was burned early this morning, causing a loss of $350,000; fully insured. The concern manufactured various kinds of machinery and electrical goods as well as blowers. The company recently had added $75,000 worth of tools and machinery, and had a large amount of electrical work ready for shipment. It also had a large number of engines and blowers for the Government for use on battleships and cruisers, in course of construction, all of which were destroyed. Superintendent Chamberlain states that the business will be carried on without much delay.

THE C. & C. ELECTRIC COMPANY, of this city, reports the receipt of contracts from C. R. Heap, of 47 Victoria Street, London S. W., calling for nine motors averaging 15-hp each. John Wanamaker, of Philadelphia, has ordered four 75-kw and one 50-kw generators; also five motors, two of 18-hp each, the same number of 12-hp each and one of 6-hp. These machines are intended to be installed for lighting and general power purposes in new buildings being constructed by the Pennsylvania merchant. The Defender Manufacturing Company, of New York City, has ordered twenty-nine C. & C. motors, which vary from 5 to 6-hp each, to drive sewing machines, laundry equipment and blowers. They will be direct-connected to the shafts.

EQUIPPING RAILROAD SHOPS.—The new large machine shops being erected at Elizabethport, N. J., for the Central Railroad of New Jersey, for which Mr. George Hill is consulting engineer, will be equipped exclusively with Lundell power apparatus manufactured by the Sprague Electric Company. The equipment will consist of three 100-kw generators of 240 volts and 250 r. p. m., direct-connected to Ball & Wood engines, and 75 motors of various sizes for driving the machine tools. All of the motors and one generator are booked for delivery in June and the other two generators will be delivered in July. This is probably the most important contract of the kind ever awarded in the railroad field.

FOREIGN TRADE FIGURES.—The monthly statement of the imports and exports of the United States, issued by the Treasury Bureau of Statistics, shows that during the month of March, 1901, the imports of merchandise amounted to $75,949,088, of which $36,706,366 was free of duty. The total is a decrease from March, 1900, of $7,200,000. The exports of domestic merchandise amounted to $122,300,579, a decrease of $9,450,000, attributable apparently to lower prices. The gold imports amounted to $2,487,019, an increase of $500,000. The gold exports amounted to $490,269, a decrease of $600,000. Silver imports amounted to $2,731,733, a decrease of $400,000. Silver exports were $5,150,186, a decrease of $300,000.

THE VEZIN MACHINE COMPANY, of New York, has secured an order through the American electrical engineering and contracting firm of Bagnall & Hilles, Yokohama, for the shipment of two high-speed engines developing 1350 and 1100 revolutions per minute respectively. One of these engines will be direct-connected to a Sprague Electric dynamo. The Vezin machines will be utilized for electric light purposes in Japan. The Jones & Moore Electric Company, of Toronto, has ordered one 10-hp engine of 1000 revolutions per minute, and two 6-hp machines of 1250 revolutions. Recently closed domestic orders include a small engine sold to the General Electric Company having a capacity of 2400 revolutions a minute.

THE ST. LOUIS CAR COMPANY, of St. Louis, Mo., has just closed a number of domestic contracts through its recently appointed New York representatives, Edward D. Floyd & Company, whose offices are in the Taylor Building, 39-41 Cortlandt Street. The Oneonta Cooperstown & Richfield Springs Railway Company has requisitioned for nine 50-foot high-speed cars; the Schenectady Street Railway Company has ordered six 45-feet cars, while the Hamburg Railway Company, of Buffalo, N. Y., is to be furnished with four cars having a length of 38 feet each. These orders aggregate nearly $75,000 in value.

NEW MANUFACTURING PLANT.—It is stated that H. M. Shaw & Company, 115 Broadway, New York, will erect a plant at Ampere, N. J., for the manufacture of their specialties, including trolley devices. The firm at the present time is having its goods manufactured at different places and the object of building a plant of its own is to enable the firm to manufacture all the different devices in one plant. The contract for the equipment has not yet been given out.

ECONOMIZERS.—The Boston Elevated Railway Company has ordered two more Green economizers for its Lincoln Wharf power station and also another one to be installed in Charlestown Station, which will then double the present economizer capacity there. The contract was placed with the Green Fuel Economizer Company, the sole maker in the United States, through its Boston office, at 53 State Street.

BALL ENGINE CONTRACTS.—Among recent installations by the Ball Engine Company, Erie, Pa., of engines for electrical purposes are the following: American Circular Loom Company, Aldine, N. J., one 100-hp direct-connected engine; Maryland Telephone Building, Baltimore, Md., one 80-hp and one 60-hp direct-connected engine.

A FLOATING EXPOSITION is proposed to be organized at Buffalo during the summer and to visit the chief cities of the Gulf of Mexico and the Caribbean Sea. The success of a similar French scheme is cited. Those who remember the story of the "White Special" organized a few years ago to travel over the railroads in this country do not appear to be oversanguine as to results.

THE CINCINNATI PLANER COMPANY, of Cincinnati, Ohio, is pushing its new building to completion, and expects to have it ready for occupancy by June 1. This is an addition to the company's present plant and will give a total floor area of about 25,000 square feet. The buildings are one story brick fitted with travelling cranes, and are well adapted to the building of heavy machine tools.

THE LAMBERT HOISTING ENGINE COMPANY, Newark, N. J., has installed a three-motor, electric travelling crane, manufactured by the Northern Engineering Works, of Detroit, Mich.

General News.

THE TELEPHONE.

CLARENDON, TEX.—The Clarendon Telephone Company has been incorporated with a capital stock of $3,000.

HUDSON, OHIO.—The Central Union Telephone Company (Bell) has completed a new toll line from this place to Twinsburg.

CARTERSVILLE, GA.—The Southern Bell Telephone Company has applied for a franchise to put in an exchange in Cartersville.

WOODBURY, PA.—The Eastern Telephone & Telegraph Company has been granted a franchise to operate its business in Woodbury.

NORWALK, OHIO.—Messrs. Frank H. Knapp and C. R. Callaghan, of Bellevue, have purchased the Huron County Telephone Company.

HOLLY SPRINGS, MISS.—After a long fight the Cumberland Telephone Company obtained permission from the board of aldermen to operate an exchange here.

LOHRVILLE, IOWA.—At the recent municipal election the proposition to grant franchises to the Central Telephone Company and the E. H. Martin Telephone Company carried.

BOSTON, MASS.—The Erie Telephone system made a net gain of 2221 subscribers in March; net gain since January, 3020; total connected March 31, 144,619; waiting connection 3490.

CAMDEN, TENN.—The Camden Telephone Exchange has been incorporated. Capital stock, $1,000. Incorporators: W. L. Morris, T. J. Lowery, W. P. McGill, U. A. Potts and D. G. Hudson.

CHESTER, PA.—The stockholders of the Delaware County Telephone & Telegraph Company have sold the property and franchise of the company to the United Telephone & Telegraph Company.

SAN ANTONIO, TEX.—The San Antonio Telephone Company has 650 instruments in operation, and as soon as the new cable arrives connection will be made with nearly 1,000 additional instruments.

CHICAGO, ILL.—The Advance Electric & Telephone Company, Chicago, has been incorporated. Capital stock, $15,000. Incorporators: V. Horace Messenger, H. Henry Hansen, and George A. Thompson.

TRENTON, N. J.—The American Home Telephone Company has been incorporated; capital, $2,000,000. Incorporators: Alfred G. Brown, of East Orange, N. J.; Edward B. Hawkins, Edward T. Magoffin.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has put into service in its main exchange a $125,000 new relay common battery switchboard, said to be the largest of the kind in the world.

SULLIVAN, MINN.—The Sullivan Telephone Exchange has been incorporated to operate a local exchange. Incorporators: John R. Pogue, A. O. Harrison, Sarah H. Kirk, John L. Kirk and James L. Kirk.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has been buying large numbers of poles in Idaho, and it is said that the company will build 300 miles of telephone lines in the Clearwater region this year.

LANCASTER, PA.—A mortgage given by the United Telephone & Telegraph Company, of Philadelphia, to the Equitable Trust Company, of Philadelphia, has been entered in the Recorder's office. It is for $2,000,000 and is payable January 1, 1931.

ALBANY, N. Y.—The Central New York Telephone & Telegraph Company, of Utica, has filed with the Secretary of State a certificate of increase of its capital stock from $800,000 to $1,000,000. The company has a paid-in capital of $800,000, and debts and liabilities of $210,961.

ALEXANDRIA, IND.—The Alexandria & Elwood Central Union exchanges have been consolidated and Ira M. Stabler, the former manager of the Alexandria exchange, will be transferred to Terre Haute. It is not improbable that many other exchanges will be consolidated where feasible.

ASHLAND, KY.—The Citizens' Telephone Exchange was completely destroyed by fire on April 5 and the entire service for this city and the district from Parkersburg, W. Va., to Greenup, Ky., and Cleveland, O., to Rush, Ky., was paralyzed. The fire was caused by a crossed electric light wire.

RICHARDSON, TEX.—The homes of farmers in this section will soon be connected by telephone. A company which proposes to run lines from here to Alpha and to Audelia was organized with a capital of $750. C. H. Blewett was elected president, Sam Harben secretary, and William Guion treasurer.

ATLANTA, GA.—The directors of the Standard Telephone Company elected F. V. Turner secretary. While no definite plans are announced, the directors say they will make every possible improvement in the system, and that connection with a large number of Georgia towns will be made as soon as possible.

SAN FRANCISCO, CALIF.—During the first quarter this year the net gain of the Pacific States Telephone Company central stations was 7,766 subscribers, total 93,510, equal to over 36 per cent per annum. The city of San Francisco showed a net gain of 2,678, total 24,002, equal to over 50 per cent. per annum.

PORTLAND, ORE.—The Columbia Telephone Company, of Portland, has extended its lines to Sellwood, Oregon, and to Mt. Scott. An extension to Forest Grove is projected. There is also talk of building a long-distance line to connect Portland with the lines of the new independent telephone company in Seattle, Wash.

CARLYLE, ILL.—Col. J. H. Allen, of St. Louis, has been granted permission by the Bond County supervisors to construct a telephone line in that county. He intends to connect by telephone the towns of Greenville, Smithboro, Woburn, Mulberry Grove, Pleasant Mound, Hookdale, Tamalco, Keysport, Beaver Creek, Dudleyville and other places.

PITTSBURG, PA.—Director J. O. Brown, of the Department of Public Safety, has awarded contracts for telephones in police patrol booths to the Central District & Printing Telegraph Company at $3 each a year, and for office telephones to the Pittsburg & Allegheny Telephone Company at $48 each a year. There are 210 telephones in patrol boxes.

FT. WAYNE, IND.—The Fort Wayne Home Telephone Company held its annual meeting last week and declared a dividend of 6 per cent. This is an independent company, and the owners are Fort Wayne business men exclusively. The company recently purchased the long distance lines controlled by the independent companies in this vicinity, and is preparing to extend the long distance service.

WABASH, IND.—At a meeting of the National Telephone & Telegraph Company held here recently the capital stock of the company was reduced from $1,000,000 to $250,000. The company owns a large system of telephone toll lines, covering the section of the State surroundings Wabash. Heavy taxation of the capital was the motive for the reduction. Four Western men will take the place on the board of directors recently occupied by New Yorkers.

CLEVELAND, O.—Extensive improvements and extensions are in contemplation for the operating telephone companies, of which the Federal Telephone Company is the parent financing corporation. Bonds for $3,000,000 of the Cuyahoga Telephone Company, the local operating company, are to be sold and the money used for the completion of the plant in Cleveland and for extensions of the long-distance lines throughout the State. New exchanges and systems will be placed in Ohio towns.

BRITT, IOWA.—The Iowa, Dakota & Minnesota Telephone Company was organized about six months ago with a capital stock of $100,000. The general office is at Sioux Falls, S. D., and there is a branch office at Britt, Iowa. The officers of the company are as follows: Thos. A. Way, president; Stitzel X. Way, vice-president; T. A. Potter, general manager; B. C. Way, secretary, and E. P. Healy, treasurer. This company owns and operates telephone lines in Iowa, Minnesota and South Dakota.

WABASH, IND.—The Central Union Telephone Company is making a secret but determined effort to gain control of the Home Telephone Company, of this city, offering liberal premiums for stock. The franchise of the Central expires next year. The Grocers' and Butchers' Association attempted to boycott the Central by ordering the telephones all taken out, but the customers remonstrated until a few declined to abide by the agreement, and now all are coming back in order to hold their trade.

ROCHESTER, IND.—The Rochester Telephone Company has purchased the telephone line along the Standard Oil Company's pipe line from Roann to San Pierre, a distance of seventy-five miles. The company will at once rebuild the line and open stations at all intermediate points between the two cities. At Roann connection will be had with the independent long-distance telephone service of Indiana, Ohio, Illinois and other States. It will also connect with the local telephone systems of a dozen or more of the cities in Northern Indiana.

LANCASTER, PA.—The Independent Telephone Company, of Lancaster County, has been absorbed by the United Telephone & Telegraph Company of Pennsylvania. The officers of the local company resigned and in their stead the following were elected: President, Edward Davis, Philadelphia; Secretary and Treasurer, F. E. Smith, Philadelphia; Directors, W. D. Barnard and E. M. Yarnell, Philadelphia; R. G. Park, Merion; F. G. Hobson, Norristown; Hon. Ward R. Bliss, Chester; G. R. Van Alen, Northumberland; C. M. Clement, Sunbury; S. P. and H. P. Light, Lebanon; A. J. Harner and W. H. Hartman, Lancaster. The purchasers are now in possession of the local companies in a dozen counties in eastern Pennsylvania and are gradually extending their system in the East to New York.

OTTAWA, ONT.—A bill has been introduced into the Dominion Parliament by a private member, that is designed to make the Bell Telephone Company live up to the provisions of its act of 1892. The new bill renders it obligatory upon the company, where it has already constructed or may hereafter construct a main or branch telephone service or system, to furnish all persons requiring telephones whose premises front upon or are adjacent to such service. The bill also provides that no higher rates than the rates now in force in the municipalities of Canada respectively, shall be chargeable in any such community; and any sum paid in excess of the said rates may be recovered at law or deducted from any rates unpaid. This act is retrospective in its operation, and will, if passed, compel the Bell Telephone Company to refund those of its subscribers who have been forced to pay higher rates than contemplated by the act of 1892.

PITTSBURG, PA.—The Federal Telephone Company, whose office is in this city, has recently absorbed the following telephone companies located in Western Pennsylvania: Elizabeth Telephone Company, Elizabeth, Pa.; Carnegie Telephone Company, Carnegie, Pa.; Latrobe Telephone Exchange Company, Latrobe, Pa.; McKeesport Telephone Company, McKeesport, Pa.; Washington County Telephone Company, Washington, Pa.; Washington Telephone Company, Washington, Pa.; Kiskiminetas Valley Telephone Company, Apollo, Pa.; Pennsylvania Telegraph & Telephone Company, Beaver Falls, Pa.; Ewing Telephone Company, Avonmore, Pa.; Home Telephone Company, Cecil, Pa.; Home Mutual Telephone Company, Canonsburg, Pa.; Home Mutual Telephone Company, Houstonville, Pa.; Local Telephone Company, Leechburg, Pa.; Home Mutual Telephone Company, McDonald, Pa.; Home Mutual Telephone Company, Venice, Pa.; Mutual Home Telephone Company, Washington, Pa.; Youngstown Telephone Company, Youngstown, Pa.; Coraopolis Telephone Company, Coraopolis, Pa.; Sewickley Telephone Company, Sewickley, Pa. In addition thereto, the Federal Telephone Company has built or owns or controls the telephone properties in fifty-four cities and incorporated boroughs in Pennsylvania and has completed its lines in and through sixteen villages.

ELECTRIC LIGHT AND POWER.

PHILADELPHIA, PA.—The Ambler Electric Light Company, Ambler, Pa., has offered its plant to the borough for $25,000.

GREENWOOD, IND.—A special election will be held in this city to pass upon an ordinance providing for a new electric light plant.

PORTSMOUTH, OHIO.—The city council has passed a resolution to spend $30,000 for rebuilding the municipal electric lighting plant.

PORTSMOUTH, OHIO.—The Heer Shoe Company, of Portsmouth, is preparing to install a 100-kw, 220-volt generator, and four or five motors, in a new shop.

DRESDEN, ONT.—A by-law to borrow $10,000 to purchase an electric light plant for the town of Dresden, has been approved of by the ratepayers of the town.

SEATTLE, WASH.—The Seattle Cataract Company recently filed a petition with the board of public works for leave to extend its electric light and power system.

SALISBURY, N. C.—Mr. Edwin I. Frost, acting for himself and New York associates, has purchased the property of the Salisbury Gas & Electric Light Company.

NEW ORLEANS, LA.—The New Orleans Lighting Company, capital $2,000,000, has been incorporated by Henry B. Royson, of New York, C. F. Schumann, M. N. Butler and W. R. H. Hardingham.

NEWARK, N. J.—The Board of Directors of the United Electric Company of New Jersey has decided to accept the ordinance passed by the Board of Works of this city providing for the burial of the company's wires.

ST. LOUIS, MO.—The Imperial Electric Light, Heat & Power Company is confronted with the possibility of a general strike in all of its departments. Union firemen have been discharged and negroes put in their places.

TRENTON, N. J.—The New Orleans Lighting Company has been incorporated in this State. Capital, $2,000,000. Incorporators: Henry B. Payson, Charles F. Gehrmann, Malcolm M. Butler and Walter R. H. Hardingham.

ALBANY, N. Y.—The Au Sable Electric Light & Power Company, of Au Sable Forks, Clinton County, has been incorporated; capital, $25,000. Directors: James Rogers, George Chahoon and J. Monroe Sheffield, Au Sable Forks.

RICHMOND, VA.—The Petersburg Gas Company has been chartered, with capital limited to $200,000 to manufacture and distribute gas and electricity for motive power, etc. F. H. Shelton, Philadelphia, is secretary and treasurer.

SAN FRANCISCO, CALIF.—The American Fuel & Power Company has been incorporated in San Francisco. Directors: H. Sherwood, C. E. Tarrent, M. Sherwood, W. M. Kratz and C. E. Jones. Capital stock, $25,000, fully subscribed.

KINGSTON, ONT.—Mr. Frederick Thompson, of Montreal, has been appointed electrical expert for the city of Kingston, to evaluate the plant in the power-house there, which the city purposes purchasing by arbitration. He will draw $25 per day salary.

VINCENNES, IND.—The city authorities have notified the City Electric Lighting Company and its sureties that the company has failed to comply with its contract; that the service is unsatisfactory and that action would be taken unless the service is improved.

SAN FRANCISCO, CALIF.—It is reported that the Truckee River General Electric Company has taken over the Virginia (Nev.) & Gold Hill Water Company's electric lighting plant and arranged to supply current for lighting the towns from the electric transmission plant in Floriston, Cal.

APPLETON, WIS.—Articles of association have been filed by the Fox River Valley Gas & Electric Company. The company is capitalized at $350,000. David N. Cameron, Thomas A. Rockwell and James H. Jenkins, of Oshkosh, are the incorporators. All the plants of the company are generating power and gas and the general offices will be located at Appleton .

SAN FRANCISCO, CALIF.—It is reported that John Martin, president of the Bay Counties Power Company, has purchased the lighting systems of Marysville, Chico and Woodland, Calif., and is negotiating for those of Petaluma, Santa Rosa and San Rafael. He has taken possession of the electric lighting plants of Grass Valley and Nevada City, Calif., and it is said he will install a gas plant at one of these towns.

SAN FRANCISCO, CALIF.—The Riverside Power Company recently entered into an agreement to supply the town of Riverside, Calif., with electricity at the rate of $6 per horse-power per month. The steam-power municipal electric lighting plant, which was constructed at a cost of $50,000, is unable to supply the demands. The Power Company has arranged to begin work on a water-power electric transmission system at an early date.

OTTAWA, ONT.—A bill to incorporate the Ottawa & Hull Power & Manufacturing Company has passed the Private Bills Committee of the Dominion Commons. This bill incorporates Messrs. W. C. Edwards, J. A. Cameron, J. C. Edwards, R. G. C. Edwards, Hiram Robinson, H. K. Egan, Robert L. Blackburn and Russell Blackburn, with a capital of $1,000,000, to develop electric power, do a lumbering, farming, mining and steamship business and other works.

SYDNEY, N. S.—A syndicate, promoted by Mr. B. F. Pearson, of Halifax, N. S., is buying out the Sydney Gas & Electric Light Company, paying therefor $40,000. The Sydney Ferry Company, the Eastern Telephone Company and the Electric Tramway Company, to which latter company the local legislature of Nova Scotia last year gave an extensive franchise, are included in the deal. An electric tramway will immediately be constructed from Glace Bay to Sydney.

SAN FRANCISCO, CALIF.—The Interstate Power Company has been incorporated, with Dalles City, Oregon, as the principal place of business. Directors: E. Kurtz, W. H. Moody, J. P. McInerny, Max A. Voght, H. L. Kuck, L. E. Crow and Ed. M. Williams. It is proposed to operate an electric power plant on the Des Chutes River and conduct electricity for lighting and other purposes to Dalles City and other places in Wasco County, Oregon, and into Klickitat County, Washington.

COLUMBUS, OHIO.—Bids are being received by the board of public improvements of this city for lighting, for periods ranging from five to ten years. The bid of the Columbus Light Company to furnish enclosed alternating arc lamps for ten years all night lighting at $78 per lamp per year, was the lowest proposition received. A temporary injunction was granted, restraining Director Kauffman from awarding the contract on the ground that a proposition had already been made to the municipal lighting plant.

PITTSBURG, PA.—The new electric light plant of the Pennsylvania Light, Heat & Power Company, located at Preble Avenue and Ontario Street, in lower Allegheny City, will be ready for operation within the next sixty days. The power plant occupies an entire square and is equipped with the latest machinery. The installation consists of two 250-kw Westinghouse generators. The company intends to compete for patronage with the Allegheny County Light Company of Pittsburg. It has already secured over 1000 subscribers, the lines have been put up, and the management expects to furnish current to its customers by June 1.

OTTAWA, ONT.—Ottawa will soon have a third big electric corporation furnishing electricity for heat, light and power. A charter is about to be granted by the city council of Ottawa to the Consumers' Electric Company for such purposes. The new company's rates will be 10 per cent. lower than those of the Metropolitan company. Sixteen candle-power incandescent lights will be supplied at 10 cents per week and arc lights about $55 a year. The city, under its present agreement with the Ottawa Electric Company, pays $65 a lamp per year. There will also be the same reduction in the price of power. The Metropolitan company's figures for power, as set forth in its agreement with the city, are from 1 to 4 horse-power, $50 per annum; 5 to 9, $45; 10 to 19, $43; 20 to 49, $38, etc.

SAN FRANCISCO, CALIF.—City Engineer Grunsky, of San Francisco, under the orders of the Board of Public Works, has been obtaining figures and data on the question of municipal ownership of public utilities. It has been proposed to establish a water system, bringing water from the Sierras by gravity and using the same to generate electricity for lighting and power purposes and to operate a municipal electric street railway line, taking current from an underground conductor. It is a part of the plan to have a distributing station located in the City Hall and to install an underground conduit system to distribute electricity throughout the city. The Geary Street cable line is talked of for a municipal electric road, as the underground conductor could be placed beneath the cable slot at small expense.

APPLETON, WIS.—Articles of association were filed April 1 by the Fox River Valley Gas & Electric Company, whose object is to furnish light, heat, steam, power and hot water to the cities of Neenah, Menasha, Appleton, Kaukauna and Green Bay, also in all towns and villages in various counties. The new company is capitalized at $350,000. David N. Cameron, Thomas A. Rockwell and James H. Jenkins, of Oahkosh, are the incorporators. All the immense plants of the company for generating power and gas and the general offices will be located at Appleton. Big electric power houses will be erected. The energy will be transmitted to sub-stations in the adjacent cities and towns. The company has purchased the Appleton Gas Light & Fuel Company's plant and also the Neenah and Menasha gas and electric plant.

THE ELECTRIC RAILWAY.

CINCINNATI, OHIO.—The Cincinnati, Milford & Hillsboro Railway Company has been incorporated with $100,000 capital stock.

CHARLOTTE, N. C.—Surveyors have begun work on the route of the proposed electric line between Gainesville and Dahlonega, Ga. J. F. Moore, of Dahlonega is interested.

BIRMINGHAM, ALA.—J. B. Stagg, of Pratt City, has asked for a franchise to construct an electric railway from Pratt City to Brookside. The matter has not been acted upon.

NEWARK, OHIO.—The Newark & Granville Electric Railway Company has commenced work on a new power house near here. Contracts have been placed for two 300 hp. Corliss engines.

FOSTORIA, OHIO.—The Ohio Northwestern Railway, which was recently incorporated, has organized as follows: William D. Marks, president; J. A. Bradner, secretary and treasurer.

VINCENNES, IND.—The County Commissioners have granted a franchise to B. G. Hudnut, of Terre Haute, to build and operate seventy-five miles of electric railway in Knox County.

ANDERSON, IND.—The farmers in the southern part of this county have organized for the purpose of building an electric line from New Castle to Pendleton, a distance of thirty-five miles.

GARRETT, IND.—The Garrett, Auburn & Northern Electric Railway Company has been incorporated. The directors are J. D. Hauseman, F. S. Mitchell, E. B. Johns, J. F. Camerni and F. D. Welshmein.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has paid off $250,000 of its bonded indebtedness. This means the consolidation of its line with that of the Rapid Transit Company of Chattanooga.

CHILLICOTHE, OHIO.—A franchise has been granted the Columbus & Southern Electric Railway Company by the Ross County Board of Commissioners. The terminal points are Columbus and Chillicothe.

RAVENNA, OHIO.—The council has agreed to grant a franchise to the Northern Ohio Traction Company for its extension from Kent to this place. Contracts for rails have been placed and grading has been started.

CHICAGO, ILL.—The Riverdale, Harvey & Chicago Heights Railway Company has been incorporated with a capital stock of $10,000. The incorporators are Samuel M. St. Clair, George E. Ruher and Myles J. O'Kelley.

LYONS, N. Y.—The Palmyra Electric Railway Company has been incorporated, with a capital of $45,000 to build and operate an electric road at Palmyra. The incorporators are the Lyons Electric Light & Power Company and others.

CHICAGO, ILL.—The Chicago & Desplaines Valley Electric Railway has been incorporated. The capital stock is placed at $1,000,000. This completes the consolidation of the Desplaines Valley and the Chicago and Desplaines Valley railways.

CANTON, OHIO.—The Canton & Akron Electric Railway Company has been incorporated by W. H. Hoover, Charles A. Kolp, John C. Welty and Austin C. Brant, of Canton, and Philip Saltonstall and William Tucker, of Boston, Mass. Capital stock, $600,000.

FREMONT, OHIO.—The Lakeside, Napoleon & Western Railway Company, which proposes to build a line from Lakeside to the Indiana State line, has purchased the properties of the Fremont Electric Street Railway Company, operating the local line. Construction work has been started.

BRANFORD, ONT.—Messrs. Icaes & Armstrong, Pennsylvania capitalists, have asked the city council for a franchise enabling them to enter the city with an electric street railway, which will have its northern terminus at the city of Galt, Ont. The route for the road has already been laid out.

TOLEDO, OHIO.—The Cincinnati, Hamilton & Dayton Railroad Company will erect an immense elevator on the site of one recently destroyed in this city. It will cost $300,000, and all machinery will be operated from an independent power plant. The MacDonald Engineering Company has the contract.

TROLLEY FREIGHT.—In the case of the State vs. the Dayton Traction Company, tried in the Supreme Court in this city, the decision was in favor of the street railway company. The case was one in which the State sought to restrain the street railway company from operating freight traffic on city streets.

LIMA, OHIO.—The Western Ohio Railway Company has secured a franchise in Celina, and has the right of way between St. Mary's and Celina, and a branch will be built to the latter place. Right of way is being secured to extend the road from Minster to Sidney and Piqua, thus making connection with lines to Cincinnati.

TOLEDO, OHIO.—The Toledo & Ohio Northeastern Railway Company, recently incorporated, and which has secured a number of franchises in this State, is working for a right of way through Northern Indiana. It is the intention to build a direct line from Toledo to Chicago. W. H. Cummer is president of the company.

COLUMBUS, OHIO.—The Union Electric Railway Company, which is incorporated under the laws of New Jersey with $200,000 capital stock, has secured franchises over three different routes from the commissioners of Union county. The system will have fifty-three miles of track, and the power house and car barns will be located at Marysville.

DOVER, N. H.—Among the electric railway charters granted by the New Hampshire Legislature, are two for the formation of a trolley line connecting the cities of Dover, Somersworth and Rochester, with the State capital. The roads authorized are: The Concord, Dover & Rochester Electric Railway, capital $400,000, and the Dover, Somersworth & Rochester Street Railway, capital $300,000.

COLUMBUS, OHIO.—The stockholders of the Columbus, London & Springfield Railway Company have elected officers as follows: J. S. Harshman, president; Fred J. Green, vice-president; Emmett Thompson, secretary; John G. Webb, treasurer, and H. A. Fisher, general manager and second vice-president. The above and A. E. Appleyard and C. A. Alderman constitute the board of directors.

UTICA, N. Y.—Horace E. Andrews, representing a syndicate with headquarters at Cleveland, Ohio, purchased of President John W. Boyle, of this city, the controlling interest in the Belt Line and Suburban street railroads in this city and county. It is said to be the intention of the syndicate to build the projected lines up the Sauquoit Valley and to Clinton, and to parallel the Central Hudson from Rome to Little Falls .

NEW YORK, N. Y.—It is reported that A. L. Johnson has secured all of the necessary rights for the construction of his proposed electric railway between Philadelphia and New York. The roadbed will be in every respect equal to that of the standard steam railway. Ninety-five-lb. rails will be used, and the cars will have a seating capacity of 60 persons. Mr. Johnson is reported to have said that be expects to have the entire line between the two cities named, in operation by next Thanksgiving.

ANDERSON, IND.—The Union Traction Company closed the local power plant at Marion March 29, and began furnishing power from its central power house in this city for the local systems of Anderson, Marion, Muncie, Alexandria and Elwood and for its lines to Indianapolis, Marion, Muncie and Elwood. Only two of the two thousand horse-power engines are running, but they are sufficient. A third engine is being placed, and then all other local power stations on the entire system will be dismantled.

ALBANY, N. Y.—The Ellenville & Kingston Railroad Company has been incorporated with a capital of $300,000, to operate a standard gauge road by steam or electrical power, twenty-eight miles long, to connect with the Ellenville branch of the New York, Ontario & Western Railway Company, near Ellenville, Ulster County, and run to the city of Kingston. The directors are: Thomas H. Fowler, who subscribes for $200,000 of the stock, and John B. Kerr, O. D. Ashley, C. Ledyard Blair, F. K. Culbert, C. L. Hoyt, A. S. Roe, Grant B. Schley and Thomas B. Childs, of New York.

ALBANY, N. Y.—The New York & Port Chester Railroad Company has been incorporated with the Secretary of State to operate an electric street surface road, twenty-five miles long, from the Harlem River at Port Morris through the borough of The Bronx to Mount Vernon, Pelham Manor, New Rochelle, Larchmont, Orienta, Mamaroneck, Milton, Rye and Port Chester, to the Connecticut line, with a branch to Classon's Point on the East River. The company has a capital of $250,000, and the directors are: Charles Heinecke, of Whitestone; M. H. Germend, of Dumont, N. J.; W. H. Heath, of Brooklyn; M. H. Baldwin, E. D. Mailloux, Messmore Kendall, Christopher Kaiser, C. O. Mailloux, of New York City, and Ernest Muller, of Westfield, N. J.

THE AUTOMOBILE.

AUTOMOBILE RUN.—Mr. L. R. Adams, president of the Long Island Automobile Club, is sending out announcements that a 100-mile endurance test of the club will be run on Saturday, April 20. An informal smoker will be held in the club rooms, Brooklyn Borough, on the evening of April 19.

COLONEL MAX FLEISHMANN, of Cincinnati, is having constructed at the factory of the Automobile Company of America, Jersey City, N. J., a racing automobile. In the summer Mr. Fleishmann will make a trip from Cincinnati to New York and return. He will participate in the races at Newport, R. I., and in New York State; and will probably represent the Cincinnati Automobile Club in the race for the Gordon-Bennett Cup in France next summer.

THE CALIFORNIA AUTOMOBILE CLUB of San Francisco has been stirred up by the action of Stanford University in barring autos from the campus. The club will endeavor to have the roads opened and may have to resort to legal action. A hundred-mile race around San Francisco Bay from San Francisco to Oakland via San Jose is on the tapis. The North Pacific Coast Railroad Company and the Santa Fe Railroad Company now carry automobiles on their Bay ferries.

AUTOMOBILES FOR THE PAN-AMERICAN EXPOSITION.—The equipment of the Woods Motor Vehicle Company, of Wisconsin, which has a livery in this city, will be sent to the Buffalo Woods Motor Vehicle Company to be used during the Pan-American Exposition. The local company will temporarily close up its livery, but expects to reopen a new livery in the near future. The company reports having experienced a very satisfactory business during the one year of its existence.

AUTOMOBILES IN GOLDEN GATE PARK.—The Park Commissioners of San Francisco have put into operation the new rules governing automobile driving. All chauffeurs desiring the privileges of Golden Gate Park are required to subject themselves and their machines to an examination by the Park Engineer, as to speed and brake power of the automobile and the owner's ability as a driver. The maximum speed is limited to ten miles an hour. Non-transferable certificates are issued for each machine and its operator. Fifteen prominent chauffeurs were granted certificates at a recent examination.

NEW INDUSTRIAL COMPANIES.

THE JOY PRINTING-TELEGRAPH COMPANY, of New York City, has been incorporated; capital, $30,000. Directors: O. J. Smith, Dobbs Ferry; G. W. Cummings and J. H. Grant, New York City.

TRENTON, N. J.—The Frenchtown Electrical Construction Maintenance Company, Frenchtown, N. J., has been incorporated; capital, $50,000. Incorporators: Peter J. Magee, Franklin Dewsnap, James S. Gilbert.

THE PIXLEY ELECTRICAL COMPANY, Columbus, Ohio, was incorporated with $1,000 capital stock by M. A. Pixley, C. F. Pryor, H. W. Webb, J. F. Pixley and R. Fullerton. The company will deal in electrical and automobile supplies.

THE INTERNATIONAL ELECTRIC COMPANY has been incorporated at Trenton, N. J.; capital $3,000,000, to build and operate plants for the purpose of furnishing electric light, heat, and power. Incorporators: Adrian H. Miller, Charles M. King and Stephen C. Smith.

LEGAL.

TROLLEY FREIGHT.—It has been decided by the Ohio Supreme Court that street railroads have the right to carry freight.

TELEGRAPH SUIT SETTLED.—A Toronto, Ont., despatch states that the suit of Morrow & Clarke, of Boston, to annul the lease by which the Great Northwestern Telegraph Company has for seventeen years controlled and operated the lines of the Montreal Telegraph Company, has been settled out of court in favor of the defendants.

ANCHOR ELECTRIC COMPANY'S AFFAIRS.—Judge Bond, of the Superior Court, Boston, has appointed James E. Leach Receiver of the Anchor Electric Company. The appointment was made upon application of counsel for Norman Marshall and Guilford M. Stuart, who had brought a bill in equity against George C. and Guy H. Proctor, of Somerville. The plaintiff alleged mismanagement of the company by the defendants.

GAS INJUNCTION DISSOLVED.—The State of Illinois Appellate Court on April 8, in an opinion delivered by Judge Windes, reversed Judge Dunne's previous order and dissolved the injunction restraining the People's Gas Light & Coke Company from collecting more than 72 cents per thousand on fuel gas in Hyde Park. The injunction, which was granted about two months ago, caused a great deal of comment, as it was held that it established a precedent under which the rates charged by all street railways, gas, and electric companies and big corporations could be fixed by the municipal governments.

TELEPHONE DISCONNECTION.—The right of the telephone company to disconnect the citizen's service if the citizen is not prompt in paying his telephone bill was asserted not long ago by the Appellate Court of Indiana in the case of the Rushvile County Coöperative Telephone Company vs. Irvin (59 N. E. Rep. 328). The company had a rule that all moneys due it should be payable on the 5th of the month succeeding that in which the charges were incurred, and that if not paid by that date the service of the delinquent patron would be disconnected until the bill should be paid. The court held that this was a reasonable rule, and a proper way of obtaining payment of the bills.

OBITUARY.

MR. JAMES KNIBBS.—James Knibbs, Superintendent of the Troy (N. Y.) fire alarm system, died at his home there on April 16. He was stricken with paralysis a few days ago. Mr. Knibbs was born in England in 1823 and came to this country in 1840. He was twice married, his second wife surviving him. His only son died several years ago. Mr. Knibbs was very prominent in Masonic and Odd Fellows circles, but was best known throughout the country by his invention of what is known as the "Knibbs Run Around." This is an attachment to steam fire engines which prevents a waste of water and saves the hose and suction pipes. The "run around" was utilized almost everywhere, and by advice of counsel he brought suits against many municipalities. Many of the latter settled for large sums, but the City of New York defended the action. Recently a verdict was given in the United States Court for nearly $1,000,000 in favor of the persons to whom Mr. Knibbs assigned his invention. One of these is ex-Collector of Customs Thomas Murphy, of New York.

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PERSONAL.

MR. T. A. EDISON entertained Mr. Marconi at his Orange Laboratory this week, together with Mr. John Bottomley and some railroad officials.

DR. H. T. BARNES, who has for some time past been engaged in special physical research at McGill University, Montreal, has been a visitor during the past week in New York city.

MAURICE J. FIEBERG, member of the Water Works Board of Cincinnati, is mentioned as probable president of the new lighting combination, to succeed General Andrew Hickenlooper.

MR. C. T. MURREY, who is identified with electric railway business at Buffalo, N. Y., it is reported, has been appointed general manager of the Toledo Traction Company, to succeed the late T. H. McLean.

MR. WILLIAM R. HEWITT has been appointed Permanent Chief of Fire Alarm Telegraph for the city of San Francisco. He has been at the head of the Fire Alarm and Police Telegraph system for the past thirteen years.

PROF. G. D. SHEPARDSON informs us that the legislature of Minnesota has just appropriated $60,000 for the State University at Minneapolis, for the College of Engineering. Most of the money will go into the electrical laboratory and lighting plant.

MR. L. E. FRORUP, for several years past with Schiff, Jordan & Company, has severed his connection with that firm, and on May 1 will become connected with the Falcon Electric Manufacturing Company, New York, as General Sales Agent for its various lines of well known specialties.

MR. CHARLES P. TURNER, M. E., who has been connected with the International Correspondence Schools, Scranton, Pa., since 1895, has resigned to accept a position with the Garrett-Cromwell Engineering Company, Cleveland, Ohio. Prof. Turner's successor as principal of the School of Mechanical Engineering is Prof. A. B. Clemens.

MESSRS. F. H. NALDER and P. A. Ransom, who have been making a rapid tour through the manufacturing districts of this country, besides visiting Canada, sailed for England last week. Mr. Nalder met many old electrical friends, who were glad to see him on this side again. Many establishments were thrown open wide to them, and a warm welcome met them everywhere.

MR. H. McL. HARDING, president of the United Telpherage Company, has started out on a long trip all through the Middle and Western States to lay out and arrange a large number of important agencies for the telpherage system, in regard to which the inquiries are already so numerous that the home office is swamped with them. Mr. Harding will visit all the larger cities and some of the mining districts.

HOUGH-WARD.—Lieut. Henry Hughes Hough, U. S. N., and Miss Flaurence Olyphant Ward, daughter of Mr. George Gray Ward, vice-president of the Commercial Cable Company, were married on April 16 in New York City at the Church of the Heavenly Rest by the Rev. Dr. D. Parker Morgan, rector of the church, and the Rev. Reese F. Alsop of St. Ann's Church, Brooklyn. The bridesmaids were Miss Florence Stebbins, of New York; Miss Harriet Brownson, daughter of Captain Brownson, United States Navy; Miss Cornelia Knox, daughter of Lieut. Col. Knox, United States Army; Miss Rose Hoppenstedt, Miss Alice Byrne, and Miss Addie De Witt, of Brooklyn. The maid of honor, Miss Helen Holmes, was in pure white. The ushers and best man, all naval men, were in the uniform and were as follows: Lieut. De Witt Blamer, United States Navy, best man; Lieuts. H. H. Caldwell, A. E. Dewie, A. Allthouse, and C. F. Preston, United States Navy; Capt. R. H. Lane, United States Marine Corps; Lieut. Irwin, and Naval Constructor R. M. Watts, United States Navy. A reception followed the ceremony at the residence of the bride's parents, 51 West Fifty-third Street, which was largely attended, the guests and friends including many people well known in electrical circles.

Trade Notes.

THE UNION HARDWARE & ELECTRICAL SUPPLY COMPANY, Providence, R. I., was burned out recently.

BUSINESS CHANGE.—The Elwood Electric Company, Rochester, N. Y., has been succeeded by the J. B. Snyder Supply & Electric Company.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, recently entered a twelfth order for Cross oil filters for the International Paper Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that it is making large shipments of Packard transformers, for which it is general Western agent.

ROSSITER, MACGOVERN & COMPANY are moving from their Brooklyn factory, Raymond and Willoughby Streets, to 14 and 16 Morris Street, Jersey City.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has sold a large generator and several motors for installation in a large power plant in Baltimore.

CHICAGO OFFICE OPENED.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has opened a branch office at No. 40 Fisher Building, Chicago, Ill. This office will be in charge of Mr. C. H. Norwood.

WATER TUBE BOILERS.—The new plant which is now in course of construction for the Champion Coated Paper Company at Hamilton, Ohio, will contain Stirling water tube boilers with a capacity of 3,200 horse-power.

THE CHRYSLER RAILWAY SCHOOL has been incorporated in Indianapolis, Ind., for the purpose of instructing and preparing men for service on electric and steam railways, and to assist them in obtaining employment.

DAMAGE BY FIRE.—The building on Canal Street, New York, in which was located the factory of J. H. Bunnell & Co., was recently destroyed by fire. The Bunnell Company's loss was $75,000. The firm is now fitting out a new factory.

THE BUNNELL TELEGRAPHIC & ELECTRICAL COMPANY, of New York, has purchased the property of the National Electrical Manufacturing Company in Milford, Conn., for $12,500. Mr. Albert J. Wise represented the company in the negotiations.

MILWAUKEE, WIS.—The Browning Manufacturing Company is now turning out its small power motors from the new plant. The new shop is modern by equipment in every respect. The company is crowded with orders, and has several orders booked for foreign shipment.

FIFTIETH ANNIVERSARY.—The American Steam Gauge & Valve Company, Jamaica Plain, Boston, Mass., celebrated the fiftieth anniversary of its organization on Tuesday evening, April 16. The company was organized in 1851. Invitations to attend the celebration were sent out to the trade.

THE BERLIN IRON BRIDGE COMPANY has contracted to furnish the Province of New Brunswick, Canada, four bridges. There will be required four 63-foot riveted spans, one 150-foot through pin-connected span, one 200-foot deck pin-connected span, and one 80-foot deck pin-connected span.

SUPPLY BUSINESS FOR SALE.—The stock in trade, fixtures, leases, etc., of the Anchor Electric Company, 71 Federal Street, Boston, Mass., was advertised to be sold at public auction by the receiver on April 16. The business of the concern was carried on by the receiver until the day of the sale.

CONSTRUCTION MATERIAL.—The Central Electric Company, of Chicago, carries in stock large quantities of construction material, such as cross arms, pins, brackets, insulators, wires, etc. By making a specialty of prompt shipments this company is in a peculiarly good position to handle large construction orders.

MACHINE TOOLS.—The Newton Machine Tool Works, Philadelphia, Pa., has issued a catalogue, No. 34, of its extensive line of machine tools. This company makes a line of electrically driven tools of every description. The catalogue contains 192 pages and is very fully illustrated with cuts of machine tools of all kinds.

DIEHL ELECTRIC FANS.—The Diehl Manufacturing Company, Elizabethport, N. J., has issued a catalogue describing and illustrating its line of 1901 fans. This company is making these machines for all currents except alternating. The fans are of the ceiling, electrolier, column, desk, bracket and telephone booth types.

REMOVAL.—John W. BROOKS, sales agent for Pass & Seymour, Syracuse, N. Y., announces that the company's Chicago office and stockroom has been moved to 130 W. Jackson Boulevard. This change was made necessary in order to obtain more room to take care of the rapidly increasing demand for the P. & S. specialties.

CONTINENTAL ENCLOSED ARC LAMP.—This lamp, which is designed for 110-volt direct-current constant-potential circuits, is the subject of Bulletin D, just issued by the Helios-Upton Company, Philadelphia, Pa. It is claimed that a gain of light and economy of 35 per cent. over other lamps is effected by the use of the Continental lamp.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is carrying a stock of standard apparatus at its Westfield, N. J., factory, and at its New York office, 136 Liberty Street, for the convenience of its eastern customers. It also has facilities at its Westfield factory for manufacturing any special motor controlling devices promptly.

WORM GEAR CUTTING.—The Garvin Machine Company, New York, on a large mailing card announces that it has facilities for quick cutting and finishing gears with standard hobbed teeth up to 20 inches diameter. A list of the standard hobbs in stock is given. The company also announces that it cuts and planes beveled gears up to 12 inches in diameter.

CONVEYING AND HOISTING MACHINE.—The C. W. Hunt Company, of West New Brighton, N. Y., has issued a neat little pamphlet giving an introduction to the general line of machinery manufactured by it. Only a portion of the manufactures is illustrated. The list includes industrial railways, electric locomotives, steam and electric hoisting engines, etc.

ELECTRIC PLANTS IN FOUNDRIES.—Representatives of the Carnegie and Federal Steel Companies have been inspecting the electric plant of the Bullock Electric Manufacturing Company in Norwood, Ohio. The gentlemen propose to construct an electric plant at Youngstown, and the Carnegie Company is contemplating the installation of several like plants in Eastern Pennsylvania.

LIGHTNING ARRESTERS.—The Garton-Daniels Company, Keokuk, Ia., in pamphlet No. 28, just issued, illustrates and briefly describes the Garton lightning arrester for use on electric railways, light and power circuits, either for direct or alternating currents. The operation of these devices is fully described in the company's general catalogue, which may be obtained on request.

TELEPHONES AND SWITCHBOARDS.—The Sun Electric Manufacturing Company, Philadelphia, Pa., has issued a 28-page catalogue of its line of telephone apparatus. This company has a new manufacturing plant which is strictly up to date, and it guarantees its apparatus, both as to its efficiency and mechanical construction. The illustrations show the construction of these devices very clearly.

H. F. BORBEIN & COMPANY.—The business of H. F. Borbein & Company, manufacturers of automobiles, running gears and parts, St. Louis, Mo., has been bought by the Brecht Automobile Company. The latter concern will manufacture automobiles and running gears on a large scale at 1201 Cass Avenue, St. Louis. Mr. H. F. Borbein, who is interested in the new company, will be manager of the mechanical department.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, Philadelphia, has recently added to its already extensive list of good agencies, an agency for the Guttmann wattmeter. It reports having received numerous orders, many of which are duplicate ones, which speaks well for the meter. Mr. Roberts also reports being extremely busy in other lines and that the outlook for spring business with the company is most encouraging.

SIMPLEX TELEPHONES.—The Simplex Interior Telephone Company, of Cincinnati, Ohio, describes and illustrates its various styles of telephone apparatus for factories, stores, offices, hotels, residences, street railways, etc. The company's products embrace intercommunicating instruments, telephones for short line work, hotel and telephone annunciators, hotel telephones, switchboards for apartment houses, and street railway telephones.

TELEPHONE APPARATUS.—The Haines & Noyes Company, Chicago, Ill., has issued six bulletins, A, B, C, D, E and F. These are devoted to descriptions and illustrations of the various styles of telephone apparatus manufactured by this company. Bulletin A relates to intercommunicating systems; B, apparatus for hotels and public buildings; C, apartment house telephones; D, telephone exchanges; E, railroads, and F, grange and party lines.

VOLTAGE REGULATORS.—Mr. W. H. Chapman, Portland, Me., manufacturer of the Chapman Voltage Regulator, has recently removed his headquarters to the Southworth Block on Middle Street, where increased factory facilities have put him in position to handle his increasing business more promptly than ever. He reports that the demand for these instruments is rapidly increasing, and many duplicate orders are being received from various parts of the country.

PROTECTIVE PAINT is a necessity in the maintenance of iron and steel structures. The "Carbonizing Coating" manufactured by the Goheen Manufacturing Company, Canton, Ohio, is recommended by the manufacturer as a durable and perfect protective paint and a preservative from rust and corrosion. In a catalogue just issued by the company many illustrations of buildings, railroad trestles, roofs, etc., treated with "carbonizing coating," are shown in connection with copies of testimonial letters.

DRAWING INSTRUMENTS.—Because of the difficulty experienced by its students in small towns in securing suitable drawing instruments, the International Correspondence Schools of Scranton, Pa., have arranged to sell an outfit to students only at about half the usual retail price. Among the recent visitors at the International Correspondence Schools were Arnold Shanklin, of the National Cash Register Company; K. Yonekra, chief engineer of the Hakkaido Coal & Railroad Company, Japan, and K. Kamio, electrical engineer of the same company.

I. T. E. CIRCUIT BREAKERS.—"Circuit Breaker Practice" is the title of a publication of the Cutter Company, Philadelphia, treating of the progress made in the art and the development of various types of circuit breakers for special uses. The April number, which is the first one, includes the following articles: The Principle of Automatic Circuit Breakers; Circuit Breakers Contrasted with Fuses; Circuit Breakers as Indicators, and Circuit Breakers for the Protection of Generators. The publication is in pamphlet form and the type is unusually large so as to facilitate easy reading.

PUMPING MACHINERY.—A general catalogue has just been issued by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, in which are illustrated and described pumping machinery, jet and surface condensers, air compressors, etc. In addition to this line of work the company manufactures the Victor turbine water wheel, and the Stilwell motor and purifier for exhaust and waste steam. The catalogue contains 124 pages and is very artistically illustrated with the various types of machinery described. In addition to the descriptive and illustrative matter there are some useful engineering tables.

PROGRESS IN RAILROADING.—In a leaflet issued by the New York Central & Hudson River Railroad Company, some idea of the marvelous development in railway practice is given. It appears that in 1844 it took 30½ hours to travel by mail train from Albany to Buffalo. Now it takes 5 hours and 37 minutes by the Empire State Express. In 1844 the cars were lighted with candles; there were no sleeping cars and meals were obtained at primitive taverns. In 1901 the cars are lighted by both gas and electricity, and the trains include sleeping cars at night and parlor cars by day, together with dining cars, etc.

MR. J. L. PUTNAM, the engineer of The Clark Automatic Telephone Switchboard Company, of Providence, has just returned from Buffalo, where he has been spending considerable time upon the exhibit which the company is preparing for the Pan-American Exposition. The automatic telephone will probably prove one of the most interesting attractions among the electrical exhibits for manufacturers and others who have need of large interior systems and for municipal authorities looking for the cheapest method of installing and maintaining a telephone system in their community. The need is growing daily, and there is doubtlessly a good future in store for the company which can meet the requirements.

THE RAHN-MAYER CARPENTER COMPANY, of Cincinnati, manufacturer of engines and turret lathes, has sent out a celluloid match safe with the name of the recipient engraved thereon. On one side is a fac-simile of a portion of its letter-head, while on the reverse side is an illustration of its lathe. The company is sending out this matchbox not only to call attention to the lathe, but as a reminder of the fact that it is built only by skilled artisans, who have been picked from among the best mechanics in America, therefore guaranteeing that every machine turned out by it will be just as carefully made as it is possible for skilled workmanship to produce.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., announces the issue of a new Bulletin. This one is No. 116, and illustrates and describes a new type of S. K. C. static ground detector, designed for circuits carrying very high voltages. This is said to be the first instrument of the kind combining thorough reliability with absolute immunity for switchboard attendants from danger of shock. The vanes of the instruments are charged statically through the medium of condensers, thus live wires are kept out of and entirely away from the instrument. Those familiar with ground detectors and their uses and advantages will be prompt to appreciate its superiority. A copy of the bulletin will be mailed to all such upon request.

ANNIVERSARY CELEBRATION.—The W. R. Garton Company will celebrate its third anniversary on May 1 by moving into its new quarters at 118 Jackson Boulevard, West, Chicago. Its business has shown a substantial growth and extends practically from one coast to the other. It has also built up a very nice foreign trade and it is now compelled to get into larger quarters to accommodate its expanding trade. The W. R. Garton Company acts in the capacity of manufacturers' agent and engineer, and although it started out to confine its trade to the railway field, it is compelled to take care of an increasing business in the electric light and power departments as well. The company will be prepared to take prompt care of this business in its new quarters.

HOTEL TELEPHONE EQUIPMENT.—The Lambert Schmidt Telephone Manufacturing Company has just secured a contract for equipping the Majestic Hotel, Seventy-fourth Street and Central Park West, with a 400-drop switchboard equipment, this installation being one of the largest of its kind in New York. Its common battery system will also be used there. The company makes a specialty of this class of installation, and already numbers many of the higher grade of apartment houses and hotels among its patrons. Instances of this same system in factory use are its recent installations of large switchboards and telephones at Messrs. Lehn & Fink, William and John streets, New York; the Fulton Foundry & Machinery Works, Brooklyn, N. Y., and many others.

THE PHOENIX ELECTRIC TELEPHONE COMPANY, New York, has just closed contracts with the Amsterdam Automatic Telephone Company, Amsterdam, N. Y., for a 300-drop trunking switchboard and a 300-drop combined lightning arrester and distributing frame; a complete 700-drop plant, including switchboards, lightning arresters and distributing board, with the latest type of long distance telephones, for the Colonial Telephone Company, of Newburgh, N. Y.; a complete 500-drop plant for the Dutchess County Telephone Company, Poughkeepsie, N. Y., and five switchboards and combined lightning arresters, of from 50 to 200 drops each, and 500 telephones, for the South Carolina Long Distance Telephone Company, Columbia, S. C. The Phoenix Company is again doubling the capacity of its factory.

INDUCED DRAFT.—The equipment of the great shipbuilding plant of the Fore River Engine Company at Quincy Point, Mass., exemplifies in marked degree the varied applications of the fan blower. Draft for its boilers is produced by an induced draft fan drawing the gases directly from the uptake flue and discharging them through a small stack extending only a few feet above the roof. Under the forced system fan draft is likewise employed for creating the necessary intensity of combustion in the heating furnaces and forges while the smoke is removed from the forges through hoods communicating with an exhaust fan. All buildings are heated by the hot blast system, and notwithstanding their exposed position this, the first winter, has been passed with perfectly uniform internal temperature throughout all of the buildings. The entire equipment of blowers and heating apparatus was installed by the B. F. Sturtevant Company of Boston, Mass.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has just issued to the trade two catalogues, one on direct, and the other alternating current fan motors and ceiling fans. It is offering for alternating currents the New Model 1901 Emerson desk fan motors and ceiling fans. It has handled this fan for some years. The Emerson fan is too well known to need description. It calls special attention to the Parker noiseless blades with which all its fan motors are equipped. These are patented. They do away almost entirely with humming noises. For direct current it is offering the Peerless desk fan motors and ceiling fans, and is now prepared to make shipments for any voltage. In the Peerless it has a fan simply and strongly made, graceful in appearance and practically noiseless in operation. It has self-oiling and self-aligning bearings and self-adjusting carbon brushes; the highest possible efficiency, and the price is low. They mail these catalogues on application.

NEW EAST RIVER BRIDGE.—On April 7, the John A. Roebling's Sons Company took the first important step in the making and laying of the cables for the new East River bridge at New York. The contract was awarded to the company several months ago, and the preparations of plans and other preliminary work, as well as the main part of the contract, which is to follow, is under the supervision of Mr. Charles G. Roebling, the president of the company, who is assisted by Mr. William Hildenbrand. The work done last week was the placing in position of the 2¼-inch diameter ropes which support the temporary foot bridge on which the workmen will stand during the main work of cable laying. Several methods of getting the first line across have been employed in the past, and kites, swimmers and other agents have been tried, but the method employed on this occasion has, it is believed, never been tried before, and is a distinct advance over all previous ones. The method adopted was to carry the drum containing the cable across the river on a float (one end having previously been secured) and pay out the cable allowing it to rest on the river bed until at the proper time it could be raised from the water and to the desired height by means of a stationary engine and drum. The first cable was successfully raised on April 11, the time required being only seven minutes, navigation being, of course, suspended during that period.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 9, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney Times Bldg., N. Y.]

671,438. TROLLEY FINDER FOR ELECTRICAL RAILROADS; P. Goldsmith, Troy, N. Y. App. filed Aug. 16, 1900. Insulated seats for the wire are placed adjacent to the trolley wheel and the wire is directed into these seats when it leaves the main contact wheel.

671,445. DOOR FOR TROLLEY CAR BARNS; W. R. Kinnear, Columbus, Ohio. App. filed Nov. 7, 1900. The doorway is closed by a vertically moving curtain having a section of the trolley wire on its lower edge.

671,458. ELECTRIC TELEPHONE RECEIVER; E. H. Strauss & F. J. Stein, Chicago, Ill. App. filed Aug. 13, 1900. Details of construction.

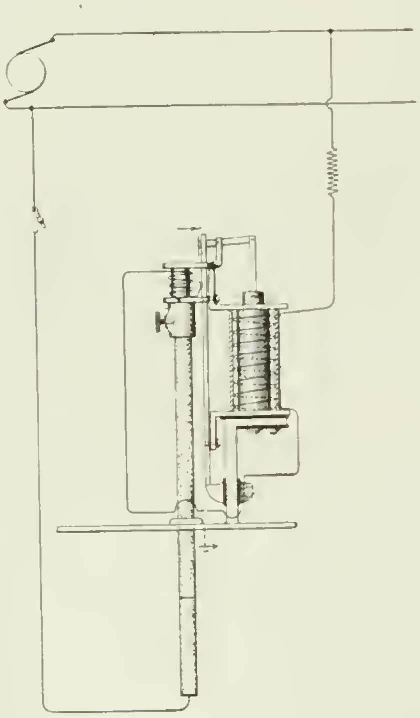
671,473. HOLDER FOR TELEPHONE RECEIVERS; T. Emerson, Newport, R. I. App. filed Sept. 27, 1900. A bracket to support the receiver while it is in use.

671,482. ELECTRIC RAILWAY SYSTEM; P. E. Herkner, Berlin, Germany. App. filed Nov. 30, 1900. The resistances which are used in controlling the motors on the car are in the form of magnet spools, so arranged as to magnetize the wheel, so that during acceleration or braking or whenever an excessive supply of current occurs, a maximum track adhesion will be obtained without the operation of any separate switching device.

671,489. BOOSTER CRUSHER; M. Pfatischer & C. H. Bedell, Philadelphia, Pa. App. filed Aug. 24, 1900. Automatic devices are arranged to alter the field magnet of a motor-generator in such a manner as to increase the difference of potential between two points of a generator circuit, or decrease the same in order to keep the said difference of potential constant.

671,490. CONTROLLER FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Dec. 30, 1897. A switch is so arranged that it will reduce the controlling resistance by one-half and at the same time double its current carrying capacity when the motors are connected in parallel.

671,491. SYSTEM FOR TRAIN CONTROL; W. B. Potter, Schenectady, N. Y. App. filed June 12, 1899. In an electric train system, a plurality of motor cars, a controlling system for said train, and a controller provided with means for adjusting its capacity to correspond with the number of motor cars in the train.



671,512.—Electric Arc Lamp.

671,512. ELECTRIC ARC LAMP; T. E. Drohan, Chicago, Ill. App. filed June 12, 1900. The feed of the carbons is controlled by a magnetic clutch.

671,515. CONTACT SHOE FOR ELECTRIC RAILWAYS; G. T. Hanchett, Hackensack, N. J., and J. M. Murphy, Torrington, Conn. App. filed July 27, 1900. The contact shoe has a curved contacting face and is pivoted at one end to a link which is pivotally connected with the hanger, the shoe thereby being free to rock upon the conducting rail.

671,603. ELECTRIC LAMP RECEPTACLE; W. E. McDonald, Chicago, Ill. App. filed Sept. 22, 1897. Provision is made for inserting the lamp receptacle in a line of tubing.

671,618. FLEXIBLE AND ADJUSTABLE SUPPORTING DEVICE FOR ELECTRIC LAMPS; W. F. Brewster, New York, N. Y. App. filed Nov. 30, 1900. For electric sign purposes the lamp receptacles are mounted upon pivotally connected sections, so that the shapes of the figures making up a sign, may be varied at will.

671,619. FLEXIBLE SUPPORTING STRUCTURE FOR ELECTRIC LAMPS; W. F. Brewster, New York, N. Y. App. filed Nov. 30, 1900. A modification of the preceding.

671,660. ELECTRICALLY OPERATED FAN; R. W. Schmelz, Brooklyn, N. Y. App. filed Nov. 6, 1900. Two solenoids are arranged to vibrate a swinging fan or punkah.

671,662. ELECTRIC MOTOR; H. P. White, Kalamazoo, Mich. App. filed Oct. 5, 1899. The armature and field magnet both rotate, and are connected together through a differential gearing, so that as the motion of the field magnet is lessened, the greater will be the speed of the armature, though it will then run with less torque, and vice versa.

671,715. SYSTEM OF ELECTRICAL DISTRIBUTION; C. I. Young, Philadelphia, Pa. App. filed Aug. 8, 1899 (See Current News and Notes.)

671,725. HEATER FOR ELECTRIC GLOW LAMP; Frederick M. Goddard, of Pittsburg, Pa. App. filed July 20, 1899. The heating wire is wound in grooves in one face of a flat body of insulating material like talc.

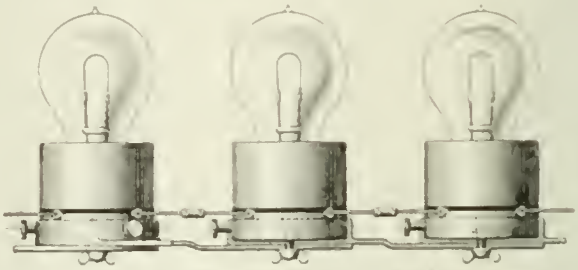
671,730. FREQUENCY OR SPEED INDICATOR; R. D. Mershon, New York, N. Y. App. filed July 12, 1899. (See Current News and Notes.)

671,732. WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 18, 1900. Relates to the construction of the plugs between which the metallic particles in the tube of the coherer are confined.

671,762. JUNCTION BOX; E. T. Greenfield, New York, N. Y. App. filed March 2, 1901. The necks of the junction box with which the tubes are connected are given a bell shape internally, so as to avoid injuring the conductors when they are drawn through.

671,763. JUNCTION BOX; E. T. Greenfield, New York, N. Y. App. filed March 2, 1901. A modification of the preceding.

671,776. ANNUNCIATOR; D. Ro[illegible]u, New York, N. Y. App. filed July 21, 1899. Details.

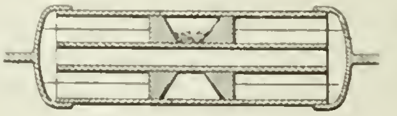


671,619.—Flexible Supporting Structure for Electric Lamps.

671,863. TEMPERATURE ALARM AND INDICATOR FOR CAR AXLE BOXES, R. C. Callum, Washington, D. C. App. filed Oct. 5, 1899. A thermostat located in or near the axle box will send an alarm to the engine cab, when the temperature of the axle rises above a certain degree.

671,866. ELECTRIC RAILWAY SYSTEM; J. M. Murphy, Torrington, Conn. App. filed Aug. 4, 1898. An electric railway system, having an electromagnetic switch for shunting the feed circuit and initially operated by a source of energy on the car, said source of energy comprising a rotary transformer having an auxiliary winding for the field-cores in circuit with the high potential armature through the switch controller.

671,876. SELF-LOCKING INSULATOR; W. P. Beardsley, Altoona, Pa. App. filed March 19, 1900. A device whereby the wire will be automatically locked in the insulator against sagging after having been stretched during the operation of stringing.



671,732—Wireless Telegraph System.

671,883. ELECTRIC SWITCH; F. Head, Philadelphia, Pa. App. filed Jan. 28, 1901. An electric switch operated by fluid under pressure, said switch having a magnet to govern the pressure at which it opens and having a spring operative upon the movable member of the switch which determines the pressure at which it closes.

671,891. ELECTRIC TOY; A. A. Kent, Lebanon, N. H. App. filed Jan. 29, 1901. An electric motor adapted to rotate a number of color disks is started by giving its armature spindle a twist which at the same time closes the motor circuit by stopping the spindle. The circuit automatically opens, the device being therefore easily handled by a child.

671,907. CONTROLLER FOR MOTORS; F. B. Duncan, Madison, Wis. App. filed July 9, 1900. The operation of the rheostat is controlled by a solenoid and a spring; the solenoid releases the moving arm so that it may travel back on the action of the spring.

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NEW YORK, SATURDAY, APRIL 27, 1901.

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The Havoc of the Storm.

It looked as though the Middle and Eastern States were escaping with a fairly mild and harmless winter, but the storms of the past week have resulted in the usual floods, stalled trolley systems, steam railroad washouts, and broken telegraph and telephone lines. The telegraph lines have suffered particularly, as any one will bear witness who has tried to communicate East and West this week. The telegraph companies have been prompt in their efforts to repair, but the damage has been too extensive to be dealt with in five minutes, and the result is the whole business of the country has suffered. We know that many veteran telegraph managers do not believe in the feasibility of putting transcontinental lines underground, but it does seem to us that here again ingenuity should find a solution for the problems, including those of expense, clogging "capacity," etc. For example, such plans as those of Dr. Pupin suggest a way out of many serious difficulties, and ought to be tried very thoroughly. The wastefulness of such ruin as these spring snows and floods bring in their destruction of aerial electric circuits is a stimulus to every inventor and engineer in getting underground all the wires that can be put there.

Street Lighting.

A very interesting report on the subject of street lighting has just been issued by the committee on light of the Board of Legislation of Cincinnati. It is a record of visits paid by the board to the cities of St. Louis, Chicago, Milwaukee, Pittsburg, Allegheny, Baltimore, Washington, Philadelphia, New York, Hartford, Boston, etc., and notes their observations on this very important branch of municipal work. There seems to have been some kind of idea of adopting Welsbach incandescents in the streets of Cincinnati, and the committee devoted its energies to finding out whether a change to that form of illumination in the place of electricity would be advisable. Its decision points emphatically against the desirability of any such substitution.

In St. Louis the enclosed arcs are much preferred, and "the general sentiment seems to be that Welsbach street lighting is not a success for the business part of the city." The same results were reported by Mr. Ellicott, city electrician of Chicago, who stated that "where electric lights are used the streets are much better lighted than those on which other illuminants are used; and that the cost of lighting per mile of street per year is about 10 per cent more with gas than with electric arc lamps." From Baltimore the same results were obtained. "Welsbach gas lamps are in Baltimore found to be unsatisfactory for the business section of the city where electric lighting is used exclusively." In Boston it was discovered that "arc lamps are not replaced by Welsbach lamps in any portion of the city but that Welsbach gas lamps are to some extent being replaced by arc lamps." These statements will serve to offset many of the efforts made lately in different parts of the country to crowd out electric lighting by representations that the Welsbach system is more efficient and is worsting its adversary.

The conclusion of the whole matter is that the arc lamp is about as permanent as anything can be in its present function of street lighting, but the report points to the fact that the enclosed arc is preferred to the open, as mitigating the "glare," without diminution of serviceability. The committee, indeed, closes its report by specific recommendations of the enclosed arc above all the other illuminants seen by it in use.

Speed Variations of Direct-Connected Engines.

Mr. Kruesi's article upon this subject shows how complex is the problem of causing two reciprocating engines to run smoothly in unison; in fact, considering the magnitude of the forces which have to be reversed many times a minute in a large reciprocating engine, it is, perhaps, wonderful that they can be made to maintain steady rotation of their flywheels or attached generator armatures as closely as they do in actual practice. This is another reason why electrical engineers look with hope to the advent of the steam turbine which, if successful in other directions, will probably eliminate the difficulty of the pulsation that is occasionally found in the existing reciprocating engine. Considering how successful simple rotary motion is in the operation of the electric generator, it is a pity to have to employ reciprocation in the engine which drives it. We think that the variation of speed and acceleration in engines of the best existing types is, however, often exaggerated, and that difficulties in running large generators in parallel are sometimes attributed to the engine when, in reality, they are due either to other causes of dissymmetry between the units, or to defective governor action.

An Electro-chemical Phonograph.

Some twenty years ago a few inventors worked to produce a telephone, and after many efforts a telephone was developed. After the guiding principles were thoroughly understood by the multitude of electrical workers in general, the difficulty was actually experienced of putting electrical apparatus together so as to avoid making a telephone. There were hot-wire telephones, and electrostatic telephones and chemical telephones. Almost any electric apparatus could be modified into developing some telephonic action.

There has been something similar in the case of the phonograph. Originally, a phonograph was produced at great labor and effort. Now it becomes possible to construct various kinds of phonographs. The latest is an electro-chemical apparatus. Nothing can, perhaps, be imagined less likely to "talk back" than an electroplating vat. Yet Messrs. Nernst and V. Lieben describe a minute electrolytic cell in which voice currents set up minute and imperceptible surface variations on a moving electrode, such as will re-establish current variations in a similar cell and reproduce the vocal sounds. The Poulsen electromagnetic phonograph is another instance of delicate and imperceptible surface variations occurring in a moving band of iron, capable of reacting subsequently upon a telephone circuit, and duplicating the original vocal sound.

It would be of great interest to pursue the inquiry further into the nature of the superficial variations which occur in the electrolytic phonograph. They may be, of course, exceedingly minute, since the rapid vibratory repetition of a very feeble disturbance may eventuate in the production of those feeble vibrations to which human ears are sensitive; but a study of the nature of these delicate superficial changes in the electrode should prove of considerable interest and importance.

Compensated Compounded Alternators

An article this week by Mr. E. J. Berg has special interest in view of the importance of automatically compounded alternators. In the direct-current, constant-potential generator the drop of pressure in the armature is proportional to the current strength delivered at its terminals, and, consequently, it is not a difficult matter to compensate its excitation for variable load. The excitation has to be a certain minimum for rated voltage at no load, and also a certain maximum to maintain the rated voltage at full load. If the number of field turns in the series winding is such that the full-load current will just produce the extra magneto-motive force required at full load, then the compensation will be nearly correct for all lesser loads.

In the case of alternators, however, the matter is much more complex. The drop of pressure in the alternator is indeed proportional to the strength of outgoing current, as before, but since the phase of the current varies with the nature of the load, the effect of this armature drop upon the terminal pressure is markedly affected by the phase of the current delivered, which in its turn is affected by the power factor of the load. Consequently, we have with constant excitation the anomalous conditions: First, that the reduction of pressure at the terminals under load is not proportional to the outgoing current, but increases more rapidly than the current; and, second, that whereas a greater lag of current, accompanying a small power factor, rapidly increases the apparent drop for any given strength of current, a condenser load may actually increase the terminal pressure, or produce a negative apparent drop. Consequently, no method of automatic compounding can be successful which does not take the phase of the outgoing current into account. As a result of this complexity, we find that larger alternators are almost invariably constructed uncompounded, and possessing an apparent drop of from 5 to 10 per cent under full, non inductive load; while this drop greatly increases with inductive loads. In other words, large alternators have to be regulated by hand for constant pressure under varying load.

The only accurate method of compounding such a machine automatically is, as Mr. Berg shows, to supply to its fields a magnetomotive force which is the vector sum of two components, one representing to scale the normal no-load voltage, and the other representing to phase and scale the drop actually occurring in the armature. The vector sum total magnetomotive force would then produce the proper internal e. m. f. in the armature, from which the actual drop would leave the required terminal e. m. f constant, under all normal loads, no matter how the current might vary in magnitude or in phase. On the assumption that the flux in the magnetic circuits of the alternator are substantially proportional to the magnetomotive forces, the pressure at the field terminals of the alternator must be a vector sum of a constant pressure and of a variable pressure representing the actual armature drop to scale and phase. If the magnetic circuit is fairly well saturated, then the compensation will be rendered imperfect, but if the vector compensation is correct at full load it is usually not far in error at lesser loads.

Having developed the theory of automatic compensation, the article proceeds to describe the method actually employed in the machine represented. It is not easy to understand from the description just how the compensation is effected in this case, and a clear description of the *modus operandi* would be very interesting. It would appear that the method is an approximate one, and does not aim at accurate compounding. On the other hand, however, according to the numerical results quoted, the terminal voltage of the alternator is kept constant to within a small fraction of one per cent, and this is so nearly accurate as to leave nothing to be desired. The connections seem to show two armatures and two fields in the exciter, one field and one armature being rotated synchronously with the alternator.

ELECTRO-CHEMISTRY.

The institution recently in one of our great universities of a department of electro-chemistry brings to mind the neglect to which in the past this branch has been subjected in American technical schools. It is true that electro-chemistry figures as a study in the courses of perhaps all such schools, but in most cases the instruction appears to be meagre in quantity and antiquated in character. Such indications as may be gathered from college registers denote a lack of recognition of the great revolution operated in the theories and methods of this branch by the Arrhenius-Van't Hoff-Thomsen-Nernst-Ostwald school. Indeed, we know of no English text-book in use which gives any adequate treatment of modern electro-chemistry as established by this school. This conditon is reflected by the absence of English equivalents for many important German electro-chemical terms, as is illustrated from time to time in these columns in articles contributed by writers who have received their instruction in electro-chemistry in Germany. In this country the instruction is evidently largely based upon the theories and methods current a quarter of a century or more ago, and it is high time for measures to be taken to correct this unenviable situation. It may be said that the theories of the continental school are not as yet sufficiently established to replace as a basis for electro-chemical technics those of the Faraday-Berthelot school, and it must be admitted that some of the conceptions are highly transcendental in character. The fact remains, however, that these theories are illuminating as applied to explanation of processes, and have been highly fruitful in practical results. The electro-chemical industry has even now reached enormous proportions in this country, and no field offers a better future than this to the properly equipped technical graduate. As a consequence, any of our larger universities would be amply justified in establishing a chair in electro-chemistry, which might well be filled by an American graduate of a German course, or by a German teacher of note.

The Hewitt Vapor Lamp.

We give in a brief article by Mr. Cooper Hewitt this week curves showing the characteristics of the very brilliant and striking vapor-tube lamps shown by him at the recent Conversazione of the Institute. This exhibit is very noteworthy, both from a theoretical and from a practical standpoint. The use of mercury vapor or kindred substances instead of a solid conductor at incandescence, or a tube of rarified gas under excitation of high-tension electric discharges, leads to a set of curious quasi-conductive properties of a most interesting character. Study of them is likely to lead to results of no little theoretical importance, particularly in view of the fact that mercury has a monatomic molecule and a high atomic weight. Its spectrum, too, bears some curious relationships to those of the other members of its metallic family, and the power of getting from tubes like Mr. Hewitt's a tremendously powerful and very steady light facilitates research into these relationships. If these tubes were merely intended for scientific purposes they would offer a splendid field for investigation into some of the most abstruse problems of molecular dynamics, and we trust that such an opportunity will not pass unutilized. But in this case pure science and applied science join hands, for in these tubes we have seen publicly exhibted for the first time really powerful lights of a type hitherto commercially unutilized, lights of intensity great enough to be taken seriously, and of efficiency undoubtedly much higher than any form of incandescent lamp proposed. A total horizontal intensity of 500 to 1000 candle-power is great enough to compete with ordinary arc lamps, and that it is produced by direct current of voltage such as is ordinarily available, is a strong recommendation from a practical standpoint as against radiants that can only be worked by alternating currents perhaps of transcendental frequency.

But with all these things in its favor it is still a far cry from even the brilliant exhibits of the other evening to a lamp that will meet the every-day requirements of commercial work. No one recognizes this more fully than Mr. Hewitt himself, whose modest notes in this issue are a model of self-restraint that we can commend to inventors in general. The first and most obvious difficulty to be overcome is met in the color of the light, which in its natural state is quite impossible from an artistic standpoint, and in so far as it is due to mercury vapor cannot be really remedied by any conceivable arrangement of shades. For the thing lacking is the red component of ordinary illumination, and there is no process known under heaven among men by which colored shades or screens can put anything into a light which was not there originally. Now, mercury gives a spectrum practically devoid of red lines, and the light from its vapor can therefore never be screened into its proper color-tone except by suppressing most of it. But we cannot believe that the color situation is therefore irremediable. There is a good opportunity, under the conditions of use of these tubes, to add such substances as will provide the red rays which lack. It may be something of a task to find the right corrective, for most obviously it must not interfere chemically with either the glass of the tubes or the mercury or other substances which are concerned in the production of light. This condition, however, seems by no means impossible of fulfillment. It seems to us that this matter of color is all-important, and must be satisfactorily settled before either this or any form of vacuum tube lamp can find a place in practical illumination. Of the efficiency of Mr. Hewitt's tubes there seems to be no reasonable doubt. Of course, the measurements were in cylindrical rather than spherical candle-power, and this fact must be taken into account in comparisons; but discounting this matter one still has an efficiency comparable with the electric arc at its best considerably better than a watt per spherical candle-power.

In fact, Mr. Hewitt's tubes are far more closely comparable to arcs than to any other form of radiants. In characteristics they appear to be substantially arcs in conducting vapor, as contradistinguished from discharges such as are produced in Geissler tubes. So far as appearances go, they give more light and give it more efficiently than arcs in air of the ordinary enclosed type. But we have seen no statements and can form no opinion from the data at hand of the probable amount and rapidity of deterioration. The temperature of the vapor is by no means low and the amount of energy dissipated per tube is about the same as in an arc lamp. Whether it will be easy to get tubes that will stand up under the protracted high temperature without breaking or tending to become opaque, remains to be seen. Aside from this question of life the chief remaining difficulty to be overcome is the very considerable sensitiveness to variations of voltage which is apparent from the curves. This is something akin to that exhibited by Nernst lamps, which have to contend with the same trouble, and in both cases a remedy may reasonably be expected in due season; indeed, Professor Fessenden, in a recent patent, discloses what appears to be a satisfactory solution for this difficulty with respect to the Nernst lamp. High efficiency lamps of any form are plentifully supplied with troubles of their own, and it would be quite too much to expect that one should escape its due share. But the workers in this field deserve every encouragement, for the inefficiency of the common incandescent lamp is a standing reproach to human ingenuity. We believe at least that the beginning of the end is near at hand. Perhaps we may never get light without heat, or even as near an approximation to it as the firefly exhibits for our confusion on summer nights, but there surely is a reasonable chance for a light far better than has yet been reduced to commercial form. Mr. Hewitt is certainly to be congratulated on having obtained the union of two very valuable properties, good intrinsic brilliancy and very great efficiency We hope that in its further development he will be equally successful in combining these with all the elements of commercial success.

Bell Telephone Personnel.

It was stated in these pages as far back as last February that Mr. F. P. Fish, counsel of the American Bell telephone interests, would succeed the late Mr. Hudson as president of the American Telephone & Telegraph Company. The election of Mr. Fish was only made last week, and the new incumbent will enter upon his duties in July, when the acting president, Mr. Cochrane, gives up the office. The Bell interests are to be congratulated upon their choice, which has required, however, that Mr. Fish should make serious sacrifices in regard to his profession. The fact hardly needs stating that Mr. Fish, by great natural ability, coupled with training and practice of the most severe character, has placed himself at the very front of the patent bar, and has been distinguished by his brilliant association with some of the most notable patent litigations ever fought out in United States courts. With a monumental capacity for work, and a mind of strongly judicial cast, Mr. Fish was bound to go far and high in his profession, had he remained active in it, but like one or two other men of the same stamp, he has now been called to the control of the destinies of a great commercial corporation. It goes without saying that these new duties will require a concentration of effort, and necessitate the relinquishment of other work, such as that he has long done as counsel for the General Electric Company. Indeed, it is hard to picture that company without Mr. Fish prominent in its affairs, and it is no reflection on the directive capacity of President Coffin to say that in the executive as well as the legal aspect of his heavy duties he has long leaned with confidence on the sound advice of his close personal friend, Mr. Fish, throughout a development well-nigh unparalleled in American industrial history.

The other important news in Bell telephone is that Mr. John I. Sabin, whose remarkable work on the Pacific Coast has been made the subject of recent articles in the ELECTRICAL WORLD AND ENGINEER, will be brought to the Central States to repeat his work. It is now announced that Mr. Sabin has been elected president of the Chicago Telephone Company and of the Central Union Telephone Company, and will thus wield the Bell authority in the States of Iowa, Illinois, Indiana and Ohio, excepting Cleveland and Cincinnati at present. It is stated that the Pacific Coast work will be duplicated in these States, where the "Independents" have made enormous headway, and that Mr. C. E. Nestor, who has been at the head of Mr. Sabin's canvassing bureau and more lately of aggressive work for the Erie system, will have in hand the new campaign, upon which it is said some ten millions may be spent for new equipment, etc.

Automobile Club Annual Dinner.

A most successful second annual dinner was given by the Automobile Club of America at the Waldorf-Astoria on April 18. The work of arrangements was in the hands of Mr. J. M. Hill, acting chairman of the House Committee, who is entitled, with Secretary Malcolm M. Ford, to credit for the smoothness with which the affair went off. There were many electrical men present, including T. A. Edison, H. Ward Leonard, A. L. Riker, C. J. Field, W. S. Mallory, W. E. Gilmore, R. E. Dyer, W. Mandelick, H. M. Byllesby, H. McA. Lloyd, H. Sanderson, Isaac L. Rice, J. H. Hoadley, T. J. Ryan.

The dinner was presided over by Mr. A. R. Shattuck, the able president of the club. Lieutenant-General Nelson A. Miles sat on the president's right, and others who occupied places at the guests' table were General Roy Stone, Edward A. Bond, State Engineer; Colonel John Jacob Astor, Dr. H. H. Kane, president of the Road Drivers' Association; A. C. Bostwick, vice-president of the Automobile Club; H. B. Fullerton, of the Long Island Automobile Club; Captain Edgar Jadwin, representing Elihu Root, Secretary of War; D. R. Budd, Commissioner of Roads for New Jersey; Representative J. S. Sherman, Thomas M. Moore, T. C. Martin, toast master, and J. Dunbar Wright.

In responding to the toast of the National Highway Commission General Miles complimented the Automobile Club on the prominent stand it had taken in the cause of good roads. Road improvement, he said, was an evidence of civilization, and in assuming the lead in the movement the automobilists had naturally become leaders in civilization. He pointed out that, though the Romans had built good roads primarily for military purposes, commercial advantages had followed in their train. "If, as has been calculated," he said, "ninety-nine per cent of every load by railroad, steamboat or express must be carried in a wagon or truck over a highway; if the cost of transportation is increased more than three times by bad roads, and the mud fiend swallows up more than $500,000,000 a year, the question of road improvement seems to me to be at one and the same time the plainest and the most important economic problem for this country to consider."

State Engineer Bond, in responding to the toast, "Present Necessities for State Aid in Highway Improvements," predicted that the time was not far distant when there would be a great national highway from Maine to California. He caused much enthusiasm by announcing that a proposition was being considered at Albany to issue State bonds for $5,000,000 to be used toward improving the roads of the State. He stated that last year the amount of appropriations for good roads made by Massachusetts was 80 cents per capita, by Connecticut 77 cents, New Jersey 46 cents, and New York State only 3 3-10 cents per capita. He believed, however, that this State would soon outstrip the others named in this respect.

Speeches in which the good roads idea predominated were made by General Roy Stone, Congressman S. Sherman, M. J. Verdery and M. H. De Young, of the San Francisco *Chronicle*. Dr. H. H. Kane put in a word for the horse that was enthusiastically received. Mr. Verdery defined "Ideal Automobilism" as being "to let the other fellow own it and you ride in it." Mr. H. B. Fullerton also spoke up bravely in behalf of good roads.

The banquet room was most tastefully decorated, and the sorbet boxes were in the form of tiny automobiles. The menus were a very handsome work of art, decorated with what has come to be known as the Automobile Club poster, and with "automobile red" trimmings. The dinner ranks among the best ever served at the Waldorf by Oscar, who was therefore dubbed "autocar" as a fitting acknowledgment for the swiftness of the service.

Mr. Holland on Submarine Boats.

Mr. John P. Holland, the inventor of the submarine torpedo boat bearing his name, proclaimed his view in a lecture at the Carnegie Lyceum in New York City on April 22, that in the course of a few years submarine vessels would supplant surface craft for short journeys by water. Mr. Holland's very interesting lecture was one of a course now being given by the alumni of Manhattan College on scientific subjects for the benefit of that institution. Lewis Nixon introduced the speaker.

Mr. Holland said: "For transatlantic travel submarine boats will never be possible commercially. For short trips the submarine offers commercial advantages that will render it a dangerous rival of the surface-sailing vessel, if, indeed, it does not drive the latter entirely out of competition in certain waters. Take, for example, the trip across the British Channel. No other water journey causes an equal amount of suffering. The most hardened traveler becomes seasick there. Fogs and heavy traffic are constantly causing collisions. Storms toss the smallest boats about like cockleshells. The submarine boat will remove all these objections. There will be no seasickness, because in a submerged boat there is no perceptible motion. There will be no smells to create nausea, for the boats will be propelled by electric power taken from storage batteries. There will be no collisions, because the boats will travel coming and going at different depths, say, one at 40, the other at 60 ft. The water overhead may be crowded with small craft, but the submarine will have a free, unobstructed course. She will be kept absolutely true to this course by means of cables running from shore to shore. On these cables will run automatic steering gear attached to the submarine. Storms and fogs will have no existence for the traveler, for weather has little effect upon the water at the depth at which she moves. The appointments on such a vessel may be finer than anything on the surface. There will be no dampness, no stickiness. The passengers will enter a handsomely fitted cabin at Dover. Electric lights will make it cozy and bright. Neither the cold of Winter nor the extreme heat of summer may be felt. The temperature under water varies but little the year round. Almost without jar the boat will put off from her dock on the English side. Practically no vibration will be felt from the smoothly running machinery. Before the traveler fairly realizes that a start has been made the boat will be fast at her dock at Calais. This is no dream. It is simply the forecast of a trip that I expect to take myself some day."

The Engineering Side of Telephone Work on the Pacific Coast.

A SURVEY was given in these pages last week of the various causes which have contributed to the extremely rapid development of the Pacific States telephone companies under the vigorous management of President Sabin. That article dealt more particularly with the number of subscribers, rates and other social or commercial conditions of interest. We are now able to take up the discussion of the engineering side of the work.

EXCHANGE EQUIPMENTS AND OPERATION.

The switchboards and exchange equipments of the Pacific Coast have been developed along radically different lines from the usual Eastern practice, though not wholly unfamiliar there. Instead of a multiple board in which each subscriber's line terminates in a sufficient number of multiple jacks to be within reach of each operator in the exchange, a board is used on which a subscriber's line terminates in front of only two operators. One of these operators is an answering operator designated as an "A" operator. The other operator completes connections and rings only, and is known as a "B" operator. In the earlier types of board the A and B operators were placed side by side. In more recent boards the A boards are placed together on one side of the room and the B boards together on the other side.

The main exchange board at San Francisco (Figs. 1 and 2) is representative of the former type, and the Portland boards (Figs. 3 and 4), indicate the latter. In the San Francisco board it will be noticed that there are two adjoining sections containing drops and answering jacks, then two adjoining sections containing connecting trunk jacks, and so on alternately. With the old type of board, as shown in Figs. 1 and 2, the subscriber's line terminates in only one jack, and that jack is used both by the A operator, who is answering calls and by the B operator beside her who is completing connections. With the new type of board a subscriber's line terminates in front of an A operator, where his calls are answered, and also in front of a B operator on the other side of the room, who connects with him whenever an A operator calls for his number. The latter plan is hence designated as the duplicate jack system. In either case,

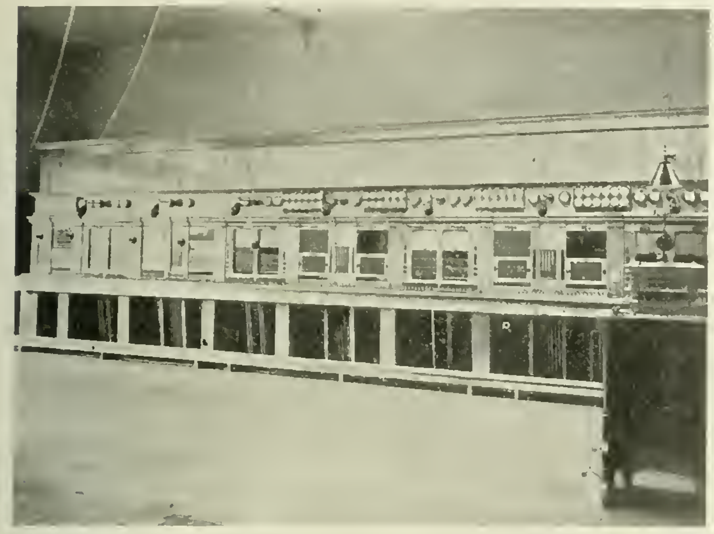
FIG. 1.—PART OF ONE OF FOUR SECTIONS, SAN FRANCISCO.

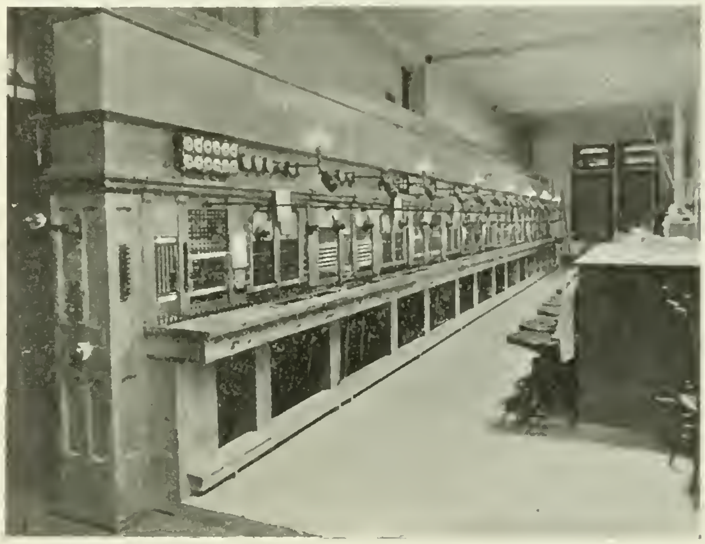
FIG. 2.—MAIN OPERATING ROOM, SAN FRANCISCO.

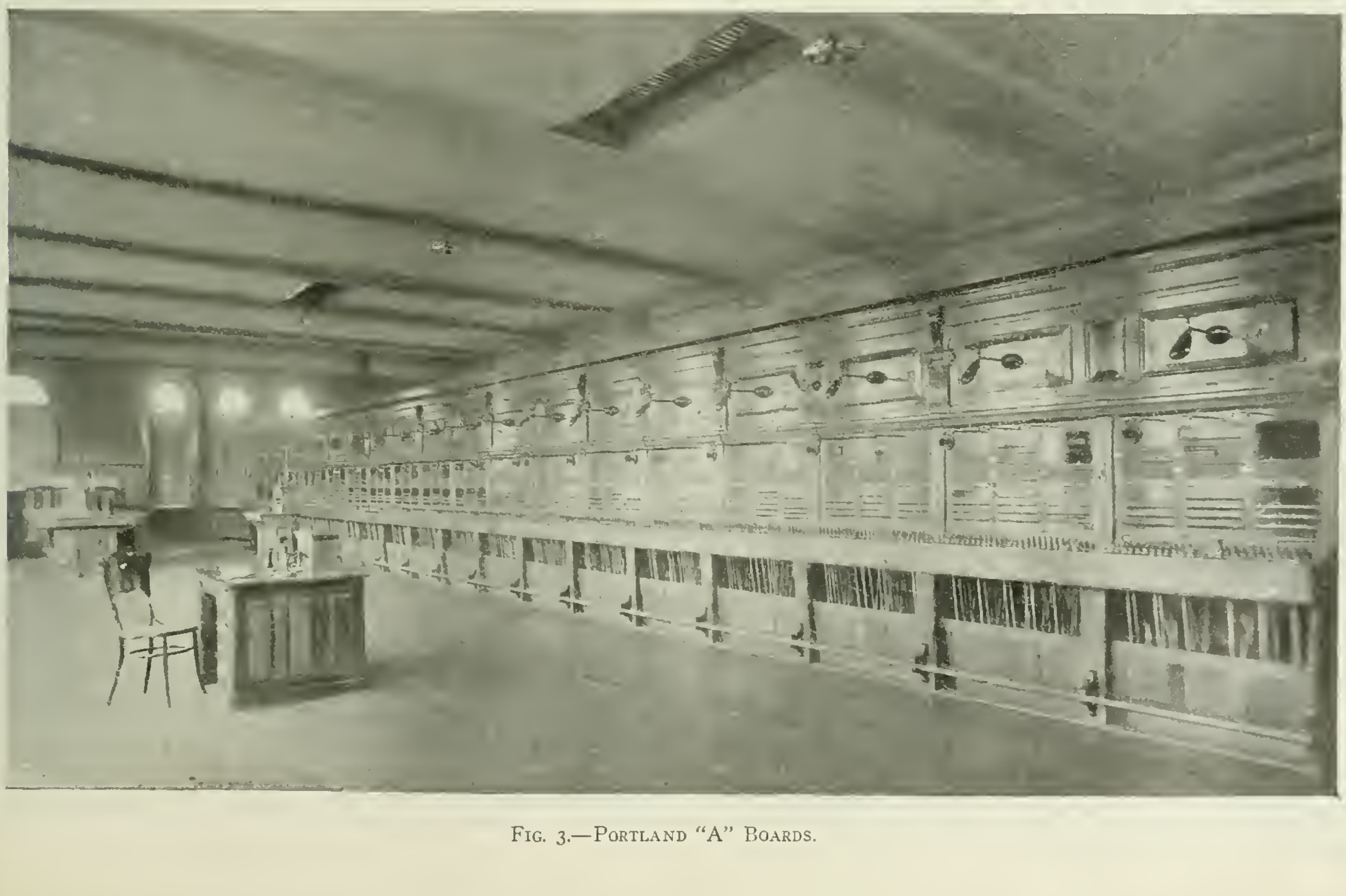
FIG. 3.—PORTLAND "A" BOARDS.

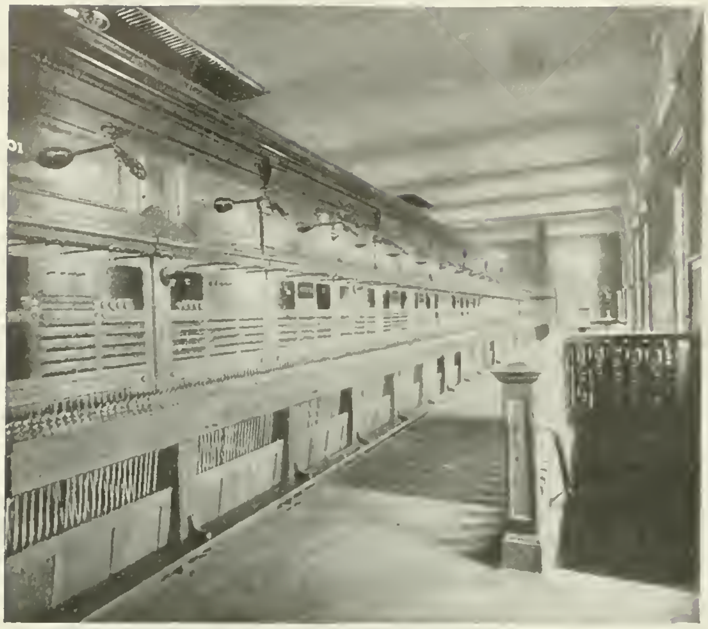

FIG. 4.—"B" BOARD, PORTLAND.

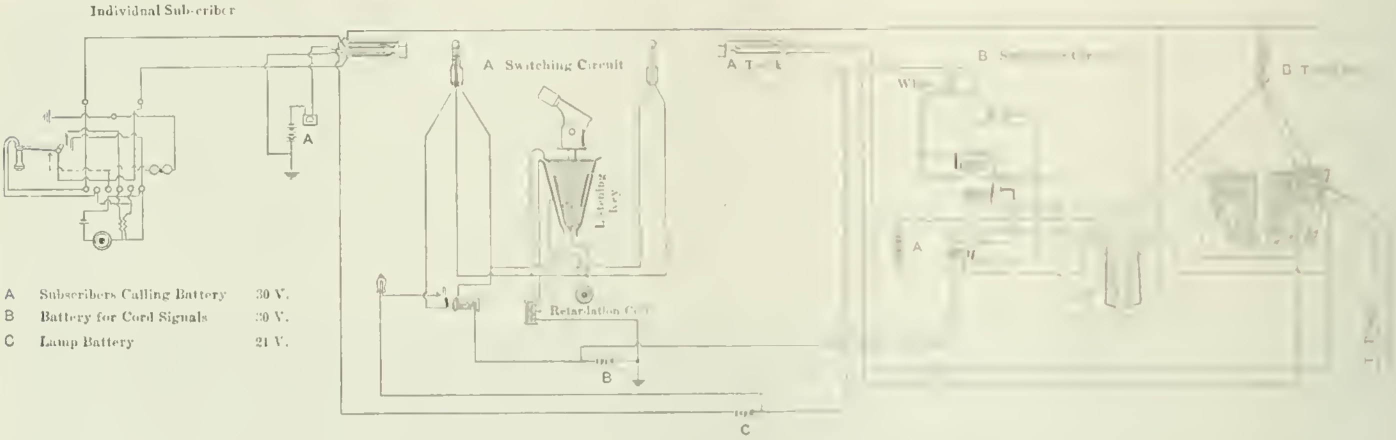

FIG. 5. DIAGRAM OF SUBSCRIBERS' AND SWITCHING CIRCUITS

the B operators do nothing but complete connections, and the A operators do nothing but answer calls. In other words, each subscriber's call has to go through the same series of operations as when connection is made between two different exchange offices—that is, connection is completed by means of trunks. Before each B operator is a row of plugs, each one of which is connected to multiple jacks in front of each A operator. When an A operator receives a call for a number she presses the talking circuit button in front of her, which connects with the particular B operator in front of whom the called-for subscriber's jack terminates. She then calls for the number wanted, and the B operator takes up one of the plugs in front of her and connects to the number wanted, at the same time repeating back to the B operator the number and designating the number of the plug with which she has made the connection. This plug being connected to multiple trunk jacks in front of each A operator it is then only necessary for the A operator to connect the calling subscriber to the trunk jack in front of her specified by the B operator and the B operator then presses the ringing key. On the San Francisco Board, shown in Figs. 1 and 2, one or two B operators occupy the space in front of the dorps and answering jacks. The A operators sit in front of the trunk jacks, and in plugging in to answer calls reach over in front of the B operators. When the board is busy there are thus two A operators side by side, then two B operators side by side, and so on. The duplicate jack type of the A board, as shown by Fig. 3, has all the A operators together in front of a board, which contains subscribers' calling signal lamps, and also multiple trunk jacks for connection to the B operators' plugs. The B board (Fig. 4) has simply subscribers' jacks in duplicate with those on the A board and the operators' trunk plugs. The equipment of these latest types of boards will be taken up in detail a little later.

The details of a connection on the old type are as follows for an individual line subscriber: The subscriber's instruments are equipped with a local primary battery—usually a dry cell. The circuits of a subscriber's instrument and switching circuits for an individual board are shown in Fig. 5, which is the diagram for the old type board with A and B operators together. Removing the subscriber's receiver from the hook closes a 30-volt battery circuit through a drop signal or through a relay governing a lamp. The A operator plugs in to answer the call and the insertion of the plug opens the signal circuit to restore the drop or relay. There is also a pilot lamp for each operator on top of the transmitter as long as there is any call unanswered. The A operator having plugged in, uses the listening key to listen in on the board circuit and get the number. She then presses the button which will connect her head telephone on the order line connecting with the B operator before whom the subscriber's jack bearing the desired number is located. Each B operator's head telephone is multiplied on an order button in front of every A operator. When the A operator gives the B operator the number wanted, the B operator notes whether the line is busy, and if it is not she plugs into that subscriber's jack and designates the number of the trunk jack to the A operator. The A operator then completes connection and the B operator rings. On the A board a lamp signifies when the calling subscriber has restored the telephone to the hook. This hanging up of the telephone opens the subscriber's circuit on one side and grounds it on the other. The opening of the circuit closes the lamp circuit through the back point of a relay. In calling a subscriber, the depression of the B operator's ringing key lights a white lamp, which is extinguished by a relay when the subscriber answers. A red lamp lights on the B board

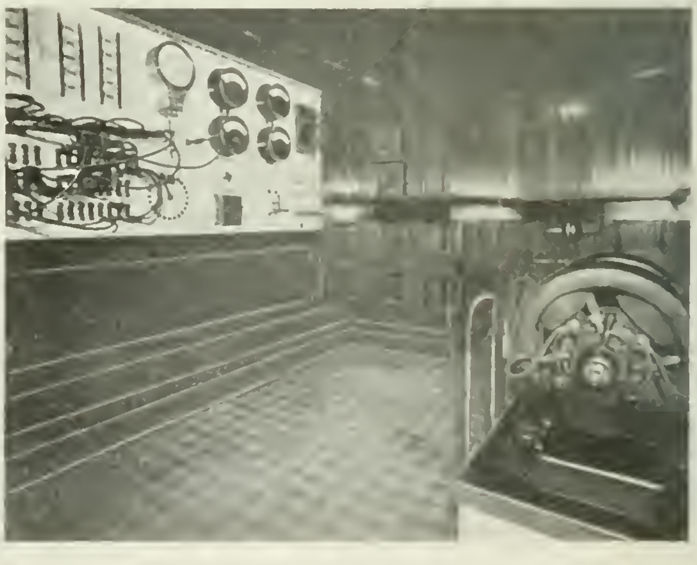

FIG. 6.—POWER ROOM, PORTLAND EXCHANGE.

when the called subscriber returns the telephone to the hook. This will go out when the B operator disconnects, but when the B operator returns the plug to its socket the red lamp will relight if the A operator has not disconnected. This is to prevent her using the trunk again until disconnection from it has been made.

In the case of a two-party or ten-party line board the general process is much the same, except that when the B operator rings, automatic-counting attachments on the key show which side of the line was rung and the number of bells rung so that she can repeat the call if necessary. Fig. 7 is a diagram of the circuits for a party line B board, and Fig. 8 the circuits of two-party line subscribers' instruments. The ringing is done through condenser to ground on one side, and direct to ground on the instrument on the other side. The signal circuits do not permit of ringing direct to ground on both sides. Ten-party lines are arranged the same way with transmitters bridged across the line and five instruments on each side for ringing.

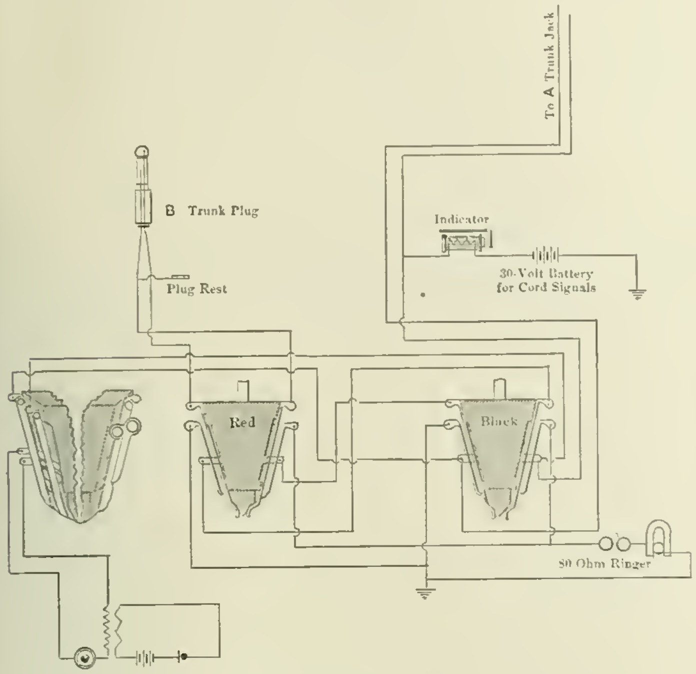

FIG. 7.—DIAGRAM OF PARTY LINE CIRCUITS.

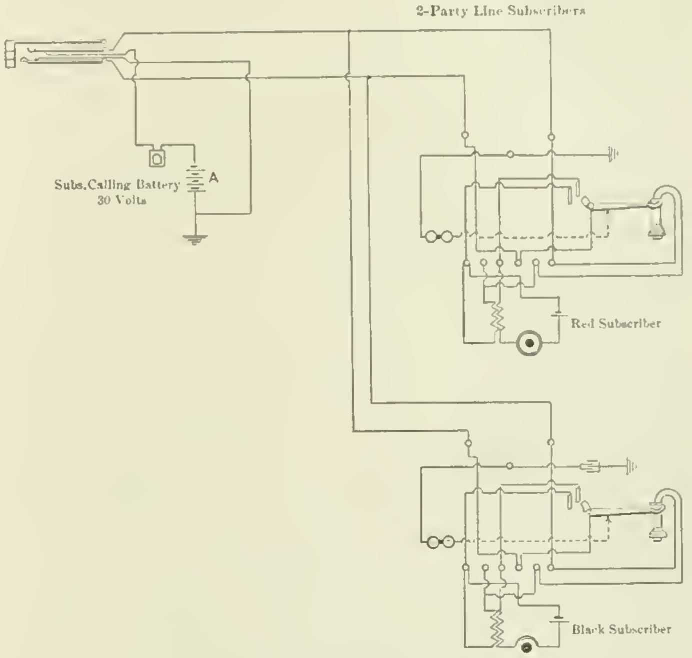

FIG. 8.—DIAGRAM OF TWO-PARTY LINE CIRCUITS.

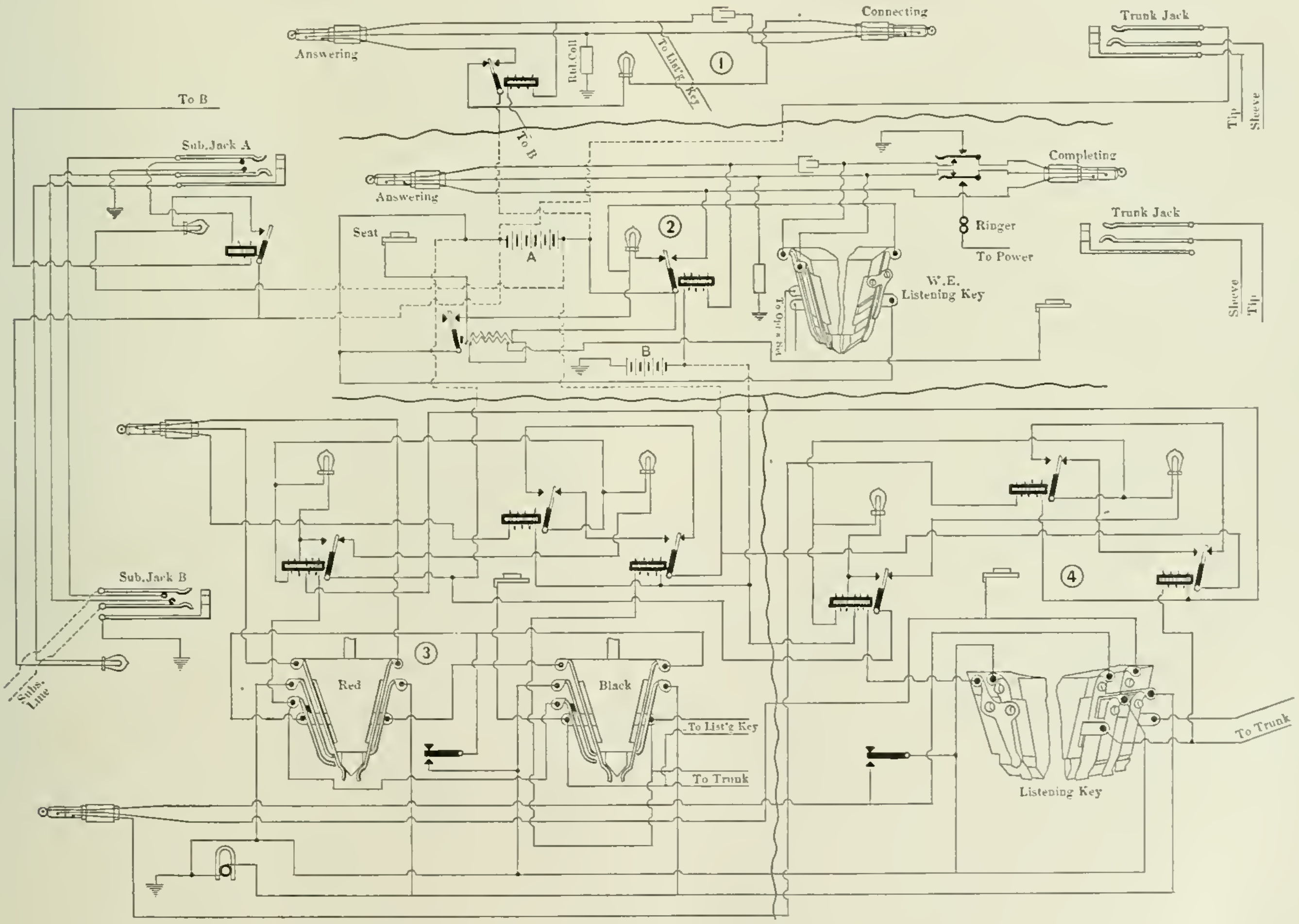

Fig. 9.—Diagram of Signal Circuits for the Duplicate Jack System.

Fig. 9 contains the signal circuit diagrams for the latest duplicate jack system in which the section of the diagram marked 1 is A board switching via trunk; 2 is A board switching via trunk and direct (the latter a plan not much used); 3 is the B board for party lines and 4 is the B board for individual lines. The batteries marked A are 24 volts, and those marked B 30 volts.

Taking up the details of the duplicate jack boards shown in Figs. 3 and 4, as installed at Portland, the A board (Fig. 3) beginning at the top has, first, in the middle panel of each section a row of jacks connected to the monitors and the information bureau. Next below these come the trunk jacks, which are multiplied in each operator's position with the B operator's trunk plugs. Underneath these are the subscribers' lamp signals and answering jacks. Next below the subscribers' answering jacks is a row of clearing-out lamp signals in the cord circuits. Then beginning on the horizontal part of the board are the plugs. A different color of cord is used for each pair of plugs. Next to the row of plugs is the row of talking and listening-in keys for the cord circuits. In the middle of the keyboard is a lamp signal which indicates to the operator when the party calling on a nickel-in-the-slot instrument has deposited the nickel. Nearest to the operator is the double row of pushes for the order wires to the B operators. The B operator's board (Fig. 4) has in the center panel of each section at the top a row of emergency trunk jacks for use when the regular trunks connected to the plugs are busy. Then come the regular subscribers' jacks in duplicate with those on the A board. On the horizontal part of the board are the numbered plugs connected with the trunk jacks on the A boards and plugs for connecting to the emergency trunks. Next to the plugs in the middle are a row of listening-in keys for the cord circuits for the emergency trunks, and in each side are the listening-in keys on the regular trunk circuits. In a row next to these are the lamps which indicate when the subscriber called for answers, and in the next row are the clearing-out lamps. The ringing keys occupy the position next to the operator. If the board is for individual line subscribers, the keys are the usual simple W. E. ringing key; but if it is a party line board, the ringing keys are provided with cyclometer counter attachments which indicate which side of the line was rung and how many rings were given. Each ringing key has a red push for one side of the line and a black push for the other, and is provided with a key for resetting the counter.

Much can be said both for and against the Pacific States switchboards as against the multiple boards so popular in the East. Their chief disadvantage is that the time consumed in making connections between subscribers whose lines terminate in the same office is as great as between two subscribers whose lines terminate in different exchange offices. That is, the connections must all be made via trunk instead of direct by the same operator. The advocates of the Pacific States type of board, however, claim that as long as a large per cent of the calls in any large city have to be trunked anyway, and are not between subscribers whose lines terminate in the same office, it is useless to go to the expense of a multiple board for the sake of avoiding connections via trunk for the small per cent of calls that are for subscribers on the same office. They furthermore claim that by giving subscribers on the same office quicker connections between themselves than between subscribers on different offices a certain precedent in quick switching is established which is likely to give rise to complaints when subscribers on different offices have to wait longer for connections. With the Pacific States board all switches have to go through the same operation, so the time is uniform. Attention is also called to the fact of the ease with which extensions to a board can be made without disturbing the rest of the board and without increasing the investment in switchboard per subscriber. These arguments certainly bear much weight, especially where the growth is as rapid as in San Francisco and other Pacific Coast cities.

The chief advantage of the new duplicate jack boards over the old type boards in which A and B operators were side by side is that when the B operators are together they can help each other and B operators can be grouped on busy portions of the board.

Electric Rights in California.

A new California law makes it a misdemeanor to unlawfully connect with any electric apparatus or wire operated by another, without his consent, for the purpose of appropriating current for light, power, heat or other use. Another law gives cities and towns in California the right to acquire or construct and operate street railways, telephone and telegraph lines, gas and other works for light and heat.

Reduction of Arsenic Ores in the Electric Furnace.

By Carl Hering.

ARSENIC ores are not mined in this country to any great extent, notwithstanding that rich ores exist in large quantities, even in the East where transportation facilities are favorable. This is all the more noteworthy on account of the high gold values of many of these ores, besides the large amounts of the arsenic. Gold bearing "mispickel" ores are abundant in North America, but they have been neglected on account of the metallurgical difficulties involved in the extraction of the arsenic, or even in getting rid of the arsenic in order to be able to extract the gold and other noble metals, as the presence of the arsenic interferes with the extraction of the other metals. In some cases, as in Butte, Mont., where copper ores containing arsenic are smelted, the arsenic is made to pass off through the chimney of the furnace in the form of the poisonous oxide, which settles over the surrounding country to the great detriment of the neighboring inhabitants.

Mispickel ores occur in the White Mountain section of New England, and are found as far south as North Carolina. Deposits are also found in South Dakota, Washington and California. Very large deposits exist in British North America, particularly in Ontario, but the ore has been mined only to a very limited extent. In British Columbia, they are found more particularly in the Rossland district. Mr. Westman recently made the original blastings in some of the great ore deposits of Ontario which were subsequently examined by the Government geologist and reported upon very favorably in the official report of the Canadian Bureau of Mines for 1900.

According to some advance estimated figures from *The Mineral Industry* the total output of arsenic in 1900 was about 7300 metric tons, made by the following countries: Great Britain, Germany, Italy, Spain and Canada, the first two producing nearly the entire amount. The output was little if any in excess of the consumption The imports in the United States may be taken at about 10,000,000 lbs. There was no arsenic produced from ores in this country last year.

Notwithstanding the large deposits of rich arsenic ores in this country, nearly all of the arsenic consumed here is imported from abroad. A description of an electrical process, of which the writer was recently called upon to make a quantitative test, and which overcomes the objections to the usual metallurgical processes, enabling the arsenic to be extracted as a metal, and leaving the other metals concentrated in the resulting matte, may therefore be of interest. It is another one of those many instances in which electricity enables a difficult and tedious metallurgical process to be carried out so much cheaper and more satisfactory that ores heretofore unused have become valuable.

The process is applicable to mispickel or arsenopyrite ores, which contain the arsenic in the form of the sulph-arsenide of iron, or in chemical symbols $FeS_2 + FeAs_2$. The ore itself, when freed from all foreign matter, contains 46 per cent by weight of arsenic, and is therefore a very rich ore of that metal. In theory the process consists simply in heating this ore in a closed furnace in an atmosphere free from oxygen. The iron then combines with the sulphur, forming the easily fusible sulphide of iron, or ferrous sulphide, FeS, and setting free the arsenic as a heavy metallic vapor, which is then collected outside of the furnace in condensers, as a very fine metallic powder. The gold, silver and other valuable metals are left in the fused matte which remains, and as it is free from arsenic it can be worked for those metals. Moreover, as the arsenic forms about half of the original material, the amount of the precious metals per ton of the resulting matte is about double what it was in the concentrated ore, and it thus becomes much more profitable as a gold or silver ore

In practice this process is carried out by passing an alternating electric current through a horizontal column of the matte, which is sufficiently conducting when cold, to enable a great enough current to pass for melting it, and when fused it conducts quite well. The granulated ore is then fed into the top of this fused matte. The furnace is therefore of the resistance type and not of the arc type. It is closed, so as to keep out the oxygen of the air, which in contact with the hot vapor of arsenic would form the very poisonous white oxide of arsenic of commerce, sometimes known as arsenious acid. The ore is fed into the furnace through hoppers which admit no air. It enters in a granulated form into which it is first ground, and then concentrated by pneumatic means to free it as much as possible from the rock or gangue. The vapors are carried off by means of a current of nitrogen which circulates continuously through the furnace and the condensing chamber, and is produced at the start from ordinary air from which the oxygen is extracted by a small quantity of the vapor of arsenic, forming the oxide. After starting the same nitrogen is used over and over again.

An idea of the furnace may be obtained from the accompanying diagram (Fig. 1). The two electrodes are shown in section at the ends of the column of ore and matte in the closed furnace, with the hopper at the top. On each side is a pair of condensers for the vapors, the nitrogen being circulated by means of a reversible blower. The object of reversing the current of nitrogen is to utilize the well-known heat regeneration principle. When one condenser has become hot from the gases, the current of nitrogen is reversed, thus enabling the condenser to give off this heat to the cool nitrogen before it enters the furnace, thereby preventing it from chilling the furnace, and enabling much of the heat carried off by the gases to be recovered. The pulverized arsenic is removed from the bottom of the condensers through suitable traps.

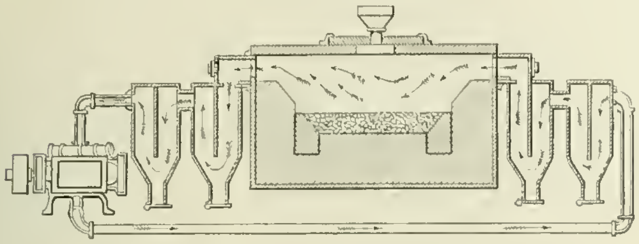

FIG. 1.—LONGITUDINAL SECTION OF FURNACE.

Fig. 2 shows the outside of the experimental furnace with which the writer's tests were made. It is built of firebrick encased in boiler iron. The electrodes enter from the rear. They are cast iron, which is said to stand the action of the fused ore quite well, and may be renewed at small cost. The tap for drawing off the fused matte is seen in front, and the transformer in the rear. This furnace was built for testing and demonstrating the process, and in general for experimental purposes. For these reasons, and its rather small size, it was not as efficient in energy consumption per ton of arsenic as a larger one constructed for economy would be; but by measuring some of the avoidable losses and calculating others, a very fair estimate was obtained for the energy per ton which would be required in a well constructed furnace, operating on a large scale and continuously.

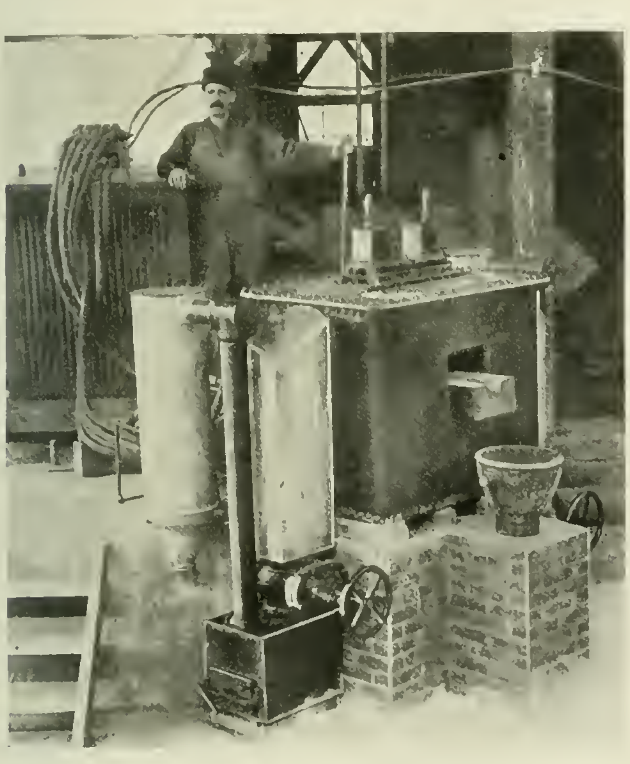

FIG. 2.—VIEW OF EXPERIMENTAL FURNACE.

The measurements and calculations of these losses were somewhat involved. For instance, the alternating current of 8000 to 10,000 amperes at a frequency of 120 passed through rather long, solid, cast iron electrodes, about 6 inches square in section, which involved very large losses by skin effect, resistance, hysteresis, Foucault currents and conduction of heat from the furnace. The losses amounted to more than half of the energy in the secondary circuit of the transformer. The losses in the leads alone from the transformer to the furnace were found to be about 44 kilowatts and 9 to 10 kilowatts were led off as heat by the electrodes, besides many kilowatts lost by Foucault currents and hysteresis. The unavoidable losses in a well constructed furnace had to be considered also. To lead such large alternating currents into a furnace is no simple matter. The conductors must necessarily be large to reduce their resistance and they will then conduct off considerable heat.

In one of the runs the ore was fed at the rate of 185 lbs. per hour, and the power consumed in the furnace was about 105 kilowatts, the current varying from about 4000 to 8400 amperes, and the voltage from about 22 to 12. This is at the rate of about 1140 kilowatt-hours per 2000-lb. ton of ore. This could no doubt be reduced considerably in a large furnace constructed for economy. It is, in the opinion of the writer, quite safe to say that in a well designed and large furnace the power required at the engine shaft will not be more than 1000 kilowatt-hours (about 1350 horse-power-hours) per ton of 2000 lbs. of the ore, such as was used in the test. It may even be considerably less.

Unfortunately no data seems to exist concerning the heat of combination of both of the compounds involved in this process, nor for the specific heats at such high temperature, nor the latent heat of vaporization of the arsenic, and it is therefore not possible to make any definite calculations of the amount of heat required theoretically to bring about this reaction. It has been variously estimated to be from 200 to 400 kilowatt-hours per short ton. If these estimates are correct there is still left a large margin for improvement.

At $20 per kilowatt per year, which is about the cost at Niagara Falls, and a recovery of 90 per cent of the arsenic, the cost of the power per pound of arsenic is about one-quarter of a cent. Metallic arsenic is worth about 6 cents per pound, and the white oxide called arsenious acid 4 to 5 cents. The output of such a furnace is so great that a few of them of fairly good size, would supply the world's consumption of arsenic, but there is little doubt that metallic arsenic could be used for many more purposes than at present.

After freeing these ores from the arsenic the resulting matte becomes in many cases a valuable gold ore, and as it is then reduced to nearly half its bulk it contains nearly twice as much gold per ton. At first the process will be applied only to gold-bearing mispickel ores, but the fact that many of these ores contain large percentages of nickel and cobalt, greatly extends the field of its application.

The action in the furnace is based on an ore having the composition of mispickel, which contains just the right amounts of iron and sulphur to form the easily fusible ferrous sulphide. It contains 46 per cent of arsenic. If the ores also contain the mineral leucopyrite which has 64.1 per cent of arsenic, or loellingite which contains 72.8 per cent of arsenic, some iron sulphide is added in order to free all the arsenic and make the matte a simple iron sulphuret.

Mr. Gustaf M. Westman, of New York, who is the inventor of this process, has been experimenting with it for some time, and is now about to apply it to the large, rich deposits of mispickel ore of the Big Dan claim in Ontario, recently acquired by the owners of the process, the Arsenical Ore Reduction Company, of Newark, N. J., the ores of which, according to the recent official report of the Bureau of Mines, of Ontario, run from $1 to $31.20 in gold and silver, averaging about $5.75. There is a large waterfall near the mine from which cheap power is to be obtained, thereby saving the cost of transporting the ore. It seems probable therefore that the production of arsenic will be transferred to this country by means of the electric furnace.

A study of the losses in the small furnace with which the experiments were made leads to some conclusions which may be of interest to those designing resistance furnaces for other purposes. Most of the losses point to the importance of using continuous currents if possible, as it is more difficult to lead such very large alternating currents through conductors. When, however, alternating currents must be used to avoid electrolysis, as is often the case, then many difficulties are reduced by proportioning the furnace so that the current is as small as possible and the voltage as great as possible; that is, the resistance column of the material should be made as long and as small in cross-section as the circumstances permit. The loop formed by the alternating-current circuit should have as small an area as possible so as to diminish the induction. The leads should, of course, be made as short as possible, every inch saved in length being important. The transformer should be placed within as few inches of the furnace as possible. Those parts of the conductors which are unavoidable, as, for instance, where they pass through the walls of the furnace, should be made of insulated laminations alternately of opposite polarity, otherwise the skin effect and the inductive effects will become important. For these parts the best electrically conducting material should be used so as to reduce the cross section as much as possible, as such large pieces of metal conduct considerable heat away from the interior of the furnace. The frequency should also be made as low as possible when such very large conductors have to be used. Metallic casings of the furnace should be avoided, particularly of iron. If bands are necessary they should be made of a non-conducting material or have insulated joints in them to prevent closed circuits in the neighborhood of the large alternating field necessarily produced in the part of the circuit in the furnace itself. These are some of the considerations underlying the design of large alternating-current resistance furnaces.

The heat led off through the walls of the furnace, which was about 3-ft. cube, amounted to about 5 kilowatts, the inner temperature being about 1000 to 1200 degs. C., that necessary for the vaporization of the arsenic being only 450 degs. C. The channel for the liquid matte was about 20 inches long and 4 inches wide. This loss, which is not large for a furnace of about 150 horse-power, could be diminished only by having thicker walls, but it becomes relatively less the larger the furnace. Theoretically, the following relations can be shown to exist for different sizes of furnaces, the assumption, for enabling a general law to be stated, being that the furnace is a hollow sphere, with relatively thick walls, and that the temperature of the outside surface remains the same. The capacity (or interior volume) increases as the cube of the inner diameter. The thickness of the walls will increase with the square root of this diameter, and the radiation loss per unit volume of the capacity or interior space will diminish in inverse proportion to the square of the diameter. That is, for twice the inside diameter the capacity becomes 8 times as great, the walls 1.4 times as thick, and the radiation loss per unit volume of the inside becomes only one-quarter as great, showing the great advantage of larger furnaces in diminishing this loss. For rectangular furnaces, especially if quite long, these relations will not be quite as favorable, and these general laws then apply only approximately.

Heating the material quickly, that is, making each particle pass through the process as quickly as is consistent with the proper operation, will, of course, reduce the size of the furnace for the same output, but assuming that a certain definite number of heat units are required per ton of material, as is generally the case, the larger furnace would require the smaller current. Both should, therefore, be considered in designing a furnace.

In all electric furnaces the firebrick lining, when very hot, becomes a conductor, a quality which is made use of in the Nernst lamp. In resistance furnaces this should be taken into consideration, as it lowers the resistances between the electrodes and necessitates a greater current at a lower voltage to produce the same heating effect. This means that greater flexibility in the regulating apparatus is required. The heat generated in this lining is not lost, except in so far as it diminishes the thickness of the heat-insulating walls of the furnace. The conducting of the lining can be prevented only by keeping it cool, which is wasteful.

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The Independent Telephone Convention.

Judge J. M. Thomas, president of the Independent Telephone Association of the United States of America, writes us from Cleveland as follows: "We have just determined to hold the fifth annual convention of the Independent Telephone Association of the United States of America at the Pan-American Exposition grounds, city of Buffalo, June 11, 12 and 13. The programme for the meeting will be arranged later. Arrangements have been made by the Pan-American Exposition with all the railroads to carry visitors at one and one-third fare for round trip. The committee on arrangements is composed of Samuel E. Wayland, Scranton, Pa.; Robert R. Hefford and Clark L. Ingham, both of Buffalo, who will arrange for special rates at hotels for those attending the convention."

An Electrochemical Phonograph.

THE sound-recording devices now in commercial use have in common this radical defect: The mechanical operation of making the record is performed by a stylus carried by the vibrating disk, and hence this work is performed directly by the sound waves. It is sufficiently obvious that whether this work consist in indenting or cutting a yielding surface, or in tracing therein an undulating line of even depth, a record so made cannot conform absolutely to the impressed vibrations, but that all vibrations representing less energy than that required for forming the plastic surface must be lost and all others must be modified to some extent. It results from this that record and reproduction of human speech, the vibrations corresponding to which are exceedingly intricate, must fail of exactness.

The Poulsen electromagnetic phonograph announced last year relieves the vibrating disk to a great extent of this work, and according to published reports attains a corresponding fulness and exactness of reproduction and freedom from extraneous sounds. For the plastic surfaces of the earlier types of phonograph, this device substitutes a steel wire moving through the field of an electromagnet excited by the microphone currents, and the varying magnetic effects produced by these currents in successive portions of the wire constitute a record of the currents and hence of the disk vibrations.

In the *Zeitschrift fur Elektrochemie* for April 4, 1901, Nernst and V. Lieben describe experiments illustrating a principle of sound reproduction which represents as radical a departure from commercial types as does the Poulsen device, and which resembles the latter in that the record is only indirectly produced by the movements of the microphone disk. The general principle of this new phonograph is exceedingly simple: Two electrodes, the one movable and the other stationary, are in contact with an electrolyte which is traversed by a fluctuating current, produced by the superposition of microphone currents upon a direct current. Upon the surface of the moving electrode changes occur, the precise nature of which has not yet been determined, but which follow the fluctuations of the current, and which possess some degree of permanence, so that if the electrode be again moved through the bath and a current passed, this current also will fluctuate in accordance with the local surface conditions of the moving electrode, and these fluctuations may be employed to reproduce, in a telephone, the original sounds.

Two devices for carrying this principle into effect are diagrammatically illustrated in the figures reproduced herewith. In the construction shown in Fig. 1, *A* is a storage battery of 10 volts; *M* a microphone; *P* the primary and *S* the secondary of a transformer; *C* a switch; *T* a telephone, and *W* wooden wedge, bearing on periphery of a platinum board; *E* is the electrode, and *B* a battery employed for reproduction. A platinum band constituting the moving electrode passes over two pulleys, and at one point moves in light contact with the wooden wedge, saturated with and partially immersed in a suitable electrolyte. Adjacent to this wedge and contained within the same vessel is a second electrode, and the circuit including the two electrodes and the electrolyte is closed through the secondary coil of a transformer, through the primary of which passes the variable current caused by the superposition of the microphone currents upon the direct current from five accumulators. The traveling band registers the fluctuations of the current, and if subsequently a current from a second and lower source of e. m. f. be passed through the band and electrolytic cell and through a tele-

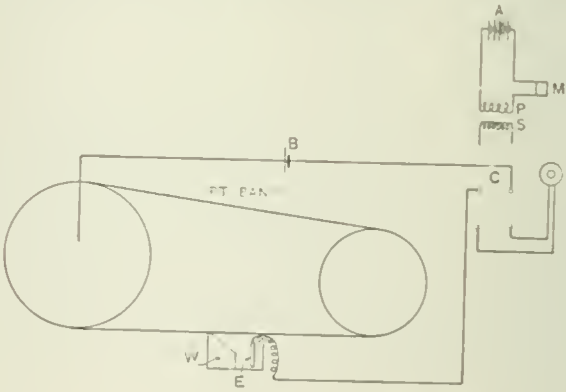

FIG. 1.—ELECTROCHEMICAL PHONOGRAPH.

phone included in the circuit, this current fluctuates in such manner as to reproduce in the telephone, with more or less disturbances, the impressed sounds.

Fig. 2 corresponds precisely to Fig. 1, except that a stiff copper disk is substituted for the plantium band, and the battery employed for reproduction is connected in the circuit through a variable resistance, whereby compensation may be made for the varying resistance of the electrolytic cell under different conditions. In this form the periphery of the revolving disk constitutes the record. It is necessary in order to avoid extraneous sounds due to the crystallization of the electrolyte upon the recording surface, that a pad of blotting paper, moistened with the electrolyte be gently pressed against the periphery. In Fig. 2 *R* is a sliding resistance for bringing the galvanometer *G* to zero.

A second paper by V. Lieben, dealing with the form of device represented by Fig. 2, details the results obtained under many different conditions as regards electrode materials and electrolyte. The best results noted are:

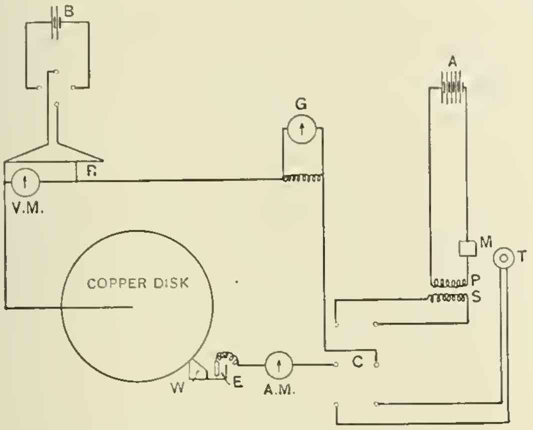

FIG. 2.—ELECTROCHEMICAL PHONOGRAPH.

1. With a copper anode in the electrolytic cell the periphery of the copper disk constituting the cathode, and an electrolyte of thrice normal zinc sulphate solution rendered alkaline by potassium hydrate, a current of 4 volts being employed both for record and reproduction. Under these conditions the reproduction was very loud and clear, often repeated 200 to 300 times without marked diminution.

2. Anode, zinc; cathode, copper periphery; electrolyte, potassium zincate solution. Reproduction loud and clear, and capable of some hundreds of repetitions.

3. Anode, silver; cathode, silvered copper periphery; electrolyte, double cyanide of silver and potassium. Reproduction less loud than in the preceding case, but very clear, and permitting some hundreds of reproductions. The original record may be made without the use of an external source of current.

Concerning the nature of the alteration undergone by the moving electrode, the authors consider several possible explanations. The fluctuations cannot be attributed solely to the polarization currents of a charged electrode, for it seems to be essential that a source of e. m. f. be included in the circuit during reproduction. They can scarcely be due to variations in the resistance of the contact surface, for such variations, if caused by hydrogen or oxygen polarizations could hardly be expected to effect in platinum a change of the permanence noted, and, moreover, resistance changes of this character could scarcely occur in the case of silver electrodes and silver cyanide solution noted above, nor can they be due to the variations in frictional resistance due to a polarized electrode, for clear reproductions were obtained when no gas evolution could occur. The authors say: "We believe the following to be the most probable explanation: The fluctuations of the microphone currents cause a superficial disintegration (auflockerung) of the moving electrode, according to the extent of this disintegration, which naturally is connected with an alteration of the polarization capacity, there arise during reproduction fluctuations of the constant current, which actuate the telephone."

On account of the frequently erratic behavior of the device the authors are inclined to disclaim for it any practical utility. It is, of course, obvious that the constructions illustrated are incapable of practical use. A copper disk of 450 mm. diameter, for instance, requires a minimum speed of 60 r. p. m., and at this rate only one or two words can be recorded upon its periphery. Difficulties of this character, however, are readily overcome. The whole device constitutes a most interesting application of electro-chemical principles, and the limits of its possible usefulness can scarcely now be foreseen.

The principle involved in the method is not, broadly considered, novel. United States patent 404,850, granted in 1889 to G. W. Littlehales, presents many points of similarity. This patent covers a method of recording and reproducing articulate speech and other sounds by electro-chemical methods, and like the apparatus of Nernst and V. Lieben. The device consists of two electrodes, one movable and the other stationary, the circuits between them being closed through a thin layer of electrolyte. These electrodes are maintaind in close and invariable relation, and the electrolyte is such that the passage of the current serves, by reason of the liberated products of electrolysis, either to diminish or to increase the resistence of the circuit. The electrolyzing circuit includes a telephonic transmitter, shown as of the variable contact (Blake) type, and the vibrations of the diaphragm cause corresponding fluctuations of the current. Corresponding to these fluctuations, a variable action occurs upon the surface of the moving electrode. For instance, unequal thickness of silver may be deposited thereon, and these irregularities constitute the sound record. For reproduction, acidulated water is substituted for the electrolyte, and a telephone for the transmitter; the revolving electrode now produces fluctuations of the constant current, which the telephone reproduces as sounds. In this apparatus the sound record traces a helix upon the surface of a cylinder as in the ordinary phonograph.

The Value of Telephone Investments.

In a recent study of the subject of investments, Mr. G. M. Walker says that in the interval from September, 1893, to September, 1900, the resources of the national banks of this country increased over 62 per cent, or $1,938,000,000. During this same time the deposits in American savings banks increased over $700,000,000, while those in State banks and trust companies increased some $1,300,000,000 more. The effort to place this enormous amount of new capital aggregating almost $4,000,000,000, has disorganized the entire field of investment. The national banks have completely absorbed the issues of government bonds. There has also been going on a struggle for the great issue of municipal bonds until they command better prices than did government bonds four or five years ago, and mortgage loans, so long regarded as the standard investment for trust funds, are constantly decreasing in volume. He, therefore, thinks the best available investments at present are those of a quasi-public character. He gives the following table showing the charge per capita upon population of quasi-public corporations:

Railroads	$20.00
Street railways	8.50
Gas	3.50
Electric light	2.50
Telephone	1.50

The measure to which these charges can or cannot be reduced in times of business depression in a great degree determines the stability of invstments in quasi-public securities. Mr. Walker considers telephone securities the acme of security and value. Their per capita charge upon the people is the lowest of any quasi-public corporation, because the construction of a telephone plant requires a smaller investment in proportion to the population served than does any other public utility, and the operation and maintenance cost is extremely low when compared with other quasi-public companies. Next to telephone securities he approves of those of gas and electric light companies because they are usually aided by income from municipal sources. The street railways he considers next in the scale as they are largely relieved from the effect of depressing times by the manner in which their receipts are collected.

Automobile Speed.

The State Department has been prevailed upon by those who believe there should be general restriction of the speed of motors in cities, to procure from consuls of the United States reports showing the rules in force in foreign countries that have been constrained to apply rules.

Speed Variations of Engines Direct-Connected to Alternators—II.

(*Concluded.*)

By A. H. Kruesi.

In Fig. 7, AD is the line of absolute zero pressure, and $ABCDEFA$ represents the pressure at cross-head for one revolution; the point C, for example, is found by subtracting the back pressures NJ and NK from the forward pressure NI, resulting in the net pressure CN. The net pressure may then be converted into force, and this into turning moment at the crank-pin by resolving into a vertical thrust* and a component along the rod (Fig. 5), when we get:

Moment of crank effort $= \overline{Q - CM} = \overline{P - CN} =$

$$Pr\sin\theta\left(1 - \frac{r\cos\theta}{\sqrt{l^2 - r^2\sin^2\theta}}\right)$$

In Fig. 8, curves A are crank effort diagrams for two strokes, neglecting the inertia of reciprocating parts. The first gives the correct diagram, curve B, for one-half revolution, when combined with the inertia curve. It is interesting to note from equation (1) that the inertia increases as the square of the speed of the engine, and from Figs. 7 and 8 that the effect of the inertia of the reciprocating parts is to make the crank effort more uniform.

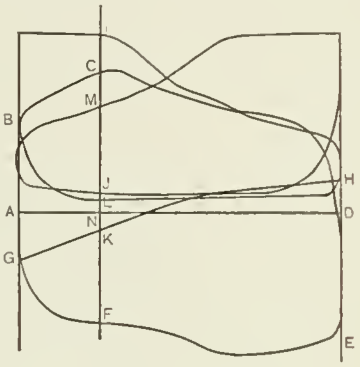

FIG. 7.—INDICATOR DIAGRAMS.

The area of the diagram enclosed by the base line and the torque curve is the work of a revolution in foot pounds, when the ordinate is moment in pound-feet, and the base the angle in circular measure, or if the ordinate is tangential force in pounds and the base the linear motion of the crank-pin in its circular path. Integrating this area by planimeter we get the mean torque required to do the work of the engine, neglecting internal friction. This can also, of course, be calculated, knowing the output, speed and radius of crank. Any excess or deficiency of torque, with respect to this mean torque, must produce either acceleration or retardation, and from the equation

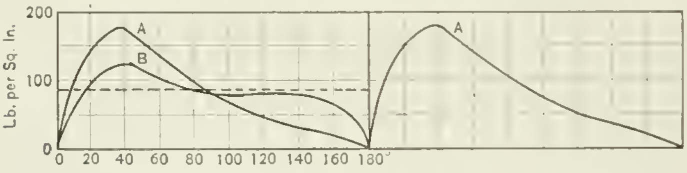

FIG. 8.—CRANK EFFORT DIAGRAMS.

Σ moments $= \frac{Ia}{g}$ where $I =$ moment of inertia and $a =$ acceleration·

we get an acceleration — — θ diagram with the mean torque line as a zero line. From this we can calculate velocity and displacement in terms of θ, but the process* is tedious. We know that the motion is very nearly uniform, and may assume without much error that equal angles are passed through in equal times,* hence our acceleration — — θ diagram at once, becomes an acceleration-time diagram, and since $v = at$, the area of this acceleration-time diagram gives velocity and a velocity-time curve. Then since $s = vt$, by integrating this velocity-time curve (that is, taking the double integral of acceleration) we get displacement in degrees and then in phase.

These diagrams may be constructed graphically, but the following tabular method† is easier and more satisfactory. In Fig. 8, curve B represents the crank effort diagram, in terms of pounds per square inch of high-pressure piston, for one stroke of a certain cross-compound engine with cranks at 180 degs., intended to drive a three-phase, 48-pole, 400-kw generator at 150 r. p. m., thus giving a frequency of 60 cycles. For simplicity we assume that the diagram for the return stroke is identically the same, and find the mean ordinate to be 86.5 lbs. per square inch. The piston area is 380 square inches, and the crank 10 inches equals .834 ft. long. Hence the mean torque is $86.5 \times 380 \times .834 = 86.5 \times 317 = 27{,}400$ lb.-ft. In the same way we find the torque at equal intervals throughout the stroke, as in column III. of the following table. The flywheel weighs 19,000 lbs., and has a radius of gyration of 4 ft., or a moment of inertia $I = 19{,}000 \times 4^2 = 304{,}000$ in ft.-lbs.-sec. units. Since E, the excess or deficiency between momentary torque and mean torque $= Ia \div g$, we get acceleration in radians per second $= E \times 32.2 \div 304{,}000 = E \times .000106$, from which Column V. is obtained. On the assumption that equal angles are passed through in equal times, we find that 10 degs. represents $\frac{10}{360}$ of .4 second equals .0111 second, since the engine makes 150 r. p. m., or 2.5 revolutions per second, or .4 of a second per revolution. Then, since v, the change in velocity (in radians per second) $= at + c$, we get δv in r. p. m. $= (a \times .0111 \times 60 \div 2\pi) + c = (a \times .106) + c$.

The average acceleration for the first period is:

$$-\left(\frac{2.90 + .774}{2}\right) = -1.837 \text{ and change in } v = \delta v =$$

$$(-1.84 \times .106) + c = .195 + c. \text{ r. p. m. for the first period.}$$

In the same way we find that during the next 10 degs. the velocity changes by $-.032 + c$ r. p. m., and so on for the rest of Column VI. But we may save a step in calculation by taking the average E and multiplying by $.000106 \times .106 = .00001124$, thus converting to $\delta v + c$ directly. For example, for the period of 10 degs. — 20 degs. the average $E = \frac{-7300 + 1600}{2} = -2850$, and

$$-2850 \times .00001124 = -.032 + c \text{ r. p. m.}$$

We must now determine the value of the constant of integration, c. The velocity at any point is the algebraic sum of the change for any period, and the velocity at the beginning of that period, and since we have assumed that both strokes are identical, the velocity curve must repeat itself, that is, must have the same numerical value at the beginning and end of the stroke. This requires that the sum of the positive changes of velocity shall equal the sum of the negative changes or, combined, they must equal zero, whence we get:

$$\Sigma_{180}\,\delta v = -(.8240 + 13c) + (.3780 + 5c) = 0$$

where .8240 is the sum of the numerical parts of all the negative changes and .3780 is similarly obtained. Hence,

$$c = \frac{.4454}{18} = .02475 \text{ r. p. m.}$$

We can now find the value of each δv as in Column VII., and by combining these changes algebraically get the velocity curve as in Column VIII., and Fig. 9. In this figure the velocity is plotted with reference to an arbitrary zero, so that the rise or fall in speed will have for its actual zero line the average speed of the whole stroke or revolution, which is the arithmetical average of all values of the velocity curve. This is indicated by the broken line. From the area of the positive portion of the curve we find a mean rise in speed of .1274 r. p. m. extending from 51 degs. to 171 degs., or through 120 degs. We have already found that 10 degs. represents .0111 second, hence 120 degs. is equivalent to .133 second, or .00222 minute, and angular displacement $= .1274 \times .00222 = .000283$ revolutions. Then phase displacement $= .000283 \times 24 \times 360° = 2.44°$.

But it is obviously incorrect to overlook the velocity change in the other stroke since it will rarely be the same. This should be ascertained in the same way and the mean of the largest gain in speed should be numerically added to that of the largest loss, from which the total possible pulsation between two similar engines may be calculated.

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* Ewing.

* Perry: Applied Mechanics, p. 270.

* Suppose this involves an error of 1 per cent in t. Then the displacement, or s, which is a function of t, will also be in error by 1 per cent. But the *phase* displacement, which is the result we are seeking, is proportional to (momentary displacement) ÷ (whole displacement or one revolution), hence the error in the result will be a small percentage of 1 per cent, or entirely negligible.

† Perry: The Steam Engine, p. 111. Applied Mechanics, p. 265.

The following approximate method, which is shorter but less satisfactory, has been used extensively. It is based on the assumption that the actual curve of acceleration may be replaced by a uniform acceleration having the same mean value, thus giving a straight line for the velocity curve. The mean velocity will then be the average of its maximum and minimum values and the energy stored in the flywheel is $\frac{W}{2g}(v_1^2 - v_2^2)$ where W = weight of wheel in pounds and v_1 and v_2 are maximum and minimum linear velocities of the radius of gyration of the wheel.

To find the energy stored in the flywheel we take the ratio of the unbalanced energy of one impulse to the energy of one revolution and call this K; that is, K is the ratio of the area of that part of B above the mean torque line in Fig. 8 to the area of the whole curve for two strokes, and the unbalanced energy absorbed by the flywheel is the fraction K of the whole energy of a revolution. The energy per revolution in foot-lbs. equals

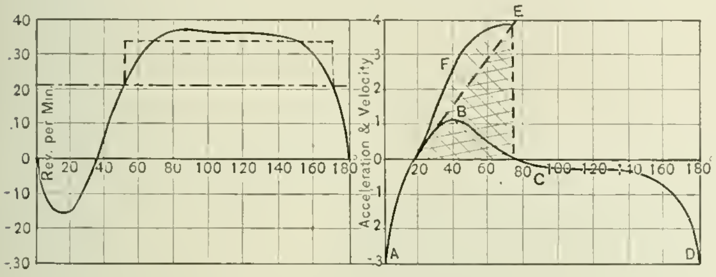
$$P = \frac{KW \times 33000}{.746 \times \text{efficiency} \times \text{r. p. m.}}$$

Then unbalanced energy $= K \times P = P_1 = \frac{W}{2g}(V_1^2 - V_2^2)$

If V_0 = mean speed, we have $\left(\frac{V_1 + V_2}{2}\right) = V_0$, and if we let $\left(\frac{V_1 - V_2}{V_0}\right) = 2s$, we get, by multiplying both sides:

$$\left(\frac{V_1^2 - V_2^2}{V_0^2}\right) = 4s$$

Thus we find $(V_1^2 - V_2^2)$, know V_0^2 and find s, the variation of the maximum or minimum peripheral speeds from the mean, expressed as a fraction of the mean. This variation occurs twice in an impulse, or while $\frac{p \times 360°}{2n}$ electrical degrees are being passed through. The phase-displacement θ is due to the average value of s, or $\frac{s}{2}$, hence $\frac{s}{2}$ is such a fraction of the mean speed as the phase-displacement is of the total angle passed through while s occurs, and we get:



FIGS. 9 AND 10.—VELOCITY AND ACCELERATION CURVES.

$$\frac{s}{2} = \frac{\theta}{\frac{p \times 360}{2n}} \text{ or } s = \frac{\theta \times 4n}{p \times 360} \text{ and } \theta = \frac{s \times p \times 360}{4n}$$

Hence, knowing s, we easily determine the phase displacement. Or, if we wish to know the size of flywheel to limit θ to our 2.5-deg. limit, we find s from the last equation, know P_1, and have $\frac{W}{2g}(V_1^2 - V_2^2) = \frac{W}{2g} V_0^2 \times 4s = P_1$, and taking a suitable diameter for the wheel, find the weight W, or vice versa.

Applying this method to the same engine, in Fig. 8, the area of crank-effort diagram above the mean line is .28 square inch, while the area of the whole diagram for one stroke is 2.7 square inches.

The unbalancing factor is:

$$K = \frac{.28}{2.7 \times 2} = .0518$$

$$P = \frac{400 \times 33000}{.746 \times .93 \times 150} = 127{,}000 \text{ ft.-lb. per revolution.}$$

Unbalanced energy $= 127{,}000 \times .0518 = 6570$ ft.-lb. $= P_1$

$$(V_1^2 - V_2^2) = \frac{64.4}{19000} \; 6570 = 22.3$$

$$V_0 = 4 \times 2 \times \pi \times \frac{150}{60} = 62.8 \text{ ft. per sec. and } V_0^2 = 3950$$

Then: $4s = \frac{22.3}{3950}$ and $s = .00141$

$$\text{Angle} = \theta = \frac{.00141 \times 24 \times 360}{4 \times 2} = 1.52° \text{ displacement.}$$

It is easy to see wherein lies the discrepancy between this result and the one already obtained. In Fig. 10 the acceleration curve *ABCD* is plotted from the values in the table, and is, of course, similar in form to the resultant torque curve *B* in Fig. 8. We measure the area of the positive part of this curve and find its mean value, which we take as a uniform acceleration, and construct its velocity curve *E* (which will, of course, be a straight line) assuming that the velocity is zero at the beginning of the period. This is exactly equivalent to what we do when we take the ratio between the excess area in Fig. 7 to the whole area of crank effort for a revolution, and thus find the mean energy which the flywheel absorbs, thereby changing its speed. But if we construct (graphically in this case) the velocity curve which results from the actual acceleration from instant to instant, we obtain the curve *F*, which, it will be seen, has a considerably higher mean value, and thus gives a larger displacement than does the straight line velocity curve. Or, in other words, the second method assumes that the velocity changes uniformly between the maximum and minimum values V_1 and V_2, the displacement then being that due to the arithmetical mean of these two values. This would be correct to determine the size of flywheel to keep the velocity variation within given limits disregarding the space passed through while the velocity changes, whereas in the present problem it is the displacement which chiefly concerns us and we cannot properly integrate the velocity curve without first finding its shape, instead of assuming it. It should be understood, however, that great accuracy in determining the phase displacement is useless, since all the conditions are changed for any other load than the one we have been considering and a slight readjustment of the valves may make the engine much worse or much better. What we want to know is the order of magnitude of the phase-displacement only.

I	II	III	IV	V	VI	VII	VIII	IX
Degrees.	Press. sq. in.	Moment.	E excess over average moment.	a = Accel. $\frac{Eg}{I}$	Change in velocity — $c = \delta_t$	Change in velocity $= \delta_v + c$	Velocity.	Average E.
..	..	......	—27,400	—2.90	.....	+.02475	+.025	......
10	65	20,100	— 7,300	— .774	—.195	—.170	—.145	—17,350
20	94	29,000	+ 1,600	+ .170	—.0320	—.007	—.152	— 2,850
30	117	36,200	+ 8,800	+ .933	+.0584	+.083	—.069	+ 5,200
40	125	38,600	+11,200	—1.186	+.1124	+.137	+.068	+10,000
50	115	35,600	+ 8,200	+ .87	+.109	+.134	+.202	+ 9,700
60	102	31,600	+ 4,200	+ .445	+.0690	+.095	+.297	+ 6,200
70	92	28,400	+ 1,000	+ .106	+.0292	+.054	+.351	— 2,600
80	83	25,600	— 1,800	— .191	—.0045	+.020	+.371	— 4,400
90	80	24,700	— 2,700	— .286	—.253	.000	+.371	— 2,250
100	80	24,700	— 2,700	— .286	—.0304	—.005	+.366	— 2,700
110	81	25,000	— 2,400	— .254	—.0286	—.004	+.362	— 2.550
120	81	25,000	— 2,400	— .254	—.0270	—.002	+.360	— 2,400
130	81	25,000	— 2,400	— .254	—.0270	—.002	+.358	— 2,400
140	79	24,400	— 2,000	— .318	—.0304	—.005	+.353	— 2,700
150	75	23,200	— 4,200	— .445	—.0404	—.015	+.338	— 3,600
160	67.5	20,900	— 6,500	— .690	—.0600	—.035	+.303	— 3.250
170	50	15,500	—11,900	—1.26	—.1034	—.078	+.225	— 9,200
180	..	......	—27,400	—2.90	—.220	—.195	+.030	—19,650

◆

Colorado River Power.

It is proposed to utilize the power of the Colorado River for electrical purposes. For many months hydraulic engineers have been studying the project and they have just made a report. They declare that in 150 miles of the river's course a dozen times more electrical energy can be secured than is taken from Niagara Falls. If the Government's consent can be secured it is intended to install this summer a plant of sufficient size to furnish electrical power to cities, towns and mining camps within comparatively easy reach of the Colorado, and then to increase the scope of the company until all of Arizona and most of the lower part of California can be supplied from the cañon torrent.

Compounding of Alternators by Compensating Exciter.

By Ernst J. Berg.

In an alternating-current generator of r ohms internal resistance per phase, x ohms reactance per phase, e terminal voltage per phase, and a current of $i + ji_1$ amperes, the following relation exists:

$$e_0 = e + (i + ji_1)\ (r - jx)$$

where e_0 is the induced e. m. f.—that is, the no-load e. m. f.—corresponding to the resultant flux due to the combined armature and field excitation.

As this e. m. f. is 90 degs. behind the magnetism, the resultant magnetism can be expressed as follows:

$$M_r = -jke_0 = -jk\left[e_0 + (i + ji_1)\,(r - jx)\right]$$

The armature m. m. f. is in phase with the resultant current, and can, therefore, be expressed as $n\ (i + ji_1) = M_a$.

Therefore the field excitation, which is the difference between resultant magnetization and armature magnetization, is:

$$\begin{aligned} M_f = M_r - M_a &= -jke_0 - n\,(i + ji_1) = \\ i_1\,kr - in - ikx &- j\left[ke + ikr + i_1\,kx + i_1\,n\right] \end{aligned}$$

or the absolute value of $M_f =$

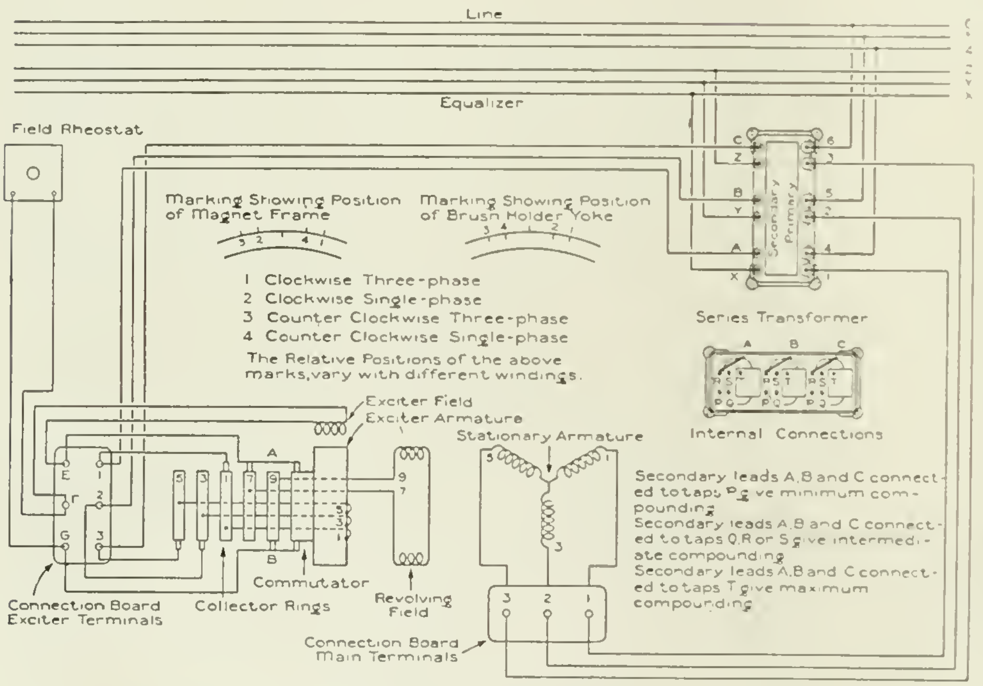
$$\sqrt{\left[i_1\,kr - i\,(n + kx)\right]^2 + (ke + irk + i_1\,(kx + n))^2}$$

$$= \sqrt{I^2\left[r^2\,k^2 + (n + kx)^2\right] + k^2\,e^2 + 2\,k\,e\,\left[irk + i_1\,(n + kx)\right]}$$

where $I = \sqrt{i^2 + i_1^2}$.

Or, since the voltage across the fields is proportional to the m. m. f., we can express it as follows:

$$ef = a\sqrt{I^2\left[r^2\,k^2 + (n + kx)^2\right] + k^2\,e^2 + 2\,ke\left[irk + i_1\,(n + kx)\right]}$$



Line
Equalizer
Field Rheostat
Marking Showing Position of Magnet Frame
Marking Showing Position of Brush Holder Yoke
1 Clockwise Three-phase
2 Clockwise Single-phase
3 Counter Clockwise Three-phase
4 Counter Clockwise Single-phase
The Relative Positions of the above marks, vary with different windings.
C
Z
B
Y
A
X
6
5
4
1
Secondary
Primary
Series Transformer
A B C
R S T
P Q
Internal Connections
Exciter Field
Exciter Armature
Stationary Armature
E
G
r
A
B
5 3 1 7 9
Commutator
Collector Rings
Revolving Field
Connection Board Exciter Terminals
Connection Board Main Terminals
3 2 1
Secondary leads A, B and C connected to taps P give minimum compounding
Secondary leads A, B and C connected to taps Q, R or S give intermediate compounding
Secondary leads A, B and C connected to taps T give maximum compounding

FIG. I.—DIAGRAM OF CONNECTIONS.

The voltage across the alternator fields at no-load is found by substituting $I = O$, thus $ef_0 = ake$. Therefore, for a given load I the voltage across the field has to increase from ef_0 to ef, or:

$$e_x = a\left[\sqrt{I^2\,(r^2\,k^2 + (n + kx))^2 + k^2\,e^2 + 2\,ke\,\left[irk + i_1\,(n + kx)\right]} - ek\right]$$

and neglecting terms of r^2, since the armature resistance is very small compared with its reactance, we have:

$$e_x = a\left[\sqrt{I^2\,(n + kx)^2 + k^2\,e^2 + 2\,ke\left[irk + i_1\,(n + kx)\right]} - ek\right]$$

in which equation e_x is the direct current voltage which has to be generated as the load on the alternator changes, and a the ratio of e. m. f. across the fields to the corresponding m. m. f. Also:

$I = \sqrt{i^2 + i_1^2} =$ resultant current per phase of alternator;
$i =$ energy component of current,
$i_1 =$ wattless component of current,

$$\frac{i_1}{i} = tg\ \omega \qquad Cos\ \omega = \text{power factor.}$$

n equals ratio of the armature reaction expressed in ampere turns to the resultant current.

k equals ratio of resultant m. m. f. of field and armature to the corresponding induced e. m. f.

e equals e. m. f. per phase at terminal of alternator.

r equals resistance per phase of armature winding.

x equals reactance per phase of armature winding.

Perfect control of generator voltage requires, therefore, a device which gives this value of e_x for any current I, and this e. m. f. should be algebraically added to that which the exciter gives at no load on alternator.

A close approximation to this can be obtained by the arrangement invented by Mr. E. W. Rice, Jr., which consists of directly connecting, gearing or otherwise operating an exciter synchronously with the generator, and exciting this exciter by the current of the alternator (with or without the use of current transformers).

It is obvious that an alternating current supplied to such exciter armature will magnetize the machine and cause it to give any desired direct-current voltage, and that the voltage depends not only upon the magnitude of the current, but also upon its phase relation to the field poles.

In practice, one exciter is often used not only to give the required voltage across the alternator fields at no-load, but also to increase the voltage with the load when part of the m. m. f. is obtained by a shunt field, as in a regular direct-current generator, and the increase in voltage with the load by the alternating current entering the armature and magnetizing its field.

The m. m. f. of this alternating current is expressed by

$$M_a = c\ I\ sin\ (\omega + o)$$

and the corresponding voltage as $e_a = b\,c\ I\ cos\ (\omega + o)$, where c is the numerical ratio between the m. m. f. and the current, b is the ratio between the e. m. f. and corresponding m. m. f., I is the total current of the alternator and ω is the angle corresponding to the power factor of the load. $tg\ \omega = \frac{i_1}{i}$. o is the angle between field poles of alternator and exciter; in other words, the angle which has been chosen in displacing the field of the exciter to give the best results all round.

Were it not that even at full non-inductive load the voltage across the alternator fields has to be higher than at no load, it would be best not to offset the poles of this exciter relative to the poles of the alternator, since then with, say, full inductive load the magnetizing effect of the armature current is a maximum in one direction and with full condenser load a maximum in the other direction, and at non-inductive load no effect takes place, which obviously is just what is wanted. Since, however, considerable compounding is necessary even at non-inductive load, the armature has to be offset from this position and thereby the control made less accurate. All commercial loads are, however, inductive, and therefore it is not of great importance to be able to compound for condenser loads or loads requiring leading current, at least not for such loads of very poor power factors.

Let us assume, for simplicity, that the excitation is obtained by two exciters, one direct-current generator giving a constant voltage corresponding to the voltage across the alternator fields at no-load, and the compounding being obtained by another synchronously driven exciter with its direct current circuit connected in series with the main exciter, and its excitation obtained solely from the alternating current supplied from the main alternator through its armature winding.

The constants of this exciter can be ascertained from the previously given equation by substituting numerical values. For instance, if it is desired that the potential of the alternator shall be exactly the same at no-load, full non-inductive load and a load of 70 per cent power factor, we have:

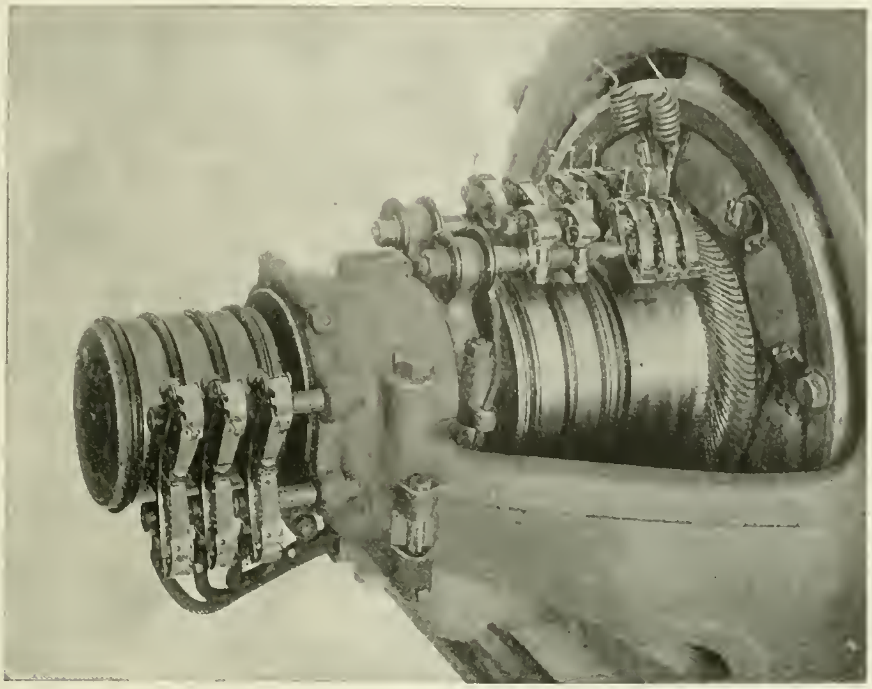


Fig. 2.—Collector Rings.

At full non-inductive load.

$$e_x = e_a$$

$$a\left[\sqrt{I^2(n+kx)^2+k^2e^2+2k^2eIr}-ek\right]=b\,c\,I\cos(0+\phi)$$

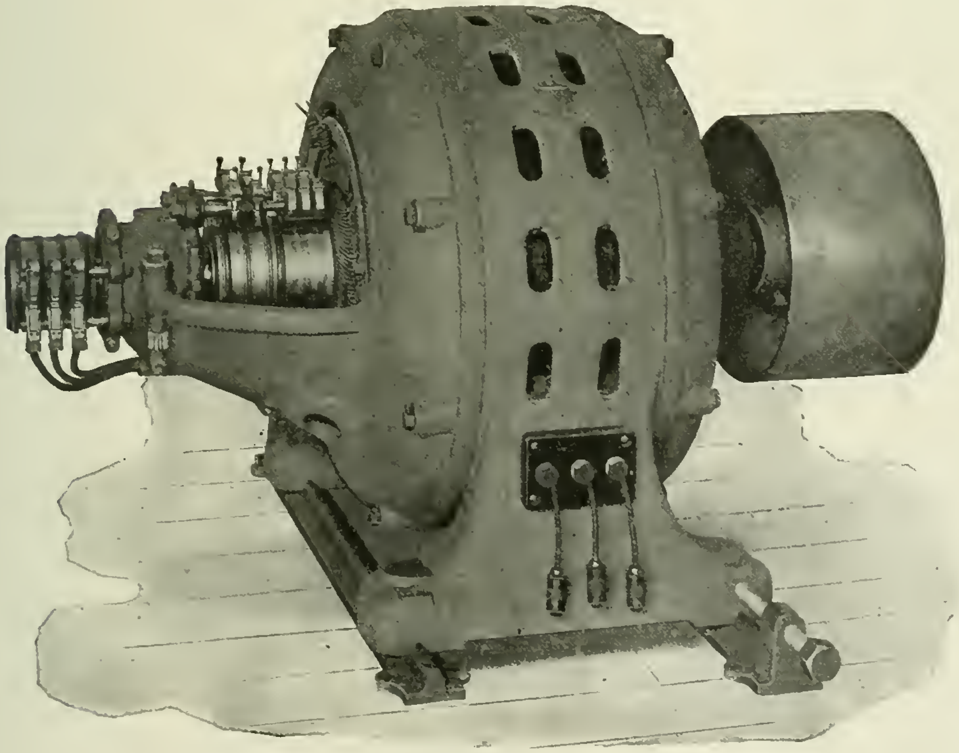


FIG. 3.—ALTERNATOR.

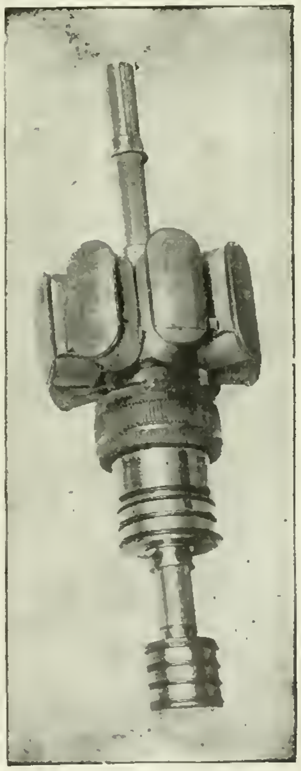


FIG. 4.—ARMATURE.

At 70 per cent power factor, $i_1 = i$, $\omega = 45$.

$$a\left[\sqrt{I^2(n+kx)^2+k^2e^2+1.42\,keI(rk+n+kx)}-ek\right]$$
$$=b\,c\,I\cos(45+\phi)$$

To take a numerical example:

Let $e = 1$ $\quad I = 1$ $\quad Ir = .01\,e$ $\quad Ix = .25\,e$

$k = 1$ $\quad n = .25$ $\quad a = 1$ $\quad b = 1$

Solving these equations in reference to ϕ and c, we find:

$$\phi = 20^\circ \qquad c = .128$$

By substituting different values of current it will be found that the voltage of the alternator remains practically constant for non-inductive loads and inductive loads of all power factors.

To appreciate what is gained by this control, we find from the expression of e_f that disregarding the effect of saturation of alternator fields with the usual separately excited alternator, the voltage would for instance, rise 13 per cent when full non-inductive load was thrown off, would rise 31 per cent if the same kilovolt-amperes at 90 per cent power factor were thrown off, 40 per cent if same kilovolt-amperes at 70 per cent power factor were thrown off, etc.; whereas with the present control, as can be ascertained by inserting proper values, the voltage in these cases is constant within a small fraction of a per cent.

The practical arrangement of this exciter and alternator is illustrated in Figs. 2 to 4, and the connections are diagrammatically shown in Fig. 1.

The alternator itself is a standard machine of revolving field type. The exciter armature with commutator is placed on the same shaft as the fields of the alternator, and this shaft carries in addition two sets of collector rings. Depending upon the system used, one set has three or four rings for a three-phase and two-phase alternator, respectively, which carry the alternating current from the series transformers to the armature winding of the exciter. The second set, which has two rings only, carries the direct current to the alternator field. This exciter is usually wound for 75 volts, which is a convenient voltage, enabling the field spools of the alternators to be made of flat copper ribbons.

The size and character of this exciter is the same as any other directly connected exciter, and with the exception of the collector rings, it is a standard direct-current generator.

Electrical Speed Recording Instrument.

By Frank B. Rae.

In the determination of car operating economy as affecting the selection of the proper size of motors for any specific duty, and also to obtain some knowledge of the efficiency of the man at the controller in relation to the current used in the operation of the car, there seems to be a necessity for a simple and effective speed rgistering device that is capable of drawing an acceleration curve, a continuous speed line and also showing the drift and braking curve of a car as operated by different motormen over a given route. An instrument of this kind, which could be easily applied to any car, would determine many points that are not brought out by the present somewhat elaborate apparatus required in car testing. The methods now used necessitate considerable preparation and several observers, the best results obtained being a specimen run where all conditions are made as nearly perfect as possible. Such a test does not fairly represent the actual everyday work of the car, nor is it a fair basis upon which to calculate the performance of other cars, and none whatever for the personal characteristic of the man at the controller.

The writer has designed an instrument, shown in the accompanying illustration diagrammatically, which it is believed will be of real service to engineers and railway managers in recording the performance of cars on electric, steam or other roads, and which draws a reasonably true acceleration, running, drifting and braking curve. The instrument is also of value in the determination graphically of the speed of revolution of any shaft, and secures an indication of operation not obtainable by the ordinary methods of observation, in that it may be made to record the variations in the speed during one revolution. The several elements of design and construction as combined to produce the desired results are well known, and in their respective uses are entirely reliable.

Referring to the accompanying drawing, there is shown a centrifugal governor of the usual ball type, the speed of which is proportional to the speed of the revolving shaft to be measured. This governor carries an arm for making a record or indicating on a scale, which arm is preferably made to move its indicating or recording point in a straight line by forming it in the shape of a steam engine indicator pencil arm. The governor is driven by a train of gearing from a motor, which may be an electric motor, a weight or spring motor or other suitable means; and in the train of gearing between the motor and governor there is interposed a divided shaft with a friction similar to the friction used in printing telegraph instruments—particularly in the Phelps motor printer. The shaft, intermediate between the driving motor and the governor, has an escapement wheel such as is employed in the stock quotation instrument, and the pallet of this escapement is controlled by a magnet in such manner that the shaft is permitted to revolve only at the speed determined by the oscillations of the escapement pallet. This movement allows the shaft to run one revolution for every eight complete oscillations of the pallet, or to escape one tooth of the escapement wheel for each movement of the pallet.

The magnet releasing the escapement of which the armature forms the pallet, is controlled by a circuit-closing device attached to the revolving shaft or axle, the arrangement being such that a current of one sign is made to energize the magnet during one-half a revolution of the shaft, and a current of the opposite sign operating the magnet during the second half revolution of the shaft; or this effect may be produced each quarter revolution by arranging the circuit closing device to do this. By using an alternating current in this way and a polarized magnet as shown, a uniform and equal strength of movement in both directions of the armature and pallet is obtained.

The record made by the recording hand or pointer is a straight vertical line, and is directly proportional to the speed of the governor as controlled through the escapement. The record is made upon cross section paper, which is drawn underneath the hand by a clockwork chronograph of usual make, by means of which the paper is carried forward at a predetermined rate of speed, say, one inch in 20 seconds. If the vertical section is divided into equal distances representing miles per hour on a scale, say, of 20 miles to the inch, and the movement of the governor pointer is calibrated to this, then the resultant line drawn by the pencil will indicate both the speed and the rate for any instant, and the area enclosed by the speed-time curve shows the schedule speed.

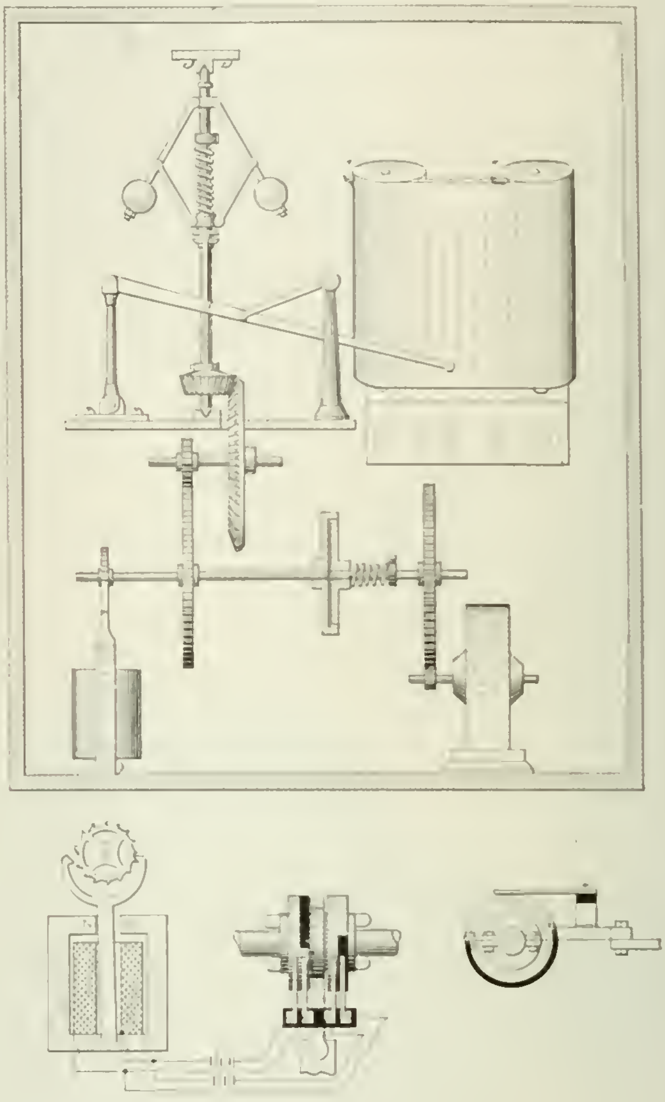


DIAGRAM ELECTRICAL SPEED RECORDER.

Many further results desirable in the operation of cars will be at once apparent as obtainable with the instrument. Having the curves of the motors, with which the car is equipped, it can be at once ascertained whether the schedule used is within their capacity, or if the cost of maintenance seems excessive it may be shown as due to abuse, which a somewhat slower acceleration would correct, or that to maintain the schedule demanded with the stops required, larger motors should be substituted.

The instrument is also of value in the inspection of steam roads and could, with advantage, form a part of the equipment of the division superintendent's private car. In this use the performance of the engine and its handling by the engineer is graphically shown, a continuous run producing a continuous record of acceleration, drifting, the use or abuse of air, etc., by plotting a profile of the road on the record made by the instrument a very complete data of train performance would be shown and possibly point out very many economies.

Notes on the Cooper Hewitt Lamp.

By Peter Cooper Hewitt.

THE purpose of the exhibit which I had the honor to present at Columbia University before the American Institute of Electrical Engineers on April 12, 1901, was:

1. To demonstrate that light can be produced from a gas or vapor in great quantity by means of the electric current, and in the quantity desired.

2. To demonstrate that light can be produced from direct-current low-voltage circuits by means of a gas or vapor.

3. To show that this light is extremely efficient.

4. To illustrate laws of conduction of the electric current by gases or vapors, and to show by experiment the effect of current on a conducting vapor or gas, and the effect of variation in density of the conducting vapor on the current passed.

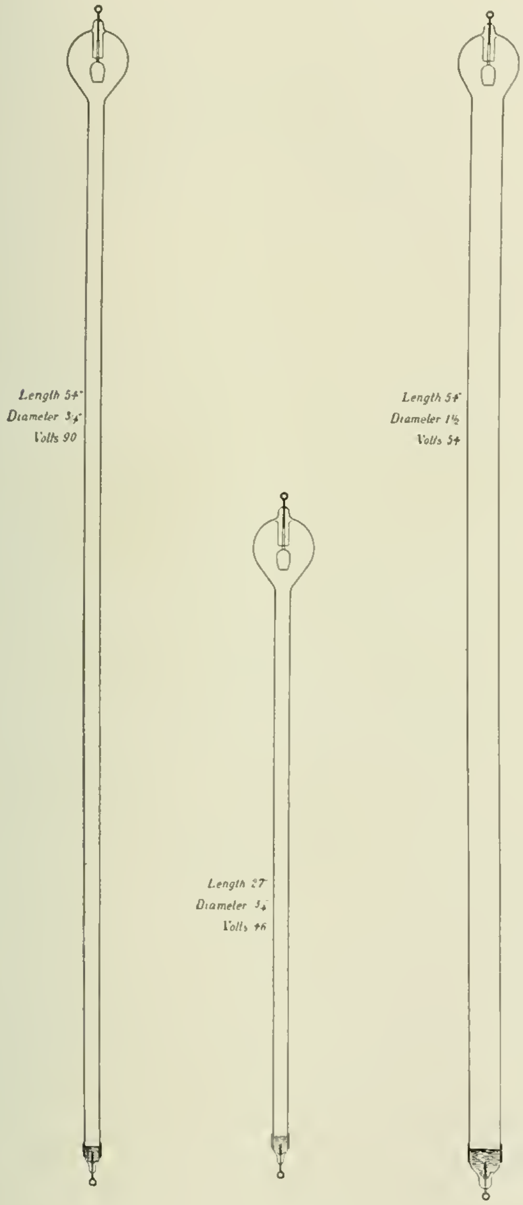


FIG. 1.

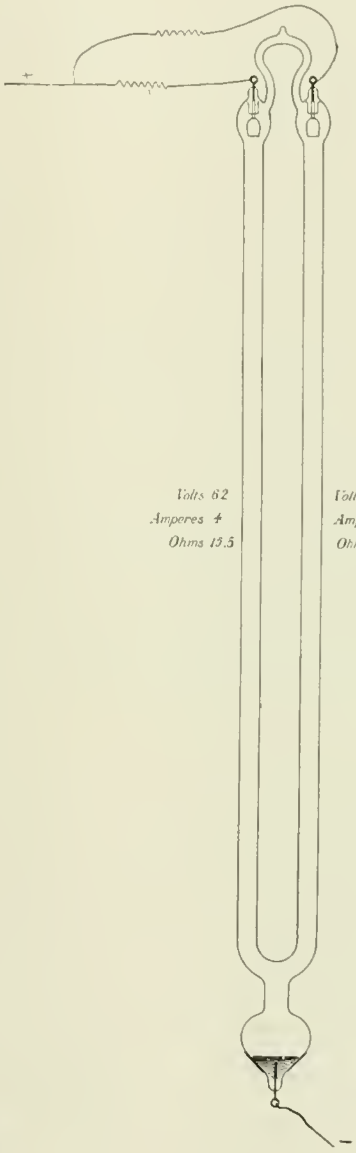


FIG. 2.

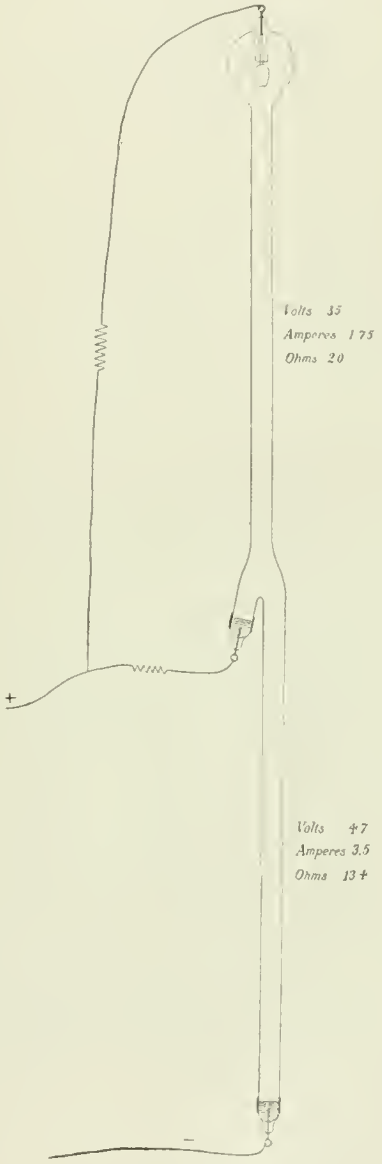


FIG. 3.

5. To exhibit the electrical phenomena at the joint of the negative electrode with a gas or vapor.

6. To exhibit practical electric vapor or gas lamps of very high efficiency.

7. To demonstrate that change in the color of the rays of light proceeding from a gas or vapor lamp of this character can be brought about by means of certain materials.

8. To show, by means of curves, that the resistance of a particular vapor in a lamp can be made to vary in a predetermined manner within wide limits by varying the proportion of the vapor subjected to the current and the heat-radiating ability of the lamp.

The demonstrations actually made are illustrated by the accompanying drawings, and the measurements on the drawings were taken by Weston instruments while the lamps were in operation.

Fig. 1 illustrates the relation of the volts to the dimensions of a gas-carrying current. The demonstration consisted in the operation of three lamps illustrating the tendency of the volts to vary directly as the length and inversely as the diameter, as seen by the figures of the drawing. One lamp is 54 inches long and three-quarters of an inch inside diameter, another is half the length and the same diameter, and the third is the same length as the first and twice the diameter. The drop in volts of the second and third is approximately one-half that of the first. The error in the lamp having the greater diameter, which measured 54 volts instead of 45, as should have been the case, was probably due to impurity developing in the vapor and a factor which appears on comparing tubes of widely different diameters.

Figs. 2 and 3 of the drawings illustrate the relation of current to resistance. The resistance varying inversely with the current, the

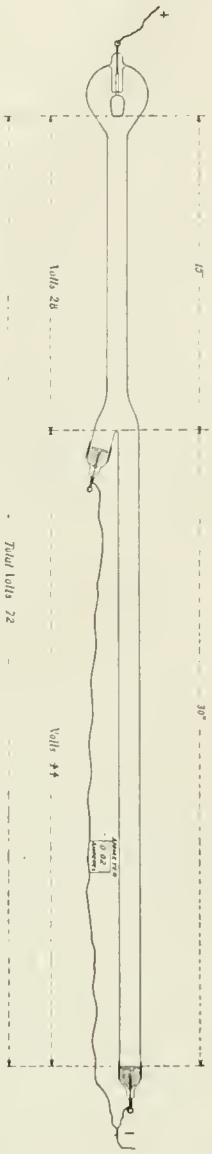


FIG. 4.

Illustrating negative electrode resistance or initial reluctance to allow current to pass. Also illustrating the passage of only a limited amount of current by an electrode prior to having its initial reluctance overcome.

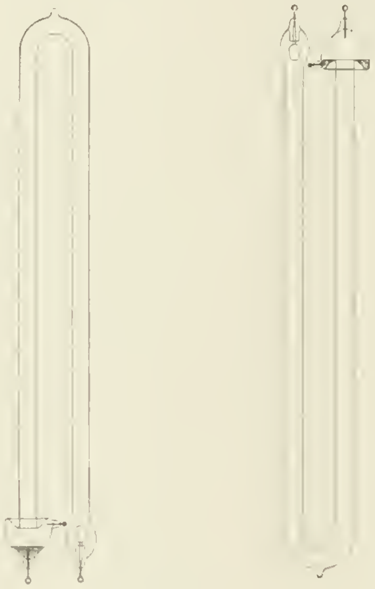


FIG. 5.

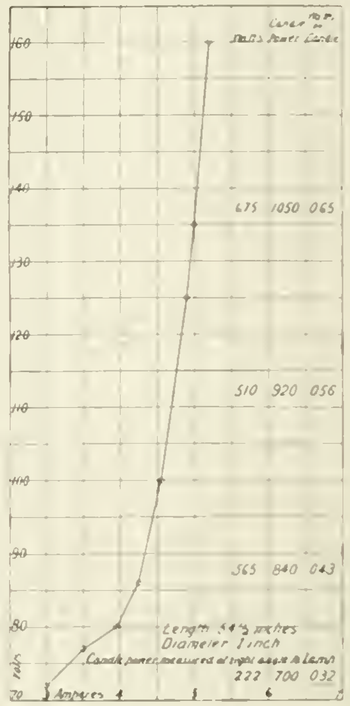


FIG. 7.

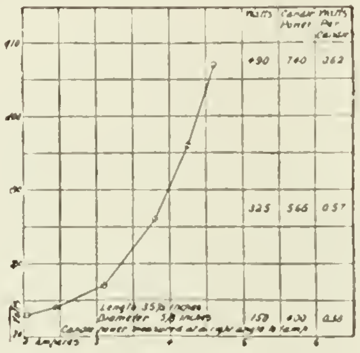


FIG. 8.

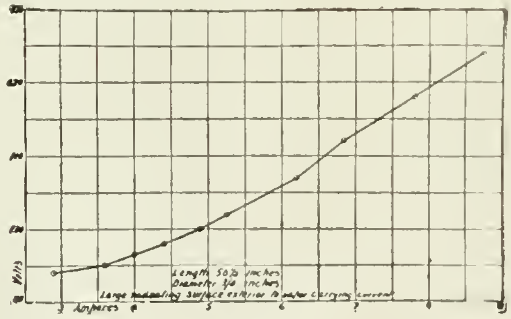


FIG. 9.

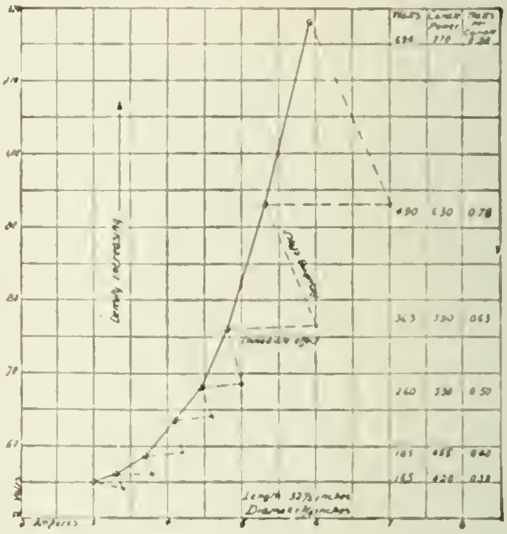


FIG. 10.

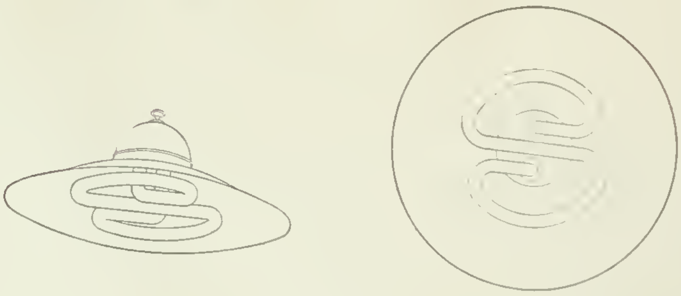


FIG. 6.

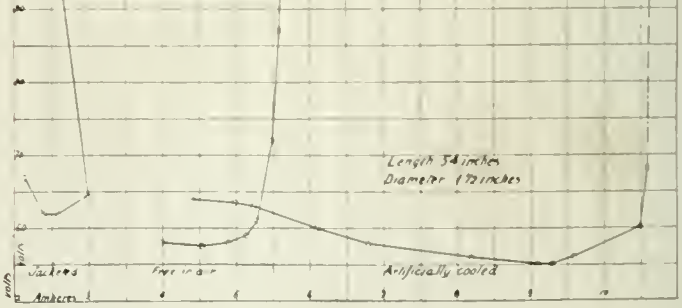


FIG. 11.

Figs. 4 to 11.—Cooper Hewitt Lamp.

volts tending to remain constant. Fig. 2 illustrates a divided vapor circuit, one leg carrying four amperes, while the other leg is carrying two amperes, the voltage over each leg being approximately the same.

The second demonstration (Fig. 3) illustrates a divided circuit consisting of a lamp with an additional electrode midway between the other two, whereby the current in the upper portion of the lamp is one-half that in the lower portion. The drop in volts over each of these portions should have been the same and the resistance of one should have been half that of the other, but for the discrepancy which was due to the greater vapor density in the lower portion owing to the presence of the mercury forming the negative electrode.

The next demonstration (Fig. 4) was a lamp having an auxiliary electrode one-third of the distance between the positive and the negative electrode, which on being connected with the negative electrode by a conductor having a negligible resistance, allowed only 0.02 of an ampere to pass through this short circuit, although it was subjected to a measured electrical pressure of 44 volts, while the lamp was passing about three amperes.

These demonstrations practically illustrated results obtained by me from a great number of experiments.

Figs. 5 and 6 illustrate two forms of my lamp adapted to run on a 110-volt circuit with an efficiency of one-half a watt per candle.

Figs. 7, 8 and 10 show actual efficiencies of my lamp at different electric pressures, while Figs. 7, 8 and 9 illustrate the control of the resistance of the lamp.

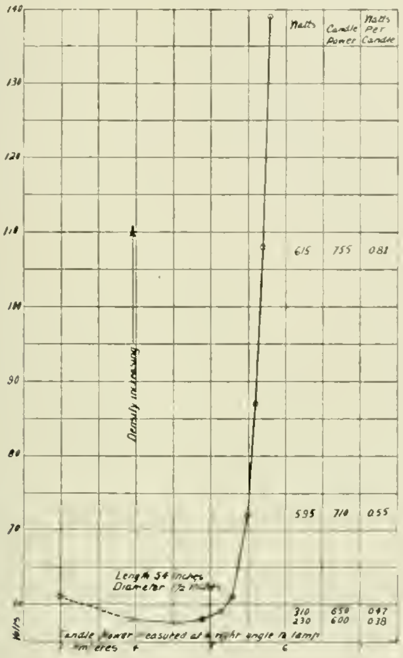


FIG. 12.

Fig. 10 illustrates the electrical variation due to variation in gas density and an immediate effect of variation in current and a result brought about by a variation in gas density.

Fig. 11 illustrates the effect on one of my lamps, of varying its heat-radiating ability.

Fig. 12 is the efficiency curve for the same lamp.

The large lamp exhibited was operated by direct current. The Weston ammeter in circuit with the lamp indicated 7 amperes. The drop in volts across the lamp was 100 volts measured by a Weston voltmeter, and the light given by this lamp was approximately 1500 candles. It was, I believe, the first public exhibition of a high-power vapor lamp, and it was exhibited with standard instruments attached for measuring its current consumption; in fact, all the demonstrations were made with standard instruments attached for general inspection.

CURRENT NEWS AND NOTES.

LIGHTING CANALS.—The Soulanges Canal in Canada is now well lighted by electricity, and the Dominion Minister of Railways and Canals states that the system is now to be extended to other canals there.

PAN-AMERICAN.—Owing to the storm and the heavy snowfall, the Pan-American Exposition will only open in an informal way on May 1, and the regular full-dress exercises will be postponed until May 20.

TELEPHONE CABLE FOR GOVERNOR'S ISLAND.—The Western Union cable boat "Western Union" Thursday afternoon, April 18, laid a four-pair telephone cable from Governor's Island to the Barge Office landing at the Battery. The cable was manufactured by W. R. Brixey, and is owned by the Government. The work was done on the Government's behalf for army purposes.

NEW CONSTRUCTION OF ARMATURES.—A patent issued April 16 to Oskar Lasche, of Berlin, Germany, describes a method of constructing armatures which dispenses with the use of the cast-iron casings and spiders heretofore employed. An iron ring is built of laminæ, which are held together by bolts, and the ring is held together by tension devices consisting of rods set up with turnbuckles.

NAVY YARD DRAFTSMEN.—An examination will be held at the New York Navy Yard on April 30 for eight draftsmen on electrical and other work, at pay ranging from $5.04 to $3.28 per diem. Applications must be filed on or before April 29, with the Commandant there. Details are given in the Navy Yard Order No. 205, issued by Secretary Long. The chief draftsman at the yard is Mr. Edgar H. Berry.

LOCATING METALLIC MINERALS.—A patent issued April 16 to Fred H. Brown describes an electrical method for locating metallic minerals. The method consists briefly in taking electrical measurements over the same length of ground along lines radiating from a central point. Two such central points are chosen so that when the lines representing the radii are plotted the lines intersect. It is stated that the point of intersection of the two lines plotted representing the lowest resistance will be in closest proximity to the body of mineral.

WESTMINSTER ABBEY will fare better and last longer when electric light is installed. A dispatch from London states that a few weeks ago a small marble shaft fell from one of the windows in St. Andrew's Chapel, the iron pin that had sustained it for 600 years having been corroded. Iron pins are doing the same duty in innumerable places throughout the Abbey and further dilapidation is apprehended. To overhaul and renew these pins will be a superhuman labor. Professor Church says that the use of gas as an illuminant in the Abbey, which is a limestone building, sets up a chemical change which is followed by disintegration.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The 153d meeting will be held at 12 West Thirty-first Street on Friday, April 26, 1901, at 8.15 p. m. A paper will be presented by Professor Harris J. Ryan, of Cornell University, Ithaca, N. Y., on "The Transformer for Measuring Large Direct Currents." A paper will also be presented by Professor Frank W. Brady, of the New Mexico College of Agriculture and Mechanic Arts, Mesilla Park, N. M., on "Electricity in Mountain Mines." This paper will be illustrated by lantern slides. The annual meeting of the Institute for the election of officers, presentation of the council and treasurer's report, etc., will be held in New York on Tuesday, May 21, 1901. The list of new candidates for associate membership includes no fewer than 40 names.

SUBMARINE SEARCHLIGHT.—A special telegram from Lakeville, Conn., of April 20, says: The effort to recover the body of Otis Sawyer, of Montclair, N. J., one of the Hotchkiss School students drowned by the upsetting of a canoe, was resumed to-day, when a diver made another descent. As the lake is 70 feet deep at the point where the search is being carried on, the diver has had to work in darkness, with the added disadvantage of being in ooze to his hips. To assist in the search, arrangements were made for the employment to-day of a submarine arc light, the invention of a recent graduate of the Hotchkiss School. Ten thousand feet of insulated wire, brought from New York for the purpose, was connected with a dynamo in the academy grounds to furnish light for the diver's submarine lamp.

ELECTRIC FURNACES.—Among the patents of April 16 are two on electric furnaces, one being issued in the name of the late Lieutenant F. J. Patten, and the other to G. De Chalmot. The Patten furnace is of the open-hearth type, the electric arcs playing downward against an open furnace floor, the process being thus plainly open to view. Each furnace has three working hearths of the form of a sector of a circle, and arranged to revolve in the same horizontal plane about a central supporting post. In revolving, a furnace comes to each of three positions, one for discharging and recharging, a second for preliminary heating and a third for final smelting. The De Chalmot patent refers to the type of electric furnace in which the material is placed in a crucible and subjected to heat generated elctrically and transmitted through the walls of a chamber, in contradistinction to furnaces of the arc type. The crucible is contained within an insulating chamber and rests upon a carbon support which forms one electrode of the circuit. The other electrode is horizontal and in four parts, which bear on the four vertical sides of the crucible.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Generators.—SHORT.—An abstract of a paper read before the Manchester section of the Brit. Inst. Elec. Eng. He remarks that "it is apparent that modern design is tending to a greater number of magnets in the direct-current generator, and it is interesting to see that on the other hand the modern alternating-current machine is being made with fewer and fewer poles." He advocates the standardizing of steam dynamos. He assumes a unit dynamo with one pair of poles, the capacity of which is 137½ kilowatts, and the number of revolutions 800 per minute. He applies the best average working values to this unit dynamo with one pair of poles, and for greater capacities he adds two or more of these units together in the form of multipolar machines, to determine the best relation between speeds and capacities. For instance, without making any changes in the dimensions of the parts or in the electrical and magnetic values, he puts two of these units together in the form of a 4-pole generator. There will now be four poles, but they will have the same section and the same magnet spools. The armature will be doubled in circumference, also the slots and armature coils, commutator bars, brushes, brush-holders and various other parts, all being interchangeable with those of the unit machine. In the same way he constructs an 8, 10, 30-pole dynamo, the results being summed up in a table. This table shows that when certain running values have been established to be used in the construction of multipolar generators, the speed of the machines will depend upon the output. The advantages of such a standard system of design is due to the interchangeability of parts and the certainty of uniformly perfect operation of every machine regardless of capacity. In all sizes of machines the same pole piece would be used. The magnet spools would all be interchangeable. The armature coils would all be alike; the brushes, brush-holders and all the connecting parts would be made after the same patterns. The slots in all the armature laminations would have the same width and depth. "The steam engine stands in the way of accomplishing these results. The speeds and capacities of engines have been established by their makers without reference to the best conditions for the successful operations of the generators they are to drive." He urges builders of engines and direct-current dynamos to co-operate in establishing a standard scale of speeds and capacities for steam dynamos.—Lond. *Elec.*, April 5.

Starting Three-Phase Induction Motors.—An illustrated description of a device of the General Electric Company, of Berlin, by which in starting a three-phase induction motor the armature is automatically short circuited at a certain speed, and this short circuiting is performed for all three phases at the same time and suddenly. This is done by means of a switch mounted on the motor shaft and operated by centrifugal force.—*Elek. Rund.*, March 15.

REFERENCES.

Polyphase Sub-Station Machinery.—EBORALL.—A continuation of his illustrated Brit. Inst. Elec. Eng. paper. He deals at some length with the regulation of the power factor. He discusses the no-load "V" curve of a synchronous machine. He speaks briefly on the overload capacity of polyphase sub-station machinery and begins to discuss parallel running.—Lond. *Elec.*, April 5.

Starting Three-Phase Motors.—BERGMANN.—An illustrated description of a method of calculating the starting resistance and its single steps, for three-phase motors.—*Zeit. fuer Elek.*, March 24.

POWER.

Printing Establishment.—GRIGGS.—An illustrated description of the electric plant of the Curtis Publishing Company, of Philadelphia. It furnishes light, heat and power; 220 volts direct current is used throughout for light and power. Underneath the presses, on the floor, there are nearly 100 motors. Each press motor is provided with two controllers. One is a series controller, or starting box, used when "making up" or starting slowly, and is never in use for more than a few seconds at time. It brings the motor up to about half speed. For the regular operation of the press, the particular speed required under the varying conditions, is obtained from the second controller, which is a special rheostat in the shunt field; by increasing or decreasing the amount of saturation of the field, the speed is varied. The motors are located underneath the apparatus, driven in such a position that they take up no floor space. He calculates that the erection of an isolated plant has resulted in a very considerable saving.—*Elec. Rev.*, April 6.

TRACTION.

Liverpool.—This city is now completely equipped with electric railways, the work having been completed during the present year. In 1897 a special committee decided that the city should own the tramways, and that electric traction should be installed. There are two main stations, which are similar to each other. The Pumpfield station is situated on a canal, and receives its fuel by water. The Lister Drive station is situated on the railway track, and receives coal in cars. The former plant obtains condensing water from the canal, the water for the condenser in the Lister Drive station being cooled by cooling towers. The equipment of the stations consists of six sets of Willans condensing engines direct connected to Siemens Brothers' generators. Four of the engines at one station are compound, and the remainder in both stations are triple expansion. The capacity of the engines is 1200 horse-power. On the wall near the engines are steam gauges and voltmeters. The stations supply both light and power to the city, and there are two switchboards in each station, one each for the different services. These are so arranged that by transposing connections to the switchboard, and engine and dynamo may be used either for lighting or transmission service. A battery of storage cells is connected to each station, which has a capacity of 200 ampere-hours, and is used to assist in balancing the load to the two sides of the three-wire supply for the lighting service. The boiler houses are situated on either side of the engine room. It is thus divided into two distinct parts, each half supplying the engines on that side of the building. The boilers are of the Lancashire type, and there are 14 on each side. Mechanical stokers are used. Besides these two main stations, there are several smaller stations distributed throughout the city. In one of these refuse destructors are used. The rails are laid on a bed of concrete. All the curves are fitted with renewable hard steel strips and bolted to the rails. Several types of cars are used on the road, but the standard car is double deck, with three large windows on the side. It has a reversed staircase, which has given great satisfaction, and is claimed to prevent accidents and allow a greater facility in ascending the stairs. There are large repair shops situated on Lambeth Road, capable of holding 60 cars. All the repairs are done at the main shops, only the lightest kind being undertaken at the car sheds. The overhead construction consists in a large part of the center pole type. These poles are used to support both incandescent and arc lamps, and add materially to the appearance of the streets. On narrow streets side pole construction prevails as well as rosettes. The growth of this company in the last few years has been very great, the total number of passengers for 1897 being about 38,000,000, and for 1900 about 82,000,000.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Notes on Seattle Street Railway Practice.—This company has employed soldered rail bonds for three years with good satisfaction. The bond is illustrated and consists of seven layers of sheet copper, each about 1 inch wide and .025 inch thick. The bonds are about 8 inches long, and about ½ inch at each end is tinned when the bond is made, and that much is soldered to the rail. The remainder of the bond is bent into a U-shape. These bonds are fastened underneath the base of the rail. The method of soldering is described in detail, and consists briefly of heating the rail with a powerful gasolene brazing torch, and then soldering in the usual way, using plenty of solder and heat, and protecting the end which is soldered from the heat which is used to solder the other end of the bond. The block signal system of the company which operates a good deal of single track road is then shown diagrammatically. It differs from other block signal systems principally in the use of a lamp in the middle of the block to indicate that the system is in working condition, and also from the fact that the block can be set by the motorman without leaving his car. This is done by the use of a small switchbox, suspended from one of the span wires and provided with two cords, one of which is pulled by the motorman. The form of snowplow used by the company is shown. It is connected between two cars. Some particulars are then given of the freight business done by the company and its method of settling accident claims. A novel flexible bracket employed on the overhead line is shown. The arm is hinged near the pole and is suspended by a wire from the pole to the end of the bracket or arm. An extended description is then given of the operation up steep grades by means of counterweights. This method has been described briefly before, but is shown in detail.—*St. R'y Jour.*, April 6, and Int. Ed., April.

REFERENCES.

Chicago.—An illustrated description of the power plant of the Northwestern Elevated Railroad which is the latest of the Chicago elevated roads to be completed. There are four generating units of together 5250 kilowatts.—*West. Elec.*, April 13.

New Zealand's First Electric Railway.—This is a line 1½ miles in length, near Dunedin. The cars are short and equipped with two 25-hp motors, on account of the grades of 8½ per cent. The line was opened Dec. 4. The principal railway in Dunedin will also be acquired by the municipality and equipped with electric power.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Tramway Brake.—An illustrated description, taken from a patent specification of a brake invented by Planta. By an electromagnetic device brake shoes are released which fit the rails and against which the wheels are running and thus are braked.—*Schweiz. Blaett. fuer Elek.*, March 22.

Tramway Motor.—Short.—An illustrated description of "The construction of an electric tramway motor." A full description is given of the various stages of manufacture of a standard type made by the English Elec. Mfg. Co.—Lond. *Elec. Rev.*, March 29, April 5.

Monorail Electric Traction.—Behr.—A rather long abstract of his recent lecture on the proposed high-speed electric monorail line between Liverpool and Manchester, a briefer abstract of which was noticed in the Digest, April 6.—Lond. *Elec. Rev.*, March 29.

Automobiles.—A series of articles on "The automobile industry in the United States," comprising a brief article by Maxwell on "The industry in brief." An illustrated description of the wiring connections of an electric automobile. Brief and partly illustrated descriptions of electric automobiles of different American companies, etc.—*Elec. Rev.*, April 13.

Installations, Systems and Appliances.

Three-Phase Extensions in Manchester.—An illustrated article on the scheme of electricity supply over 45 square miles, for lighting and traction purposes. Direct current will in all cases be delivered at the consumers' terminals and to the tramways. The distribution will be by a five-wire network in the central part of the city, and from a three-wire network in the remainder of the area, with a pressure of 400 volts across the outers in each case. The tramway network will be supplied at a pressure of 500 volts. Both networks are to be fed partly by current generated at low pressure and partly by high-tension current. The present station, in which current is generated at 440 volts, is to be retained and to be supplemented by an additional generating station, now in course of erection. The capacity of these two stations will be 26,000 horse-power together. These two stations will eventually supply all the demand within a half-mile radius from them. The remainder of the network will be supplied from a single generating station on the eastern border of the city. Here three-phase current will be generated at a pressure of 6500 volts, and be transmitted to sub-stations, placed about a mile apart and containing transformers and synchronous converters, the arrangement being made that two distinct pressures are obtained, 420 volts for lighting and 500 volts for traction. Each sub-station is designed to supply a radius of about half a mile. The three-phase generating station would eventually have a capacity of 50,000 horse-power.—Lond. *Elec. Eng.*, April 5.

Insulation on Cables.—O'Gorman.—The conclusion of his long Brit. Inst. Elec. paper (Digest, April 6, 13), together with the discussion that followed. Swinburne said this was the first scientific paper written on the subject, but he thought that O'Gorman's calculations on "grading," when reduced to practice, would be found to be misleading. The really best cable would be a matter of compromise and experiment between layer and layer, and was not a thing which could be calculated out carefully.—Lond. *Elec.*, March 29, April 5.

REFERENCE.

Switzerland.—A reprint of the Swiss law of 1900 concerning electric installations.—*Rev. de l'Elec.*, May 31.

Electro-Physics and Magnetism.

Dielectric Losses.—Drysdale.—An illustrated article on "Dielectric losses in condensers and cables, and their bearing on electrical supply." He first calls attention to the importance of this question in alternating-current practice. He has made some laboratory tests on both cables and condensers. In a table he gives the results of his measurements of the losses in dielectrics. A number of measurements of the capacity of the cables and condensers were also made at different potentials during the tests, by observing the current and p. d., the wave form being approximately sinusoidal. While Mordey had recently found the capacity to be constant in this case, the present author found the capacity in most cases increasing at high pressures. In a table he gives a summary of the measurements made by Ayrton, Mather, Hoor, Addenbrooke and himself, of the power factor in different condensers and cables. It appears that the power factor for most dielectrics when new lies between 0.02 and 0.03; but it seems that this may be largely increased with age or treatment. In view of the important part which cables and condensers play in alternate-current working, this matter seems worthy of especial investigation.—Lond. *Elec.*, April 5.

Electric Arc.—Child.—An article on the velocity of ions drawn from the electric arc. A study of the rate of discharge from an arc to a neighboring body, shows that under varying conditions of difference of potential, distance and current, in the arc itself, the positive ions drawn out from the arc move more rapidly than the negative ones. This is not to be explained as an effect due to ultra-violet light. The positive ions from a carbon placed in an oxy-hydrogen flame, also move the more rapidly than the negative. In cases of an arc between metals the negative ions move the more rapidly. While his work does not prove that the positive ions in the arc itself move more rapidly than the negative ones there, it is in every respect consistent with such a hypothesis, and it shows that it is possible for the positive ions to do so.—*Phys. Rev.*, March.

Coherers.—Kinsley.—An article on coherers suitable for wireless telegraphy. For this purpose the most sensitive coherer is the one which, with unchanged conditions at the transmitting station, will receive the signals when its own aerial wire is the shortest. He recommends the following method of testing, which he calls the direct potential difference method. If a coherer has a p. d. between its terminals when its resistance is high—practically infinite—its resistance will be unchanged as the potential is raised until a certain value is reached when the resistance will suddenly fall. The more sensitive the coherer, the smaller is the p. d. necessary to produce this sudden change in its resistance. He gives in tables the results of various tests of coherers. He emphasizes the fact that the sensitiveness does not depend on the metal or metals used. Coherers of any degree of sensitiveness desired may be made of any metal. It is only necessary to treat each metal in accordance with its peculiar nature. In general, the more readily the metal oxidizes, the more carefully must it be manipulated. Nickel is a very satisfactory metal to use, as it can be handled in the open air and can easily be made to give any sensitiveness and ultimate resistance desired for wireless telegraph work. The local p. d. he has found best to use is 0.4 volts. As the current must also be kept small, say, less than 0.002 ampere, it is obvious that a very sensitive relay must be used. He has found that a relay which is operated by a current of 0.001 ampere is the most satisfactory.—*Phys. Rev.*, March.

Metallic Reflection of Electric Waves.—Lindmann.—In his experiments on the reflection of electric waves by metallic surfaces, Righi had claimed to have discovered an elliptic polarization of the waves by reflection; but this elliptic polarization is very improbable for theoretical reasons. The present author has repeated Righi's experiments with improved apparatus and did not detect any ellipticity. As regards positive results, he is inclined to attribute them to disturbing reflections.—*Ann. der Physik.*, No. 3; abstracted in Lond. *Elec.*, March 29.

Solar Corona.—Bigelow.—An article on "The magnetic theory of the solar corona." The coronal effects at the sun are explained by a magnetic field in conjunction with an electric discharge radiation acting upon ionized products. The earth is immersed in a true external magnetic field, and the variations on the normal type are explained by the action of the ionization in the atmosphere, the ions being generated by the electromagnetic radiation. The base of the magnetic field in which the earth is immersed is in the sun. The earth rotates with the field in space. Consequently, the 11-year period of the earth's magnetic and meteorological elements is caused by efficient internal solar process. The 26.68-day period, by the sun's axial rotation; the semi-annual "inversion of the type curve," by exposures to the solar lines at the earth in different aspects, such that oppositely directed couples are produced twice annually.—*Am. Jour. of Sc.*, April.

Phosphorescent Glow in Gases.—Burke.—The conclusion of his long investigation of the phosphorescent glow in gases. His results are summed up as follows: The glow is a volume effect. It consists of unelectrified particles. It is not the result of the recombination of ions liberated by the spark, as these ions travel down the long tubes away from the spark, but is the result of the production of molecules in the bulb by the spark directly. An e. m. f. has no effect upon the glow. The glow conducts as it passes through the gas. The destructive effect of sparks on the glow is due to cathode rays or fast-moving negative ions. The glow is due to impurities, but oxygen is a necessary element, and most probably ozone, but they are not sufficient by themselves. There is an analogy between the glow and thermoluminescence which is of importance. There is a certain amount of energy stored up in the gas by the passage of the spark. The glowing particles resemble in some of their properties the emanation from thorium. The phosphorescent particles appear to be one kind of particles emanating from the sparks quite distinct from those molecules to which the explosive pressure is due. The conductivity appears to be electrolytic, depending upon the presence of impurities. The phosphorescent particles appear to be large molecular groups formed by the spark whose existence may be maintained for some time, notwithstanding the bombardment from the molecules of the gas, in consequence of repulsion which they must exert on molecules that approach them.—*Phil. Mag.*, April.

Crookes Tube.—Willows.—An account of an experimental investigation of the absorption of gas in a Crookes tube. It appears that most, if not all, of the gas absorbed is to be accounted for by a chemical combination with the glass. That if tubes are desired in which the pressure remains constant they should be made of Jena glass in preference to lead glass, and of lead glass rather than of soda glass, and finally that in the first two cases hydrogen is absorbed to a far less extent than air or nitrogen, the last two gases showing little difference.—*Phil. Mag.*, April.

REFERENCES.

Analyzing Distorted Waves.—Langsdorf.—A description of "A graphical method for analyzing distorted alternating-current waves." The method merely requires the use of circles and straight lines.—*Phys. Rev.*, March.

Cathode Rays.—J. J. Thomson.—A paper in which he first gives an account of an experimental investigation of a kind of easily absorbed radiation produced by the impact of slowly moving cathode rays. He also gives a mathematical theory of the negative glow, the dark space, and the positive column, based upon the hypothesis of corpuscles.—*Phil. Mag.*, April.

Coherer.—Schlabach.—A summary of our present knowledge on coherers, with a very long list of articles and papers on this subject.—*Phys. Zeit.*, March 30.

Electro-Chemistry and Batteries.

Storage Battery.—An illustrated article on the Rosenthal storage battery. It is claimed that it will stand heavy over-discharge, and that although the plates are of the pasted type, they can be charged in a very short time, with a charging current of four or five times the usual rate, without sustaining any permanent injury. The plates have central supporting grids of lead designed to allow free expansion of the paste in every direction during the process of forming and when in use. The grids consist of vertical rods having a diamond section, and of interconnecting horizontal bars having a circular section, the positives and negatives being similar except in thickness. The paste is a mixture of finely powdered lead oxide, and a preparation of an inert material, with a solution of specially treated sulphate salts, the object being to make a very coherent and yet extremely porous material. Some results of tests are given. One is as follows: A battery of 140 ampere-hours nominal capacity, at 20-ampere charge and discharge; charge at 20 amperes for 9 hours, 180 ampere-hours; acid solution, 1.170 to 1.300; discharge at 20 amperes for 8 hours, 160 ampere-hours, at 2.01 to 1.8 volts; ampere-hour efficiency, 88.9 per cent; weight of plates with terminals and separators net, 19 lbs.; weight of complete cell, 23.75 lbs.; watt-hours per pound of plate (average 1.95 volts), 10.38; watt-hours per pound of complete cell, 13.1. "This cell was taken from a battery of 36 cells, which had been in use for 9 months in a motor car, running over 500 miles on ordinary roads, many times discharged at 60-ampere rate, and at an average discharge taken as 25 amperes."—Lond *Elec. Rev.*, April 5.

Primary Batteries.—Reynier.—A description of two new batteries by Fontaine-Atgier, which were shown at the late Paris Exposition and seem to be intended chiefly for medical apparatus. In the first the depolarizing action is due to an iron wire gauze which offers a very large surface for the hydrogen to escape It is a zinc-iron couple, the solution being caustic soda. The e. m. f. is 0.45 volt, and the internal resistance is very low It is claimed to be quite as constant as one in which there is a perfect chemical depolarization With a gauze of copper or brass the e. m. f. becomes 0.05 volt, but the depolarizing action is far less energetic. With silver, the e. m. f is 1.25, but the depolarizing action is very poor, from which it is claimed that the iron has an action peculiar to itself. Some data are given, among which the difference of potential after the initial drop is given as 0.22. The second cell described has two liquids like the Bunsen, but instead of the sulphuric acid, he uses a strong solution of caustic soda and in place of the nitric acid, he uses a secret nitrogenous mixture which avoids the production of bad odors, as the vapors are transformed almost entirely into ammonia. The e. m. f. is 3.20 to 3.5 volts. The difficulty lies in the porous cup. These are described and he has found one which will stand the action. The retaining vessels are made of sheet iron, and the batteries have a small weight. The cost of the energy with these is said to be about 80 cents per horse-power hour —*L'Elec.*, Feb. 9.

Electromotive Force and Osmotic Pressure.—Lehfeldt.—A long paper, in which he develops an expression for the e. m. f. of a concentration cell, with or without migration, by means of a thermodynamic cycle. The expression, which is applicable to strong as well as weak solutions, is given first, on the assumption of Boyle's law, in terms of the degree of dissociation of the salt as found from the electrical conductivity; afterwards, without that assumption in more general terms. According to this expression the e. m. f. of a cell depends on the total osmotic pressure of the salt, not on that of the metallic ion only. Experiments are then described, both old ones recalculated and new ones made for the occasion, in which the e. m. f. of concentration cells of chloride of zinc and sulphate of zinc are measured, the results being expressed by curves and tables. From the data thus provided the osmotic pressures of those salts in solutions nearly up to the points of saturation, are calculated, and the analogy between those pressures and the pressures of highly compressed gases pointed out.—*Phil. Mag.*, April.

Electrolytic Oxygen and Hydrogen.—Buffa.—A long article in which he discusses the industrial electrolysis of water under five sections—electrolytic cells, chemical changes, industrial installations, industrial yields and applications. He describes the cells of Renard.

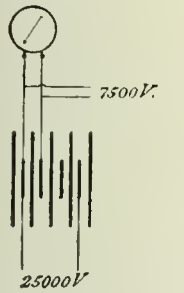
Garuti and Del Proposto. The first uses diaphragms of asbestos, the others metallic diaphragms which have proved more satisfactory. "These are of thin sheet steel, it having been found that below pressure of 3 volts these sheets act as diaphragms and not as secondary electrodes, as one would have expected." He describes the electrolytic plant at Rome, designed by Bossi and Bassani, for the production of hydrogen for inflating military balloons. High tension alternating current is furnished by a supply station, and is transformed into direct current at 50 volts. A 14 per cent sodium hydrate solution is used with iron electrodes, a film of oil covering the surface of the electrolyte. At Rome, 1 horse-power-hour, measured at the terminals of the primary circuit of the transformers, yields 0.086 cubic meter hydrogen gas. At Brussels 1 horse-power-hour, measured at the terminals of the decomposing cell, yields 0.12 cubic meter of hydrogen. At Rome the kilowatt-year costs 96.6 francs, and the cost of 1 cubic meter of hydrogen and ½ cubic meter of oxygen is 20 centimes, interest and depreciation charges excluded. The cost of a 100-hp installation, with the necessary pumps for compressing the gases produced, is estimated at 110,000 francs.—*Ass. Ing. El. Liege, Bull.*, Sept. 30, 1900; abstracted in *Science Abstracts,* March.

REFERENCE.

Frasch Process.—An illustrated article on the Frasch electrolytic process for refining nickel, which was noticed in the Digest, Sept. 22. This description is a summary of five recently issued United States patents.—*Eng. and Min. Jour.*, April 6.

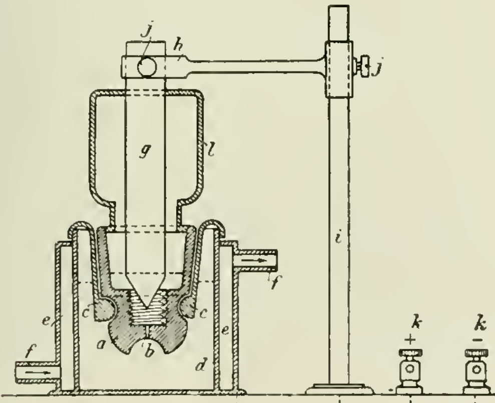
UNITS, MEASUREMENTS AND INSTRUMENTS.

Static Voltmeter for High Tensions.—Benischke.—A brief illustrated paper read before the Electrotechnical Society, of Berlin. He showed a high-tension voltmeter of the Gen. Elec. Co., of Berlin, with two scales, one up to 7500 volts, the others up to 25,000 volts. As far as the 7500-volt scale is concerned, it is an ordinary static voltmeter. The second scale to 25,000 volts is obtained by means of condensers. The arrangement is based upon an older suggestion of Peukert, who had recommended reducing high-tension measurements to low-tension measurements by connecting several condensers in series and shunting one of them by a static low-tension voltmeter. As seen in the adjoining diagram, the present author uses the same idea to get a second scale reading up to 25,000 volts, besides the original scale, reading up to 7500 volts. The dielectrics of the condensers consist of micanite, placed below the bottom of the instrument. Both scales are obtained by calibration.—*Elek. Zeit.*, March 21.



STATIC VOLTMETER.

Electrolytic Interrupter.—Haerden.—An illustrated description of an electrolytic interrupter, which has been in use continually for several weeks proved successful. It is a modification of the Caldwell interrupter. In the bottom of a china insulator *a* a hole *b* of about 1.5 mm. diameter is drilled. The insulator is suspended in a lead cylinder *d* by means of a lead ring *cc*. The cylinder *d* is surrounded by the cylinder *ee* for water cooling. The lead cylinder *d* is the cathode, while a lead strip *g* is the anode, which can be raised or lowered at will; *k k* are the terminals for the electric circuit. Dilute sulphuric acid of 23 degs. B. is used as electrolyte. To prevent spilling of the sulphuric acid, a bottle *l* with a hole in the bottom is placed above the insulator. He found that lead was the best metal to use. It will be seen that the interruptions occur at the hole *b* which connects the two portions of the electrolyte in the cylinder *d* and in the insulator *a*. During the operation he observed a peculiar periodical change of the level of the electrolyte in the insulator, which, however, has an influence upon the successful operation of the interrupter.—*Elek. Zeit.*, March 21.



ELECTROLYTIC INTERRUPTER.

Clark Cell.—Carhart.—A summary of the various determinations which have been made of the e. m. f. of the Clark cell. If Clark's own determination is omitted, because his cells, when set up with boiled zinc and mercurous sulphates, are not comparable with the others, then there remain only three absolute determinations by others. The mean of these is 1.4333 volts at 15 degs. He is convinced that the e. m. f. of the Clark cell at 15 degs. C. is nearer 1.433 than 1.434 volts.—*Phys. Rev.*, March.

REFERENCES.

Ballistic Galvanometer.—Robertson.—The first part of a mathematical article, illustrated by diagrams, on "The apparent resistance of a ballistic galvanometer of the moving coil type, and a method of allowing for the damping current."—Lond. *Elec.*, April 5.

Rheostats and Bridges.—Edelmann.—A brief illustrated article on sliding rheostats and bridges, of precision.—*Elek. Zeit.*, March 21.

Effect of Tramways on Magnetic Observatories.—A reprint in full of the paper by Ruecker "On the magnetic field produced by electric tramways." Also of the paper by Glazebrook, giving "Notes on the practical application of the theory of magnetic disturbance by earth-currents," which were noticed in the Digest, Jan. 12.—*Phil. Mag.*, April.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—Guarini and Poncelet.—An article on the part played by the antennæ in wireless telegraphy. They arrive at the following conclusions. "Instead of the long, vertical antennæ employed up to the present, it is only necessary to arrange small antennæ (about 1 meter in length), provided or not with Hertzian reflectors, arranged parallel in the two corresponding stations, and in such a position as to be comprised within the normal planes passing through their extremities. It does not matter whether they are horizontal, vertical or oblique, so long as the above-mentioned conditions are fulfilled. If between the two stations there are any obstacles such as the curvature of the earth, metallic objects, houses, trees, etc., which absorb the radiations, the distance of transmission will be diminished, and communication may even be stopped. In this case the two antennæ must be raised so as to be above any obstacles. At sea the curvature of the earth has less influence, as the electric waves pass through the water, and in this case the absorption depends on the quantity of salt in the water. The curvature of the earth only intercepts wireless telegraphy waves at sea at long distances, when the electric waves come in contact with the bottom of the sea."—Lond. *Elec. Rev.*, April 5.

REFERENCES.

Statistical.—Statistical articles on telegraphy and telephony in Hungary in 1898 and 1899, in Austria in 1899, in Sweden in 1897 and 1898.—*Jour. Teleg.*, March 25.

Congo.—An article on the construction of the telegraph line from Loango to Brazzaville.—*Jour. Teleg.*, March 25.

Coherers for Wireless Telegraphy.—See the abstract of Kingsley's article under Electro-Physics.

MISCELLANEOUS.

Electrical Heating of Metals.—De Tunzelmann.—A very long article. He discusses the method of applying electro-fusion to casting. He says that the premature cooling of the upper surface of a steel casting is the cause of faulty castings. The supper surface of the casting should, therefore, be kept in a fluid state while the lower portion is solidifying. For this purpose the liquid metal surface is made to form the positive pole of an electric arc, while a steel or carbon rod forms the negative pole. The latter can be raised and lowered by a special mechanism. The thick iron walls of the mold have a thin metal prolongation lined with firebrick, or similar resisting material. The fused metal does not stick to this, and since the firebrick is an insulating material, no arc will be formed between the rod and the sides, and hence the latter will not be destroyed as might happen if no firebrick were interposed. Experiments have shown that for the treatment of three blocks of crucible steel, each weighing about 6 tons, and one block of Martin steel of about 14 tons, a direct current of 800 amperes at 60 to 70 volts is necessary. Calculations as to the cost of production of steel by the above method show that Martin steel costs about 10 per cent less and crucible steel 22 per cent less than when made in the ordinary way. Three processes in commercial use are described in detail, namely, the Bernados process of electrofusion, the Voltex process of electrofusion, welding, brazing, etc., and the Thomson process of electric welding. Data are given as to the amount of current used in these processes. He claims that the Voltex process of electric heating is far cheaper and more economical in many phases of manufacture and repairing than methods now in use. In the brazing and filing of a cycle frame the cost of the old method by gas and coke is $1.43 against 46 cents by the new one.—*Feilden,* Oct., Dec.; abstracted in *Science Abstracts,* March.

New Books.

The Theory of Commutation. By C. C. Hawkins. London: Geo. Tucker. 81 pages, 24 illustrations. Price, 2 shillings, sixpence.

This pamphlet is a reprint of a series of articles which appeared in the London *Electrician* about the end of last year. It is intended for those who are familiar with this subject and understand higher mathematical discussions involving differential calculus.

In the introductory paragraph the author discusses the three causes of current change, namely, the dynamo electric, the electromagnetic and the electrical. He then discusses their relative importance in a dynamo and in a motor. The greater part of the book is devoted to a discussion of the short-circuit equation. This he considers first, irrespective of the brush contact resistance, and then includes this resistance, and describes at some length the mathematical solution of the short-circuit equation by Arnold and Mie, which includes the brush contact resistance. This leads to a formulation of the mathematical conditions of sparkless running. The theory is illustrated by some numerical examples using carbon as well as copper brushes, in connection with which he uses certain curves. The next portion of the pamphlet deals with the interchange of energy during commutation, in which use is also made of these curves to explain still further the nature of the process of commutation. The conditons of sparklessness are then discussed and are shown to be three in number, which, however, are to a certain extent inconsistent with one another, and he shows that herein lie many of the difficulties of securing sparklessness. The remainder of the pamphlet deals with the disadvantages of large angles of lead, the application of the results to motors, and the experimental measurement of the current and the interpolar field. A 10-page appendix contains numerical data and constants, which refer to certain curves that he uses.

The author has written considerable on this and allied subjects, such as armature reaction, a long series of articles by him having been abstracted in the Digest of the Electrical World and Engineer a number of years ago. He seems to be quite conversant with the subject, and the present pamphlet will not fail to be of interest and use to those who wish to study the theoretical side of this difficult question, and who are able to follow the mathematical discussion.

Recenti Progressi Nelle Applicazioni Dell' Elettricita. Di Rinaldo Ferrini. 3a edizione, completemente rifatta. Milan: Ulrico Hoepli. 283 pages, 109 illustrations. Price, 7.50 lire.

This book is a curious mixture of scientific and popular description, and might be aptly styled "Many Inventions." It appears to be the work of a man who is fond of his subject, and who keeps abreast of the times throughout an extremely wide field. Only the most modern aspects of electrical science and engineering are touched on. The first part is entirely theoretical, and takes up the theory of induction and then gives an exposition of the modern methods for studying periodic currents by means of vector analysis or the algebra of complex quantities. The second part considers the most recent improvements in dynamo design and apparatus used in connection with power plants. The third part is devoted to the more strictly scientific forms of invention and discovery as distinguished from the large applications of power. Thus here are described experiments with polarized light, Röntgen rays, the Marconi telegraph, the Wehnelt interrupter, Hertzian waves, physiological experiments, etc.

BOOKS RECEIVED.

Die Theorie des Bleiaccumulators. Von Dr. Friedrich Dolezalek. Halle: Wilhelm Knapp. 122 pages, 30 illustrations, Price 6 marks.

Instruction for the Use of Telephones. United States Signal Corps, U. S. A. Prepared under the direction of General A. W. Greeley, Chief Signal Officer, U. S. A., by Captain Samuel Reber, Signal Corps. Washington: Government Printing Office. 34 pages, 20 plates,

Jahrbuch fur Elektrochemie. V. und VI. Jahrgango, 1898-9. Von Dr. W. Nernst und Dr. W. Borchers. Halle: Wilhelm Knapp. Volume for 1898, 496 pages and 195 illustrations. Price, 20 marks. Volume for 1899, 431 pages and 204 illustrations. Price, 16 marks.

Practical Electrical Testing. By C. D. Aspinall Parr, Asso. M. E. E. E. London and New York: Longmans, Green & Co. 392 pages, 231 illustrations. Price, $2.50.

N. E. L. A. Convention.

Mr. C. O. Baker, Jr., master of transportation of the National Electric Light Association, writes us: "It gives me pleasure to advise you that the Trunk Line Association, the New England Passenger Association, the Central Passenger Association, the Southeastern Passenger Association and the Canadian lines have granted a rate of a fare and a third on the certificate plan from all points in their territory to Niagara Falls and return, for delegates and friends attending the twenty-fourth convention of this association, to be held May 21, 22 and 23. The time limit of these tickets—three days before and three days after the meeting, not including Sundays—will enable members who desire to do so to attend the dedicatory ceremonies of the Pan-American Exposition at Buffalo, which takes place on Monday, May 20."

Storage Battery Plant of the Cleveland & Chagrin Falls Trolley System.

In order to increase the efficiency of its road the Cleveland & Chagrin Falls Electric Railway Company has recently erected the storage battery sub-station herewith illustrated. The battery installed by the company (Fig. 6) is of the Willard standard type of 400 ampere-hours capacity, the elements being placed in lead-lined tanks large enough to allow the capacity to be raised to 600 amperes by the addition of plates. The plates and elements are lead burned to bus-bars, and at all points where necessary to connect from one group of cells to another, the bars are reinforced with copper. The leads from the battery to switchboard are all of bare copper and covered with lead wherever necessary to protect it from the acid fumes. The tanks containing the elements rest on eight glass petticoat insulators in two tiers. These in turn rest on stringers four by four, which are supported by brick piers built at intervals of every 5 ft. the whole length of the battery room. The battery has a momentary discharge rate of 400 amperes, allowing in extreme cases for discharge rates as high as 900. The circuit breaker on the switchboard is set at this point.

In a room partitioned off from the main battery room is situated the switchboard, which for this type of battery is of very simple construction. The board is of Italian marble, the voltmeter and ammeter being of Weston round pattern, standard type. The circuit breaker is of the I. T. E. pattern, the switchboard switches being furnished by the Graves Electric & Manufacturing Company, of Cleveland.

The battery house (Fig. 7) is a handsome and substantially built brick structure, 30 by 60 ft. The roof is of slate, and the floor is paved with brick. The station is situated at a point 11 miles west of Chagrin Falls and three miles east of Cleveland. The length of the western division of the road from Chagrin Falls to Cleveland being 14 miles.

Before installing the battery a great deal of difficulty was found in operating this division of the road, owing to the excessive drop in the voltage at or near the western terminal. In many cases while operating the regular schedule, the voltage dropped below 200, and it was almost impossible to operate this part of the road if anything unusual happened, such as the necessity of using a snowplow or running a special car. Since installing the battery, the voltage is maintained between the extreme western end and a point 7 miles east, at an average voltage of over 450, and it does not fall below 350 at any point.

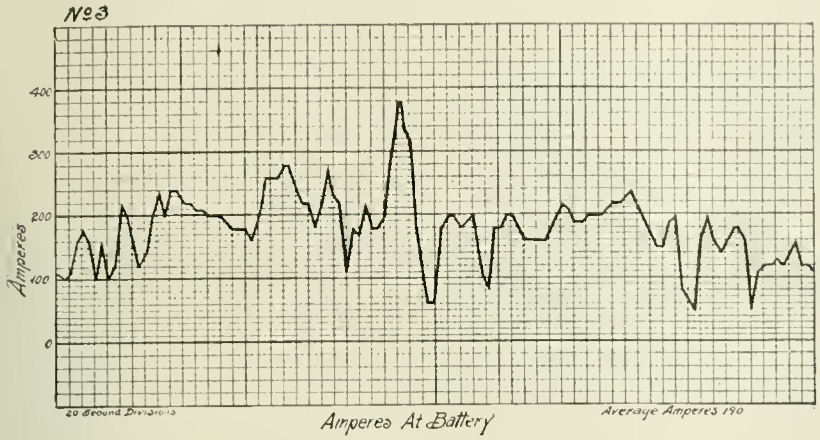


FIG. 3.

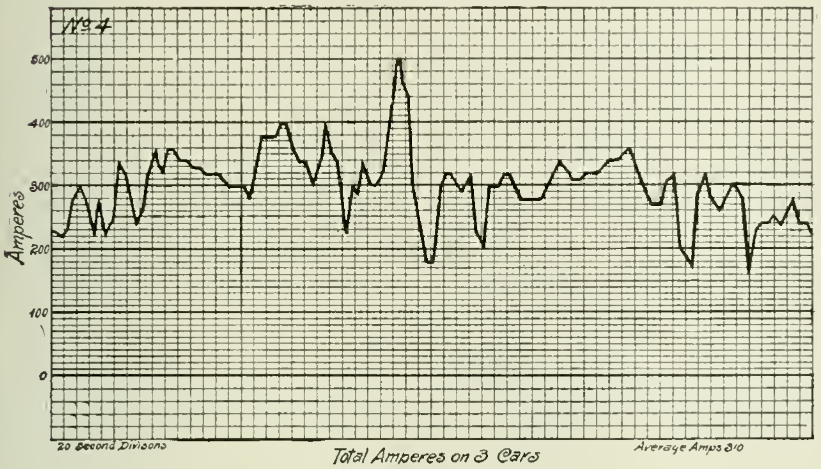


FIG. 4.

The curves presented herewith were taken from simultaneous readings while a test was being made by the management of the road to ascertain the behavior of the battery while working under maximum load conditions.

Curve 1 (Fig. 1) shows the voltage at the battery while operating under the above conditions, the average voltage being 425.

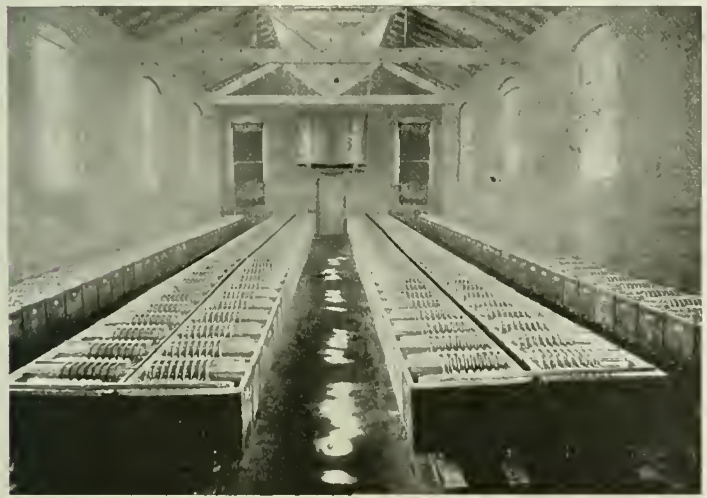


FIG. 6.—STORAGE BATTERY PLANT.

Curve 2 (Fig. 2) shows the average voltage taken on the cars. In the center of curve No. 2 an arrow is shown to designate the point at which the cars passed the battery station. The voltage on the cars at this point being practically the same as that of the battery. Curve 3 (Fig. 3) shows the ampere readings taken at the battery station. Curve 4 (Fig. 4) shows the total number of amperes taken by the three cars. Curve 5 (Fig. 5) shows the amperes furnished by the station. It is claimed that it would have been practically impossible to have operated the three cars as above, without the battery station, as the drop in voltage would have been so great at times that there would have been no current at all. As stated above, these results were obtained under maximum conditions of load. Under the regular schedule the voltage at a point near the battery is maintained at over 450 volts.

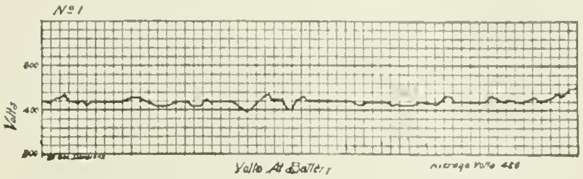


FIG. 1.

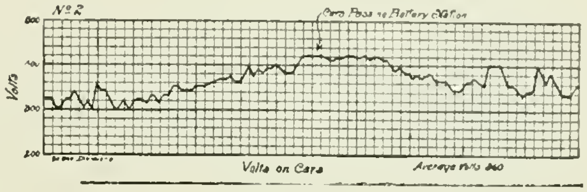


FIG. 2.

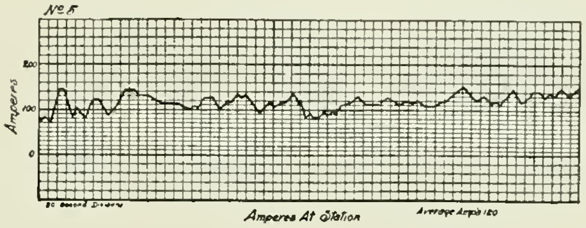


FIG. 5.

It is claimed that in order to have secured the results obtained through the use of the battery, by the addition of extra copper, the cost of the same would have been nearly three times as great as the cost of the battery, and even then the results would not have been as good had there been any unexpected or heavy demand. It is stated that on several occasions the battery has operated all the cars on the western division for several hours.

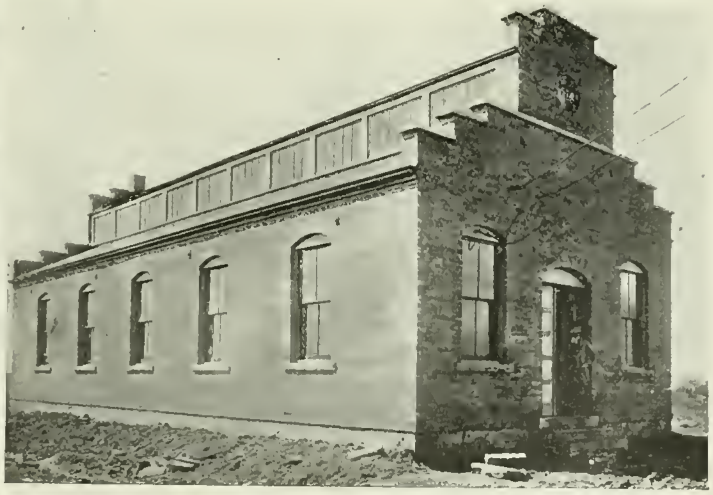


FIG. 7.—STORAGE BATTERY HOUSE.

It might also be stated that in addition to the work described, the battery furnishes current for 20 or more incandescents used in the residence and grounds of General Manager Palmer, whose summer home is located a short distance from the station. As evidence of the fact that this station is giving excellent satisfaction, the same company has placed a contract with Messrs. Sipe & Sigler, Cleveland, who furnished the equipment, for a second battery outfit of 265 cells to be placed at Steel's Corners, 14 miles east of the power station. This will be used in maintaining the voltage on the eastern division of the road, including the new extension now being built to Garrettsville. However, instead of floating on the line as in the case of the above battery, the second station will be insalled with an extra feeder to be supplied by a booster at the station.

General Electric Exhibits at the A. I. E. E. Conversazione.

A frequency indicator shown by the General Electric Company at the recent Conversazione of the American Institute of Electrical Engineers, consists of a direct reading instrument, indicating the number of cycles on the circuit to which it is attached. It consists of two fixed coils making a right angle with each other, and a small piece of sheet iron fastened to a shaft mounted in two jewels without springs or other controlling force and moving a pointer over a scale marked in cycles. In series with one of the coils is inductance and in series with the other resistance. When the frequency of a circuit changes the ratio of the two currents in the coils is changed also. The iron blade takes up a position depending on the relative ampere-turns in the two circuits, and this changes the reading on the scale. When the voltage of the line varies both currents vary in the same proportion and therefore the instrument is not affected by change of pressure.

The power factor indicator which was shown is constructed on the principle that in a balanced two or three-phase system, the power factor changes the ratio of watts as found in the two-wattmeter method of measuring the power of the system. This principle has been applied by the General Electric Company in various ways in the construction of power factor indicators. The one on exhibition at the Conversazione had a fixed current coil and two potential coils. The current is led into the movable coils by leads, the controlling force of which is negligible in comparison with that between the fixed coils and the movable coils when the instrument is connected to a circuit. The scale of the instrument is found by actual calibration, that on the instrument exhibited being adapted to rotary converter work with a power factor of one in the middle of the scale and a power factor 90 per cent lagging at one end of the scale and 90 per cent leading at the other.

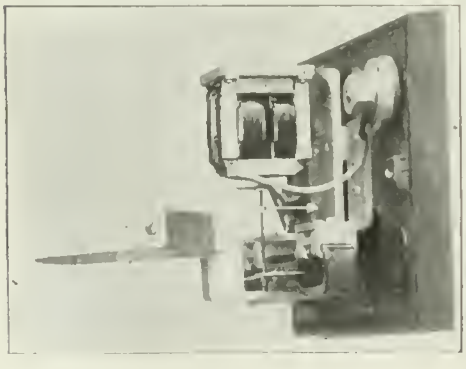


FIG. 1.—FREQUENCY INDICATOR.

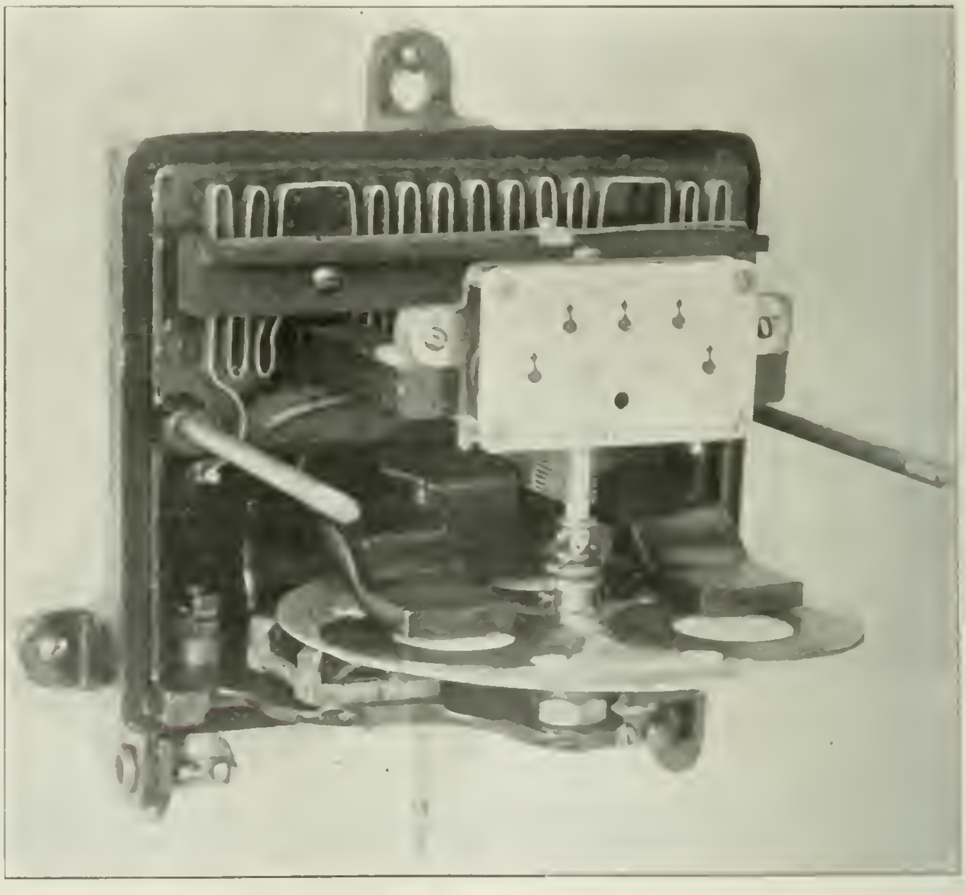


FIG. 2.—LOAD METER.

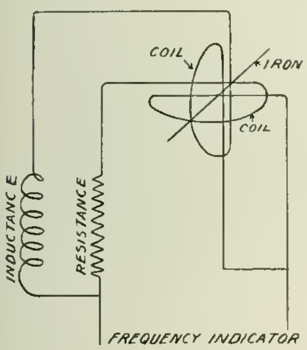
A wave-form indicator exhibited at the Conversazione is for determining the wave form of e. m. f. or currents, and has been in nearly constant use at the works of the General Electric Company for a number of years. It consists of a contact disk, and a small synchronous four-pole motor, to the shaft of which is fixed a revolving brush which slides over the edge of the disk, the motor being arranged to run without hunting or oscillation. Formerly the disk was attached to the shaft of the generators to be tested, but the great number of poles of large modern machines made it desirable to have an apparatus independent of the angle of one pair of poles. As constructed it is also much more flexible for general use.

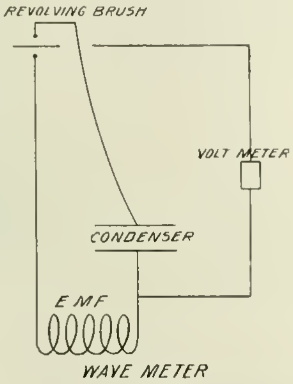
The contact device consists of a number of metallic segments on the edge of a hard-rubber disk. They are four large and four smaller segments, each pair consisting of one small and one large segment, the number of pairs corresponding to the number of poles of the small synchronous motor. All the small segments are connected to one terminal and all the large ones to another. When the revolving brush slides over a small segment it connects a condenser directly to the potential difference to be measured, permitting current to flow into the condenser. At the instant at which the brush leaves a small segment, it leaves the condenser charged with the instantaneous potential difference which the circuit had at that instant. The brush then sliding over the large segment closes a circuit consisting of the charge condenser and a direct-current voltmeter, and causes the condenser to discharge through the instrument. These charges and discharges occur four times per revolution and are, with the instrument actually used, at ordinary commercial frequencies sufficiently rapid to produce steady deflection. To the hard-rubber disk is fastened a finger which can be revolved by hand, and by the means of a scale moved every five degrees so as to enable the operator to read off equidistant instantaneous potential differences. A change of condenser capacity or resistance of the instrument does not affect the relative values indicated, as the capacity and resistance are not altered during the test. The deflection on the voltmeter is actually proportional to the instantaneous voltage, as dampening, etc., does not affect the steady deflection. The instrument has given much satisfaction and apparatus made like the model has been in use in colleges, factories and stations

Astatic instruments have usually been constructed by doubling the movable part either magnet or coil. The Thomson astatic instrument exhibited is constructed on a radically different principle. It is a direct-current instrument, with electromagnets and a light movable coil, which receives the current from its extremely flexible leads, the torque of which is negligible. The controlling torque of the instrument is due to a piece of magnetic material fastened to the same shaft on which the movable coil is fixed. When the needle points to zero the greater length of the magnetic control piece is in the direction from one pole to the other. When the instrument is connected to the circuit the movable coil receives current and overcoming the controlling force of the control piece causes a deflection.

If the field of the magnet is changed by any cause whatever, the controlling force changes in the same proportion as the deflecting force and the deflection is left unchanged. The instrument shown was of interest on account of an improved arrangement of the magnetic circuits by which four poles of alternate sign were produced by means of one magnetizing coil.

The Röntgen ray exhibit consisted of 12-inch Thomson inductorium sets with a special form of electrolytic interrupter and liquid resistance, in charge of Mr. Westbury. A new form of fluoroscope was shown with a special detachable frame so that the screen could be removed at will, the crystal platino-cyanide of barium being covered with a gelatine cover to prevent deterioration through dust collecting on it. Mr. M. P. Rice, of Schenectady, was to have exhibited a Röntgen ray apparatus, but unfortunately it could not arrive in time.





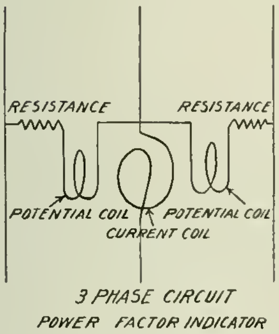


FIG. 3.—DIAGRAMS OF CONNECTIONS.

A Thomson load meter was shown, consisting of a recording integrating device for the commercial measurement of current delivered to continuous current lighting and power loads. Being devised for use upon constant-potential systems of close regulation, it is calibrated in watt-hours. The speed of the meter, however, bears a direct ratio to the current traversing its coils.

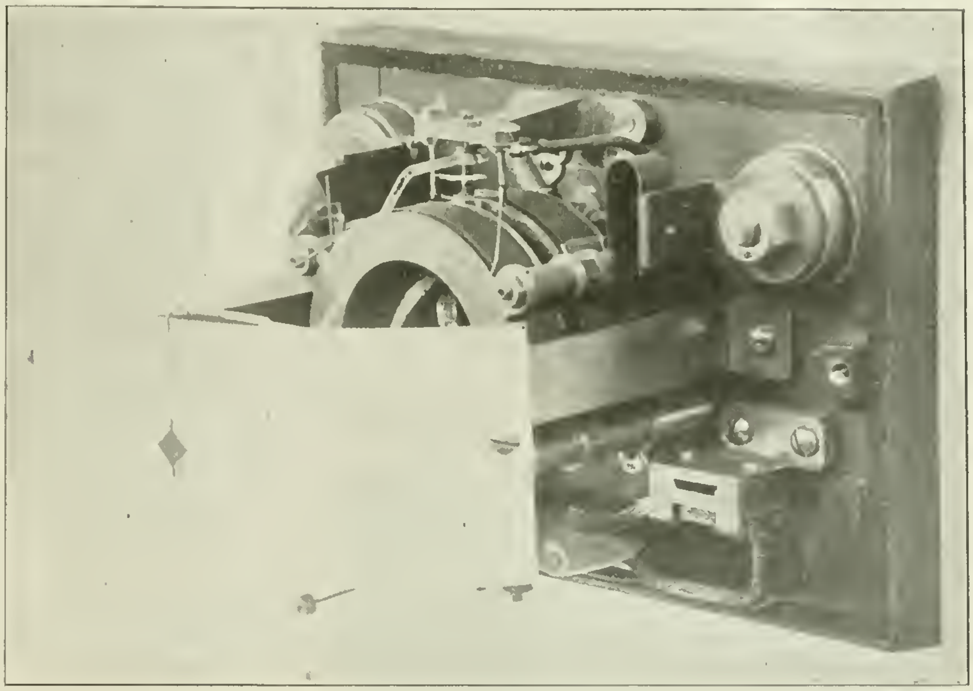


FIG. 4.—POWER FACTOR INDICATOR.

The meter consists in its principal element of an aluminum disk mounted upon a vertical shaft, engaging at the top with a recording train and the lower end of the shaft resting upon an appropriate jewel. The aluminum disk is free to rotate between the jaws of permanent magnets. Upon the aluminum disk are mounted three pancake coils, which constitute an armature, the energy of which is derived through a commutator carried on a shaft or spindle. The armature energy is derived around a fixed resistance contained within the meter, the armature or revolving element thus being in shunt to the resistance. The three pancake coils constituting the armature and physically fixed to the disk, produce torque as in an ordinary motor, the permanent magnets constituting the fields. The same permanent magnets constitute the magnet element of the drag or load, which consists of foucault currents generated in the revolving disk. Friction compensation for light and load operation is provided for by replacing a small electric magnet in such a position as to bring the outer edge of the disk within its jaws. The drag of this magnet increases as the load increases, because the winding is in series with the meter load. The drag is thus less at light loads than at heavy loads, which offsets the effect of the friction.

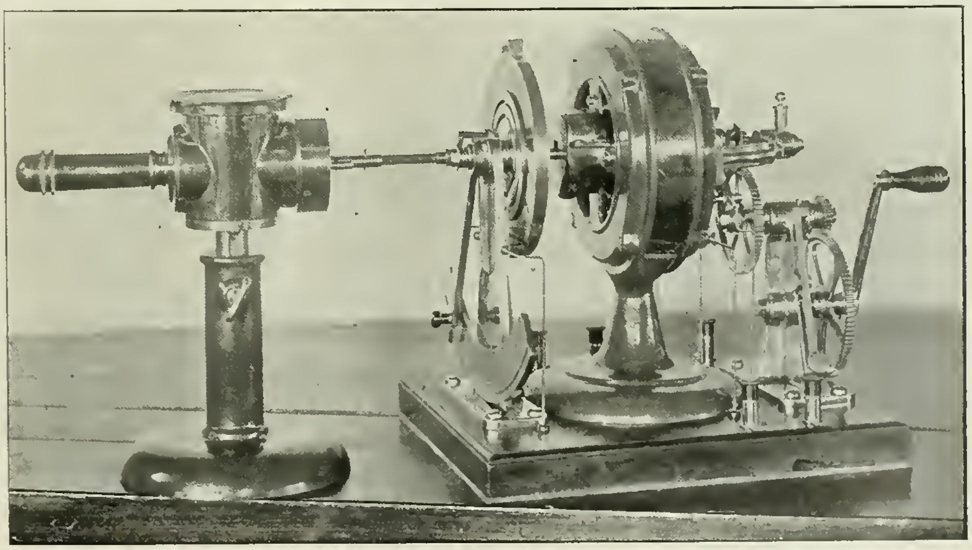


FIG. 5.—WAVE-FORM METER.

High-Voltage Testing Sets.

The accompanying illustrations refer to a method of testing with high voltages, for which apparatus has been devised by the Stanley Electric Manufacturing Company, the object being to provide the extreme pressures required for factory and station tests of insulators, insulating materials, machinery, etc. Many and varied forms of testing sets, for such purposes, have been devised, and as pioneers in alternating-current work, the Stanley Company has had exceptional opportunity for observation of the workings and defects of these. The method described and illustrated is the result of much experience, investigation and experiment on the part of this company's engineers.

Fig. 1 shows, besides the testing outfit proper and a switchboard, a transformer wound to change the supply-line pressure to test-line pressure. The latter is generally 50 or 100 volts. A rheostat is introduced between this transformer and the test line to accomplish any desired further regulation. Leads are taken from the test line, to each of the three special transformers shown, which are introduced into the circuit purely as a precautionary insulation.

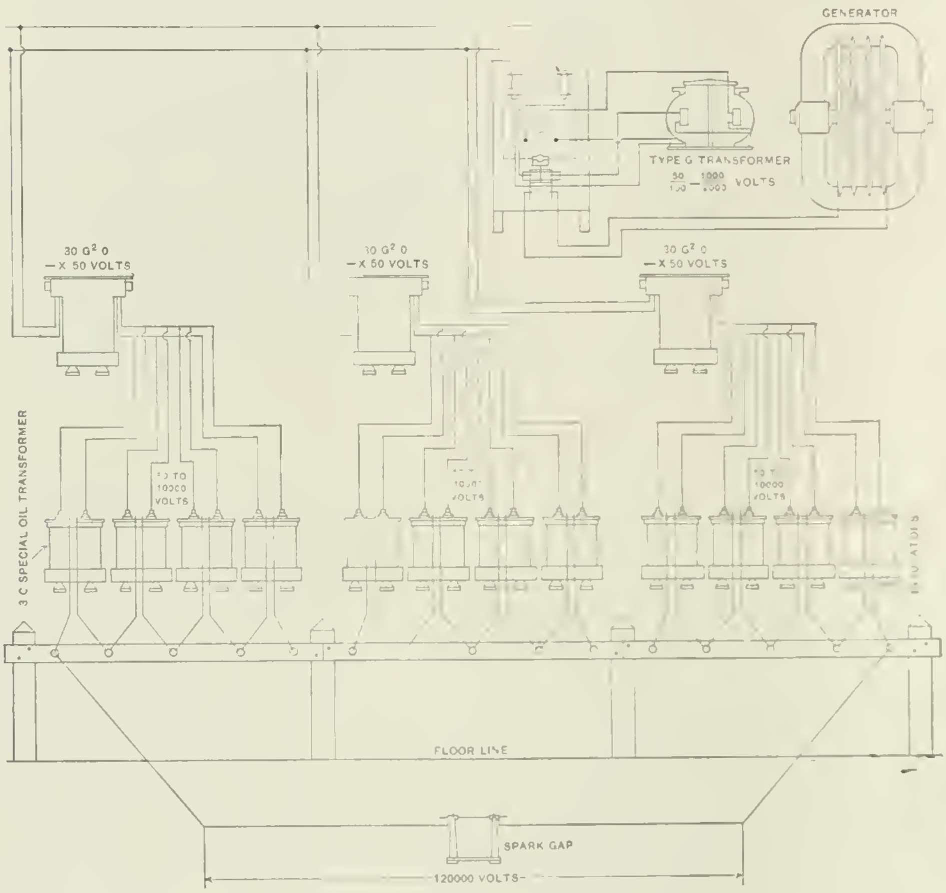


FIG. 1.—DIAGRAM OF TESTING OUTFIT.

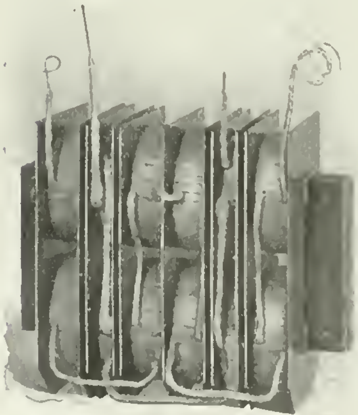


FIG. 3.—TRANSFORMER COILS.

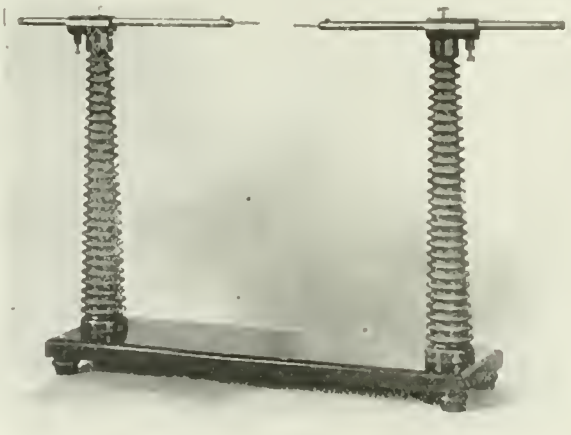


FIG. 4.—SPARK-GAP.

The secondaries of each of these transformers are connected in multiple to three individual sets of special oil transformers, changing the test-line pressure from 50 or 100 volts to 10,000 volts. Connecting the secondaries of these 12 transformers in series affords at the end terminals a maximum pressure of 120,000 volts. The advantages of this arrangement are many. The introduction of one set of transformers as a precautionary insulation, precludes the possibility of any accident producing a strain upon the system of the extreme high potentials dealt with. The carrying of the 10,000-volt terminals each to a solid stationary contact post mounted on the terminal board, prevents the possibility of their coming into undesirable proximity.

Between points having a difference of potential exceeding 40,000 volts there intervenes the insulation of four transformers. The path for any such short circuit must, therefore, overcome this insulation, which in each transformer is designed to provide for just such emergencies. Each one is subjected to thorough and severe tests before leaving the factory. Both types of transformers are special transformers, most highly insulated and designed particularly for this special use and arrangement. Fig. 2 shows one of the 12 high-voltage transformers, and Fig. 3 the coils of the same; Fig. 4 the spark-gap.

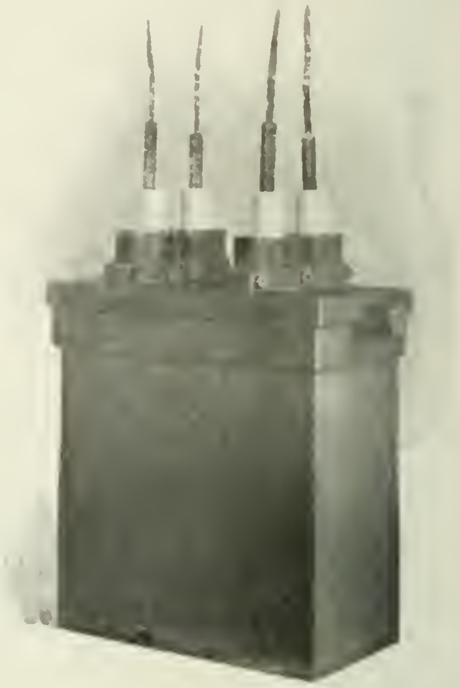
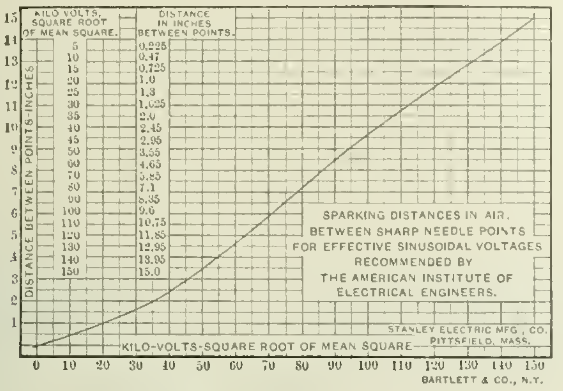


FIG. 2.—TRANSFORMER.

The test leads are flexible and may be attached to any of these contact posts, thus providing an adjustment of steps of 10,000 volts from 10,000 to 120,000 volts, intermediate variations to be effected by the rheostat. These flexible terminals should be of standard manufacture highly insulated. It is not contemplated that they will be handled while alive. Before making adjustments, the main switch should be opened. Both sets of transformers should be thoroughly insulated from the ground by means of wooden blocks, and glass or porcelain insulators. Should one of the oil transformers from any mishap fail, it is but a simple mater to bridge the secondary terminals and disconnect the primary terminals of the same and operate at the reduced voltage until repairs can be effected.

If a local generator, accessible for desired regulation is to be the source of supply, the test line may be taken direct from the generator. That is, the required voltage will be furnished without the intervention of a transformer, voltage variations in such instances being effected in the generator.

The spark-gap (Fig. 4) is used virtually as a voltmeter, and the curve in Fig. 5 gives the voltages at which the sparking should take place from 50000 to 150,000 volts. The spark-gap is designed to withstand the tremendous voltages to which it will, in practice, be subjected. The base is 18 inches by 5 inches of best quality hard rubber, three-quarters of an inch thick; the edges are beveled and the whole is neatly and substantially put together. Extra insulation is provided by the four legs or supports. The posts carrying the adjustable terminals are of a form offering the greatest creepage resistance. They are also of best quality hard rubber, and the whole will successfully withstand a pressure many times that for which designed. Fig. 5 is a curve showing the relation between voltage and sparking distance.



KILO VOLTS, SQUARE ROOT OF MEAN SQUARE.	DISTANCE IN INCHES BETWEEN POINTS.
5	0.225
10	0.47
15	0.725
20	1.0
25	1.3
30	1.625
35	2.0
40	2.45
45	2.95
50	3.55
60	4.65
70	5.85
80	7.1
90	8.35
100	9.6
110	10.75
120	11.85
130	12.95
140	13.95
150	15.0

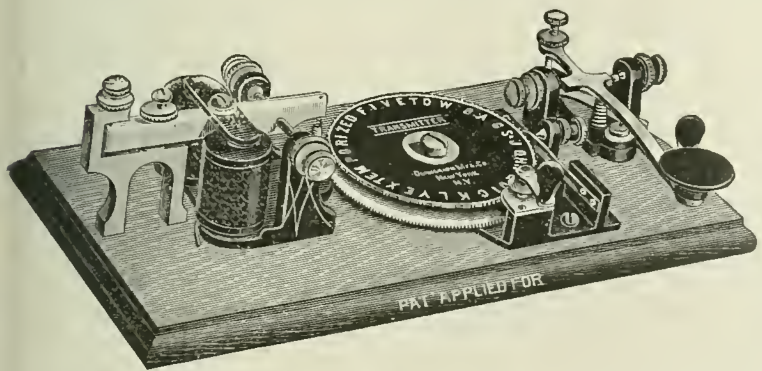
FIG. 5.—CURVE OF SPARKING VOLTAGES.

The only other feasible apparatus for the production of high testing voltages is the single transformer. These have been built to supply such pressures, but they are expensive, unwieldy affairs, and to be avoided if possible. There is no comparison between the single great transformer and the combination of units herein described, which affords a flexible and portable outfit possessing all the qualities to be desired.

◆

An Improved Telegraph Teaching Instrument.

The "Omnigraph" illustrated herewith is designed to assist students of telegraphy in learning to read by sound. In connection with the key and sounder of a regular learner's outfit is arranged a type disk of brass which is operated by a small crank geared thereto. On the circumference of the brass disk are cut the dots and dashes corresponding to the letters of the alphabet, and as the disk is revolved the characters on its periphery come into contact with a stationary spring contact point. Since the disk and contact point are in circuit with the sounder the effect is to reproduce the characters on the sounder, thus enabling the student to acquire practice in receiving. For sending practice it is necessary to close the circuit by allowing the contact point to remain in contact with any one of the characters on the periphery of the disk, and then use the key in the usual manner, the sounder, disk, contact point and key all being connected in series.



THE OMNIGRAPH.

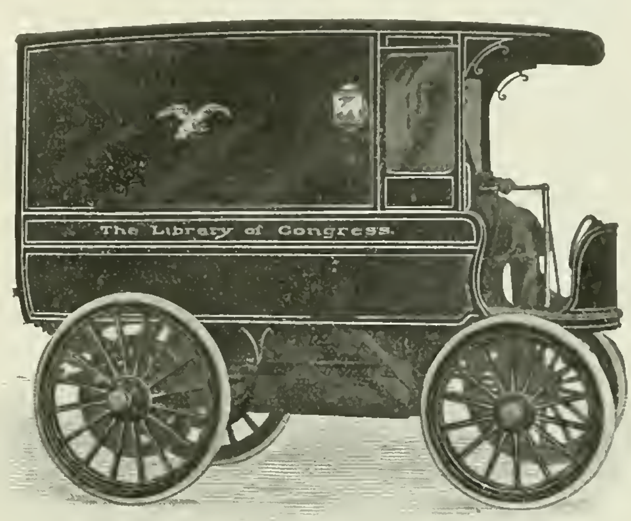
The characters and spaces on the disk are of correct lengths, hence the student hears the characters accurately formed, which is not the case when they are transmitted by hand on the key.

This instrument is manufactured by the Omnigraph Manufacturing Company, 39 Cortlandt Street, New York. At the present time the disk is provided with the sentence, "John quickly extemporized five tow bags," which contains all the letters of the alphabet, but it is the company's intention to provide interchangeable disks with the letters of the alphabet and the numerals in regular sequence, and the punctuation marks.

◆

Automobile for the Library of Congress.

Concerning the type of Columbia delivery wagon, which has recently been sold to the Government for the distribution of books from the Congressional Library, the manager of the Washington Electric Vehicle Transportation Company reports as follows: "Before the Library people purchased this vehicle, they sent out circulars asking for bids from all the different manufacturers. They also investigated the subject very closely, and while our vehicle was the highest in price, still the contract was awarded to us. The fact that we have vehicles of this type and other types running successfully in Washington had great weight in the matter. The Library people have been operating this vehicle themselves for the last month, and are very much pleased with it, and we have every reason to believe that this is but a forerunner of a number of vehicles which we will be able to sell to the Government."



ELECTRIC LIBRARY DELIVERY WAGON.

Another Columbia vehicle of this type is under contract to carry the mails between the Buffalo Post Office and the Pan-American Exposition grounds.

◆

A New Method of Silvering Searchlight Mirrors.

The greatest drawback in the employment of strong focus lenses and high-current values in searchlights at the present time is the short life of the common silver backing of the mirrors. It is found that with a coating of pure silver, even though it has a thickness of but a few hundred thousandths of an inch, the difference in ratio of expansion causes the silver to peel off in a short time if the glass is heated much over 175 degs. Fahr. The Rushmore Dynamo Works, which make a specialty of lens projectors and claim the largest lens making plant in the world, have perfected a new process of silvering their lenses and have produced a silver-platinum backing that is stated not to be affected by any degree of heat.

The metal film in direct contact with the glass is of pure silver, and is but a few millionths of an inch thick, so thin, in fact, that when held to the light it is transparent and simply gives a bluish tinge to the glass. On the back of this thin film of silver there is deposited by a new process a coating of a new compound which contains 90 per cent of platinum. The platinum having nearly the same coefficient of expansion as glass, it always maintains perfect contact with the glass at all temperatures. While the combined thickness of the silver and platinum alloy is extremely small, it is heavy enough to resist any disintegrating action of the protective compound used as a backing for the mechanical protection of the metal coating.

On a recent test a lens silvered by the new process was heated almost to the melting point of the glass without any effect upon the silvering. The platinum coating may be deposited directly upon the glass, but it has been found that the silver produces a more brilliant surface and does not in any way interfere with the heavier backing metal.

Improved Electric Signs.

CONNECTING-UP LAMP.

There has been on exhibition recently in the Knickerbocker Theater building in this city a new system of electric sign construction that possesses some interesting features. The invention comes from England, and is controlled by the Electric Lighting Boards, Limited, of London, the system being known as the E. L. B. system.

The unique feature of the system is that of an electric sign or a design of any sort may be made up at once without any preparation or special wiring, by simply pressing the lamps into the surface of the board wherever it is desired to locate them. The signboards may be made of any size and shape. They are constructed in the following manner: Upon a backing of wood or similar supporting material is placed a sheet of asbestos covering the entire surface of the board. On the asbestos is placed a layer of rubber and on top of that the bare stranded copper ribbon conductors laid in equidistant parallel lines. Between the conductors is placed a strip of hard fibre as a spacing piece as well as an insulator, and on top of the conductors and fibre strips is laid anothre sheet of rubber, and above this a sheet of asbestos. On top of the asbestos is placed a layer of a composition composed of ground cork and heavy oils, which forms the exterior front surface of the board. This cork composition, which is 3-16 inch thick, is quite elastic and acts as the support for the lamps when they are placed in position. By pressure the conductors are shaped into the form of ribbons ½ inch wide, the thickness of the fibre insulating wall between them being ⅛ inch. Since the conductors are arranged in lengths parallel to one another, and connected up as branches from the supply wires, it is evident that practically the entire surface of the board is "alive."

The lamps have a special base, the outer terminals of the leading-in wires consisting of two prongs or needle points, about half an inch apart. It is evident that by sticking a lamp almost anywhere on the surface of the board the prongs will penetrate the strands of two adjacent conductors and thus close a circuit through the lamp. It may happen that in inserting the prongs a fibre strip is encountered. All that is necessary in such cases is to pull the lamp out and press it home again in a new position, which can never exceed ⅛ of an inch from the first one. The conductors may be run horizontally or vertically, it makes no practical difference how. In either case, continuous connecting surfaces are available in the direction in which the conductors run, and practically continuous surfaces at all angles therefrom. It will thus be seen that a lamp may be placed in circuit practically anywhere on the board by simply pressing its prongs through the surface into the stranded conductors.

The shape of the board is immaterial. It may be in the form of a narrow molding with two wires, or square, oblong, etc., with any number of parallel branches from the two supply wires. There were shown examples of various uses to which the invention can be applied, including moldings, flexible strips for decorating purposes and for sign letters, advertising boards, etc. In all, the central feature is the possibility of placing lamps where needed, without special wiring or the installation of sockets or other special appliances.

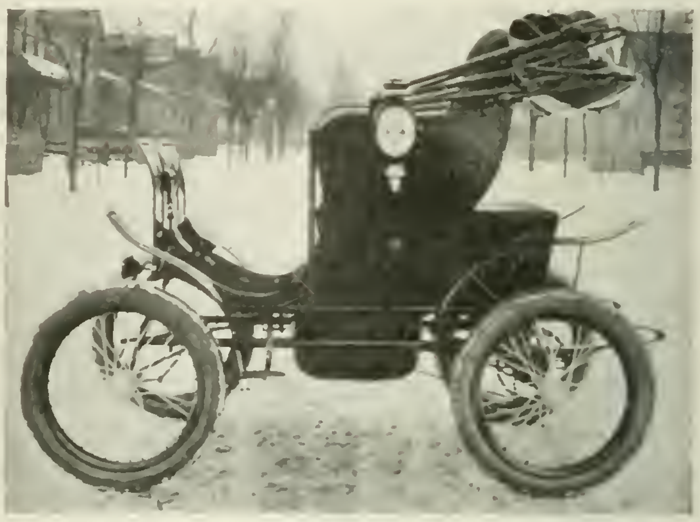
A novel application of the system is in using a board of the proper dimensions as the top of a desk or table. This permits the placing of a lamp standard anywhere on the table or desk, almost as easily as moving an oil lamp about. The extreme flexibility of the system renders it specially useful for temporary decorations, illuminations, etc.

A New York syndicate has purchased the American rights and will exploit the invention.

Electric Stanhope Phaeton.

The Baker Motor Vehicle Company, of Cleveland, Ohio, whose electric runabout has been illustrated in these columns and which has attracted widespread attention and much favorable comment at the various motor vehicle exhibitions, is bringing out, as a companion to the runabout, the Stanhope phaeton herewith illustrated. It was especially designed in answer to a demand for a light vehicle which can be handled by a lady; in fact, the original vehicle of this pattern was designed for the use of Mrs. W. C. Baker, who is an enthusiastic operator. The mechanical equipment of the vehicle is practically the same as that of the runabout. It has a 1-hp motor, and is equipped with 10 cells of battery, giving, it is claimed, a radius of 20 miles over average city roads on one charge. There are three speeds, forward and back, the reverse being controlled by a lever under the foot.

The highest speed of the motor gives about 15 miles an hour, and on the first speed there is a choke coil which avoids the sudden jar in starting. The speeds are controlled by one handle, which also controls a brake on the motor shaft. There is also a powerful foot brake operating on the differential gear. The motor is hung under the center of the body, and is protected by a dust and water-proof covering. The steering lever is of the side-steering type. The vehicle is finished and upholstered in the best manner. Ball bearings are used throughout. The running gear is tubular, except the side reaches, which are hickory, enameled, giving extreme flexibility and insuring easy riding. The carriage complete weighs 800 lbs., and, as will be seen by reference to the illustration, is light and neat in appearance.



STANHOPE PHAETON.

Rogers Telegraph Apparatus.

The Rogers Electrical Works, of 55 Dey Street, are a corporation putting on the market a line of telegraph instruments and specialties which they are manufacturing under patents issued to Ulysses G. Rogers. Among the instruments are pole-changing devices, switches and cut-outs. One of the specialties is a standard pony relay of very rigid construction. The frame to which are attached the front and back contacts passes down between the magnet coils, and is milled to conform to the curve of the coils. The metal parts are finely finished. The spools have polished rubber covers. The base is of mahogany with a japanned surbase. Another instrument is their improved learners' telegraph outfit, comprising steel level key and sounder.

The key base, the sounding lever, yoke, etc., are of a finely finished composition, there being no painted cast iron used in the construction. The sounder gives an extraordinarily clear sound, with minimum amount of current, while the contacts are located on the top and the bottom of the key, which permits the use of a dry or any other type of open circuit battery in connection with the instruments.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 3 per cent nominally. Time money was quoted at 4 per cent for 30 days to 4 months, and 4½ per cent for 5 and 6 months. Mercantile paper was quiet throughout the week, the closing price being 4 per cent for 60 to 90 days' indorsed bills receivable, 4@4½ per cent for choice 4 to 6 months single names and 5@6 for others. The stock market continues strong, active and excited, with heavy manipulation in prominent stocks and extensive public participation in speculation. On Friday, April 19, all previous records in stock transactions were broken, the number of shares sold on that day having reached the enormous number of 2,200,000. All records of bank clearings were also broken last week, aggregating $3,047,934,602, a total of 15.2 per cent higher than the largest previous weekly total recorded—that for the second week in January, this year. Compared with last week there is an increase of 21 per cent, and over the same week a year ago there is a gain of 77 per cent. Outside of New York, clearings were 10.7 per cent larger than the week previous, and one-third larger than the same week a year ago. New York clearings for the week were just double those of a year ago. There was considerable activity in traction stocks, with advancing prices. Metropolitan Street Railway closed with a net gain of 5½ points, the sales for the week amounting to 141,868 shares. Brooklyn Rapid Transit made a net gain of 3¼ points, the sales being 121,245. In the electric list, General Electric slumped 3 points, the sales being 5250 shares. The tendency of Western Union continues upwards and at the close of the week the stock was 1¼ points above the closing figure the previous week. There was considerable activity, the transactions amounting to 60,430. The curb market on Saturday made little response to the enormous activity shown on the Stock Exchange, most outside issues remaining dull, with irregular price movements. There was a movement in General Carriage which carried the stock up to 2¾, and at the close 2½ was bid, a net gain of ½ point. Following are the closing quotations at New York, Boston and Philadelphia, the absence of Chicago quotations being due to the derangement of telegraph wires by the storm:

NEW YORK.

	Apr. 13	Apr. 20.		Apr. 13.	Apr. 20.
General Electric	226½	223½	Electric Vehicle	12	12
Brooklyn Rapid Transit	83½	86¾	Electric Vehicle, pfd	20	20
Metropolitan Street Ry	168½	174	General Carriage	2	2½
American Tel. & Cable	100	100	Illinois Elec. Veh. Tran	⅞	⅞
Western Union Tel	92½	93¼	Hudson River Tel	120	—
American Dist. Tel	36*	—	N. E. Elec. Veh. Tran	2½	2½
Commercial Cable	170	179	N. Y. Elec. Veh. Tran	5½	4½
Electric Boat	21	17	Tel. & Tel. Co. of Am	5	5
Electric Boat, pfd	50	47	N. Y. & N. J. Tel	160	—
Electric Lead Reduc'n	4½	4½			

BOSTON.

	Apr. 13	Apr. 20.		Apr. 13.	Apr. 20.
New England Telephone	141	—	Erie Telephone	61½	60
Mexican Telephone	3	3	General Electric, pfd	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel	171	176½
Westinghouse Elec., pfd	—	—	Boston Electric Light	—	—

PHILADELPHIA.

	Apr. 13	Apr. 20.		Apr. 13.	Apr. 20.
Electric Storage Battery	75	69¾	Philadelphia Electric	6⅜	6⅜
Elec. Storage Bat., pfd	75	74	Pa. Electric Vehicle	1	1¼
Elec. Co. of America	8¾	9⅜	Pa. Elec. Veh. pfd	¾	1
General Electric Auto	—	—	Am. Railways	40	42¼

CHICAGO.

	Apr. 13	Apr. 20.		Apr. 13.	Apr. 20.
Chicago Edison	154	155	Chicago Telep. Co	230	—
Chicago City Ry	257	—	Union Traction	15	—
National Carbon	15¾	—	Union Traction, pfd	57	—
National Carbon, pfd	83	—	Northwest Elev. Com	40	—

*Asked.

DIVIDENDS.—The directors of the Columbus, Ohio, Railway Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. The directors of the Bell Telephone Company, of Philadelphia, have declared the regular quarterly dividend of 2 per cent. The Cincinnati, Newport & Covington has declared the regular quarterly dividend of ¾ of 1 per cent, payable May 1. The directors of the General Electric Company have declared the regular semi-annual dividend of $3.50 per share on the preferred stock, payable August 1, to stock of record June 15. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 1½ per cent upon the assenting stock of the company payable May 15. The Edison Electric Illuminating Company, of Boston, has declared a quarterly dividend of 2½ per cent. The previous quarterly dividend was 2 per cent and 1 per cent extra. The Denver City Tramway Company has declared a quarterly dividend of 1 per cent upon its capital stock, payable May 15. The regular quarterly dividend of 2 per cent on the preferred stock of the American Graphophone Company will be paid on May 15.

ELECTRIC COMPANY OF AMERICA.—Mr. W. J. Latta has resigned from the board of the Electric Company of America, following the lead of Martin Maloney, who retired some time ago. Clement A. Griscom, president of the International Navigation Company, has been chosen to fill the vacancy. The full board will be: W. L. Elkins, P. A. B. Widener, Thomas Dolan, H. T. Hartman, Clement A. Griscom, C. A. Porter, A. Loudon Snowden, Joseph B. McCall and James E. Hays. A director of the company says: "The annual report will make quite a favorable showing. We are well supplied with funds and no call is in sight." The extension of the Atlantic City lighting system to Chelsea and Ventnor, N. J., will require poling and wiring, which will be paid for, it is stated, with money on hand. About one hundred of the stockholders attended the Electric Company of America annual meeting. The statement showed $410,695 net profits for the year ended Dec. 31, 1900. The profit from operation of plants in 1900 was $374,538 and other income $36,156. A year's dividend is $1 per share on 406,281 shares outstanding. The net profits from operation of plants in 1899 were $407,975, and the income from other sources $633,359. The general balance sheet as of Dec. 31, 1900, shows total assets of $3,810,819, and a profit and loss surplus of $742,045.

ERIE TELEPHONE.—During the past 17 years the Erie Company has paid 69 dividends, the last one being at the rate of 1¼ per cent quarterly. During this time the company has raised $28,000,000 for construction purposes, putting in with this money 137,000 telephone stations, 95,000 miles of long-distance lines, and 60 telephone buildings, as well as 95,000 miles of exchange wires underground, out of a total wire mileage of 300,000.

KANSAS CITY.—The Metropolitan Street Railway Company, of Kansas City, has bought out the East Side Electric Railway, a short trolley line promoted and partly owned by men interested in the Ferd Heim Brewery, for $250,000. It now gives the Metropolitan Company a complete monopoly of the street railways of Kansas City.

GENERAL ELECTRIC STOCK.—The General Electric Company informs holders of its 7 per cent cumulative preferred stock that the company will give them common stock for it share for share. The common stock is now on an 8 per cent basis.

B. R. T.—The sale is noted to a syndicate by the Brooklyn Rapid Transit Company of $3,111,000 Brooklyn Union Elevated 4-5 per cent gold bonds, authorized betterments, improvements and for equipping the system with electricity.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies indicate that trade developments in the main are favorable, the exceptions being in the Central West and part of the Northwest, where cold, rainy weather prevails, restricting distributive trade. The great volume of general business and the enormous size of financial operations now proceeding are reflected in record-breaking clearings, not confined, however, to speculative centers but reported from all sections of the country. Current gross railway earnings remain favorable. Though the ratio of gains is not as great as in recent preceding weeks, net earnings are very good and furnish ample basis for some excited movements in securities. All sections of the country show gains, the most remarkable being the increase of 53 per cent in the coal roads, of 28.6 per cent on the Southwestern lines, of 19 per cent by the Eastern roads, and of 18.6 per cent by the Southern lines. The smallest gain in the net earnings is 4.2 per cent, contributed by the Central Western roads. *Bradstreet's* reports the number of failures for the week as 212, against 225 last week and 161 the corresponding week last year. R. G. Dun & Co. compute the liabilities for the two weeks of April at $2,493,075, against $4,865,470 the corresponding period last year. In the metal market Lake Superior copper ingot is quoted at 17 cents and electrolytic at 16⅝ cents. There was no quotable change in either price, and in certain quarters of the trade electrolytic is held with more firmness.

THE THRESHER ELECTRIC COMPANY, of Dayton, Ohio, has been incorporated under the laws of the State of West Virginia, with an authorized capital of $600,000, for the manufacture and sale of all kinds of electrical machinery and appliances. This corporation succeeds the company of the same name of which Mr. Alfred A. Thresher has been the sole proprietor, and which he has incorporated for the purpose of providing more ample facilities for conducting the large and growing business which has been built up during the past eight years under his individual management. Mr. Thresher is a member of the American Institute of Electrical Engineers, and of the Franklin Institute of Philadelphia, an associate member of the Society of Naval Architects and Marine Engineers and a graduate of Denison University. After graduation, he spent more than a year abroad in travel and observation, and soon after his return established the business which he has prosecuted to the present time, overcoming all the obstacles incident to a new enterprise with persistent energy, determination and ability. In thus adding to the list of Dayton's successful manufacturing enterprises, it has been the aim of Mr. Thresher in addition to obtaining the discipline and knowledge of details, requisite to the conduct of any successful business, to also gain such a grasp of practical mechanical knowledge as well as a personal acquaintance with the requirements of purchasers as would fit him to design and construct the highest grade of electrical machinery. In entering the general market, the Thresher Electric Company offers three complete lines of direct-current apparatus for electric railways, lighting and power transmission, viz., generators, both direct connected and belted, of the most approved design, exact in regulation under all degrees of load and economical in operation; a complete system of motors for the transmission and application of electrical power to the varied requirements of industrial uses, including an entirely enclosed type giving very high efficiency combined with complete protection; and marine generating sets, of highest efficiency, designed to meet the severe requirements of the government naval service. It will be remembered that in a recent article we showed a vertical type of generator of original design, to be run direct connected to the shaft of a turbine. Plans are being prepared for extensive shops with a complete equipment, affording the most approved facilities for manufacturing and testing.

TRADE IN SOUTH AFRICA.—A merchant at the Cape writes thus to a friend at Wolverhampton, England: The ultimate result of all this tumult will no doubt be a very great expansion of trade, not only for England, but for other countries, and if the British manufacturers don't mind what they are about they will be beaten out of this market in many things. America, Germany, Canada, Australia and other countries are sending out representatives and appointing resident agents to work up business direct with the buyers here and in the other colonies. These agents are well paid, they are liberally supplied with samples, catalogues and other means for making the goods known. The manufacturers ship the goods and draw for value through bankers at 30 to 90 days' sight direct on the customers. British manufacturers (with a few sensible exceptions) consider they are safer in doing their business through the old-fashioned way of the London merchant; but those who have tried the direct way will never go back to the old way. Even in the simple matter of correspondence, America and other countries set England an example, not only in manners, but in wisdom, and this is a complaint I have heard from several good firms in this city: "That English houses are not only dilatory in replying to letters, but in many cases do not reply at all." I have written to scores of firms in America, Australia, Germany, France and other places, and even when there was no probable chance of doing business I have never failed to get a courteous reply, giving all the information available.

STEEL RAIL PRICES.—It is stated that within a week the price of steel rails will be advanced from $26 to $28 a ton. A meeting has been called for this week at which members of the pool will take action on an advance in price. The increase, it is stated, will take effect on May 1. The tonnage of steel rails placed so far this year exceeds that of any year in the history of the trade. It is estimated that since the pool made the price of rails last fall, orders for more than 2,000,000 tons have been placed. Advances in prices have been made by other steel and iron pools in billets, beams and plates, but as yet no advances in rails have been made nothwithstanding the higher prices for pig iron and other raw forms. Billets, beams and plates have been advanced on an average of $6 a ton, while pig iron is now selling at prices considerably higher than when the prices for rails were announced. All the large rail mills are filled to their utmost capacity.

CASE CRANE SALES.—The Case Manufacturing Company, of Columbus, Ohio, reports the following list of crane sales made recently: Lewis Foundry & Machine Company, Pittsburg, one 20-ton 50-ft. span; Hoeffinghoff & Lane, Cincinnati, Ohio, one 25-ton 46-ft. span; Carnahan Tin Plate & Sheet Company, Canton, Ohio, one 15-ton crane; Camden Iron Works, Camden, N. J., one 30-ton 56-ft. span; Niles Boiler Company, Niles, Ohio, one 10-ton 47-ft. 6-inch span; W. S. Tyler Company, Cleveland, Ohio, one 5-ton electric hoist; Weiskittle & Son, Baltimore, Md., one 3-ton 3-motor crane; William R. Trigg Company, Richmond, Va., one 3-ton 32-ft. span 3-motor crane; United States Cast Iron Pipe & Foundry Company, one 25-ton crane; Natural Food Company, Niagara Falls, N. Y., two 1-ton traveling cranes; James Leffel & Co., Springfield, Ohio, one 15-ton 50-ft. span.

ENGINE BUILDERS CONSOLIDATION.—It is reported that Vermilye & Co. are the bankers behind a projected combination of manufacturers of stationary and mining engines. According to reports the negotiations have reached an advanced stage, and it is proposed to combine these five firms: Pennsylvania Iron Company, E. P. Allis Company, Milwaukee; Frazer & Chalmers, Chicago; Gates Iron Company, Chicago, and Dickson Manufacturing Company, Scranton, Pa. Of the proposed capital of $25,000,000, it is said $1,000,000 of 7 per cent cumulative preferred stock of the new company was offered for the Pennsylvania Iron Company's plant and fixed assets. There is still a good deal of verbiage and vagueness about the transaction. It will be noted that several big concerns are not in the proposed deal.

SARATOGA TROLLEYS.—Joseph J. Powers, of Troy, and ex-State Treasurer Addison B. Colvin, of Glens Falls, have purchased the control and assumed charge of the Saratoga Traction Company. These gentlemen, with John W. Herbert, of Helmetta, N. J., are extensive trolley managers in New York State and Canada. The new purchase includes the beautiful park opened late last season, Saratoga Lake and the race track terminals. It will become a feature of the Powers-Colvin system of Hudson Valley roads, and with the Stillwater and Mechanicsville, Greenwich and Schuylerville, Saratoga and Northern and Warren County railroads, owned by these men, it will in time afford an opportunity for frequent and rapid transportation of persons and freight between all the cities, villages and towns from Albany and Troy north to Warrensburg.

CONSOLIDATION OF CHATTANOOGA TROLLEY.—Messrs. Clarence P. King and J. H. Jeffries, of Philadelphia, who own the controlling stock of the Chattanooga Rapid Transit Company, have been there for the purpose, it is said, of finally taking possession of the lines reaching Lookout Mountain, including the two inclines, the Lulu Lake broad-gauge and narrow-gauge roads. This deal has been hanging fire on a technicality for some time. It is also said that the Rapid Transit people will close the deal by which that company will absorb the Chattanooga City Electric Railway Company's plant. The consolidation of these lines will merge the electric railways of Chattanooga into one system capitalized for over a million dollars.

THE TRINIDAD ELECTRIC LIGHT & POWER COMPANY, West Indies, is at present making some purchases in this market for the additional equipment of its plant at Port au Spain. The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., whose local offices are in the Mail and Express Building, 203 Broadway, are to build a 300-hp horizontal compound engine. A 200-kw belted generator has been ordered of the General Electric Company. The Trinidad plant at present develops 2,000 horse-power. The engines and generators were furnished by the above mentioned concerns. Further contracts are expected to be placed very shortly.

TARIFF ON MACHINERY IN DUTCH INDIA.—Consul Hill sends from Amsterdam, March 12, 1901, a statement of the tariff of the Netherlands East Indies. The tariff rates are as follows: Factory and steam engines, machinery; machines and tools for agricultural, factory and steam purposes, mining and trades, and also parts thereof, if considered so by the custom house officers free. Iron, ironware, cast, wrought, milled or forged, not separately specified, 10 per cent ad valorem.

POWER FOR BINGHAMTON.—A project is under way to dam the Susquehanna River, two and one-half miles below the junction of the Susquehanna and the Chenango, near Binghamton, N. Y., the intention being to install an electric-power generating plant for the use of the city. The proposed dam will be of great sanitary as well as industrial benefit to the city, the three miles of back-water flooding shallows where now sewage collects.

COLORADO FUEL & IRON COMPANY, of 71 Broadway, New York City, is adding to its equipments in the West, and is enlarging its power plant. Two Westinghouse 500-kw, 220-volt generators have been ordered, direct driven by an Allis compound condensing engine. Worthington surface condensers have also been ordered, and boilers added.

THE CHARLESTON EXPOSITION.—J. L. Malcomson, chief engineer of the electrical and motive power departments of the Charleston International & West Indian Exposition, has been in Cincinnati, placing orders for machinery and supplies required in his department. As a result of his visit, the Bullock Manufacturing Company will have a handsome display there.

ELECTRIC FOUNTAIN.—The promoters of the Fall Festival Association, at Cincinnati, which will hold its second annual celebration September 16-28, are contracting for an electric fountain. It will become a permanent ornament to the city.

W. B. COWLES & CO., of Cleveland, Ohio, are installing two 75-hp engines built by the Ball Engine Company, of Erie, Pa., in the Power building in that city.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended April 3: Antwerp—9 cases electrical material, $863; 2 cases electrical machinery, $149. Berlin—18 packages electrical material, $600; 7 packages electrical machinery, $3000. Brazil—18 packages electrical material, $811; 3 packages electrical machinery, $1845. British Guiana—61 packages electrical material, $5,128. British West Indies—10 packages electrical material, $122; 2 packages electrical machinery, $400. British East Indies—261 cases electrical machinery, $4.275. Cuba—84 cases electrical material, $1,240. Chili—1 package electrical material, $19. Central America—12 packages electrical machinery, $684. Dutch West Indies—1 package electrical material, $12. Ecuador—1 package electrical material, $27. Genoa—79 packages electrical material, $18,970. Havre—168 packages electrical machinery, $22,622; 26 packages electrical material, $1,231. Hamburg—18 packages electrical material, $608; 6 cases motor vehicles, $1,800. Hayti—2 packages electrical material, $51. London—71 packages electrical machinery, $6.551; 110 packages electrical material, $5,947; 21 packages motor vehicles and parts, $14,000. Liverpool—70 packages electrical machinery, $7,767; 26 packages electrical material, $2,034. Manchester—41 cases electrical machinery, $10,365. Mexico—64 packages electrical material, $2,583. Moscow—6 cases electrical material, $420. Newcastle—1 case electrical machinery, $200. Oporto—3 cases electrical machinery, $196. Peru—5 packages electrical machinery, $1,532; 16 packages electrical material, $393. Southampton—37 packages electrical material, $3.322; 1 case motor vehicle parts, $117. Santo Domingo—12 packages electrical material, $160. United States of Colombia—29 packages electrical material, $235.

EQUIPMENT FOR KANSAS CITY.—The Metropolitan Street Railway Company, of Kansas City, and the Kansas City Electric Light Company will each build a new power house within 18 months. These two power houses will make a complete change in the system for power for trolley lines and for lighting. The power house of the lighting company is to cost $1,150,000. The building alone is to cost $220,000. The company has already contracted for $450,000 worth of electrical machinery for this plant, but has not yet bought its engines and boilers. Besides the central station, there are to be four sub-staions. At each sub-station will be a reducing transformer for lighting. By this plan about 200 miles of electric light wires now in the two Kansas cities will be dispensed with. The power for all the trolley lines of the Metropolitan Street Railway will be generated in two central power houses. One of these is to be in Kansas City, Mo., and the other in the Riverview station, across the Kaw River in Kansas City, Kans. The capacity of the Riverview power house is 14,000 horse-power. That of the new station will be 30,000 horse-power, and it will cost $1,000,000. A part of the electrical equipment for this house has been contracted, but not all of it.

THE STURTEVANT FIRE.—The fire which visited the works of the B. F. Sturtevant Company at Jamaica Plain, Mass., on Sunday, April 14, proved to be far less disastrous than was first reported. Only the engine and electrical departments were injured. The power plant was started up with but a single day's delay incident to renewing belts damaged by fire, and the entire blower, heater, forge, galvanized iron and shipping departments, with the foundry, pattern shop, etc., were in full operation on that day, and the shipments going forward as usual. No valuable office records were lost, the most serious damage occurring in the advertising department, where a large amount of printed matter was destroyed. Fortunately, however, an entirely new catalogue was in press, and copies were issued on the 16th in time to meet all demands for information. New offices were established on Monday morning in a nearby building, and by Monday noon the business was running as usual. With these facilities at its disposal there is no likelihood of any delay in shipments, except such as may occur in the electrical and engine departments, and arrangements are already made for handling this work.

STEEL CAR PLANT.—The new plant of the American Car & Foundry Company in Detroit, Mich., is complete in its equipment, and represents an investment of nearly three-quarters of a million of dollars. The main buildings, which are over 800 ft. long and 200 ft. wide, are equipped with electric, pneumatic and hydraulic machinery. Three kinds of power will be distributed by means of pipes and wires throughout the shops. One of the features of the plant is a large traveling crane above the network of railroad tracks in the yards. This crane will pick up cars in all stages of completion and transfer them from track to track, as desired. There will also be several cranes and transfer tables in the shops. The entire plant is built after the plans of the Westinghouse, Church, Kerr & Co., and will be equipped throughout with electric motors, hydraulic and pneumatic apparatus, and will be lighted by arc and incandescent lights.

LUNDELL MOTORS FOR GOVERNMENT.—In Government work Lundell motors and generators, manufactured by the Sprague Electric Company, are used to a large extent. Recent orders include 17 motors of various sizes for the Norfolk Navy Yard, three 35-hp motors for the Mare Island Navy Yard, four furnished by George A. Ohl & Co., and five motors, one generator and a 2-kw ventilating set for the Brooklyn Navy Yard. In addition to the Government orders, the Sprague Electric Company reports the following among its larger sales: Steelton Light & Power Company, one 125-kw belted type generator; Columbia University, three 75-kw engine type generators; C. S. Ashley, one 125-kw generator; Pittsburg Reduction Company, one 25-hp motor and one 166-hp motor; National Meter Company, one 37½-kw engine type generator; Chase Rolling Mill Company, one 125-kw belted type generator, and the Evansville Gas & Electric Company, one 150-kw generator.

THE ELECTRICAL FIRE RISK.—President James, of the Northwestern National Insurance Company, Chicago, charges the increased losses by fire to the use of electricity. He says: "The present uses of electricity have increased fire losses in the United States in the last five years 25 per cent, and the companies doing business in this country will be compelled to advance rates to meet this hazard or retire from the field." President James said he expected the present year to be the culminating one in losses. He believes something will have to be done by companies remaining in the business, as the candle is burning at both ends—low rates and heavy losses.

CAHALL BOILERS.—The Altman & Taylor Machinery Company, Mansfield, Ohio, through its sales agency, reports the demand for Cahall boilers as steadily increasing. Among the recent orders are the following: Four boilers, aggregating 1000 horse-power, for the Grand Rapids, Holland & Michigan Railway Company, Grand Rapids, Mich.; four boilers, aggregating 1300 horse-power, for the Des Moines City Railway Company, Des Moines, Iowa; three 500-hp boilers for the E. P. Allis Company, Milwaukee, Wis., and three boilers, aggregating 1000 horse-power, for the American Steel & Wire Company, Chicago, Ill.

THE MORRIS ELECTRIC COMPANY, of 15 Cortlandt Street, New York City, is in the market for the following items needed for export purposes: Tell-tale arrangement for a switchboard to attach to 16-feeder panel circuit-breakers and three generator panels; steam-driven automatic air compressors, with tanks, and so forth; motor-driven automatic compressors to be used for blowing the dust out of generators, motors, cars, etc.; 2000 brake shoes and woodworking machinery suitable for car shops.

NINE-HOUR WORKDAY.—The Electrical Machinists and Instrument Makers' Union, which is a branch of the International Association of Machinists, held a meeting last week in this city and decided to join the nine-hour demand of the machinists, which goes into effect on May 20. Both the union and non-union men will make the demand.

MR. L. T. LEVY, who has been the sales agent for the Falcon Electric Manufacturing Company, will open an office at No. 234 Greenwich Street, and will act as the sales agent for both the Falcon Electric Manufacturing Company and several other firms. Mr. Levy has formed a co-partnership with Mr. L. E. Frorup at the above address.

EUROPEAN WANTS.—Our advertising pages present the interesting feature this week of two well-known European concerns advertising for American electrical engineering talent to be employed in their shops, and one prominent manufacturer of telegraphic, telephonic apparatus, etc., asking for agencies for such American goods for Germany and Russia.

THE RICHMONDT ELECTRIC WIRE CONDUIT COMPANY, not incorporated, of Milwaukee, Wis., is removing its business to Waukegan, Ill., where it will occupy a part of the plant of the Thomas Brass & Iron Company. It is now transferring its machinery, etc.

ELECTRICITY FOR RAILWAY TUNNEL.—It is reported that the Great Northern Railway Company will substitute electric power for the present steam locomotives in hauling trains through the tunnel at Cascade. The eastern end of the tunnel is 235 ft. higher than the western end.

RAILS FOR GLASGOW.—Rails for the extension of the electric lines of Glasgow are to be furnished by American manufacturers, according to cable advices received here. About 3,450 tons of rails will be required, at a cost of $110,000. Nearly all of the original equipment of the Glasgow lines also came from the United States.

THE MONTAUK MULTIPHASE CABLE COMPANY, of New York City, has secured an order for the installation of its automatic fire-alarm service in the American Museum of Natural History, Seventy-seventh Street and Columbus Avenue. The system is eminently adapted for this important class of service.

THE AMERICAN BRIDGE COMPANY will furnish to J. G. White & Co., Inc., New York, the structural steel work for the power plant for the Kalgoorlie Electric Power Company, Kalgoorlie, Australia. This plant consists of an engine house 43 ft. by 159 ft., with a lean-to 17 ft. by 40 ft., and a boiler house 41 ft. by 132 ft.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The linemen of the People's Home Telephone Company, of Birmingham, have returned to work, all differences growing out of the working of white and colored labor together having been adjusted. The races will now be worked in separate squads.

SAN FRANCISCO, CALIF.—The Lake County Telephone & Telegraph Company has been organized in Paisley, Oregon.

SAN FRANCISCO, CALIF.—In Oregon and Washington there is a good deal of activity among the independent telephone companies, although the Pacific States Company has a comprehensive long-distance system, extending from Los Angeles, Calif., to Spokane, Wash., and has promised to install an exchange in every town on the Coast.

SAN FRANCISCO, CALIF.—The San Francisco exchange of the Pacific States Telephone & Telegraph Company's system, reported an increase of 1,500 telephones during the month of March, making the total number in that city over 24,000 telephones. The population of the city is placed at 342,000 and the number of telephones in use is said to be only 1,000 less than Chicago has. Los Angeles has 9,000 telephones, with a population of 102,000.

PECK, IDAHO.—The Nez Perce Farmers' Co-operative Telephone Company has completed its barbed wire line to Nez Perce. The line is over thirty miles in length, and has twelve telephones on it.

INDIANAPOLIS, IND.—The Elizaville Co-operative Telephone Company, of Elizaville, and the Farmers' Co-operative Telephone Company, of Clarkshill, have been incorporated.

INDIANAPOLIS, IND.—During the past week articles of incorporation were filed with the Secretary of State for the Carmel Telephone Company, Carmel; the Markleville Telephone Company, Markleville and the Farmers Telephone Company, Madison county.

TERRE HAUTE, IND.—The New Citizens' Telephone Company opened up for business on April 8, with 250 telephones and has added about 15 instruments daily ever since. Seventeen girls are employed on the switchboard and the plant is giving excellent service.

FRANKFORT, IND.—Judge Kent has authorized Richard C. Clark, receiver for the Energy Telephone Company, of this city, to borrow $5,000 with which to complete the plant, make repairs, pay off the laborers and otherwise place the plant in its full earning capacity. A local company has been organized to purchase the plant.

SPRINGFIELD, ILL.—The Lawrence County Telephone Company, Lawrenceville, has been incorporated; capital stock, $3,500. Incorporators, S. J. Gee, A. N. Fink and A. M. Maxwell.

BALTIMORE, MD.—The Maryland & Delaware Telephone Company, which owns the line from Queenstown, Md., to Rehoboth, Del., has been granted a franchise for the construction of a line in Cecil county to connect the various communities.

WORCESTER, MASS.—The Worcester Telephone Exchange is making extensive improvements in its service, and is installing the central energy system.

MINNEAPOLIS, MINN.—The Enterprise Telephone Company, of Edgerton, Pipestone County, has filed articles of incorporation, and fixes its capital stock at $50,000. The directors are Edward Yocum, William Lockwood, C. G. Brady, C. S. Howard and E. W. Davies.

MINNEAPOLIS, MINN.—The Twin City Telephone Company has contracted for 150,000 feet of telephone cable varying from twenty-five pairs of wires to a cable of 200 pairs. An entire season's supply has been ordered from the John A. Roebling's Sons Company, of New York.

WINTHROP, MINN.—The People's Independent Telephone Company, whose organization was recently noted in these columns, expects to begin business about May 10. It will use apparatus of the Stromberg-Carlson Company, the board having a capacity of 200 lines. The company has 65 subscribers. It expects to build farmers' lines in the Fall. Its rates are $1.50 per month for business telephones and $1 for residences.

MEXICO, MO.—A new telephone line is to be built south from Farber, Audrain county.

VERSAILLES, MO.—The Versailles Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are Louis Straus, J. W. Mills, A. Hopper, and others.

ST. JOSEPH, MO.—A meeting of representative farmers of Kansas, Northern Missouri, Southern Iowa and Nebraska was held here a few days ago, and arrangements made for extensions in telephone service to farmers in the territory named.

BUFFALO, N. Y.—The Bell Telephone Company has installed a new exchange in North Tonawanda at an expense of $12,000.

FAR ROCKAWAY, L. I.—The New York & New Jersey Telephone Company will open a new and handsome exchange here on May 1. There are over 400 telephone subscribers at Far Rockaway and Rockaway Beach.

PERTH AMBOY, N. J.—The Seaboard Telephone Company, of this city, has been incorporated. Capital, $10,000. Incorporators: Charles K. Seaman, James M. Glenn, Wm. H. McCormick, Wm. B. Bratt, James H. Voris.

LONDON, OHIO.—The London Telephone Company has been incorporated with $75,000 capital stock.

OTTAWA, OHIO.—The Putnam Telephone Company has increased its capital stock from $40,000 to $100,000 to provide for improvements.

BRIDGEPORT, OHIO.—The Belmont Telephone Company has increased its capital stock from $15,000 to $75,000 to provide for improvements.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has 370 subscribers and operates 25 miles of toll line. A number of additions are being made.

LOWELLVILLE, OHIO.—The Youngstown Telephone Company has secured a franchise in this place and is preparing to install an exchange with 100-drop capacity.

DAYTON, OHIO.—The Progress Telephone & Telegraph Company, of West Milton, has secured a franchise to run lines into Dayton, and 100 subscribers have been secured.

CUYAHOGA FALLS, OHIO.—The Central Union Telephone Company is making an effort to keep the Akron People's Telephone Company out of this field by reducing rates.

DELAWARE, OHIO.—The Citizen's Telephone Company is erecting new cables and installing an additional switchboard. The company has 553 subscribers connected up at the present time.

SANDUSKY, OHIO.—The Sandusky Telephone Company has recently installed an additional section of North Electric Company central energy switchboard giving a capacity of 2400 drops. This company has over 900 subscribers and operates about 45 miles of toll lines.

TROY, OHIO.—The Troy Telephone Company is installing an additional section to its switchboard; contract having been placed with the American Electric Telephone Company. The Troy Company is eighteen months old and has 423 subscribers connected up, with 30 on a waiting list.

KENT, OHIO.—The Kent Home Telephone Company has ordered an additional section of switchboard to accommodate 400 drops. Fifty miles of toll line are being built and 14 toll stations are being installed in surrounding towns. North Electric Company's apparatus is to be used throughout.

SPRINGFIELD, OHIO.—The Central Union Telephone Company is making every effort to thoroughly cover this field before the proposed independent company secures a franchise. A sub-exchange with 2[illegible] drops is to be installed at New Carlisle and toll lines are to be built to Vienna, Brighton, Harmony, Plattsburg, Husted, Dialton and Pinchen.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company is installing a Stromberg-Carlson switchboard of 500 drops capacity and has 130 subscribers connected. The promoters of this company are also building the following exchanges: New Carlisle, 200 drops; Cridersville, 100 drops; Waynesville, 100 drops, and Lake View, 100 drops. Franchises have been secured in all of these towns and contracts will be placed for apparatus in the near future.

CINCINNATI, OHIO.—The ninety male employees of the City & Suburban Telegraph Association of this city held their first annual banquet Saturday evening, April 13. Handsome decorations of bunting, electric lamps of various colors, flowers and evergreens added much to the attractions. Everything was done by the employees themselves. The program was unique and carried out the suggestion of a large minstrel entertainment. Speeches were made by officials.

MONROEVILLE, OHIO.—The Huron County Telephone Company, which has been bought up by Frank A. Knapp and C. R. Calaghan, of Bellevue, consists of 50 miles of toll lines with about 100 telephones, including small exchanges at Monroeville, Plymouth, New Washington and Chicago Junction. They are preparing to build about 12 additional miles of toll line, and will have long-distance connection through the lines of the United States Telephone Company.

ASHLAND, OHIO.—The Star Telephone Company is preparing to rebuild its system in this place and has placed contracts with the Kellogg Switchboard & Supply Company, of Chicago, for 400 new telephones and a 600-drop switchboard on the central energy system. A number of new toll lines will be built and long distance connection will be made over the lines of the United States Telephone Company. The capital stock of the company has been increased from $50,000 to $100,000.

PORTLAND, ORE.—The Columbia Telephone Company in this city is carrying on a large and profitable business in competition with the Bell system, but in order to compete more successfully it will need to establish long-distance lines paralleling those of its rival. The company is now looking for $250,000 to use in improving its system and extending a few outside lines already constructed. The company's present plant cost $200,000. The company is free from debt.

COOKEVILLE, TENN.—The capital stock of the Overton Telephone Company has been increased from $5,000 to $25,000, and the company has been completely reorganized.

MEMPHIS, TENN.—The telephone war between the Bell Company and the Independent Telephone Company, organized recently in this city, is now on, and the indications are that lively times are ahead which will result in giving the city a telephone service at a more reasonable cost than heretofore.

CLARENDON, TEX.—The Clarendon Telephone Company has been incorporated with a capital stock of $30,000. The incorporators are R. W. Tally, John M. Clower, J. D. Stocking and A. M. Beville.

MABANK, TEX.—The Boyett & Smith telephone lines have been purchased by the Kemp & Kaufman Telephone Company, of Kemp. By this deal the purchasers will now control over a hundred miles of wire, extending from Kaufman to Athens and from Corsicana to Tyler, with branch lines from Mabank to Prairieville, Roddy and Paynes Springs. The new owners purpose making extensive improvements in the service and will extend the line recently built to a point twenty miles south of Athens on the Texas & New Orleans Railroad on south to Jacksonville as rapidly as that road is constructed.

MILWAUKEE, WIS.—The Wisconsin Telephone Company reports a net gain of 179 subscribers in March, making a total of 21,122 subscribers on March 31.

MILWAUKEE, WIS.—A measure has been introduced in the common council to compel the Wisconsin Telephone Company to put all its cables underground. The company has all its wires underground even beyond the limit mark, and opposes this new measure.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—Mr. Emerson McMillin, of New York, has engineered a scheme which has succeeded in bringing the Montgomery Light & Power Company into the big consolidation of gas and lighting plants in the United States. Mr. McMillin invested $600,000 in a plant near Tallahassee, Ala., and wires have been run to Montgomery by which lights can be furnished to Montgomery consumers. The consolidated company has a capital of about $1,300,000.

SAN FRANCISCO, CALIF.—The Mossbrae Falls Water & Power Company, of Dunsmuir, Calif., has been incorporated. Directors: L. Van Fossen, F. B. Van Fossen, J. Beaton, E. J. Bowen and F. H. Simmons. Capital stock, $25,000; subscribed, $5,000.

SAN FRANCISCO, CALIF.—The Red Bluff Light & Power Company was recently incorporated, with San Francisco as the principal place of business. Directors: W. I. Priest, E. J. Johnson, J. E. Ennis, C. E. Trekell and G. A. Petterson. Capital stock, $75,000; subscribed $500.

MARION, IND.—Marion C. Mead & Company, a corporation operating one of the electric light plants of this city, will in the near future extend its service to South Marion.

BALTIMORE, MD.—The directors of the United Electric Light & Power Company have declared the regular dividend of 2½ per cent. on the preferred stock. Earnings of the Company have greatly increased, and there is a surplus after this payment.

BALTIMORE, MD.—The Reisterstown & Glyndon Water, Light & Power Company, of Baltimore county, Md., has been incorporated. The incorporators are Reister Russell, T. Rowe Price, William L. Shriver, Daniel H. Bollinger, Frank H. Zouck, James Gore and George W. Albaugh. The capital stock is $25,000.

AUGUSTA, ME.—The Boothbay Harbor Light, Heat & Power Company has been organized at Boothbay Harbor for the purpose of generating and supplying gas or electricity, with $10,000 capital stock. The officers are: President, K. H. Richard, of Boothbay Harbor; treasurer, C. J. Marr, of Boothbay Harbor. Certificate approved April 3, 1901.

MACKINAC, MICH.—The Municipal Water, Light & Power Company, Mackinac Island, has been incorporated; capital, $100,000.

ST. LOUIS, MO.—The construction of the new municipal electric light and power plant at Baden will be commenced about May 1. This plant when furnished will light the pumping stations, water works and water towers.

MEXICO, MO.—The question of the municipal ownership of the electric light plant and the waterworks system will probably be submitted to a vote of the people of the city this spring.

CHARLOTTE, N. C.—The scheme for developing Mott's Falls, thirty miles from Charlotte, involving, it is said, about $800,000, has matured to the point of asking a franchise from the city of Charlotte. Mr. F. I. Van de Venter and others are interested.

RALEIGH, N. C.—The Raleigh Ice & Electric Company, which is harnessing the water power at Milburnie, near Raleigh, will be ready to furnish power and light to Raleigh within two months. The entire plant will represent an outlay of about $50,000.

BELVIDERE, N. J.—A syndicate is acquiring all the extensive water rights at the mouth of the Paulins Kill, in Warren county, and the Washington Mills have just been bought. Engineers are already at work laying out plans for a big electric light plant. The object of the syndicate is to furnish power for electric lighting to Columbia, Portland, Water Gap, Hainsbury, and Delaware, and also for trolley lines from Portland to Baogor and up through the Delaware Water Gap and the Paulins Kill Valley.

ROCHESTER, N. Y.—The stockholders of the Citizens' Light & Power Company have called a meeting for May 2 for the purpose of increasing the capital stock of the company from $150,000 to $2,500,000. The increase in capital is for the purpose of assisting in the construction of the new power house, which is estimated to cost $2,000,000, and remodelling the present power station.

ALBANY, N. Y.—The Assembly has reported favorably the bill of Assemblyman Leggett incorporating the Lower River Power & Water Supply Company of Niagara, with a capital of $5,000,000, amended so as to continue its operations to Niagara county. The incorporators are Commodore P. Veeder, Tunis G. Bergen, William Williams, Charles E. Hotchkiss and Dewitt V. D. Reily, of New York, and Patrick F. King, George W. Knox and James S. Simmons, of Niagara Falls, N. Y. The company is to take its water out of the Niagara River below the falls so as to avoid the criticism of spoiling the natural beauty of Niagara.

HUBBARD, OHIO.—The Hubbard municipal lighting plant was destroyed by fire a few days ago. The loss was about $10.000; insurance $3,000.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company is connecting up its underground system with the storage batteries in its new building on Government Square.

WAPAKONETA, OHIO.—The annual report of the trustees of the municipal water works and lighting plant shows that the plant has been a good investment. The plants earned $6,642 over and above interest charges, or 7.2 on the investment.

TOLEDO, OHIO.—The Toledo Lighting & Heating Company has increased its capital stock from $125,000 to $600,000. Contracts have been closed to furnish light and power to a number of manufacturing plants. The plant will cost $250,000.

CINCINNATI, OHIO.—Thos. N. Fordyce, who is to equip the Miami & Erie Canal with boats propelled by electricity, has presented his bond of $25,000, and will commence immediately the construction of fifty boats. The power plant will be built at Hamilton.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company is making plans for another addition to its power house. Contracts have been placed for a 2300-hp General Electric generator and for a McIntosh-Seymour vertical engine. The additional building will be large enough for a further installation.

CINCINNATI, OHIO.—A strike is threatened among the electrical workers unless a new schedule is signed by the employers before May 1. The new scale demands a wage rate of $2.00 to $2.50 for outside workers and a ten-hour work day, and $2.50 per day with an eight-hour day for inside wirers. The employers are forming a protective organization, and a meeting has been called for June.

WAPAKONETA, OHIO.—A statement prepared by the officials of the municipal light plant of this city claims the experiment to have been an unqualified success. The waterworks and electric light plants of the town cost $92,000. The annual report of the trustees shows that they have netted the taxpayers, over and above interest, the sum of $6,642, or an equivalent of 7.2 per cent. The street arc lights cost the city $36.32 each.

THE DALLES, ORE.—Articles of incorporation of the Interstate Power Company have been filed in the office of the County Clerk. The object of the concern is to construct and operate an electric light plant at the mouth of the Deschutes River, for the purpose of generating and conducting electric power to points in Wasco, Sherman and Klickitat counties; to institute an electric light system in The Dalles and other points. The Dalles will be the principal office of the company. E. Kurtz, W. H. Moody, H. L. Kuck, L. E. Crowe, Max A. Vogt, J. P. McInerny and E. M. Williams are the incorporators.

NORTH AUGUSTA, S. C.—The North Augusta Electric & Improvement Company, capital $1,500,000, has been commissioned. The company has electrical rights and privileges. Alfred S. Elliott, of Wilmington, Del.; J. M. Jackson, Augusta, Ga., and Henry Brust, of Charleston, S. C., are the corporators.

MANCHESTER, VT.—An electric light plant will be installed at Manchester by John Marsden, of Utica.

CHATHAM, VA.—The Southern Milling Company, of Chatham, has been chartered, capital $25,000, with right to supply the town of Chatham with lights. J. H. Hargrave, of Chatham, is president of the company.

DAVENPORT, WASH.—The Big Bend Light & Power Company will expend $200,000 in Lincoln county during this year for the purpose of generating electric power at the falls in the Spokane River. The Davenport Council has granted the company a franchise for transmitting power through the town to the Big Bend flouring mill.

BARABOO, WIS.—Papers were filed April 12, transferring the Munger mill property and dam, with franchises, at Kilbourne, to William Guenther and A. D. Johnson, of Appleton, for $40,000. It is understood that a company is to be formed for transmission of electric power to Portage, Baraboo and Madison.

THE ELECTRIC RAILWAY.

NEW HAVEN, CONN.—It is stated that the New York, New Haven & Hartford Railroad Company will equip its Waterbury Division with electric motive power, at a cost of $300,000.

CHICAGO, ILL.—An electric railway between Elgin, Aurora, Geneva, Batavia, and other towns of the Fox River Valley and Chicago is contemplated. The Aurora, Wheaton & Chicago Electric Railroad Company, it is said, has just completed negotiations for the sale of $3,000,000 bonds to a syndicate of bankers of Cleveland. The new road will have about thirty-five miles of main line to connect with the consolidated combination, and branch lines wherever necessary. The companies that are to consolidate are the Batavia & Eastern Railroad Company, capital $100,000; Elgin City, Carpenter & Aurora Railroad Company, capital $500,000, bonds $300,000; Aurora & Geneva Railroad Company, capital $150,000; Aurora Street Railroad Company, capital $300,000, bonds $300,000, and the Geneva, Batavia & Southern, with a capital of $100,000. The present capital of the Aurora, Wheaton & Chicago Electric Railroad Company is $1,500,000, but as the plan of operation has been enlarged the capital will be increased. B. Mahler is the President of the company and L. J. Wolf is the vice-president.

TOPEKA, KAN.—The Iola Electric Street Railway Company has been incorporated with a capital of $50,000. The officers are: President, F. V. Crouch, of Carrollton, Mo.; Vice-President, L. L. Northup, of Iola; Treasurer, George Bowlus, of Iola. The company will build a line in Iola this summer.

NEWPORT, KY.—Officers of the South Covington & Cincinnati Street Railway Company have been elected as follows: President, James C. Ernst; Superintendent, James R. Ledyard; Chief Engineer, E. Darrow; Purchasing Agent, R. W. Phillips. The same gentlemen are also officers in the Union Light, Heat & Power Company, with the exception of the Superintendent, Mr. Ward Barnum filling that position in the latter named company.

THIBODEAUX, LA.—There is an excellent opportunity here for an electric railway. For further information on this subject Mr. L. H. Lancaster may be addressed.

BALTIMORE, MD.—It is understood that the United Railways & Electric Company is considering a proposition to purchase its holdings of United Electric Light & Power Company stock, which it controls. The final aim of those who desire to purchase the electric lighting stock is believed to be to unite both the gas and electric plants here, forming an illuminating monopoly in Baltimore.

JACKSON, MICH.—W. A. Boland, president of the Detroit & Chicago Traction Company, has closed a contract with the General Electric Company for $211,000 worth of electrical material for the road. It includes the machinery for the $250,000 power plant at Jackson and for the six substations to be built at Dexter, Chelsea, Grass Lake, Parma, Albion and Marshall; also the motors for the fifteen cars now being built for the line.

LYONS, N. Y.—An electric railway is to be built through the village of Palmyra.

LYONS, N. Y.—The Newark Electric Railway Company has been incorporated, with a capital of $50,000. The incorporators have franchises for electric railroads in Clyde, Palmyra and Lyons and are securing franchises in all villages between the cities named.

ALBANY, N. Y.—The Genesee & Orleans Railway Company has been incorporated. The company has a capital of $350,000, and the directors are George W. Aldridge, John H. Gregory, Houston Barnard, George Wildei, Frederick P. Allen, Charles H. Babcock and John F. Kinney, of Rochester; Charles E. Hart, of Albion, and James M. Aikenhead, of Barre, Orleans County.

CINCINNATI, OHIO.—The Cincinnati Traction Company and a company organized by Tilden R. French, C. A. Bosworth atnd L. C. Black are fighting over a franchise through Norwood.

CINCINNATI, OHIO.—The Southern Ohio Traction Company has been sued by the State of Ohio because of refusal to place safety devices at its crossings over the C., H. & D. tracks at Trenton.

WARREN, OHIO.—The Cleveland & Chagrin Falls Electric Railway Company has closed contracts for private right of way from Garrettsville to Warren and will have the new line in operation Sept. 1.

COLUMBUS, OHIO.—The Columbus, Grove City & Southwestern Railway Company, whose incorporation was recently noted in these columns, will build an extension of ten miles to Mt. Sterling. The company is renting its power at the present time.

SCRANTON, PA.—The Scranton & Wilkesbarre Rapid Transit Company has awarded a contract of $1,155,000 to the Westinghouse Electric & Manufacturing Company for the electrical equipment of the road.

THE AUTOMOBILE.

AUTOMOBILE FREIGHT LINE.—A despatch from Los Angeles, Calif., states that the Great Northern Railway Company intends to inaugurate a line of automobiles to carry oranges from the principal packing houses to the seaports.

PHILADELPHIA, PA.—Mr. W. H. Johnson, of the Philadelphia Electric Company, reports that that concern has bought a runabout from the Pennsylvania Electric Vehicle Company, to be used by its superintendent as an experiment in time saving in getting around the district and looking after the various gangs at work. This is an excellent field for the employment of automobiles.

LONG ISLAND TEST RUN.—Blue ribbons for first prize have been awarded to Fred. Walsh and H. S. Chapin in the 100 miles endurance test of automobiles on Long Island roads on Saturday last. Meyers and Uppercue were first in, but were disqualified for excessive speed, having finished the run in a little over five hours. Red Ribbons were awarded to H. B. Barruck, E. F. Grueter, and C. J. Field, and F. A. Law and A. L. McMurtry got yellow ribbons for making stops of not more than thirty minutes. Three silver trophies were awarded in the hill-climbing contest, the first going to F. A. Law, the second to E. F. Grueter, and the third to C. J. Field. The latter trophies were for various weights of machines. The weather was frightfully bad.

LEGAL.

TELEGRAPH RATES.—The Supreme Court of the United States on April 15 affirmed the judgment of the Superior Court of Nebraska against the Western Union Telegraph Company, and in favor of the Call Publishing Company, of Lincoln, Neb., that the rates on news matter to that paper were unjust and unreasonable as compared with the same service to the Nebraska State Journal, published in the same city. Justice Brewer, in announcing the decision of the court, said that the principles of common law are operative upon all interstate commercial transactions except as modified by Congressional enactment.

SWITCH SIGNALS. The United States Circuit Court, in the Pittsburg District, has made an order in the case of the Hall Signal Company against the Union Switch & Signal Company, vacating the order suspending the injunction against the defendants. The suit, which involved the rights to an improvement in circuit controlling devices, was filed on April 19, 1893, and on October 24, 1900, was decided to the effect that the defendant company had infringed the patent. A permanent injunction against them was granted, an appeal was taken and an order was made suspending the injunction upon the filing of a bond of $5000 to cover the damages. The order now made suspends this latter order, and the injunction is now in full force.

OBITUARY.

MR. E. R. BARTLETT.—We regret to record the sudden death, caused by the running away of the horse he was driving, of Mr. E. R. Bartlett, formerly of the Maintenance Company of New York City, and a member of the New York Electrical Society. Ernest Russell Bartlett was born in Brooklyn in 1870, and after receiving an ordinary public school education was interested as a contractor in the building of the first trolley lines in Brooklyn. He followed electrical railway contracting up to the time of assuming control of the exhibit of the Ansonia Electric Company at Chicago, which he represented at the Fair. At the close of that exhibition he came East in 1895, when he became interested in the Maintenance Company, and was its first treasurer, holding that position up to last October, when he resigned owing to ill-health. Since then he had been at various places trying to recuperate, and had just returned from Old Point Comfort, Virginia, two days before the accident which caused his death. He was well and favorably known in the electrical circles throughout this city and Chicago.

MR. H. H. LUSCOMB.—We regret to announce the death of Mr. Henry Herbert Luscomb, the secretary and superintendent of The Johns-Pratt Company, of Hartford, Conn. Mr. Luscomb, who was one of the pioneers of the development of street railway insulators and moulded insulation, died after an unusually severe attack of pneumonia, to which he succumbed after an illness of but six days. At thirty-five years of age Mr. Luscomb had attained a prominent position in the electrical manufacturing world, having succeeded in obtaining the important position he occupied at the time of his death by dint of hard personal effort and sterling worth and ability. He became connected with The Johns-Pratt Company in 1892, when the street railway insulation business was in its infancy. At this time The Johns-Pratt Company absorbed the Gould & Watson Company, an employee of which latter concern Mr. Luscomb was at the time. Joining The Johns-Pratt Company, as foreman of one of its departments, he rapidly rose to the position of superintendent in 1895 and was elected secretary of the company in 1898. His force of will and grit were notable elements in his character and his ingenuity as an inventor manifested itself in a great number of highly ingenious appliances used at the present time in street railway line work and other fields of applied electricity. Mr. Luscomb's death is a loss to the company, which the officers and employees severely feel, as he possessed mechanical and commercial genius to a marked degree. He leaves a widow and two children and a host of sorrowing friends.

MR. R. P. ROTHWELL.—Richard Pennefather Rothwell, editor and general manager of the *Engineering and Mining Journal* and a mining engineer of international repute, died on April 17 in New York City. He was born at Ingersoll, Ont., in 1837. He was graduated from the Rensselaer Polytechnic Institute at Troy in 1858, and studied at the Imperial School of Mines at Paris and the Mining Academy at Freiberg, Saxony. In the field of manufacturing mining and in the treatment of ores Mr. Rothwell made many notable inventions. A contour map he made in 1869 of the anthracite strata of the Panther Creek Valley for the Lehigh Coal & Navigation Company is still in use, its accuracy and completeness being such that scarcely any modifications have been made in its details. Complete surveys and contour maps of the Wyoming Valley and Cahaba coal fields, which Mr. Rothwell subsequently made, have since been adopted by the Pennsylvania and United States geological surveys. He removed his headquarters to this city in 1873 and shortly afterwards acquired an interest in the *Engineering and Mining Journal*. In 1892 Mr. Rothwell began the publication of "The Mineral Industry, Its Statistics, Technology and Trade," a cyclopedia of mining, metallurgy and industrial chemistry, which is issued yearly in one volume. Mr. Rothwell was a member of many clubs and societies. He had charge of the gold and silver statistics for the United States Census in 1890. The funeral services in his memory were held at his late residence in this city on April 20. A large number of mining engineers, metallurgists, and friends of the deceased editor were present and the Rev. Mr. Patey officiated.

PERSONAL.

PROF. G. D. SHEPARDSON has an interesting article in the May *Forum* on train lighting.

MR. G. H. DAY, president of the Electric Vehicle Company, is spending down South a well-earned holiday.

MR. JOHN W. MACKAY, president of the Postal Telegraph-Cable Company, recently arrived in San Francisco, and will spend several weeks in looking after his Western interests.

MR. ALEX. HENDERSON, of the Sprague Electric Company, reports from the West, namely, the hotel of that name at Minneapolis, Minn. He will not be back in New York for a week or two.

MR. C. O. MAILLOUX, consulting electrical engineer, has removed his offices from the American Tract Society Building to the Bishop Building, 76 William Street, corner of Liberty Street.

GEORGE PEGRAM, chief engineer of the Manhattan Elevated Railway Company, while inspecting the elevated road structure at 178th Street and Third Avenue last week had his right arm broken by a piece of iron which fell on it.

MR. GEORGE C. BARTRAM, formerly in the contracting department of the Boston Bridge Works, has recently connected himself with the Clark Automatic Telephone Switchboard Company, Providence, R. I., in a similar capacity.

MESSRS. W. N. JACKSON and J. H. Clark, presidents respectively of the Central Union Telephone Company and Chicago Telephone Company, will both retire from those offices, it is said, in order that they may be concentrated in Mr. John I. Sabin, as noted elsewhere in this issue.

MR. PETER COOPER HEWITT, whose work in electric lighting has recently attracted so much attention, has gone abroad for a little rest and recreation. The past winter has been spent in very strenuous investigation and experiment.

MR. MAX LOEWENTHAL, electrical engineer, of this city, has sustained a severe loss in the death of his father, aged only 57, from a stroke of apoplexy. The deceased, Mr. W. Loewenthal, was of amiable character, and is painfully missed by his circle of relatives and friends.

MR. J. S. FORBES. It is stated that Mr. J. S. Forbes will shortly resign the chairmanship of the Metropolitan District Underground Railway of London, and will be succeeded by Robert William Perks, M. P. for Lincolnshire. The railway referred to is the old London underground, now to be electrified.

MR. F. P. FISH, who has so long been counsel for the Bell Telephone and General Electric interests, has been elected president of the American Telephone & Telegraph Company and of the American Bell Telephone Company, now virtually one thing. He takes the place of acting president Cochrane, and his election goes into effect, it is said, as of July 1, 1901.

MR. U. G. ROGERS, general manager of the recently organized Rogers Electrical Works, brings to his company an enviable experience in the manufacture of telegraph and other instrumental apparatus. He was formerly superintendent of the factory of J. H. Bunnell & Company, and has made a close specialty of the refined mechanism in the branch of the art with which the new company will deal.

MR. F. W. TOUSEY.—We record with deep regret the recent death of Mr. Frederick W. Tousey, assistant secretary of the Automobile Club of America, after an attack of typhoid pneumonia. He was well known on both sides of the Atlantic for his active, excellent services in promoting the cause of automobilism, and it had been intended to leave much of the work on the New York-Buffalo endurance test in his hands.

DR. E. A. ENGLER.—The trustees of the Worcester Polytechnic Institute have unanimously elected Dr. Edmund A. Engler, of St. Louis, to be the successor of Dr. Thomas C. Mendenhall, as President of that institution. Dr. Mendenhall retires on account of ill-health. His resignation takes effect at the end of the present school year, and Dr. Engler is expected in Worcester in a few weeks to take up his new work. Prof. Engler was born in St. Louis in 1856, and was graduated from the Washington University there in 1876. He received the degree of A. M. in 1879 and of Ph.D. in 1892. He has been professor of mathematics in the university since 1881. Since 1896 he has been Dean of the Engineering School of the University. His specialty is higher mathematics.

MR. R. A. C. SMITH was presented last week with a gold loving cup at a dinner which was given to him at Delmonico's by a number of his friends who had recently been his guests on a trip to Cuba and the West Indies. Havana, Santiago de Cuba, and Port Antonio were among the places visited, and scenes from these cities are represented on the panels of the cup, which was made by the Tiffany Company. The base of the cup represents dolphins' heads, out of which rise cocoanut palms, the leaves of which form the cup. Mr. Smith was not the only one who was surprised by a gift. He himself had provided a pleasant souvenir of the occasion in the shape of albums containing photographic half-tones of scenes along the trip, the originals of which had been taken by Mr. Smith himself. Besides there was a complete chart of the course of the voyage as sailed, with extracts from the log.

Trade Notes.

THE CINCINNATI PLANER COMPANY will have an exhibit at the Pan-American Exposition in Section 36 of Machinery Hall.

REMOVAL.—Messrs. Sargent & Lundy, mechanical and electrical engineers, Chicago, will on May 1 occupy new quarters in the Isabella Building, 46 East Van Buren Street, Chicago.

THE WESTERN ELECTRIC COMPANY, Chicago, is sending out bulletins on speaking tubes, annunciators and combination letter boxes. This company manufactures a large line of this material, and is able to supply all such needs.

GROUND DETECTORS.—High voltage ground detectors, type D, constitute the subject of Bulletin No. 116, issued by the Stanley Electric Manufacturing Company, Pittsfield, Mass. These devices are illustrated in perspective and diagrammatically.

THE NEW YORK CENTRAL has issued a most valuable and interesting bulletin No. 13, in which Mr. Daniels, General Passenger Agent, shows how the urban population has grown, why it has grown, and where the incalculable benefits of the steam railroad come in.

MR. EDW. P. THOMPSON, the patent attorney, will on May 1 remove his headquarters to No. 156 Fifth Avenue, New York. Mr. Thompson calls attention to the central location of his new office, which will be appreciated by his clients and visitors. The building in which he will be located is near the site of one of the stations of the underground railway.

NEW CONDUIT PLANT.—The plant of the Safety Armorite Conduit Company at Rankin Station, Pa., which was destroyed by fire several months ago, is to be rebuilt. The company has given the contract to the American Bridge Company for a steel frame and iron-clad building, to take the place of the one burned. The new building will be 200x50 feet in dimensions. The plant will be ready about September 1 and will give employment to about 200 hands.

MICA MINING.—Messrs. Eugene Munsell & Company, 213 Water Street, New York, are distributing to the trade a pamphlet containing a collection of reproductions of photographs, which is quite new in this line. The object is to illustrate the methods of mica mining. The illustrations represent scenes in the mica mines of India and show the various stages in the process of mining, to the final shipment of the product to the market for consumption. Some views are also given of Canadian and North Carolina mica mines.

THE WELLMAN-SEAVER ENGINEERING COMPANY, Cleveland, Ohio, is preparing plans for the erection of a large manufacturing plant in Cleveland, in which it proposes to fill all its own contracts instead of letting out the work to other companies, as has been its rule in the past. The company controls a number of valuable patents on special machinery for steel work practice and hereafter will do all its own manufacturing under these patents, besides its own structural work and electric crane manufacturing.

MECHANICAL DRAFT.—A third edition of the instructive booklet, Bulletin J, relating to "Mechanical Draft; What it Is and What it Does," has just been issued by the B. F. Sturtevant Company, Boston, Mass., of whom a copy can be obtained upon application. It illustrates applications under both the forced and induced methods, and shows the Sturtevant blower works as they now appear without a chimney, a fan being employed exclusively for producing the required draft for about 400 boiler horse-power.

BAKER MOTOR VEHICLES.—The Baker Motor Vehicle Company, Cleveland, Ohio, is making regular shipments of vehicles. During the past six months the company has been turning out runabouts in lots of twenty-five and has sent them to all parts of the country. A lot of twenty-five is now going through which will be sent to agents recently appointed. In New York the Baker Company is now represented by Mr. Budd Gray, who makes his headquarters with the Automobile Exchange & Supply Company, West Thirty-eighth Street.

PAN-AMERICAN.—The American Bridge Company will make quite an elaborate building exhibit at the Pan-American Exposition, furnishing two buildings each about 60 feet in width and about 150 feet in length. One of the buildings will be of extremely plain construction, being designed for the use of a manufacturing plant. The second, however, will be of ornamental design, such as would naturally be used for freight depots, street car barns and that class of structures. The American Bridge Company will also make an extensive exhibit of parts of large bridges.

BALL BEARINGS FOR UNIVERSAL APPLICATION is the subject of a neat 36-page pamphlet issued by the Auburn Ball Bearing Company, Auburn, N. Y. These bearings are applicable to a great variety of purposes, such as thrust bearings, light and heavy machinery of all kinds and of every speed; for trucks, carriages, automobiles, etc. The company claims that by the use of its ball journal bearings 75 per cent. of the power wasted in friction can be saved, also 95 per cent. of oil and 100 per cent. of babbitt metal. Various kinds of ball bearings are illustrated.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has recently spent a considerable sum in increasing the size of its plant, whose capacity is now fully 50 per cent. greater than formerly. This company claims that its success in the manufacture of dynamos and motors is due largely to the fact that it has never permitted its machines to go out without critical inspection and careful tests by the heads of the house. The company assures its customers that in making additions to its plant and increasing its capacity it has also provided for equal care in ascertaining that only perfect machines leave the shops.

METAL WORKERS' ASSOCIATION.—The third annual convention of the National Metal Trades Asociation was held at Detroit, Mich., on April 9 and 10. The convention transacted a good deal of business of interest to the trades represented by the association. Among those present were N. B. Payne, of the Payne Company, Elmira, N. Y.; Ferd Schwedtmann, of the Wagner Electric Manufacturing Company, St. Louis, Mo.; G. E. Emmons, General Electric Company, Schenectady, N. Y.; Wm. Schwanhauser, of H. R. Worthington, Brooklyn, N. Y.; J. C. Hobart, Triumph Electric Company, Cincinnati, Ohio; W. A. Porter, of the E. W. Bliss Company, Brooklyn Borough, New York; S. F. Bagg, Watertown Engine Works, Watertown, N. Y.; A. B. See, of A. B. See Manufacturing Company, Brooklyn Borough, New York; Edward Reynolds, of the E. P. Allis Company, Milwaukee, Wis.; Lewis Searing, Denver Engineering Works Company, Denver, Col., and R. R. Dennis, of the Otis Elevator Company, New York. Of the above-named Messrs. Payne, Schwanhauser, Schwedtmann and Searing are members of the Administrative Council. Mr. Edwin Reynolds, of the E. P. Allis Company, was elected president of the association.

THE WORLD'S WORK, now beginning its second volume, has won its way rapidly. The May number covers important topics in Russia, Austria, England, Mexico, Cuba, besides many American matters. Of important national interest is "The Solution of the Cuban Problem," by the man who has been most prominently connected with the matter, Senator Platt, of Connecticut. John Kimberly Mumford, in a strikingly illustrated article, describes the Russian political advance on Asia. Theodore Waters writes of the great possibilities in transmission of electricity for power, and an article about the personality and work of Mr. Francis H. Clergue shows one example of these possibilities. Other interesting features are Sidney Brooks' third European article, this time considering Austria-Hungary; a story of the work of President Diaz, of Mexico, with prophecies as to his probable successor; the recounting of experiments made in profit-sharing, showing successes and failures with reasons; a defence of our consular service; and an account of some of the best new preventives of loss of life at sea. Then there are vivid character sketches of James J. Hill and Secretary Gage, and editorial tributes to ex-President Harrison and to General Funston. A group of three articles, "The Public Library and the Public School," "The Author and the Publisher at Peace," and "The Author as the Printer Sees Him," will have great interest for book lovers. As usual there are editorials on the March of Events, the terse book reviews, and Among the World's Workers. One great value of this magazine is that it compresses important and interesting material into short space and with clear-cut English.

MECHANICAL STUDIES.—The modern development of machinery along all branches of engineering and industrial activity calls for a continually increasing grade of intelligence on the part of the individual workman. Each year the steam shovel, the electric motor and the improved machine-shop equipment take away in part the physical burdens of the workman while they place upon him a growing load of responsibility. The man becomes less and less a mere system of muscles, and more and more an intelligent agent. The great technical schools provide admirably for the education of the designing and constructing engineer, but can make little provision whatever for the mechanic, the foreman, the practical man who remains in charge of engine and boiler rooms after the installing engineer has finished his work and the plant is in running shape. So it happens that many an important manufacturing or power plant is in the hands of employees who have little if any real knowledge of the design and construction of the machinery for which they are accountable. Such men are necessarily cheap men, for lack of the education which would give them greater wage-earning power. They are also the most expensive men, to their employers, since they lack the knowledge which would enable them to get the best results out of boiler, engine, electric generator and all the other factors in power development. To reach and educate these practical working men in ways which will add at once to their value to their employers, and hence to their wage-earning power, is the chief aim of the correspondence system of instruction. It is not suggested that this system is to take the place of a technical college education in any case where such a course is available; but to those who cannot attend technical schools this system brings the necessary practical instruction in brief, pithy lessons carefully stripped of all unnecessary theoretical details. The American School of Correspondence, of Boston, Mass., issues sets of instruction papers and books, covering thoroughly the practical details of stationary, electrical, mechanical, marine and locomotive engineering. These courses are prepared by trained instructors of the best standing and are well illustrated. By devoting the spare minutes of each working day to the successive lessons of such a course the student speedily advances until he has qualified himself for the diploma, which is given upon the satisfactory completion of the work. Whenever difficulties arise in following the work, the student writes to the instructors of the school stating the points in question, and receives prompt replies, embodying full answers to his inquiries. This system of direct, personal correspondence between teacher and pupil is continued throughout the course. There is no reason why a pupil should not receive by mail as much personal, individual attention on the part of the instructor as he would get if he were a member of a large lecture class such as is common in all technical schools. In fact, expert testimony has been given to show that a more intimate relationship may be established between pupil and teacher under the correspondence system than could be sustained in many college classes. Many thousands of wage-earners have availed themselves of the opportunity afforded by the American School, and there is reason to believe that a system that follows so closely the needs of the workingman will have a still more rapid development in the future. The American School of Correspondence now has among its pupils a considerable number in foreign countries; Great Britain, India, Africa and New Zealand are largely represented. More significant still of the scope and standing of the school is the fact that among its pupils are a large number of graduates of the foremost colleges in the United States, who are taking this means to add to their training such lines of work as were not covered in their college work.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 16, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

672,015. AUTOMATIC SWITCH FOR GROUPS OF TRANSFORMERS; A. Schlatter, Buda-Pesth, Austria-Hungary. App. filed Oct. 5, 1900. Details.

672,019. ELECTRIC INCANDESCENT LAMP; A. Singing-Larsen, Fredriksvaern, Norway. App. filed Oct. 2, 1899. The globe is filled with a gas that will not chemically react upon the carbon filament. The density of this gas prevents vaporization of the filament.

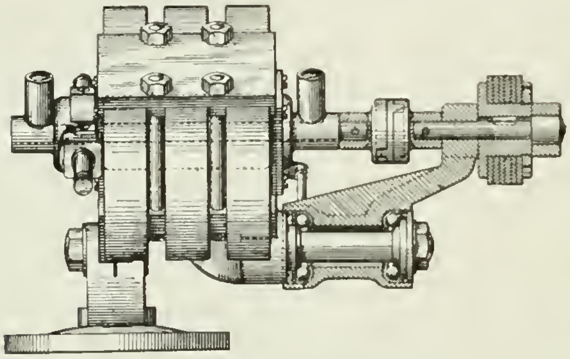
672,029. ELECTRIC GENERATOR; G. A. Burwell, Plattsburg, N. Y. App. filed Jan. 17, 1901. The invention consists in providing the armature with a flexible shaft which is constructed of two parts connected by a suitable coupling, so that the parts may move independently of each other and avoid straining and friction at the bearings.

672,032. CAR LAMP CARBON; H. A. Coughman, Burton-on-Trent, Eng. App. filed March 7, 1900. The carbon has a core composed of two parts of refractive material and one part of fluxing material.

672,047. ELECTRODE; H. E. Waite, New York, N. Y. App. filed Feb. 16, 1901. The electrode is provided with a receptacle and a passage, for a material having medicinal properties, which is administered as a spray simultaneously with the current.

672,048. STATIC MACHINE; H. E. Waite, New York, N. Y. App. filed March 8, 1901. The plates of an influence machine are clamped together at the hub by cushioning clamps.

672,064. TELEPHONE METERING SYSTEM; N. H. Holland, Brookline, Mass. App. filed Nov. 27, 1899. A signal sending device, a timing device adapted to be set in operation thereby and to continue in operation a predetermined length of time after the initial impulse which has set it in operation; and a meter controlling device operated jointly by said timing device and the device which places the telephone instrument in condition for use.


672,029.—Electric Generator.

672,071. FIREPROOF INSULATING DUCT; H. N. Speer and E. D. Speer, New York, N. Y. App. filed Sept. 8, 1900. A fireproof insulating-duct consisting of a plurality of layers of fabric saturated with a fireproofing solution, a layer of waterproofing material between the layers of fabric, and a waterproof coating outside of all.

672,074. APPARATUS FOR ELECTRICAL LAUNDERING; George D. Burton, of Boston, Mass. App. filed June 27, 1898. Electrical currents are passed through a saponaceous fluid for cleansing clothing, yarns, etc.

672,122. APPLIANCE FOR TELEPHONE SWITCHBOARDS; W. W. Dean, Chicago, Ill. App. filed Dec. 8, 1899. A device whereby calling current once applied to a subscriber's line, will be maintained in the circuit until the subscriber answers.

672,141. RAIL BOND; C. B. Thwing and C. G. Wiborg, Galesburg, Ill. App. filed Nov. 10, 1900. The bond is applied between the rail and the fish plate.

672,168. TELEGRAPH SOUNDER; W. A. Hudson, Washington, D. C. App. filed Dec. 29, 1900. The contact tip on the armature lever strikes over an aperture in the sounding post.

672,191. VOLTAIC CELL; W. H. Lawrence, Cleveland, Ohio. App. filed Oct. 9, 1897. Details.

672,195. AUTOMATIC CURRENT INTERRUPTER; H. Shoemaker, Philadelphia, Pa. App. filed Nov. 28, 1900. A separate motor is arranged to interrupt the current of an induction coil, instead of using an armature acted upon by the induction coil itself.

672,201. CARBON SORTING MACHINE; M. M. Zellers, Cleveland, Ohio. App. filed Sept. 5, 1899. A machine adapted to separate the crooked from the straight carbon pencils.

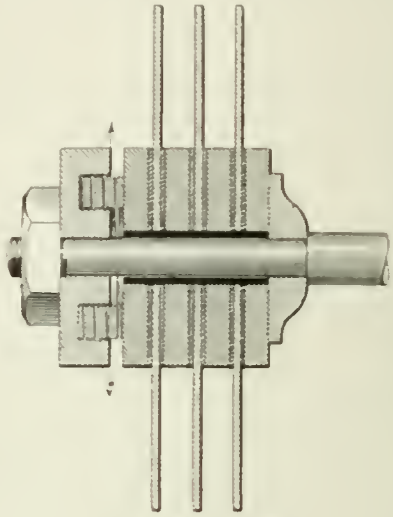
672,209. ASSORTING MACHINE; J. B. Eberling, Cleveland, Ohio. App. filed Jan. 23, 1899. A machine similar to the preceding, in which the straightness or crookedness of the carbon will predetermine its distribution, by automatically opening traps or gates placed along a track along which the carbons are carried.

672,229-30-31. APPARATUS FOR PURIFICATION OF WATER; Jean M. A. Lacomme, of Brooklyn, N. Y. App. filed July 13, Oct. 24 and Dec. 7, 1900. Electrodes are arranged in perforated non-conducting tubes supplied with contact points having at the bottom an incandescent lamp. The lamp increases the temperature and sparks are sent between the points and electrode. In another patent the sparking points are located on a rotating wheel, and in a third the sparking is between points on rod electrodes.

672,232. CONSTRUCTION OF ARMATURES AND INDUCTORS FOR DYNAMO ELECTRIC MACHINES OR MOTORS; O. Lasche, Berlin, Germany. App. filed Feb. 4, 1901. (See Current News and Notes.)

672,236. ELECTRICAL RESISTANCE WITH SMALL HEATING CAPACITY; K. Ochs, Berlin, Germany. App. filed Sept. 16, 1899. (See Current News and Notes.)

672,266. ELECTRIC FIRE ALARM SYSTEM; F. Gardner, Chicago, Ill. App. filed July 28, 1900. In an automatic sprinkling system a coil of naked wire is run through the piping, being normally held out of contact therewith by paraffin or similar material. The heat from the fire will melt the paraffin and allow contact between the wire and pipe to send in an alarm and operate the sprinklers.


672,048. Static Machine

672,309. PROCESS OF LOCATING METALLIC MINERALS; F. H. Brown, Los Angeles, Calif. App. filed Sept. 19, 1900. (See Current News and Notes.)

672,319. INSULATOR FOR CONDUIT ELECTRIC RAILWAYS; J. M. Eadie, A. Stevens and R. P. Tomassek, New York, N. Y. App. filed Aug. 2, 1900. A hanger adapted at one end to carry the line conductor, insulating material arranged to envelope and hold the opposite end of the hanger and means for supporting and securely holding the insulating material on its top and bottom only, free and clear of the walls of the conduit.

672,327. SWITCH FOR TELEPHONE EXCHANGES; F. A. Lundquist, Chicago, Ill. App. filed Jan. 22, 1900. Improvements in the switching mechanism which will make the automatic operation more certain.

672,335. TROLLEY POLE ATTACHMENT; W. P. Smith, Brooklyn, N. Y App. filed Feb. 20, 1901. Rollers are arranged transversly near the rim of the trolley wheel so as to catch the wire in case it leaves the wheel. These rollers are in the circuit, and thus maintain the continuity thereof.

672,368. JUNCTION BOX; G. L. Holshuh, Brooklyn, N. Y. App. filed Jan. 23, 1901. The box is provided with an opening and devices by which it can be easily attached to a gas pipe.

672,387. ELECTRICAL CONNECTOR; T. J. McTighe, New York, N. Y. App. filed Feb. 6, 1901. This is a bond composed of a number of strands of wire with its ends welded into a homogeneous mass.

672,388. HOLDER FOR TELEPHONE RECEIVERS; C. H. Newhall, Philadelphia, Pa. App. filed Jan. 14, 1901. A bracket for the receiver, to be attached to a desk set.

672,406. COMBINED DESK TELEPHONE AND SWITCH STAND FOR INTERCONNECTING TELEPHONE LINES; H. Herbstritt, San Francisco, Cal. App. filed Feb. 12, 1900. The switch is operated by a slide working in a slot in the standard supporting the instruments.

672,419. MEANS FOR CONTROLLING ELECTRIC MOTORS; Frederic Ayres Johnson, of Binghamton, N. Y. App. filed Jan. 16, 1901. Field core pieces have a cylindrical cavity containing a plug which can be adjusted in position to vary character of field.

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PASSING PIONEERS.

We lay with deep regret this week our tribute of love and esteem on the grave of James D. Reid, the pioneer and veteran telegrapher, the friend of Morse, the historian of the early days of his art, and the benefactor of every member of the craft. To have founded the Telegraphers' Mutual Benefit Association was honor enough for him, but interesting and pleasant associations must ever cluster around his name in the memory of those who knew him in relation to telegraphy itself. To hear him tell how in the dim past they smeared the wires with wax to get better insulation, and thus demoralized the bees throughout the entire region; or to have reminiscences of the days when Andy Carnegie was his sturdy messenger boy in Pittsburg—these and countless other anecdotes of the kind took one back more vividly than anything else could do to the exciting period when the telegraph had to struggle before it became the great agency for communication of modern times, affecting every department of life and intercourse. Old Scotland has sent us many a good and true man, but none of nobler quality than he who became the first American superintendent of telegraphs, and has now passed on to his well-earned rest, ripe in years and in the affection of the land of his adoption.

TELEPHONE ENGINEERING.

The New York Electrical Society has had some remarkably good meetings this winter, and one of the most instructive was that at which Mr. Kempster B. Miller discussed the latest features of telephone engineering. The lecture having been prepared for publication has been given out to the press, and some of its most useful portions appear in our pages this week. The society has, we are glad to learn, arranged for its appearance in pamphlet form. This lecture comes from an "independent," and we can only wish that the Bell interests would relax in their policy of silence and again contribute to the recorded literature of the art. We cannot but believe that they, too, would be gainers by adopting a more liberal attitude in this respect.

PAN-AMERICAN AND TRADE.

This month at the Pan-American Exposition at Buffalo the United States welcomes the world, and especially the sister communities to the South, to inspect her resources as exemplified in manufacturing and other products. She has also brought to Buffalo a remarkably fine collection of the products of Central and South American countries, so that the European who comes over this year has a particularly good opportunity to judge of the conditions of commerce, manufacture, mining and agriculture in the Western Hemisphere. The Buffalo Exposition, as our article this week on only one aspect of it indicates, is well worth a visit, and we are glad to know that it is the goal of a good many engineers and manufacturers from all parts of the world. They may rest assured of hearty hospitality. This country is bent upon doing all the international trade it can get, but there is a keen realization, ever growing and widening in American minds, that such trade must be based upon the cultivation of friendly relations, on reciprocity in its finest manifestations, and then upon sheer merit in the goods offered to foreign consumers.

Buffalo and Niagara are the meeting places this year of various electrical bodies, beginning with the National Electric Light Association this month, and followed up by the American Institute of Electrical Engineers, the National Independent Telephone Association, the International Association of Municipal Electricians, etc. We are glad to know that the Institute is already making extensive plans to repay in kind the warm and hearty hospitality extended to its members last year upon the occasion of its first trip to England and the Continent. No matter how many may come, it is preparing to give its friends from abroad not only an interesting time at Niagara and Buffalo, but an unequaled opportunity to study our great electrical plants and electrical manufacturing establishments.

Turning at this juncture to the more prosaic questions of trade, it is significant that with the opening of the Pan-American comes the showing that the United States has unquestionably attained leadership as an exporting nation. It could not long remain otherwise with the growth of the country, the influx of foreign population, the extension of agriculture and, above all, the growth of industries. Indeed, proportionately to population, some of the European countries still do better than the United States. But the fact remains that according to the Treasury Monthly Summary of Commerce and Finance, the average monthly exportations for the nine months ending with March, 1901, were $124,497,853, while those of the United Kingdom, our closest competitor, were $117,816,246 per month during the same period. Those of Germany, the next largest exporter, $87,551,000 per month during the 12 months ending with December, 1900; France, $56,467,000; Russia, $29,550,000 per month; British India, $26,747,000 per month; Austria-Hungary, $25,753,255 per month; Belgium, $23,568,000 per month, and Italy, $20,518,000 per month.

The total domestic exports of the United States in the nine months ending with March are $1,120,480,673, while the exportation of British and Irish produce in the same period is $1,060,346,214, showing the exports of the United States to be $60,000,000 greater than those of the United Kingdom, her greatest rival, during the term under consideration. We are glad, however, to note many signs of encouragement and activity in British trade again, and to see the signs brighter in Germany. It is, after all, only in common prosperity that the great nations of the world can go forward in the arts of peace and civilization, and the gain of one is the good of all.

ELECTRICITY IN MOUNTAIN MINES.

A paper of this title by Professor F. W. Brady was read at the last meeting of the A. I. E. E., and is noticed elsewhere in these columns. It describes some of the difficulties the engineer has often to face in the installation of a plant in mountainous regions. It often happens that the difficulties of transportation are greater than all the other difficulties connected with the mining installation of electrical apparatus. Moreover, machinery must be of the strongest, which will stand manipulation in mines and on board ship. Not only is the character of service apt to be most severe in such cases, but the facility of effecting repairs is also the least.

A peculiarity of Colorado mountain lines seems to be in their danger from lightning, electrical discharges sometimes occurring at high altitudes without the appearance of clouds in the neighborhood. In such cases "a thunderbolt from a clear sky" is no mere figure of speech. The difficulty with lightning and lightning discharges also tends to increase with the pressure employed in transmission. It is also difficult at times to obtain adequate ground connection for lightning arresters in mountain regions, and a mine often offers a special temptation to lightning, by reason of the better ground connection obtained in it than outside it. A barbed iron wire carried above the working conductors is sometimes used, and has often proved of benefit, although occasionally troubles have occurred from accidental grounds and contacts between a working conductor and the grounded barbed wire. The generating station is usually well protected, since being almost always driven by water power, a good ground can readily be established. The receiving end is where the difficulty usually occurs.

EFFICIENCY OF STEAM-PUMPING.

Some interesting tests, recently made upon a vertical triple-expansion 800-hp pumping engine having a capacity of more than a million gallons per hour, make it appear that in large steam plants under steady load, for which pumping gives almost an ideal presentation, the coal per ihp hour is only a little over 1 lb. (1.02), and that in such plants we may shortly expect to find the consumption reduced to 1 lb. avoirdupois per ihp hour, and under workaday conditions as distinguished from test conditions.

In the case recorded the boiler efficiency was over 80 per cent, and including the economizer, 85.9 per cent, while the thermal efficiency of the engine was 21.63 per cent, with a boiler pressure of 187.4 lbs. and 12½ lbs. water evaporated per pound of coal from and at 212 degs. F. Good as this result appears to be, and excellent by comparison with records of 30 years ago, it is still sad to see that only about 20 per cent of the thermo-chemical value of the coal burned was realized in mechanical energy, and that about 80 per cent was not utilized, most of it through the action of the inexorable second law of thermodynamics, being unavailable for transformation into mechanical energy through the agency of the heat engine in any of its forms. The above record is very close to the maximum efficiency of the steam engine, and while the gas engine promises somewhat greater economy, any significant improvement in utilizing the potential energy of coal must await a process of transformation in which heat will play no part, or a comparatively minor one. It is interesting to note that the economical production of light is at present limited in the same manner as the economical production of mechanical energy—in both cases by the intervention of heat between the original source of energy and the final transformation.

THE TRANSFORMER FOR MEASURING LARGE DIRECT CURRENTS.

An abstract of Professor Ryan's paper appears in this week's issue. It is theoretically interesting, as pointing out the flexibility of the alternating-current transformer, in that it may be used for the measurement of direct currents, and it is practically useful as supplying a long-felt want. The potentiometer method of calibrating direct-current ammeters, as used in laboratories, can scarcely be improved upon, no matter how powerful the currents may be. In a central station, however, the inconvenience and trouble of interrupting large conductors in order to insert into their circuit the necessary measuring apparatus, when the ammeters have to be tested, make welcome any plan by which a reasonable degree of accuracy can be secured by indirect means.

The principle of the method depends upon the fact that magnetized iron responds less readily to cyclical magnetization than the same iron initially unmagnetized. In other words, after iron has been magnetized in one direction or the other, its permeability to cyclical magnetization is less than when in the normal unmagnetized condition. This fact is usually a disadvantage which has to be faced and supported in connection with dynamo-electric machinery, since the approach of iron to the magnetically saturated conditon requires a considerable increase in the excitation to produce an increase in the magnetic flux. The failing is in this case, however, turned to advantage. An alternating-current transformer of the step-up type, designed so as to have the minimum magnetic leakage, is constructed with one turn of heavy conductor to carry the current to be measured, and with a number of turns of correspondingly smaller cross-section in the balancing coil, corresponding to the secondary coil as ordinarily employed. A comparatively feeble, and easily measured current is then passed through the latter coil, until its magnetomotive force is just equal and opposite to that of the large current flowing through the single turn. As soon as this balance is obtained, there will be no magnetic flux in the magnetic core of the transformer, and this condition is determined by using an alternated or cyclically reversed current in a testing coil on the same core, and observing when the e. m. f. so induced is a maximum in an associated secondary coil. As soon as the maximum is reached, the unknown strong direct current is greater than the measured weaker direct current, in the ratio of the number of turns in the multiple-wound exciting coil.

The advantage of the method lies in the convenience of its practical application at the switchboard. The testing transformer can be slipped over the blade or blades of a large switch at a moment's notice, and the measurement can then be made under practical conditions, assuming that the load is fairly steady, and that the current to be measured does not therefore vary rapidly. The method, then, essentially consists in causing the powerful unknown current to produce a magnetic flux in iron which can be neutralized by the m. m. f. of a measured current. Consequently, it is the magnetic field of a current which is virtually measured and not the drop of pressure produced in the known resistance by that current. The latter method, which is the ordinary plan, requires the introduction of a large and cumbersome piece of apparatus into the main circuit, at a considerable expenditure of time, and often with much inconvenience.

Methods of Street Lighting.

Ordinarily one does not expect from committees of city governments reports of real technical value, but the report of investigations into methods of street lighting, which we noticed briefly in the last issue, is on a pedestal by itself. Messrs. Mullen, Wiebling, Schwenninger, O'Brien and McDonough, of Cincinnati, deserve to go down into history as a committee that could round up the lighting facilities of a dozen cities unscathed and reach definite and valuable conclusions. We wish that they represented some other cities that we could name. The virtual subject of their investigation was the relative merits of arc lights and Welsbach gas burners for street lighting, and incidentally the comparative values of open arcs and enclosed arcs, both direct current and alternating,. Incidentally, there were disclosed some very instructive data as to relative costs, and relative continuity of service.

It is now some years since the Welsbach light has been extensively exploited for street lighting. Of its theoretical economy as an illuminant much that is favorable can be truly said. It is a very great improvement over the open gas flame in steadiness and efficiency, distributes its light well and gives initially a high candle-power. Used with gasoline gas, generated on the spot, it is a very convenient method of getting a strong light in districts where gas mains are not yet laid nor electric wires strung. It has been pushed into use in many cities large and small on account of its alleged virtues, and for other and less sanctified reasons, and is employed on a scale extensive enough to permit a fair judgment of its qualities based upon experience. And, as in many other instances, theoretical promises have not been fulfilled by the performance of things as they are. In the first place, the color of the Welsbach light and all its kindred is highly objectionable. At best, it is a greenish-white, of unhealthy appearance, and on the average a ghastly hue only fit for the illumination of a morgue or other district where the inhabitants do not worry about appearances. It is the color that condemns the quality of the light, and although new varieties of mantle have been reputed to be free from such objection it has never been our fortune to see them on the streets or anywhere else. In domestic lighting colored shades can mitigate the unpleasant hue, but we are not aware that this remedy has ever been applied to Welsbach street lights. Aside from this matter of color, the mantles—certainly when used out of doors—grow very rapidly dim, so that it is exceedingly hard to find a street that is really well lighted by these burners. Nothing short of a constant scourge of inspection and fines seems to be able to keep them going at anywhere near their rated brilliancy. Moreover, it transpires from the Cincinnati investigation that they are not really cheap. Their average contract price in the cities investigated wherein both arcs and Welsbach are used was $29.48, the cost of arcs in the same cities being $97.42. Now, one modern arc light consuming, say, 480 watts, is materially better than three Welsbachs, basing the comparison on the minimum illumination alone, while if any value be assigned to the average illumination the light of the arc is immensely superior. An agitation for lighting contracts, based on a measured minimum of illumination, is an almost infallible sign that an exploiter of Welsbach lights has quietly visited town.

As to arc lights, the Cincinnati committee found almost everywhere a strong preference for the enclosed arc, based on better distribution of light, greatly increased steadiness and greatly diminished number of lamps reported out. Of course, the first mentioned advantage is notorious. There is really no comparison between the open and enclosed arcs in this respect, since with the latter not only is the light thrown out at a much better angle, but the whole inner globe serves as a radiant surface so that the lamp supports do not cast troublesome shadows, and all the shadows are less sharp and dense. The increased steadiness is also a well known property, but it is not so generally understood that the open arcs are the more likely to be out. But such is the fact, compared even with alternating arcs which are popularly supposed to have more delicate mechanism than continuous-current lamps. The old open arcs were wonderfully reliable mechanisms, but the need of frequent trimming gave more opportunities for disarranging them, and improper trimming was responsible for many failures. As to the relative value of the different classes of arcs as illuminants, there seems to be a general agreement that the 480-watt direct-current enclosed arc is fully equal and, on the whole, superior to the so-called 2000-cp open arc. And what is more striking, there seems to be an inclination to regard the 6.6-ampere series alternating arc, properly hung, as the practical equal of either of the others. From a photometric standpoint this statement would seem exaggerated, but illumination cannot be estimated entirely from a photometric basis, since there is no doubt whatever that lowering the intrinsic brilliancy of a light while retaining the same candle-power will of itself make the illumination more satisfactory, and the strong horizontal rays from the alternating arc are of great service. Ordinarily, many would prefer an alternating arc taking about 7.5 amperes if replacing 480-watt direct-current arcs, lamp for lamp. We regret that the investigation did not extend to the enclosed arcs of moderate candle-power, taking 5 amperes or thereabouts. These are coming into use as substitutes for the nominal 1200-cp open arcs, but their real illuminative value has not, to our knowledge, yet been thoroughly investigated. It assuredly is worth it, for it appears that rather small arcs are decidedly useful in dealing with certain classes of street lighting.

Death of James D. Reid.

Every one who has enjoyed the acquaintance of Mr. J. D. Reid will regret to hear the news of the death of that veteran telegrapher this week. He was 82 years old, but had only lately succumbed to the burdens of his age, rallying at first from a surgical operation it was necessary for him to undergo. It is not so many weeks since he was downtown and a visitor at several offices, including this, when he had a bright smile and a cheery joke. Nor is it so many months since he played his last game of golf.

Mr. Reid was born in Edinburgh, Scotland, on March 22, 1819. In 1834 he moved with his family to Toronto, Canada. He took a position as a junior clerk in the Toronto branch of the Commercial Bank of Kingston. He came to the United States in 1837, and at the age of 18 years became a clerk in the Rochester post office under Henry O'Reilly, who, in 1845, obtained a contract for the construction of a telegraph line from Amos Kendall, Postmaster-General, then Professor Morse's agent and attorney.

In 1845 Mr. Reid was made an assistant to Mr. O'Reilly in the construction of the work, and was assigned to the building of the line from Lancaster to Harrisburg, Pa. His next appointment of importance was that of superintendent of the Magnetic Telegraph Company, a line from New York to Washington, and the superintendency, too, of the Atlantic & Ohio Telegraph Company, which ran a line to Pittsburg from Philadelphia. So far as can be definitely setled, he was the first regular superintendent anywhere of a commercial telegraph line.

In 1856, when the Western Union began to absorb the individual lines, Mr. Reid was made superintendent of the New York, Albany & Buffalo Telegraph Company, which was soon absorbed by the Western Union with the rest. Several other companies with which he was identified were also taken in subsequently. During his telegraphic career he was wounded in the head by some unknown assailant while at work, and he felt the effects of the blow all through his life.

Mr. Reid had a marked taste for literature and founded and edited the *National Telegraph Review*, a quarterly of the early fifties. In 1877 he published his first edition of the Telegraph in America. He was also editor of the *Journal of the Telegraph*, was intimately acquainted with Professor Morse, Cyrus W. Field, Hiram Sibley, William Orton, Peter Cooper, Marshall O. Roberts, Wilson G. Hunt, William Cullen Bryant, Henry Ward Beecher and William E. Gladstone; and his gossipy history of the telegraph includes many anecdotes of the early telegraph leaders and their work, as well as the record of telegraphic commercial development.

One of the things of which Mr. Reid was most deservedly proud in his career, next to the friendship of men like Morse, was his organization of the Telegraphers' Mutual Benefit Association, of which he was the first president. He was a warm-hearted man and one of his early deeds of kindness to Andrew Carnegie, when that millionaire was his messenger boy in Pittsburg, was never forgotten by its recipient, and was more than once generously repaid. Mr. Reid was appointed also United States Consul to Dunfermline, Scotland, through Mr. Carnegie's influence with President Harrison, and spent some happy years on his native soil, being confirmed in the appointment by President Cleveland. Mr. Reid also enjoyed the friendship of Mr. Rockefeller, who, making some judicious investments for him in Standard Oil and acting as his banker, put him into very comfortable circumstances during the closing years of his life.

Mr. Reid is understood to have left a widow and a married daughter, both of whom are living in Great Britain. The funeral services were conducted on Tuesday, and the interment takes place this week at Rochester, N. Y. The funeral exercises were attended by many of the amiable veteran's friends, who exchanged many stories and reminiscences of the early telegraphic days. Mr. Reid has himself, however, put forever on record in the pages of his "Telegraph in America" the thrilling and amusing episodes which attended the introduction of the new means of conveying intelligence, then so crude in its appliances and its technique. Thus passes away an interesting personality, a lovable character and the last link that united the pioneer work at the very outset of electrical applications with the great developments of the new century. Like many another Anglo-American, Mr. Reid gloried in the generous country of his adoption, but deep down in his heart lingered a strong pride in his Scottish blood, and loyalty to the hills and heather, about which he could never speak without tears in his eyes and voice.

Mr. Scott on Induction Motors.

The New York Electrical Society held another extremely successful meeting on April 25 at 8 p. m. at Havemeyer Hall, Columbia University, when Mr. Charles F. Scott, chief electrical engineer of the Westinghouse Electric & Manufacturing Company, lectured on the subject of "Induction Motors." In spite of the rainstorm which was the climax of two weeks of steady wet weather, no fewer than 250 members climbed the heights to Columbia and were rewarded by hearing a most instructive and valuable lecture on the topic in question. Mr. Scott explained the characteristics of different types of alternating-current motors and paid particular attention to the induction motor. These in turn were considered in their various forms and the adaptation of the various types to different classes of service was brought out in detail. The difference between motors of this type and direct-current motors was also discussed in an illuminative manner, and a large variety of performance curves as to speed, load, etc., were shown by means of wall diagrams. The lecture was supplemented by a large number of lantern slides dealing with the induction motor in its industrial application. Additional interest was given to the lecture by the demonstration of various phenomena by means of motors in actual operation, beginning with the phenomena of the rotating magnetic field as elucidated by Mr. Nikola Tesla; and following the subject through its various stages of development, Mr. Scott proceeded to show in operation types of the Westinghouse induction motor and made also a series of brake tests.

As was the case with the Steinmetz lecture, it was immediately decided by the members that the address should be put into type for general circulation, and Mr. Scott has kindly consented to do this, so that the lecture may be added to the society's publications for the season.

The following members were elected at the New York meeting: W. E. Gavit, Tucker Electrical Construction Company; Robert B. Corbett; J. C. Lynch, New York Telephone Company; Ralph Straschnow, William H. Eckert, Willard M. Miner, W. Stanley Eckert and H. P. Marshall, all of the Knickerbocker Telephone & Telegraph Company; Willard B. Kendall; C. E. Fairbanks, New York & New Jersey Telephone Company, Paterson, N. J.; Dr. Ralph Julian Sachers; Edwin L. Ross; J. C. Weart, Western Electric Company; Edgar H. Stevens, C. E. Brown.

We are requested by Secretary Guy to state that Mr. Steinmetz's lecture on alternating currents has been printed and can now be had from him at 120 Liberty Street, for 25 cents per copy. The lecture by Mr. K. B. Miller on "Modern Telephone Engineering," profusely illustrated, is now in press, and will be issued at the same price. As stated above, Mr. Scott's lecture is now to be printed also.

Programme of the National Electric Light Association

Mr. George F. Porter, secretary of the National Electric Light Association has issued the following programme for the convention of May 21-23. Papers will be read as follows: "Arc Lighting at the Beginning of the Twentieth Century," by H. W. Hillman; "The Practical Side of the Incandescent Lamp," by F. W. Willcox; "The Foresee (4-C) System of Charging," by Louis R. Wallis; "A Station Load Diagram," by C. R. Van Trump; "Distribution of Current at High Potential in New York City," by Calvin W. Rice.

Reports will be presented by the committees on Grounded Circuits, Rules for Electrical Construction and Operation, Standard Candle-Power of Incandescent Lamps, Photometric Values of Arc Lamps, Analysis of Flue Gases, The Legislation Regarding Theft of Current, Amendments to By-Laws, Amendments to Freight Classification of Electrical Apparatus, Legislative Policy, Uniform Accounting.

The International Hotel has been entirely reserved for those attending the meeting. Rates, American plan, $5 per day, with bath; $4 per day without bath. The respective Passenger Associations covering the territory east of the Mississippi River have granted a rate of a fare and one-third, on the certificate plan, for delegates and friends attending this convention, from all points in their territory to Niagara Falls and return.

The dedicatory ceremonies of the Pan-American Exposition at Buffalo, a half hour from Niagara Falls, will be held on Monday, May 20, the day before the opening of the convention, thus enabling members and delegates to attend within the time limit of their tickets.

An English Combined Central Station and Destructor Plant.

ONE of the peculiarities of London government is the reservation to numerous communities which form the geographical city, of power to control the supply of electricity within their bounds. One effect of this is naturally to prevent the carrying out of a comprehensive scheme of generation and distribution of electric current, as is done in the case of American cities. Still another and perhaps more serious effect, flows from the tendency of the smaller governing bodies to take a narrow view in considering the subject of public utility establishments, which tendency in England is aggravated by a fear on the part of such bodies of allowing private enterprise to enter into this field. An example of the manner in which electrical industry is hampered by this condition is afforded in the history of the newly established central station plant of the borough of Fulham, London.

For many years the question of electricity supply was discussed by the Fulham vestry and differences of opinion on the subject developed which from time to time gave rise to heated debates and considerable friction. Finally, in 1895, a committee was appointed to consider the desirability of obtaining authority to erect an electric lighting plant in connection with a refuse destructor. In the fall of that year the services of an electrical engineer were secured, and two years later authority to erect a plant was obtained, and in 1898 the drawing up of the plans was commenced. Disputes over the awarding of the contracts delayed the establishment of the plant, which only commenced operation last month.

The plant as erected has a capacity for 30,000 8-cp lamps, and cost, in round figures, about $540,000. Of this amount $115,000 was taken for buildings, $80,000 for the refuse destructor and boiler plant, and $230,000 for the electrical generating plant.

The generating room of the Fulham plant is a handsome apartment 110 ft. long, 42 ft. wide, and 30 ft. in height to the springing of the roof. The walls are entirely faced with white glazed bricks, relieved by bands and string courses of salt glazed bricks. The floor is paved with mosaic work, with hand-laid borders. A special feature of the room is the absence of all pipe work, this being arranged under the floor level. A gallery runs round two sides of the room, and carries the main switchboards and a switchboard attendant's office. Space is left at one end of the room for an extension engine and dynamo. Two entrances to the destructor house are provided from the engine room, one from the gallery and one from the floor, and these will be carefully protected by double doors and glazed screens, with the object of keeping out dust.

The alternators are three in number, each set consisting of a two-phase generator of the flywheel type coupled directly to a horizontal compound condensing engine. The engines are of the Musgrave slow-speed Corliss type, and each is designed for 450 b. h. p. when supplied with steam at a pressure of 130 lbs. per square inch at the engine stop valve and a vacuum of 24 inches of mercury in the exhaust pipe, the governor being specified to control the speed within 3 per cent from no load to full load, and to be adjustable while running to vary the speed 5 per cent about the mean speed.

The three two-phase generators (Fig. 2) are of the well-known Oerlikon design, but were constructed by the General Electric Company at its Manchester works. Each generator is capable of giving a normal output of 300 kilowatts at all e. m. f.'s from 2800 to 3000 volts at the terminals of the machines. The machines will also run continuously for two hours overloaded at 330 kilowatts. The speed, as already stated, is 93.7 r. p. m. and the frequency 50 p. p. s.

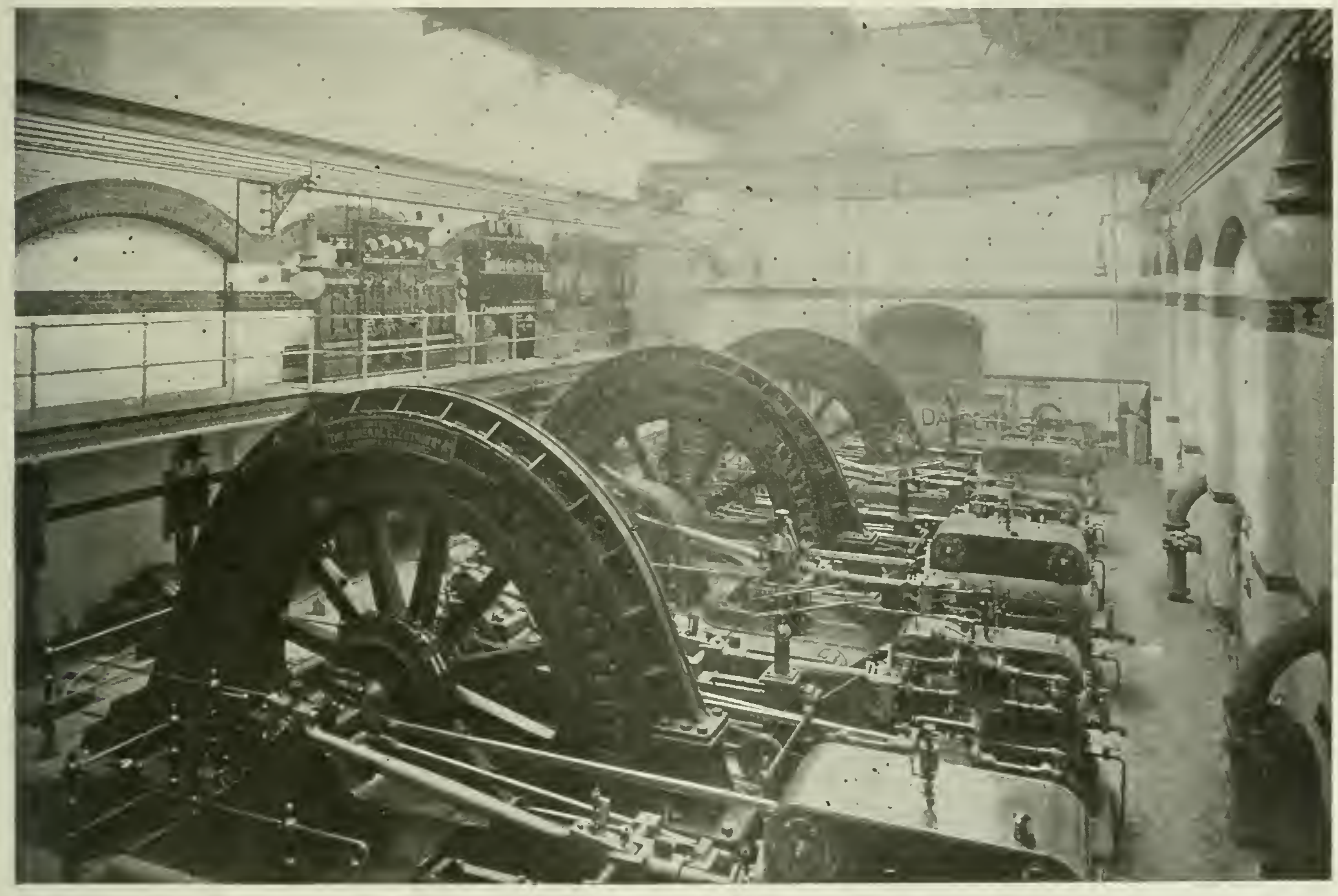

FIG. 1.—GENERAL VIEW OF ENGINE ROOM, FULHAM, LONDON.

The energy stored in the flywheel when running at its normal speed is 1,800,000 ft.-lbs. The field-magnet poles, with their windings, are fixed on the periphery of the flywheel. The poles are laminated, rivetted together, and fixed to the flywheel rim by means of steel wedges, the latter being securely fastened to the flywheel by strong bolts passing through its rim. There are 64 laminated poles on each flywheel, wound with round copper wire, the exciting current being brought to them through two slip rings. The diameter over the poles is about 14 ft. The necessary current for exciting the field coils is obtained from the continuous-current dynamos driven by high-speed engines.

On the inner circumference of the stationary armature are spaced 256 slots, which carry the copper windings. These windings are arranged to form two circuits, one for each phase. The windings of the one circuit have straight ends, while those for the other circuit have bent ends, as is the usual practice. The insulation between the coils and the iron frame is efficiently effected by mica tubes, the coils being fastened securely in the slots by means of strong fibre wedges. In Fig. 1, which gives a general view of the engine room, the upper sections only of the shields covering the end of the windings are in place. The two series of windings are quite independent, and their four ends are brought out to terminals from which the current is carried to the switchboard.

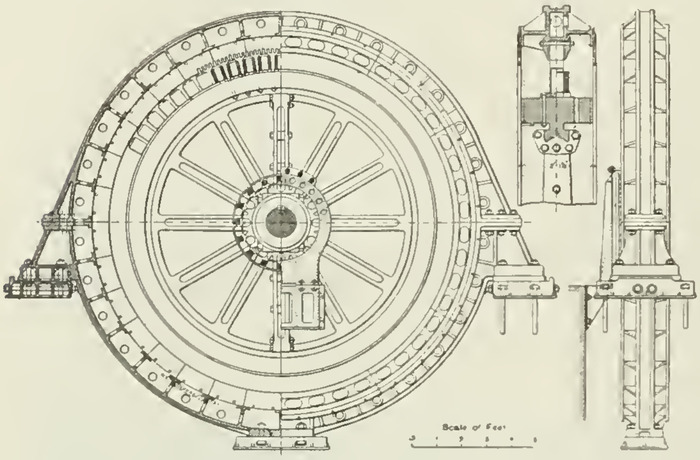

FIG. 2.—300-KW TWO-PHASE GENERATOR.

There are three direct-current dynamos, which were also made by the General Electric Company, for exciting and light and power supply in and about the works. Each is capable of giving an output of 600 amperes at 100 to 110 volts at a speed of 460 r. p. m., and each is directly coupled (on one bedplate) to a Musgrave high-speed enclosed type compound engine.

The dynamos, either of which is large enough to supply the exciting current necessary for all three alternators, are shunt-wound, having four poles with cast-steel yokes, while the armatures are of the slotted type with form-wound coils placed in the slots. The commutator is built up of hard-drawn copper, and is fitted with carbon brushes, and the machine is built to conform with the usual specification as to temperature and fixed position of brushes.

There are two arc-lighting circuits, shown o and ● on the map, with 43 or 44 lights on each circuit. These are supplied by three Ferranti rectifiers (Fig. 4) of the standard 50-light pattern, which are placed in one corner of the engine room under the stairway. There is space for a fourth, although at present one of the three is a stand-by. The switchboard in connection with these is of the usual type constructed by Messrs. Ferranti for this purpose, and it is fixed on the wall beside the rectifiers. It is arranged for three circuits, any one of which can be fed from any one of the rectifiers.

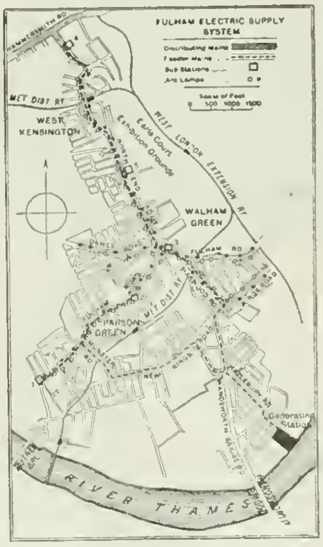

FIG. 3.—MAP OF POSITION OF MAINS.

The three alternator engines are fitted with Korting ejector condensers placed partly above the engine room floor level and partly in the pipe trench. A branch is run from each condenser to the main exhaust pipe, in which is fixed a Blake and Knowles automatic exhaust valve to enable the steam to reach the atmosphere in case of any failure of the condensing plant. Each condenser is required to give a vacuum of 24 inches of mercury when dealing with 10,000 lbs. of steam per hour. The condensers are supplied with water from a large tank, placed on the roof of the pump room, and kept filled by three motor-driven centrifugal pumps of 18 b. h. p. each, running at 1200 r. p. m., the motors being of the General Electric Company's make. These pumps are placed in the pump room, and are each capable of delivering 33,000 gallons of water per hour with a total lift of 48 ft. at low tide.

The high-pressure switchboard for controlling the 3000-volt two-phase currents is of Messrs. Ferranti's standard pattern, and is placed in the gallery 10 ft. above the engine room, as seen in one of the illustrations. It consists of 16 panels, providing for the 6 circuits of the three two-phase alternators, two rectifier circuits, and the testing circuit, and there is one spare panel. The controlling gear for the alternators is fixed below board on the regulating table, the alternators are regulated by open type rheostats in series with the field. In connection with the high-pressure board, a Ferranti plug testing box has been fitted, from which leads are run to the instrument room. Plugs can be inserted in the box and connected to any panel on the high-pressure board for making insulation tests. There are three Ferranti wattmeter panels, one for each alternator. Two wattmeters are fixed on each, with cut-outs, transformers and fuses, there being one recording wattmeter in each phase. Kelvin instruments are employed on the switchboards.

One terminal of each phase is permanently earthed to the earth bar of the switchboard in the usual manner, and, of course, the switch and fuse connections are all on one pole. The synchronizing contact is made in connection with one phase only of each alternator, the handles of the two switches of each alternator being joined by a cross-piece.

All the principal connections between the machines and the switchboards run beneath the floor, and are of rubber insulated cable which, in the case of high-pressure mains, is also lead-covered.

The two-phase high-pressure currents are led by means of pairs of concentric lead-covered cables to five stations. Here they are transformed down to 200 volts each phase in stationary transformers and distributed at that pressure to the consumers. In the low-pressure cables, the phases are also kept apart, and one employed on each side of the street. If a motor is required, a service line is run across the street and both phases are brought in. The high-pressure feeders, running in pairs of concentric cables whose outers are earthed at the station switchboard, may be traced out on the map of Fig. 3 as follows: A 7/14 feeder runs to Munster road, where it divides, 7/16 cables being "swallow-tailed" off at either side to the sub-stations 1 and 2. To No. 3 sub-station there is a 7/15 feeder, consisting, as in all cases, of a pair of concentric cables, and to No. 4 a 7/14 feeder. The latter is tapped to supply No. 5 sub-station. To avoid confusion in the map, owing to the small scale, the course of the feeders is merely shown by one dotted line whether one or more feeder, runs down the street; but the above explanation makes the arrangement quite clear. Streets in which there are distributors are

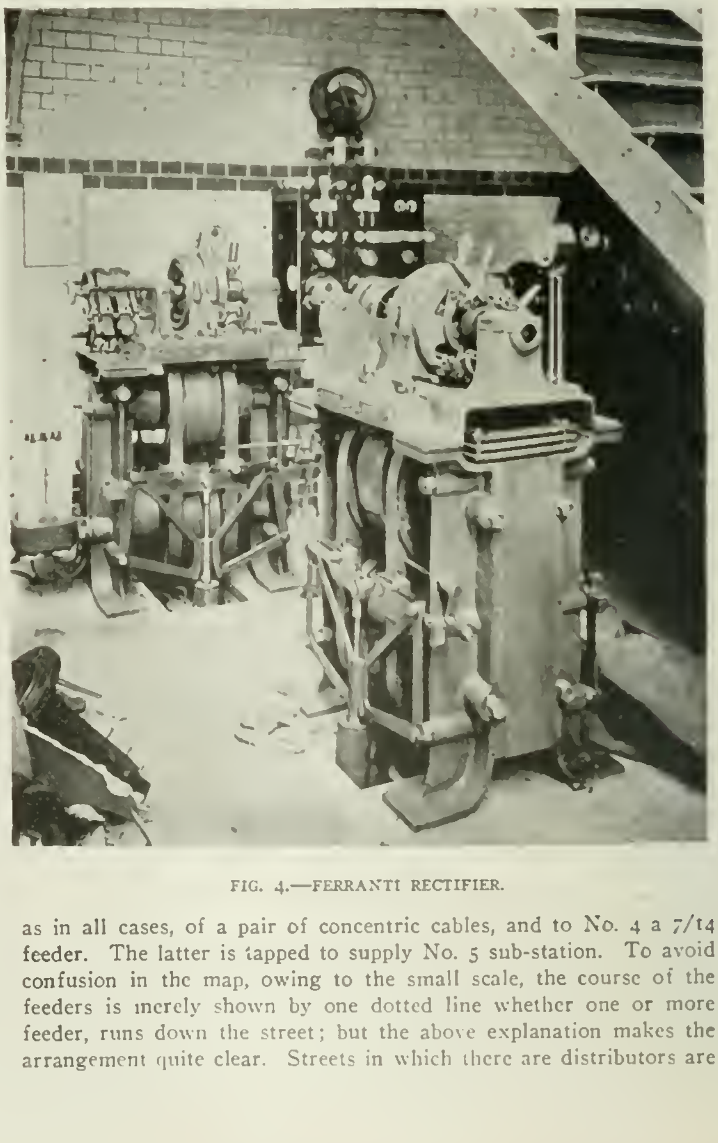

FIG. 4.—FERRANTI RECTIFIER.

shaded, and it is seen that there are no distributors in close proximity to the works. The arc-lighting circuits, which are independent, have already been referred to.

All the cables are lead-covered and drawn into Doulton ducts under the footpaths and into cast-iron pipes where under roadways. At road crossings, however, wrought-iron pipes embedded in concrete have been used, special reducing pieces of Doulton ware being employed for gradually changing the shape of the way from the square to the round form. Service and network boxes are made use of, the type with brass sleeves for plumbing to the lead of the cable having been chosen. The boxes are filled up with compound. Spare ducts have been provided liberally for future extensions.

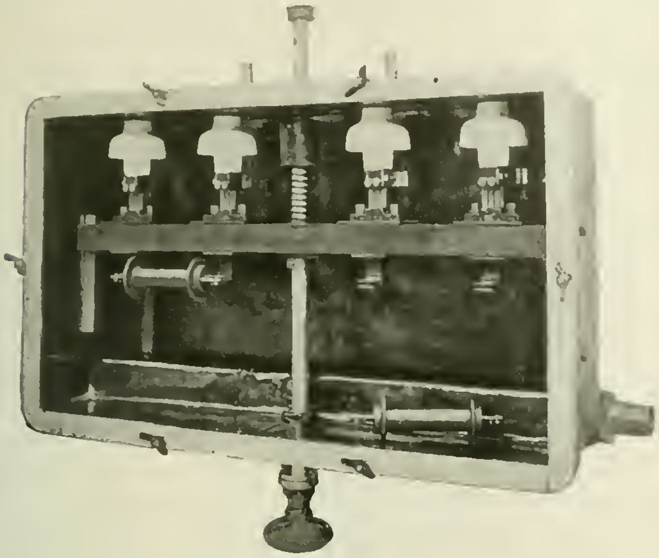
FIG. 5.—HIGH-PRESSURE SWITCH.

There are at present five sub-stations, each of which contains two 50-kw transformers, one for each phase. The switching arrangements, as well as the transformers, are placed in watertight cases; all iron work is earthed, and a Cardew earthing device fitted to each transformer. Due provision has been made for ventilating the substations, which are lighted with incandescent lamps supplied off the low-pressure bars in the switch boxes. The chambers themselves are well designed and are sufficiently large for their pair of transformers. Being lined throughout with white glazed bricks, they present a clean and wholesome appearance.

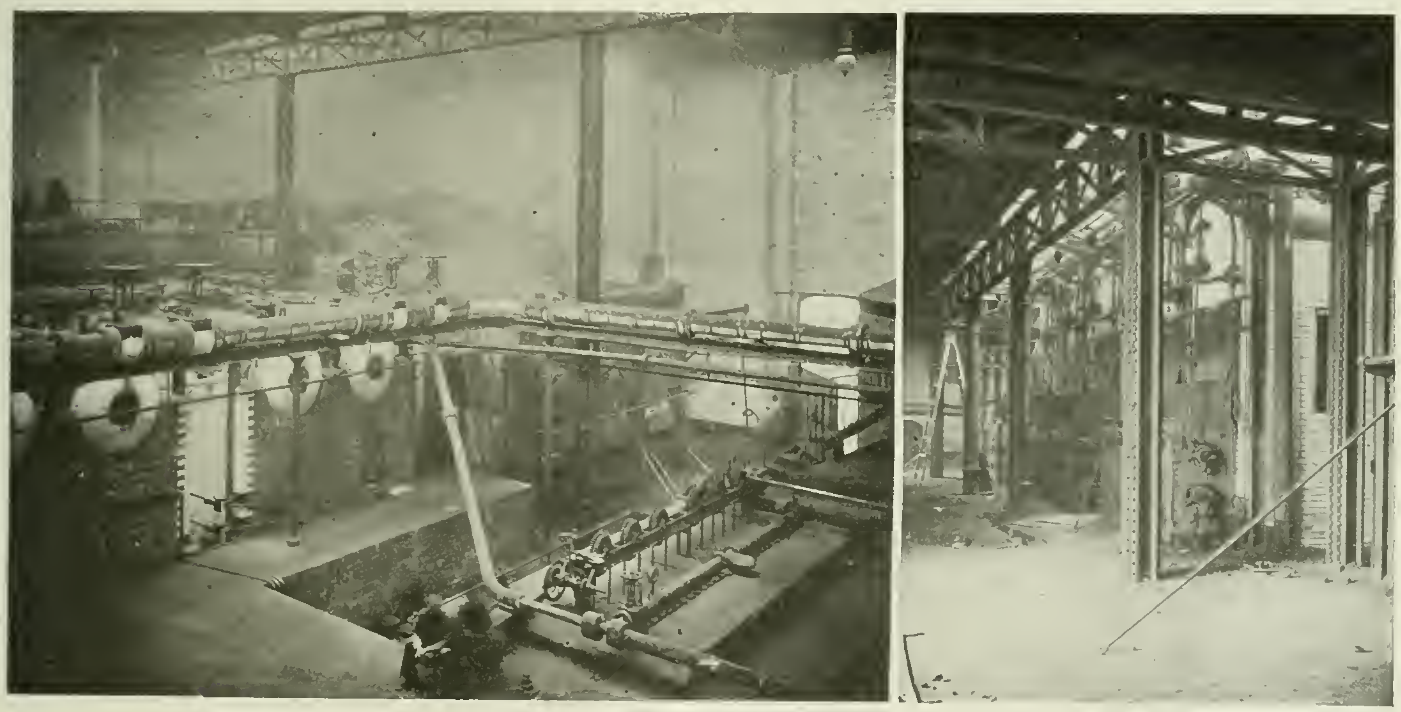
Fig. 6.—Destructor Plant.

One of the high-pressure switches is shown in Fig. 5. The box itself is of cast-iron lined with micanite. The high-pressure concentric feeder enters through the lower right-hand gland, the outer conductor being connected to the upper right-hand switch contact and the inner to the corresponding contact on the extreme left. The connections to the transformers enter through the smaller glands on the top. On turning the handle fitted to a spindle coming through the bottom of the box the cross-bar making the two contacts draws away sharply. The brake of the switch itself appears small, but is said to be effective. The cross-bar carries the fuses, which are contained in ebonite reels fitting into spring contacts on the bar.

The low-pressure box has glazed doors, the fittings consisting of a pair of bus-bars mounted on a marble base. The cables enter through glands, and the connections are made through convenient switch-fuses with substantial stoneware handles.

The public lighting is by 86 open-arc lamps, carried on posts of ornamental design, bearing the borough arms, and run in two circuits of about half the number on each. The lamps are 12-ampere 32-hour double-carbon lamps, and are fixed about 25 ft. from the ground. Brackets are also provided on each post for two 32-cp incandescent lamps, which are automatically switched on when the arc lamps are switched off or fail.

Except in the offices, the cables in the station are carried in watertight "Simplex" steel conduits. There are six distribution boards, to which the current is transmitted from the works lighting board, placed under the switchboard gallery in the engine room. The inclined roadway and destructor house are lighted by eight 12-ampere arc lamps, four similar lamps being suspended from swiveling brackets, two on either side of the engine room. There is also a large number of incandescent lamps, and wall plugs have been provided at all points where hand lamps will be required for inspecting and cleaning purposes.

The charge for lighting purposes is 10 cents per kilowatt-hour, and for motive power 5 cents per kilowatt-hour during the hours of daylight. The meters employed are of three types, Hookham, Thomson and Aron. No meter rent will be charged. Our London contemporary, the *Electrician*, from which we borrow this description, says that it is satisfactory to note that the number of applications for energy already amount to an equivalent of some 10,000 8-cp lamps, including a number of elevator motors.

THE DESTRUCTOR PLANT.

Of perhaps the greatest interest to American readers is the refuse destructor plant portion of the installation. The destructor and boiler-house is a lofty building 35 ft. high to the springing of the roof, 137 ft. in length and 87 ft. wide. It contains 12 destructor cells with room for an additional four cells. The present cells are arranged in two groups of six each on either side of six Babcock & Wilcox boilers, and are capable of destroying efficiently 120 tons of refuse in 24 hours. Over the boiler-firing floor, and extending from end to end of the building, is the tipping floor, to which the carts are brought for the purpose of discharging their loads onto the tops of the group of cells, where the refuse is fed into the furnaces. The tipping-floor is arranged to allow of the storage of a considerable quantity of refuse so that the working of the plant may be continued without interruption. Access to the tipping floor is obtained by means of an inclined roadway having a gradient of about 1 in 14, at the foot of which there is a weigh bridge and house where an account will be kept of the weight of refuse brought in.

The destructor furnaces have each a grate area of 30 square feet. The boilers have a heating surface of 1284 sq. feet, and are provided with mechanical stokers, which are electrically driven. An opening behind the bridge of each boiler leads the destructor gases in, the flue to this opening being provided with a suitable damper so that the boiler may be heated at will from the destructor or be fed with coal. Provision has also been made for firing the boilers by hand in the event of interruption in the working of the mechanical stokers, and forced draught induced by steam jets has been applied to each boiler. The boilers are constructed for a daily working pressure of 160 lbs. per square inch.

The refuse is fed into the destructor furnaces through charging openings on the tops of the blocks of cells, as mentioned above, the refuse itself closing the openings when the operation of charging is complete, and thus obviating the necessity for doors on the tops of the furnaces. Each furnace is provided with a sloping firebrick hearth on which the refuse rests before being drawn forward from below onto the grate bars. The grate bars have fine spaces between them and are made all in one length, so that there is no obstruction to the clinkering tools in traversing the length of the bars. The furnace crown is composed of special fire-resisting blocks, specially mixed and burned. capable of standing not only high temperatures, but rapid changes of temperature. At the sides of the furnaces, and extending about 8 inches above the grate bars, are cast-iron side boxes through which the whole of the air for combustion is passed. These boxes serve the double purpose of heating the air for combustion, and at the same time protecting the sides of the furnaces from the undermining action which takes place with brick sides, and is caused by the clinker adhering to the brick. Each of these side boxes is provided with a valve, controlled from the front of the furnaces, and openings for the delivery of the mixed air and steam. forming the blast, into the ashpit underneath the grate bars.

The air for the blast is drawn from above the charging decks of the furnaces, through large hoods, by means of powerful steam blasts, and thus ventilation of the upper part of the destructor house is assisted, and any smells arising from the refuse on the decks are partially drawn off and passed into the furnaces. The blasts force the air into longitudinal air passages extending under the furnaces and communicating by means of the valves above described with the side air boxes of the furnaces. There is a single outlet for the products of combustion from each furnace, placed in the crown of the arch at the front of the furnaces in such a manner as to draw off the escaping gases over the hottest part of the fire, thus cremating them before they leave the furnaces. The unburnt gases which have been given off by the refuse drying at the back of the furnace are thus subjected to a temperature of from 1800 to 2000 degs. F. before passing away to the flues.

The exhaust openings from the furnaces lead into flues, which in turn open into a main flue running the whole length of both blocks of cells and the battery of boilers between them, the flue being on ground level under the blocks of cells, but below ground level under the boilers. The furnaces are provided with massive steel buck stays and tie bolts, and with cast-iron cleaning and clinker doors, the latter being lined with firebrick. The clinker doors are of the balanced type, and are so arranged as to open the whole width of the furnaces at once. Branch flues, with dampers, are provided from the main flue to lead the gases into the furnaces of the boilers, and also by-pass flues, by means of which the hot gases can be led past the boilers to the chimney. The dampers in the hottest parts of these latter are swivel dampers of a special design, being kept cool by means of water circulation.

The destructor gases alone will be able to furnish sufficient steam to maintain the boiler pressure at 160 lbs. per square inch up to a certain point, but it is not anticipated that they will suffice at large loads. There will thus be considerable consumption of coal in the boiler furnaces and a coal-handling plant is being put down. The coal will be brought to the station by water, and will be raised from the lighters alongside the quay by a steam crane, and then dropped into a weighing machine, which automatically weighs, records and discharges the loads and adds up the successive quantities passing through the machine. After being discharged from the shoot of the weighing machine the coal is conveyed to the top of the bunker by an electrically-driven elevator, whence it is deposited in different parts of the bunker through shoots.

The clinker is drawn from the furnaces into iron skips carried on an overhead railway by which it is conveyed to the wharf alongside the river. Two Green economizers, each having a heating surface of 1920 square feet, are erected between the boilers, and there is a dust-catcher near the chimney. A by-pass is provided to carry the gases to the dust-catcher directly, when it is not desired to employ them for heating the boilers. The dust-catcher is a large circular brick chamber lined with firebrick, with a domed roof of the same materials. It is partly seen on the extreme right of our large illustration of the destructor house. The structure is strengthened by massive iron rings and buck-stays, and is so constructed as to cause the gases to swirl round rapidly within it in such a way as to throw off the dust which they carry along with them by centrifugal force. Cleaning doors are provided for the removal of the rust at any time without stopping the furnaces. The chimney has a height of 100 ft., and an internal diameter of 8 ft. It is octagonal in form, and is lined throughout with firebrick.

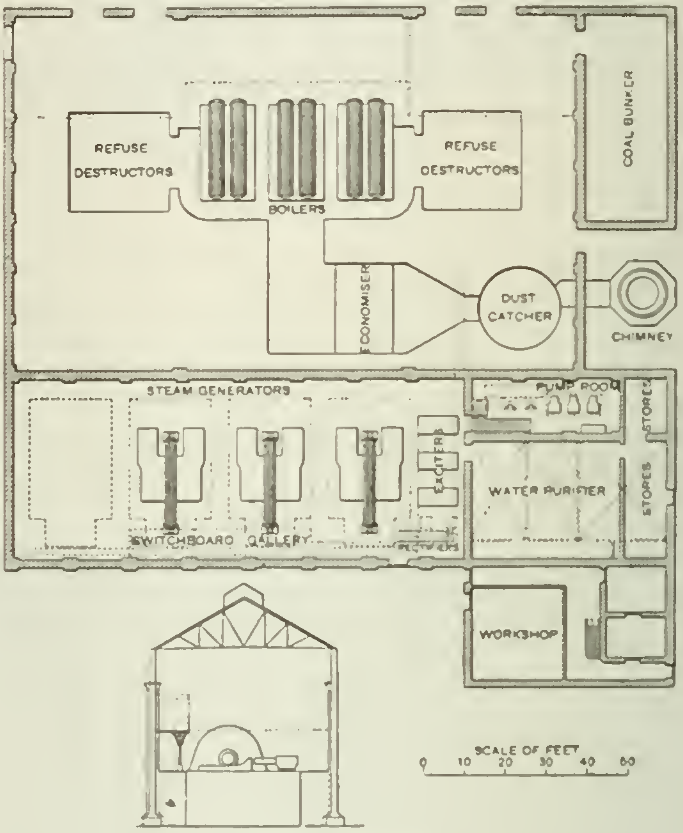

FIG. 7.—PLAN AND ELEVATION OF PLANT.

It is estimated that the amount of refuse passed through the destructor per annum will be approximately 40,000 tons, and its calorific value is placed at one-twentieth that of good steam coal. The Borough Council therefore expects to save the cost of 2000 tons of coal per annum.

WATER-SOFTENING PLANT.

The supply of feed water is obtained from an artesian well sunk to a chalk level, and requires to be freed of carbonate of lime before use, for which purpose a water-softening plant is installed. The Atkins system is employed, whereby a certain quantity of caustic lime is added to the water, mixed with it, run into large tanks, where the chalk is precipitated, and finally filtered. The plant is capable of dealing with 8000 to 10,000 gallons of water per hour. The guarantee requires that any intelligent workman can operate the plant, and that water with 15 or less degrees of hardness must be softened so that the hardness is reduced to less than one-half grain of carbonate of lime per gallon if required. The plant, whose arrangement is illustrated in Fig. 7, consists of the following parts:

1. A lime slaking, straining and storing machine. 2. A cylinder in which lime water is formed. 3. A "mixer," being a shallow trough fitted with baffle plates. 4. A cistern in which the actual softening takes place. 5. A filter.

The method of working is as follows: The lime is delivered directly into a hopper, which forms part of the lime-slaking machine. The machine is set in motion, and in a few hours sufficient lime to last three weeks is automatically reduced to the form of cream of lime, and stored in a mill under the hopper. This mill is fitted with stirring arms and a self-cleaning strainer; about once a day the cream of lime is stirred, and a certain quantity pumped itno the lime water cylinder. A jet of water is admitted at the bottom of this cylinder, and passes out at the top as a saturated solution of lime water. It is then conducted to the mixer, where it is joined by the hard water. There are two specially constructed regulating valves by which any desired quantity of hard water and the correct proportion of lime water can be adjusted, and both supplies can be turned on or off without interfering with the other. While flowing through the mixer, the lime water and hard water mix automatically in a few seconds, and the water is delivered into the softening cistern, which is always full, and where water is always flowing through. It is during this period that the actual softening takes place, which may be described thus: Chalk is dissolved in water by carbonic acid gas, forming bicarbonate of lime. When quick-lime is added the gas releases the chalk, which, together with the lime, is precipitated. The chalk being no longer in solution, the water is now soft, but excessively turbid, owing to the deposit. This is removed by filtration.

The filter consists of a series of hollow disks covered with cotton filter cloth. The disks are secured to a hollow center tube, and the tube and disks mounted in a cistern. The water is admitted to the cistern, filters through the cloth, leaving the deposit on the outside, passes inside the hollow disks to the center tube, and is delivered outside the cistern. When cleaning is necessary, usually once a day, the disks and tube are revolved by means of gearing provided for this purpose, jets of water play on the disks, and the deposit which has been arrested is washed off in a few minutes, passes down a waste pipe, and filtering can be resumed. The advantages claimed by this system of filtering are that the filtering medium is cheap, it is arranged vertically, and takes up little room, and is readily cleaned by mechanical means.

Henry A. Rowland.

By Cary T. Hutchinson.

GREAT as the services of the late Professor Rowland unquestionably were to pure science, yet I believe it is a moderate statement to say that no man has done more of permanent value for applied electrical science than he. He is unquestionably the father of the magnetic circuit, antedating the Hopkinsons by many years. He is the inventor of the first drum-wound armature, commonly known as the Siemens, antedating Gramme and Siemens by two or three years. He did more to establish the correct value of the ohm than any other man, and was from the first the leader in all efforts looking toward the systematization of electrical units and the determination of correct values. In a closely allied field, his is the accepted value of the mechanical equivalent of heat. These are a few of his notable works.

Professor Rowland's determinations of the ohm, of the conductivity of mercury, and the mechanical equivalent of heat are known to every one, but his position as the father of the magnetic circuit is not so generally known.

In 1873, ten years before the rest of the world had even a conception of anything beyond magnetic "poles," "susceptibility," "volume density," "surface density," "intensity," "moment," "fixed" and "free" magnetism, and the rest of meaningless and brain-wearying jargon of mathematical fluids, he announced in clear and simple terms the law of the magnetic circuit, in the form of

$$Q = M/R,$$

where Q stood for the number of lines of force, M the ampere-turns, and R the magnetic resistance, which he correctly defined as depending on the length, cross-section and permeability. The whole law was clearly stated, experimental data on rings were given, and results were plotted in terms of our modern co-ordinates $\mathfrak{B}$ and $\mathfrak{H}$. At the time he thought little of this, supposing everybody knew it, although it was contained in a paper thrice rejected by the *American Journal of Science,* only to be warmly received and praised by Maxwell.

Ten years later, in 1884, no other person having even advanced to his point in the interval, he applied this law specifically to the magnetic circuit of a dynamo in the exact form in which it is now used. His equation was of the form

$$\phi = NC \Big/ \left[\frac{L}{S\mu} + \frac{L}{A + p}\right]$$

where ϕ indicated the number of lines of force, NC the ampere-turns, $L/S\mu$ the magnetic resistance of the iron parts and $l/(A+p)$, the magnetic resistance of the air parts, p being a quantity added to A, the area of cross-section, to take account of leakage. It is needless to say that he analyzed each term correctly and pointed out that the parts depending on μ could be best found from permeability curves of the iron. In a word, he stated completely the present theory of the magnetic circuit as applied to dynamos, commonly attributed to the Hopkinsons, who worked it out in greater detail two years later. This, too, was to him a matter of no especial moment, and he has never made any especial claims in the matter.

His was the first direct-current drum armature ever built, antedating the Gramme and Siemens some two years. This machine, still in existence, was designed and built in 1868-9. It was a self-exciting machine, with a solid, stationary armature core, about which the armature coils revolved. He used this construction to avoid foucault and hysteresis losses, as he carefully explained. Nor was this invention pushed; in fact, he gave it no thought.

Another valuable service that Professor Rowland rendered to the electrical engineering profession was the stand he took in the matter of his professional fee with the Niagara Company. He was retained to make a comprehensive report on this project, at a time when little or nothing was known of electrical transmission of energy. After spending some eight months on the work, he asked for a fee, very moderate, when viewed in the light of his great ability; in fact, at the time I advised him to make his fee twice as great. He received from the company a check for one-third of the amount, with the statement of their distinguished counsel that he considered this sufficient and would pay no more. This insult hurt Professor Rowland greatly. He was tenacious of his personal dignity, and resented this contemptuous treatment by a man whose own fees were many times as great for work requiring a grade of intelligence commonplace compared to his own. So he brought suit for the fee and won his case.

This case illustrated several salient traits in his character. As all his friends know, he was a man of perfect simplicity and absolute truth. His mind was as devoid of guile as an infant's, and this frequently led him to make statements that to a stranger seemed egotistical, while in reality they were merely the truth as he saw it, and no less the truth in that they concerned himself. When the present Ambassador to England asked him some question regarding his membership in scientific societies, he named a half hundred or so, and among them that of foreign fellowship in the Royal Society of Great Britain. Asked to explain the difference between his status and that of an English engineer concerned in the case, he said that the Englishman was one of some thousands, many of them very ordinary people, and he one of three in America. Again, asked to name the half dozen greatest living scientists, he mentioned Helmholtz, Kelvin, Rayleigh (I think), and himself. On further questioning, he declared that there were no others in that rank! This was not what the suave counsel had expected, and he dropped the matter, with a laugh decidedly against him. This was not egotism or vanity. He was under oath and he told the truth as he knew it. Moreover, it was and is the truth, as others know it.

To exhibit the difference between the value of his recommendations and those of the English engineer referred to, he prepared a large chart with parallel columns showing his recommendations, the Englishman's, and the plan adopted. There were some 12 counts, on 10 of which he and the Englishman disagreed, and two where they agreed. On every count where they disagreed, Rowland was adopted, and where they had agreed a still different plan was followed.

Professor Rowland was not a routine teacher. His peculiarities of temperament prohibited the painstaking patience necessary for this. His lectures were a series of fertile suggestions. If a man chose to work them up he could get an insight into the workings of a master mind, but he must work. He was intolerant of stupidity. No merely worthy, hardworking student, without brains, had a chance with him. A student to be tolerated must have a quick comprehension.

He was fond of society, and he loved fox hunting and sailing. He presented a rather amusing figure on horseback. His seat was not graceful, but was good, and he was frequently in at the death. His glasses, lightly poised on his nose, were held by a silk cord around his neck, and frequently came off when riding in the woods. He used to say that every tree in the country was decorated with his eyeglasses.

Professor Rowland is conceded to have been by far the ablest photographer in this country. His was work requiring the finest scientific knowledge, and he had lenses specially made to accord with his ideas. The results were the admiration and despair of all who saw them. Some of his photographs of cloud and water effects are marvelous in the definition of all parts.

He was a lover of the best chamber music—Beethoven, Bach, Chopin, and although a cultured man, he cared little or nothing for literature. Scientific books were his chief reading.

I was associated with Professor Rowland in much of the important work in his laboratory from 1886 to 1889. The late Gilbert Wilkes and I were the only ones ever allowed to conduct experimental work in that sanctum sanctorum—the constant temperature vault where the grating machine is. There were two rooms, the second not in use. We were making a determination of the conductivity of mercury and constant temperature was essential, and after much thought he permitted the work to be done in this second room, on condition that I should go down and come up only once a day. The determination was satisfactory, but all gratings ruled during that period were worthless. Our presence in an adjoining room with door closed disturbed the temperature so much that a good grating was impossible.

The newspapers have recently said that the art of ruling gratings is lost, and that Professor Rowland's secret died with him and with Schneider, his mechanic for many years. This, of course, is incorrect, and would be so even if no gratings were made elsewhere. The machine is there. A little education will readily develop another Schneider, and gratings will be as good as before.

As a presiding officer at scientific meetings he was not an unqualified success. His mind was too quick for the verbose utterances and tedious reasoning of the usual extemporaneous speaker, whom he would cut short, without ceremony, stating in a few words the idea of the speaker, and then frequently telling him he was entirely wrong.

His faith in his own work was profound. When he had demonstrated to his satisfaction that a thing was so, only the most positive disproof was of avail. He was not a respecter of traditional ideas, and mere authority carried no weight with him. His confidence in his own work was shown many times during the tedious and delicate work that I did under his direction on the magnetic effect of a moving static charge. He had made the great discovery of this fact in Berlin in 1876, but was unable then to make a quantitative determination whether the amount corresponded to theory. This task was delegated to me; it required from September to March to eliminate all the sources of error in the apparatus, and many times during these months I announced positively to him that no such effect existed; yet he did not for an instant doubt his own observations, made with cruder apparatus 10 years before. In the end he was proved right, not only in the existence of the effect, but in its amount. I see that recently some doubt has been thrown on this work by German and French experimenters, but nothing can shake the confidence acquired from him in the conviction that he is right and all the rest wrong. His experimental methods were wonderfully ingenious. He was great as a physicist, a mathematician and a mechanic. Armed at all points, he was seldom at fault. In him the world has lost a great scientist, probably the greatest this country has yet produced.

Cameras at the Pan-American.

Under certain restrictions photographs may be taken at the Exposition. The regulations restricting the use of cameras on the grounds of the Pan-American Exposition, under the concession granted to C. D. Arnold, provide that no cameras exceeding 4 by 5 inches shall be allowed within the gates. Stereoscopic cameras and tripods will not be admitted under any circumstances. The fee for the admission of cameras 4 by 5 inches or under will be 50 cents for a day, or $1.50 for a week.

Murray Page Printing Telegraph.

It will be remembered that at the meeting of the American Institute of Electrical Engineers on Jan. 25, 1900, Mr. William B. Van Size, described the theory and principle of a page printing telegraph system invented by Mr. Donald Murray, an Australian journalist. During the past week the editors of ELECTRICAL WORLD AND ENGINEER were permitted to witness a practical test of the system in the Postal Telegraph Company's building. The system is very ingenious, and is developed to a high degree of perfection. What it accomplishes may be stated briefly as follows: The messages are first transcribed on a typewriter, which perforates a tape; the tape is then passed through a transmitter similar in design to the Wheatstone transmitter, and the messages are thus transmitted to the receiving station, where they are received in the form of a perforated tape. This is then passed into a typewriter, the keys of which are controlled by the perforations in the tape, and by operating the typewriter mechanically the messages are transcribed on the usual message blanks in Roman characters.

The telegraphic alphabet employed by Mr. Murray is of a special character, and is about 40 per cent shorter than the Morse alphabet. The keyboard perforator has for each character a separate movable lever, each character occupies an unvarying linear space on the tape, and consists of five perforated and unperforated divisions of such space. The difference in the number and succession of these sub-divisions or perforations determines the characters. There are no spaces between successive letters or characters. Either makes and breaks, or reversals can be used in transmitting. It is to this fundamental fact—all letters of the same length—that the success of the system is due. Each letter occupies half an inch on the transmitting tape, and a similar length on the receiving tape. This gives a comparatively simple perforator operated by an ordinary typewriter keyboard, and there is no necessity for employing a complicated differential paper feed mechanism to provide for letters of varying length. In connection with the ordinary typewriter keyboard there is a group of 10 punches, one punching magnet, and one spacing magnet, controlling a motor-driven escapement.

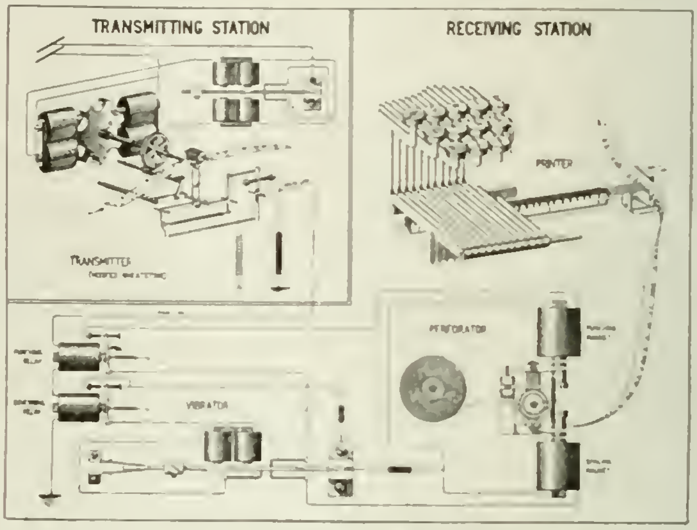

FIG. 1.—DIAGRAM OF CONNECTIONS.

At the receiving station there is an electro-magnetic perforating device which accurately reproduces the transmitting tape by producing corresponding perforations and spaces. This received perforated tape passes from the receiving perforator into the typewriter operating device. This typewriter operating device consists of five longitudinally reciprocating bars or "combs," presenting five pointed terminals to a perforated plate or die. The perforated tape passes between the surface of the perforated plate and the pointed terminals of the bars. The pointed terminals of these bars register respectively with the five holes in the die. The tape is moved along between the die and the pointed ends of the bars step by step, the length of a letter or character at each step, say, one-half inch. When perforations in the tape coincide with the pointed ends of the bars and corresponding perforations in the plate and die, and the plate is moved toward the pointed ends of the bars, the bars are or may be separated into two groups; one group is moved longitudinally, corresponding with the unperforated sub-divisions of the tape, the other group project through the perforations in the tape and in the die, and are unmoved. Lying over the five bars or "combs" at right angles thereto are a series of thin metal strips. Each strip is mechanically connected with its individual key lever on the typewriter. The upper surface of the five bars first described is notched arbitrarily. These notches are caused to be aligned below any one of the strips under the control of the perforated tape and die; when any one of the strips drops into a groove a motor-driven cam engages it and produces a movement of the typewriter lever. The movement of the die and paper tape and of the typewriter key-lever is produced by motor-driven cams. It is evident that this mechanism will operate not only a typewriter, but any keyboard machine such as a typesetting machine or linotype. The perforated receiving tape is therefore available for setting type automatically.

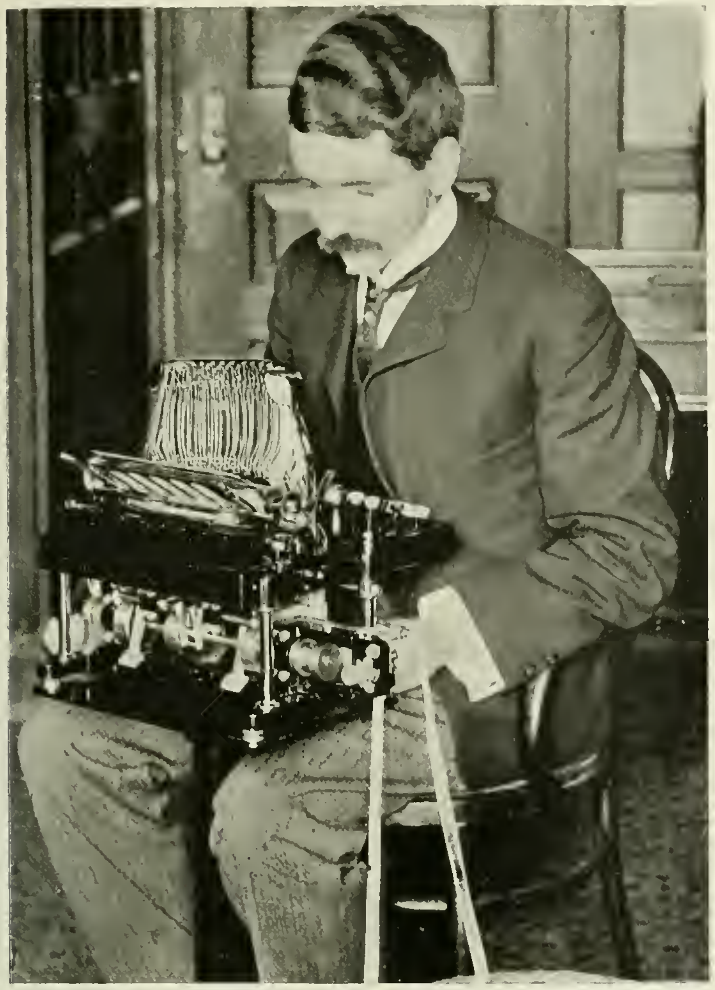

FIG. 2.—RECEIVING TYPEWRITER.

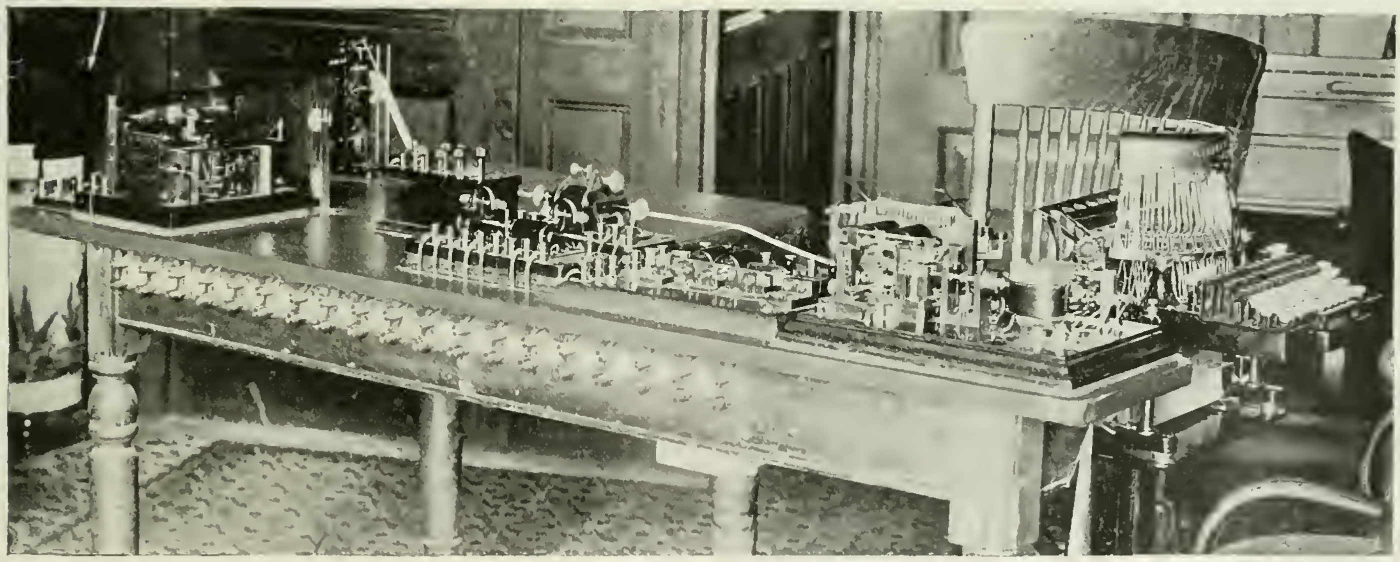

FIG. 3.—GENERAL VIEW OF PAGE PRINTING TELEGRAPH APPARATUS.

The accompanying diagram shows the general circuits and connections at both the transmitting and receiving stations.

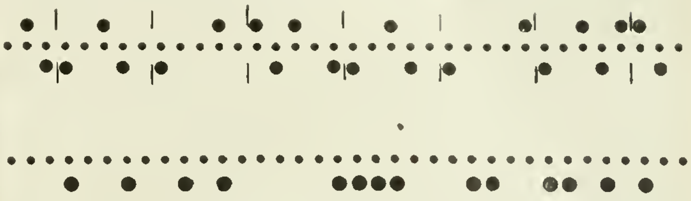

FIG. 4.—SAMPLES OF TRANSMITTING AND RECEIVED TAPE.

Synchronism between the transmitting and receiving instruments is not necessary in this system. It is, however, essential to preserve unison between the arriving impulses in the main line and the local punching and spacing impulses at the receiving station. This is accomplished in the following manner:

The governing relay operates a circuit breaker, moving between two fixed contacts, and electrically connected to the same circuit terminal, so that the moving contact in going from one to the other operates to open the circuit during its time of transit only. This break in the local vibrator circuit takes place at the beginning and end of each main line signal, and as the main line signals arrive at a uniform rate and are of unit or multiple unit duration, the governing relay operates its break-point at uniform unit intervals or multiples of these intervals. In the same circuit in which this break-point operates, there is also the break-point of the motor magnet, which works on the buzzer principle. There are thus two break-points in the same circuit. If they open and close together, then full vibratory impulses flow through the motor magnet. If, on the other hand, the rate of vibration of the reed tends to accelerate, or the rate of the arriving current signals tends to lag, then the two breaks occur more or less alternately and consequently less current gets through—the impulses are clipped—and the rate of vibration of the reed is reduced. In practice, the receiving vibrator is set to go one or two per cent faster than the rate of the arriving signals, and then the governing action of the two interfering break-points in the same circuit results in the establishment of a steady dynamic balance between the accelerating tendency of the reed and the retarding tendency of the arriving main line signals. By this arrangement the necessity for sending correcting impulses over the main line to secure synchronism is avoided, the correcting impulses being obtained locally with the co-operation of the main line signals themselves.

By varying the position of the movable weights upon the reeds at the transmitting and receiving stations the rate of vibration and the rate of transmission may be changed. To maintain unison it is necessary to have a considerable range of variation in the speed of this reed, such variation in speed to be attained in response to variation in the length of current impulses of uniform strength. This is accomplished by the aid of yielding, or spring, stops placed at each side of the reed.

By using multiple units of current and space in the formation of his alphabet, Mr. Murray has found it unnecessary to use reversals, five different time intervals combined with makes and breaks giving all the combinations required. The uniform time for each letter is divided into five equal units or sub-divisions, one or more of these five sub-divisions being a current impulse, so that current impulses or spaces of one, two, three, four or five units duration are obtained. Thirty-two possible combinations are obtained in this manner, and by using two of these letter signals as prefixes to the others, capitals, figures and lower case letters, about 87 characters in all, may be transmitted. Makes and breaks or reversals may be used, therefore, adopting the system for use in quadruplex transmission. The alphabet, however, is only available for machine telegraphy, as it is practically impossible to observe five different time intervals with sufficient accuracy in manual transmission.

The system has been practically tested at different times on loops of varying lengths and on circuits between cities. One of the most recent tests was on April 19, on a circuit from New York to Albany and back, a total length of 384 miles. This circuit was composed of copper and iron wire, 13 miles of the circuit being underground, and 19⅝ miles in aerial cable. On this occasion, 125 words per minute were transmitted and received on the typewriter. Since that time Mr. Murray informs us that he has attained a speed of slightly over 130 words per minute in one direction. On a duplex, this means practically 260 words per minute. A copy of the message, which was transcribed on the receiving typewriter at the rate of 80 words per minute, shows very satisfactory results.

In this connection it should be mentioned that any number of typewriting perforators may be operated independently to supply transmitting tape, as one typewriter is limited in its capacity to the ability of the individual operator to manipulate the keyboard. The same applies to the translating system at the receiving station, where the tape can be cut off at convenient lengths as it is received and distributed among two or more typewriters for rapid transcription.

Modern Telephone Engineering—I.*

By Kempster B. Miller.

During the past five years a complete revolution has been worked in the circuits and apparatus of telephone exchanges, due to the introduction of the systems known under such names as "common battery," "central battery" and "central energy." These systems, when properly equipped, have proven vastly superior from both an economic and operating standpoint to the old magneto systems, wherein local batteries were used for talking and magneto generators for making the calls. The local primary battery at the subscribers' station has been superseded by a large storage battery at the central office, which also takes the place of the old magneto generator. The mechanical signal or drop has given place to the lamp signal. By these innovations the apparatus at the subscribers' station has been rendered simpler and more compact, that at the central office more reliable, and the operation of the entire system has been rendered automatic as far as the subscriber is concerned, and as much so as desirable as far as the operator is concerned. Such a system employs batteries at the central office for furnishing all current, for signaling by the subscriber and for the operation of the talking apparatus. These batteries are invariably secondary, rather than primary, for large exchanges, and operate almost universally at the voltage given by 10 cells in series, i. e., 20 to 24 volts, according to state of charge.

For charging these batteries and for furnishing current for ringing the subscribers' bells complete power plants are required, these consisting of suitable generating units, driven either electrically or mechanically, together with suitable controlling apparatus. Most companies depend upon electrical power, the charging and ringing machines being motor generators running directly from city mains.

In the modern common battery exchange the operation is such that when a subscriber removes his receiver from the hook, a lamp will be automatically lighted in front of the operator at the central office, who handles the calls of the group of subscribers to which this particular subscriber belongs. The operator in response to this signal makes connection with the subscriber's line by inserting a plug into the spring jack of that line, and after having ascertained his wants, completes the connection with the subscriber called for by means of a second plug attached to the first. As soon as a connection is thus made with a subscriber's line, the line lamp normally in control of the subscriber is disassociated from the line, but another lamp associated with the plug is placed under the control of the subscriber, this lamp being known as a supervisory lamp.

In Fig. 1 is shown a complete line circuit in diagram, including the apparatus at the subscriber's station, which is shown at the left, and the apparatus at the central office, which is shown at the right. The apparatus at the subscriber's station consists of an induction coil, a receiver, a granular carbon transmitter, a two micro-farad condenser, a 1000-ohm bell and an automatic hook-switch mounted in a suitable manner. It will be noticed from the diagram that the circuit between the two sides of the line is held open to direct currents by the condenser, and to all currents by the hook-switch contact, while the receiver is on the hook. This leaves the bell in operative relation to the line, for the purpose of receiving calls; the path of the ringing current, which current is, of course, alternating, being through one side of the line, through the bell and condenser to the other side of the line. When the receiver is removed from its hook, the circuit between the two sides of the line is closed, allowing the passage of direct current through the secondary of the induction coil and the transmitter in series. At the same time another circuit containing the transmitter, the receiver, the primary of the induction coil and the condenser is closed. The object of this latter circuit which is local to the subscriber's station, will be pointed out later.

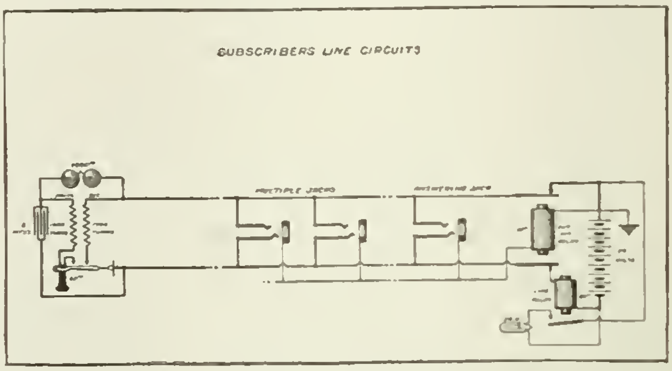

FIG. 1.—DIAGRAM OF COMPLETE LINE CIRCUIT.

At the central office, in addition to the answering jack and the multiple jacks, there are two relays, one termed the line relay, which is normally in circuit across the line in series with the 24-volt storage battery common to all lines, and the other termed the cut-off relay, which is in an auxiliary circuit, and is adapted to open the circuit through the line relay and the battery as soon as a plug is inserted into any jack belonging to its line. Under normal conditions, both relays remain unoperated and the conditions are as shown. As soon, however, as the subscriber removes his receiver from its hook, the circuit between the two sides of the line is made complete at the subscriber's station, and the current at the central office energizes the relay and closes the circuit containing the line lamp and the battery. This lamp is located in immediate proximity to the answering jack, and the operator, seeing it illuminated, inserts a plug into the answering jack in response to the call. This plug is one of many pairs within the reach of the operator and has three contacts, two of which, the tip and sleeve, are adapted to engage the two springs of the answering jack, and thus complete the talking circuit. The

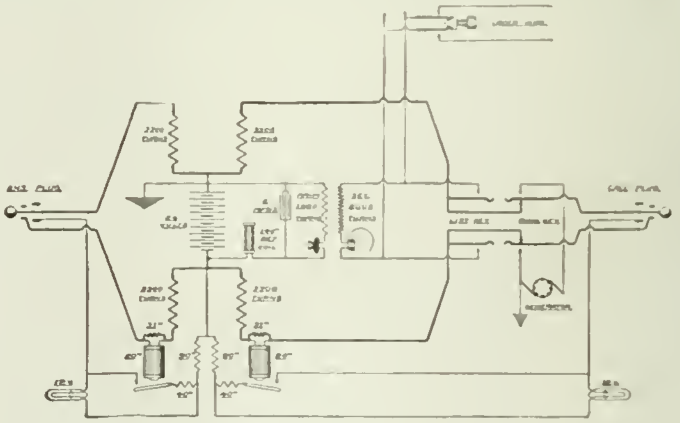

FIG. 2.—DIAGRAM OF CORD CIRCUIT.

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*Abstract of a paper read at the February meeting of the New York Electrical Society.

third is adapted to engage the ring contact of the jack, and being in connection with the live side of the battery, causes a current to pass from this side of the battery through the ring contact of the jack and the coil of the cut-off relay back to the other side of the battery. The energization of the cut-off relay serves to open the circuit of the line relay, as already described, and this, when operated, extinguishes the lamp.

One of the cord circuits is now shown in Fig. 2. In this the answering and calling plugs are shown at the extreme left and right-hand portions, respectively, each having, as before said, three contacts, two of which, the tip and sleeve, are connected by wires shown in heavy lines, which form part of the talking circuit, and the third of which is connected through the supervisory signaling apparatus to the live side of the battery, as shown. The tip and sleeve sides of the answering plug are connected together through the two halves of one side of a repeating coil, between which is connected the common battery. In the same manner the tip and sleeve strands of the calling plug are connected by the two halves of the other winding of the repeating coil between which is connected to the same battery.

This repeating coil, and there is one of them for each pair of cords and plugs, has four windings, each having approximately 3330 turns, all of these windings being on the same magnetic core. It is evident that these connections allow direct current from the storage battery to pass out over the metallic circuits of the two connected lines to energize the transmitters. A fluctuation in the current flowing in either line will, however, by induction between the windings of the repeating coil, cause a corresponding fluctuation in the current of the other line. In this way conversation between two connected lines is made possible, it being by induction rather than conduction.

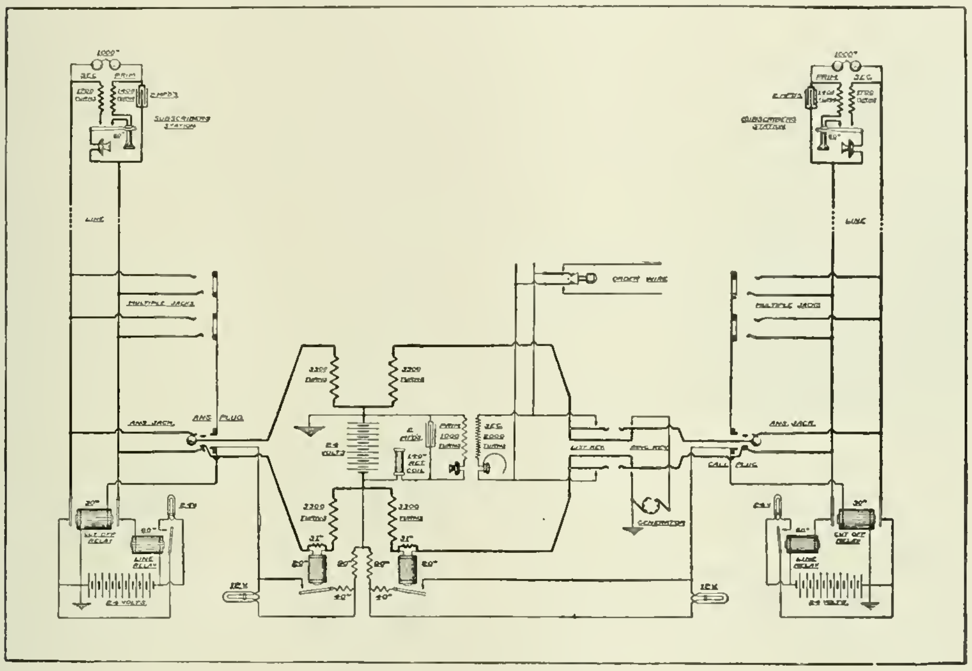


FIG. 3.—DIAGRAM OF CIRCUITS.

In the sleeve strand of the cord of each plug is connected a supervisory relay, which is energized, as is readily seen, only while current is flowing over the line to which the corresponding plug is connected, i. e., while the receiver of that line is off its hook. These relays control the circuit of supervisory lamps by the illumination of darkness of which the operator is enabled to ascertain the condition of the connected lines. On the right of this figure are shown the ringing and listening keys. The former is a device for switching the alternating current generator into the circuit of the calling plug and its connected line; the latter connects the operator's head telephone, which is shown in the center of the diagram, across the two sides of the cord, in order to enable the operator to communicate with either subscriber.

The operation of this circuit and apparatus can best be understood by referring to Fig. 3, which shows two subscribers' lines equipped as already described, connected by a cord circuit at the central office. Consider the line at the left to be that of the calling subscriber and that at the right the called. In the first place, the removing of the calling subscriber's receiver from its hook illuminates the line lamp, which remains lighted until the operator answers by the insertion of the answering plug into the answering jack. The operator, before inserting the calling plug into the jack of the called subscriber, must ascertain whether or not the line of that subscriber is already busy. This is automatically accomplished, for upon the touching of the tip of the calling plug to the ring contact of the multiple jack, she will get a click in her head telephone if the line is busy, and silence if it is free. If the line is free, she inserts the plug to its full extent, and presses her ringing key, which rings the subscriber's bell. As soon as the calling plug is inserted the supervisory lamp, shown at the right-hand lower portion of the figure, will be illuminated, because its circuit will be completed from ground through the battery, through the 90-ohm resistance coil and the lamp; thence through the third strand of the cord, the test ring contact of the jack, and to ground through the cut-off relay. This current will not only illuminate the lamp, but will operate the cut-off relay of the line called for as well. As soon as the subscriber of this line responds, he will close the circuit between the two sides of his line and thus allow current to pass over the line to operate the transmitter. This current will pass through the supervisory relay, which will then be operated to close the low-resistance shunt about the lamp and thus extinguish it. Both lamps are now out, and the operator pays no further attention to the connection until she sees one or both of the supervisory lamps again lighted. The corresponding lamp will be lighted when one or both of the subscribers hang up their receivers, which act will, by opening the circuit of the line, cause the corresponding supervisory relay to let go of its armature and thus remove the shunt about its lamp. When both lamps are thus lighted, the operator knows that the connection is no longer desired, and without further inquiry pulls down the plugs.

It is evident that any fluctuation in the resistance of the current of a transmitter at one subscriber's station will cause a corresponding fluctuation of the current flowing in the line, and this fluctuation will pass through the two windings forming one side of the repeating coil, which will act inductively on the two windings forming the other side of the repeating coil and produce a corresponding fluctuation in the other line. This latter fluctuation will pass through the secondary winding of the induction coil and the transmitter at the subscriber's station, and induce a corresponding fluctuation in the local circuit containing the receiver and the condenser.

One of the functions of this local circuit, which has already been referred to, is that of putting the receiver in inductive relation to the line without subjecting it to the passage of direct current through it, which circumstance might tend, if the receiver were connected up the wrong way, to demagnetize its magnets. This local circuit is, however, designed to accomplish still another result, this being the formation of a comparatively short path, through which the fluctuations set up by the transmitter may more readily pass; in other words, it is supposed to act as the local circuit of a sort of a booster to the outgoing telephone currents. The fluctuation in current caused by the transmitter pass through the condenser and primary winding of the induction coil, and thus induce on the secondary, which is in the line, fluctuations which tend to increase the fluctuations directly produced in the line by the transmitter.

So far, only such means have been described as would admit of the connecting of two subscribers whose lines terminate in the same exchange. Where several offices are used in the same system, the connections between subscribers in different offices are, as has already been pointed out, made by trunk lines extending between the offices. These trunk lines are spoken of as outgoing or incoming, according to which end of them is referred to. Thus an outgoing trunk line at one office would be an incoming trunk line at another. The distinction is obvious. The outgoing trunk lines usually terminate in jacks, in the regular sections of the multiple switchboard, while the incoming trunk lines usually terminate in plugs and cords and special apparatus, arranged at special incoming trunk sections.

which sections are provided with multiple jacks in the same manner as the regular sections.

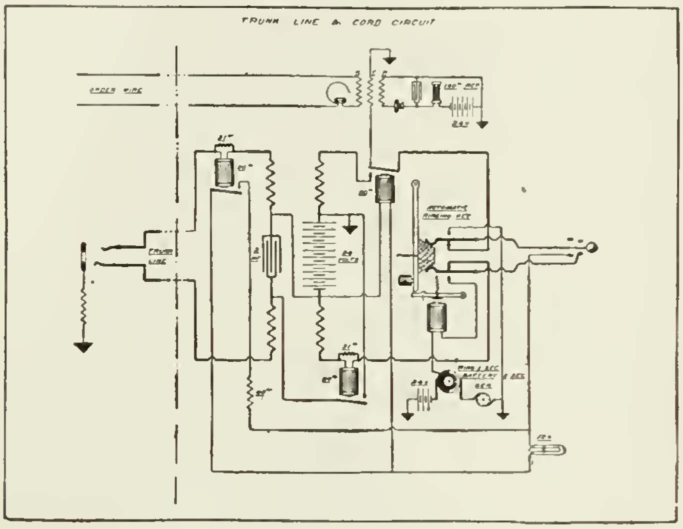
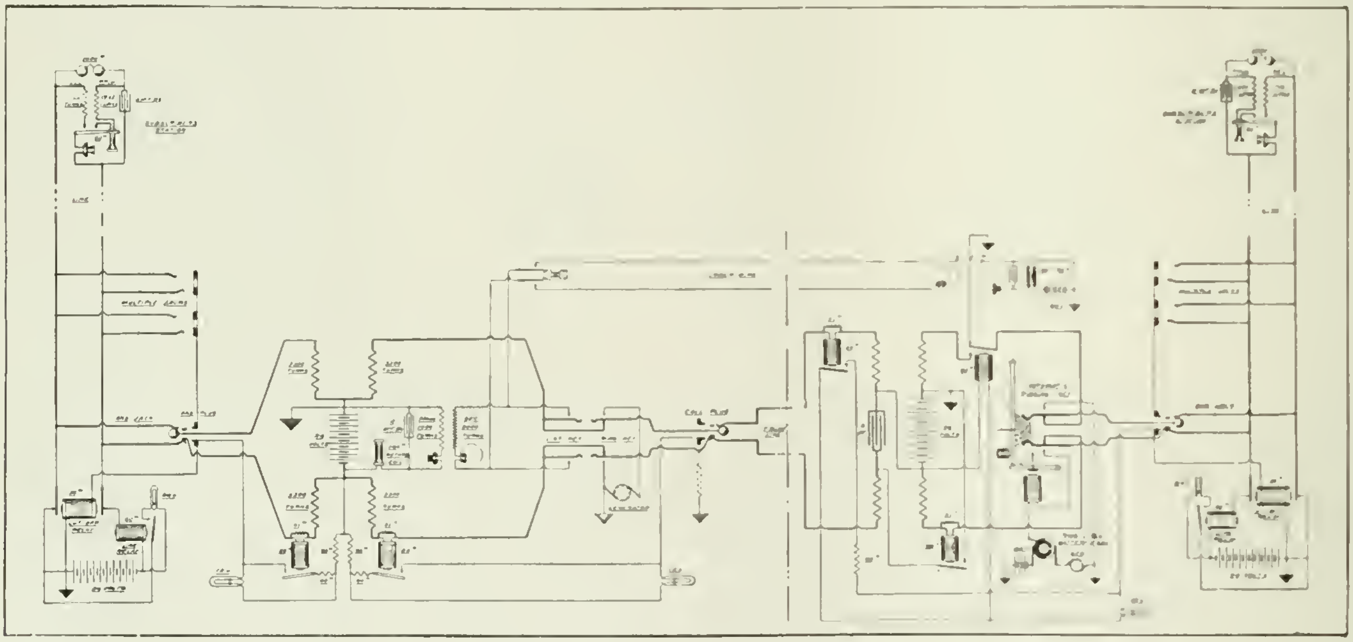


FIG. 4.—DIAGRAM OF TRUNK LINE AND CORD CIRCUIT.

In Fig. 4 I have shown the circuits of a trunk line. The outgoing end of it at one office being shown at the left of the dotted line, while the incoming end, with its accompanying apparatus, is shown at the right. This circuit is somewhat complicated and will be better understood in connection with Figs. 5 and 6, which show a subscriber in one exchange connected through the local cord circuit at that exchange, and a trunk line with a subscriber at another exchange. Assuming that the subscriber at the left has sent in a call, the operator at one of the regular sections of the switchboard will answer it in the ordinary way by inserting a plug into the answering jack, and having learned that the connection desired is for a subscriber in another exchange, she presses her order wire key and communicates over the order wire with the incoming trunk operator at one of the incoming trunk sections of the branch exchange. The incoming trunk operator repeats the order and gives the number of an unused trunk line to the operator at the first exchange. The incoming trunk operator at the second exchange then tests the line in the ordinary way with the trunk line plug, and if it is found free, she completes the connection by inserting the plug in the multiple jack of that line. As soon as this operator completes the connection, she sets the automatic ringing key, shown just to the left of her plug, which locks in the ringing position, because its controlling relay is not operated. The ringing generator is provided with an interrupter, each revolution of which switches the ringing current on to the line for one second and the 24-volt battery on to the line for five seconds. Thus the subscriber's bell rings for one second of every six until he removes his receiver from its hook. When he does this, the current from the 24-volt battery or from the ringing generator, whichever happens to be in circuit, passes through the primary magnet of the ringing key, and trips the latter into its normal position. By this means the bell of the subscriber is rung at intervals until he responds without any further attention on the part of the operator.



Figs. 5 and 6.—Diagram of Trunk Line Circuits.

The insertion of the trunk plug into the jack of the called subscriber's line allows current to flow from the battery through the test relay and disconnect lamp, shown at the extreme lower right-hand portion of the figure, and thence through the cut-off relay to ground. This does not light the disconnect lamp, because that lamp is already shunted by the armature of another relay contained directly in the trunk line circuit, this latter relay having been operated by the insertion of the plug into the trunk line jack at the other exchange. As soon as the ringing key is tripped, the current from the battery at the incoming end of the trunk line flows through the metallic circuit of the subscribers' line to furnish current for talking. This operates the supervisory relay in the incoming cord circuit, and puts a ground on the sleeve side of the cord circuit at the first office, thereby operating the calling supervisory relay at that office, and this shunts the corresponding supervisory lamp and extinguishes it, thus showing to the regular operator at the first office that the subscriber has responded. As soon as the subscriber called for hangs up his receiver, the supervisory relay at the incoming trunk section lets go of its armature and removes the ground from the sleeve side of the trunk line. This causes the calling supervisory relay at the first office to let go of its armature and remove the shunt from around the corresponding lamp. When both lamps of the regular pair of cords at the first office are lighted, the operator at that office pulls down the connection. By thus removing the calling plug from the trunk jack, current ceases to flow in the trunk line relay at the second office, which removes the shunt from the disconnect lamp at that office and allows it to be lighted for the first time. This is a signal for the incoming trunk operator to disconnect.

It will be seen from the above circuits that when two subscribers are connected over a trunk line, they are under the control of the originating operator. The disconnect signals from both subscribers go direct to this operator, and it is not until she has pulled down this connection that the disconnect signal is given to the operator at the other exchange. The later operator has no means of listening in on the circuit.

The Society for the Promotion of Engineering Education.

This society will hold its ninth annual meeting at Buffalo, N. Y., on June 29, July 1 and 2. These dates immediately follow those of the convention of the American Society of Civil Engineers at Niagara Falls. Mr. Henry S. Jacoby, of Cornell University, is secretary of the society.

Electricity in the Sandwich Islands.

By F. E. Grain.

I FIRST visited the Sandwich Islands in 1899, at a time when the city of Honolulu was filled with troops enroute to the Philippines. I carefully investigated electrical affairs and found that the progress made was not very marked, although electric lights and power plants had been installed. The city was liberally lighted with electricity and promoters were then introducing plans for the development of the electrical business by establishing electrical street car lines, putting bells into homes, adopting electrical fans, heating devices and the like. This advancement has been steadily in progress, until to-day, when the islands were visited again by your correspondent, it was discovered that not only electric lights were in service to a larger extent than ever before, but electrically driven vehicles were in use, devices for heating by electricity could be found, while electric bells, the telephone and the telegraph had made exceedingly good headway.

I interviewed some of the leading officials of the city of Honolulu, and also spoke with mine owners and proprietors of manufacturing properties in the interior. All of the people of the tropics like the electric light. For many years they have been obliged to use the petroleum oil or candle light, both of which are productive of heat to such an extent that a person cannot very well sit in a room or office in the evening lighted in this manner without suffering from the heat. Along the coast lines of the group which can be reached by wires, and which are subject to shipping, electric lights in signal towers and lighthouses have been liberally provided. I know that in coming into the harbor of Honolulu at night that I saw electrically lighted stations along the coast lines for many miles. When I was here before, only main thoroughfares of Honolulu were lighted by electric lights. Now even the remote streets are thus lighted. Besides this, circuits have been run to the suburbs and to adjoining towns, so that the entire island on which the city is situated is well illuminated at night. The stores of the city have long since put in electric lights. They believe in plenty of light and in advertising with electrical signs. During an evening patrol of the streets on which the leading mercantile houses are located, one will observe very many colored electrical signs of neat design. The mechanical advertising devices are in most instances made here, and I visited one shop in which the workmen were very busy applying mechanisms to advertising signs for the merchants of the city.

I took occasion to visit a number of the machine shops, woodworking establishments, foundries, brick works, cork cutting shops and mills of all sorts, and although in most cases the capacity of the works is small as compared with what we are used to seeing in America, the owners have taken the precaution to put in electric lights. The manufacturers of the country have not had the advantage of good power and transmission facilities and machinery and furnishings of all kinds are short in supply. The result is that the shops and mills are small, lacking in power mechanisms, poorly furnished with modern machinery and fittings, but still fairly well lighted. It looks strange to see great, white lights burning in little one-horse manufacturing apartments in which the machinery is small, often crude and sometimes entirely absent. Electric lights have also been installed quite freely in the houses of the richer classes. I visited some of the houses of the aristocracy and observed the neat arrangements of lights. Everybody lives outdoors in these climes, and the lights in some cases were arranged for both the interior of rooms and the exterior, so as to throw light on porches, grounds and perhaps street fronts. This is arranged by cutting through the walls of the building and inserting glass globes in the masonry or woodwork. The globe fills the space, and when the light is furnished for it and lighted the reflection is, of course, cast both ways.

I found that considerable demand prevailed throughout the tropics, and especially in Honolulu, for electrical heating and cooking devices. It may seem strange that heating apparatus is needed in the tropics, but there are times when storms occur and when for special reasons heating devices are needed, that some sort of a stove is convenient. Several dealers in electrical supplies informed me that they had had calls for electrical cooking apparatus. The application of the electric stove to the sub-tropics is, of course, feasible, for it is in hot climates that such a stove can be used to the best advantage. The present custom of cooking involves the use of stoves, furnaces and devices constructed by hand from stones or clay. The higher classes use imported stoves or oil burners, while at the houses of the middle and lower classes the writer saw some very curious cooking apparatus. Some of it is nothing more than several flat stones arranged in such way that a fire can be made between them and the portions to be cooked are placed above. These stones get heated and retain the heat for a long time, producing discomfort in the houses. If electrical heating and cooking devices were sent to the agents in Honolulu, it would be found that a good demand would prevail very promptly. There are no such stoves in the stores now, but I was told that some would be secured and advertising literature distributed concerning the same upon arrival.

The Hawaiians seemed to me to be especially interested in new inventions and improvements in electrical lines. I know that in cases where electrical bells have been put in, the members of the household are extremely proud of the same. I had occasion to call upon a family, and as I approached the house I observed that the enitre family which was seated on the porch entered the house when they saw me approaching. I wondered at this, until I was told later on that they did this so that their visitor would have to use the new system of electrical bells which had been put in. I am informed that when the bells are first installed, the members of the household amused themselves by ringing the bells continuously for hours at a time. Electricians who put in bells tell me that they can get plenty of orders by canvassing the districts. There is considerable room here for the establishing of electrical supply houses and shops for working in this line.

JAPANESE ELECTRICAL WORKMEN IN HAWAII.

As in most of the tropical cities and towns, the street railway of Honolulu is not yet what it ought to be to keep up with other improvements of the city. I had already found that the street railway of Manila was poorly equipped and totally incapable of accommodating the traffic. An electric line there would be a fortune to its owners, as would a line in Iloilo. At Nagasaki, Japan, and other points in the Far East touched by myself, the need of electric street railways was very evident. In Honolulu, an electric line fitted out the same as our roads in America, would earn rich dividends for the stockholders. At present the cars are old, stuffy and far too small for service. But they could not be any larger and be drawn by the little horses here. The tracks are small and in bad form and would have to be renewed for electrically driven cars. The roads, however, are in fair condition for the operation of an electrical road. One of the principal drawbacks which I found in Nagasaki, Manila and parts of Iloilo was that the streets were too narrow and the roads hardly suitable for electric lines unless considerable work is done. Buildings would have to be torn out in some squares to give room enough to get a car around a corner, so narrow are many of the streets. But in Honolulu there is plenty of space in nearly all of the thoroughfares. The pavement is also in fair order and would not need much repairing or constructing to get into shape for street cars. As to the patronage of a line of this sort in Honolulu, there is no doubting that it would pay well from the start. The traffic of the present road is beyond its capacity and the accommodations are very poor. If such a line were established, freight cars should also be put in, for it is a part of the road's business to carry packages. I know that every time I rode on one of the little bob-tailed cars, the driver had to get down and help some market woman place her load of purchases on a rack arranged in the front of the car. Freight all along the line is picked up. This freightage is charged for and usually at the rate of one passenger. I am of the opinion that there is an abundance of capital in Honolulu with which an electrical road and power station could be put in. The reasons for drawing these conclusions in this city are very similar to those of all other tropical possessions in which I have traveled recently. So many Americans and foreigners of other nations have come into the new possessions of America during the past two or three years, that modern customs and ideas of home are being introduced with rapidity. You would almost suppose some of these possessions in the Pacific to be American cities or towns because of finding so many Americans and Europeans in them, and because of the introduction of American ideas for running hotels, stores, commercial and general industrial industries. There are American hotels, shops, stores and works everywhere, not alone here in the Hawaiian Islands, but in the Philippines and in Japan. Under these conditions it is not strange that there should be a need of electrical lights, roads and vehicles. I concluded that any one wishing to start an electrical street railroad in Honolulu would find it best to import some circular saws, planers, tie making machinery and general woodworking devices for operation by steam or water power, or if the plant is installed, by electrical power. The power station would, of course, have to be equipped with engines, boilers and other machinery by importing the same from America or other countries.

For an electrical street road in Honolulu, water power can be employed, as there are several locations where damming can be done and turbine wheels installed for developing the required power. It is probable, however, that the plant would be operated by steam power, and for this purpose there is an abundance of wood for fuel. Fuel is cheap. Not only can wood be cut and hauled to the fireroom at a cost that would be about one-third the cost in America, but coal has been discovered, and if needed could be hauled to the furnaces. They say that the cost of this coal is ridiculously small for the reason that the natives employed at getting it out work for about 20 cents per day. The coal runs in leads which are broken, but which are taken up again after digging for a short while. The leads are followed in broken columns through the hills, and such coal as is secured is carted to the city of Honolulu. They have also located petroleum oil wells on one of the islands of the group, and I saw some of this oil in use in a furnace where they were running some lumber machinery. The boiler was 200 horse-power. The owners of the plant stated that the cost of generating the steam by this system amounted to about $1.50 per day for the 200 horse-power. Fuel is also plenty in the form of charcoal, for there are a number of charcoal plants in working condition, and the charcoal is brought to the consumers in sacks. I also saw some coke from gas works.

Mention must also be made of the electrical vehicles which have been introduced in Honolulu during the past few years. I did not notice any motor carriages when I was here in 1899, but to-day I can see quite a number of horseless carriages running about the streets, nearly every one of which is of up-to-date pattern. Several of the machines I saw run by electrical power and the owners appear to be getting good results with them. The machines are evidently made for the tropics, for russet colored shades, like umbrellas, are provided. The entire machinery equipment is made with a view of use in the tropics, where, as a rule, the roads are always dusty, and the bearings have to be protected, otherwise the fine dust will get into them and cut them. But in all of the tropical countries which I visited, I noticed little more dust than in America. There is hardly any need for bothering about the dust. In Honolulu I saw much less dust than often seen in the streets of American cities.

What will necessarily interest the owners of electrical light plants, electrical equipping houses, electrical street railway line promoters, and users of electrical vehicles, is the matter of an electrical repair shop.

There are no electrically fitted shops in the islands at present in which a specialty is made of repairing and constructing electrical machinery and devices. Nor is there any suitable electrical furnishing house. There is a great opening here for the establishing of a shop in which electrical devices of all sorts can be built and repaired. There is also a grand chance for some one to open an electrical supply store. At present, if an electrical device of any description is out of order, it is taken to the regular machinists, who may be familiar with ordinary mechanisms, but must experiment with the electrical apparatus before they can get it into running condition; in fact, I know of many instances in which these machinists have put an electrical device completely out of service through poor adjustments and careless handling. Electrical devices, as is known, cannot be trifled with with new hands, yet this is what is being done in the shops of Honolulu, in which the machinists are perfectly competent to repair farming machinery, pumps, waterwheels, sewing machines, printing presses, wagons and the like, but are unfamiliar with electrical motors anl dynamos and their fittings.

Ganz Transformers and Transformer Switches.

As illustrating European methods of transformer construction and regulation, we give below an account of several of the types of transformers made by Ganz & Co., of Budapest, Hungary, and of the automatic transformer switches made by the same firm:

The core of a 300-kw single-phase transformer is shown in Fig. 1. The type illustrated is constructed for a frequency of 25 periods, 5000 volts primary and 430 volts secondary. The core is composed of two circular columns of laminations connected at the top and bottom by horizontal laminations, thus forming a simple magnetic circuit. The base is in two parts, held together by screws, and encloses the lower part of the transformer core. The cast-iron part holding the upper part of the transformer is secured to the base by two forged iron rods. The primary coils are mounted directly on the iron core and are surrounded by the secondary coils, space being left for air circulation. The core is also provided with spaces for air circulation. The secondary coils are made of copper bars of 25 mms area. By arranging the coils in the above manner, the stray field is reduced to a minimum, and the primary coils, being entirely surrounded, are inaccessible to touch. By using artificial ventilation from a 1-hp centrifugal blower, the temperature does not rise more than 25 C. above the surrounding air when the transformer is loaded with 300-kilovolt amperes. The transformer weighs 8800 lbs., and has an efficiency at full load of 98.3 per cent.

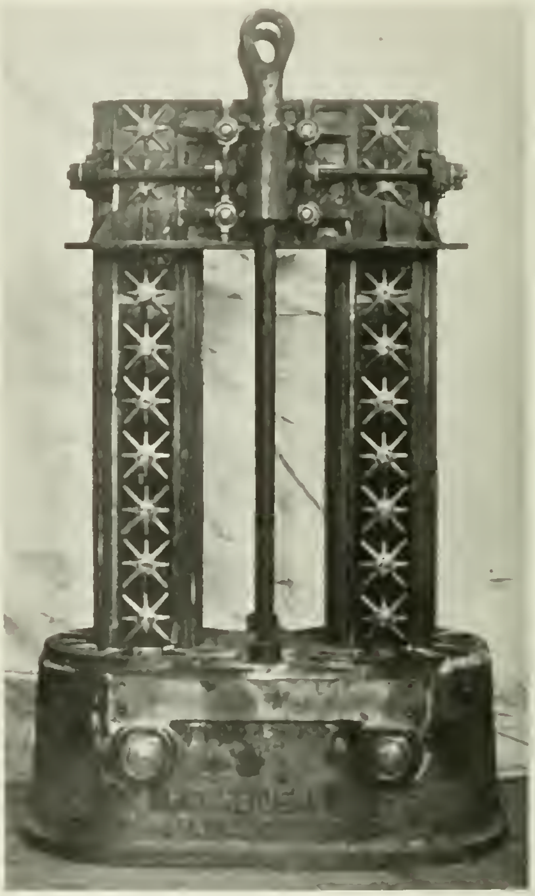


FIG. 1.—IRON CORE 300-KW SINGLE-PHASE TRANSFORMER.

Figs. 2 and 3 show a 15-kw single-phase transformer wound for a primary voltage of 2910, and a secondary voltage of 105. Fig. 3 shows a three-phase, 30-kw transformer for a 220-volt circuit, the secondary giving 200 volts. The primary and secondary windings are placed alternately. The entire weight of this transformer is 1760 lbs.

The Ganz Company makes an "Arc Lamp Divisor," or balance coil, which is in form a monophase transformer, but with a single coil placed on the middle part of the magnetic circuit. The coil is divided into three parts, each with the same number of windings, so that on a 105-volt circuit each part will have a voltage of 35, or sufficient to feed a single arc lamp. By this means three arc lamps may be operated entirely independent of each other and can be switched in or out singly. The main advantage of this apparatus is that it secures the independence of the arc lamps and makes the use of series lamps possible without any appreciable loss of energy, which advantages cannot be secured if connected with 105-volt mains with resistance or a choking coil in circuit. The loss of energy in such a coil amounts only to 20 watts, being that required for magnetizing the iron core. Even in the most unfavorable case of one arc lamp of 12 amperes burning, the consumption of energy is only 4.8 per cent larger than what it would be if the lamp were fed direct with 35 volts.

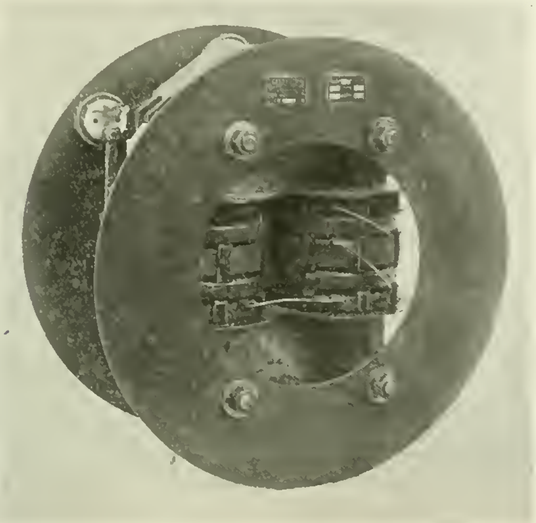


FIG. 2.—15-KW SINGLE-PHASE TRANSFORMER.

The Ganz Company manufacture two automatic transformer switches, one for use with a single transformer and another for use with a group of transformers. The first mentioned switch, shown in Figs. 5 and 6, serves the purpose of reducing to a minimum automatically the magnetizing current in a single-phase transformer during the period of no-load.

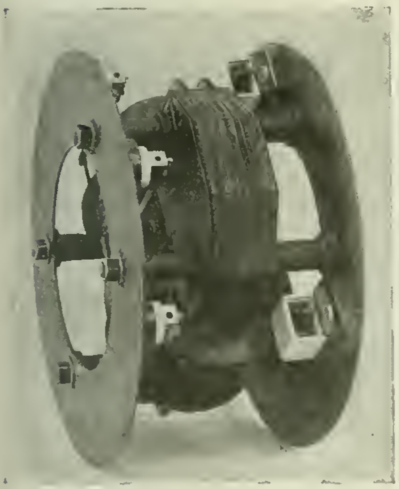


FIG. 3.—18-KW SINGLE-PHASE TRANSF.

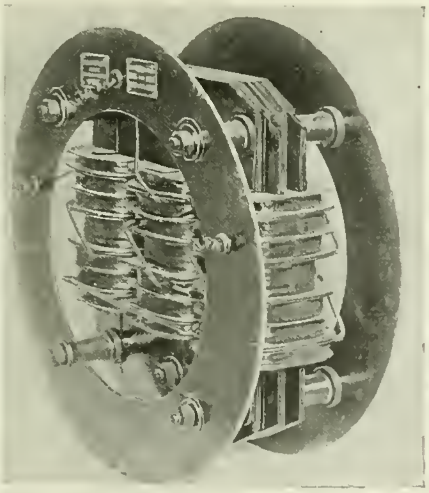


FIG. 4.—30-KW THREE-PHASE TRANSF.

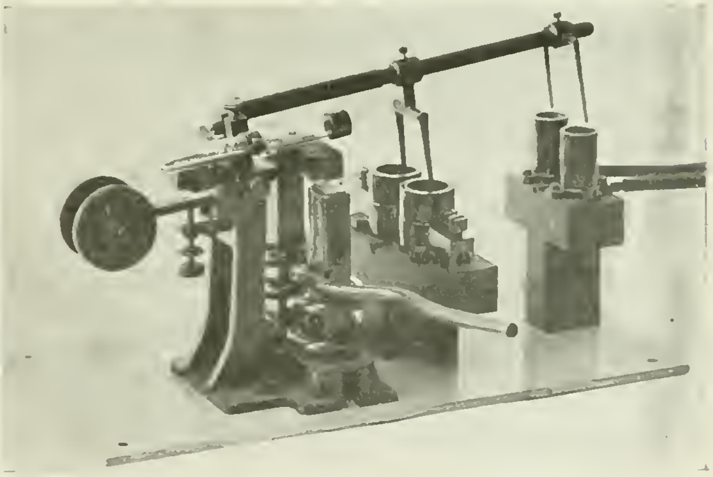


FIG. 7.—SCHLATTER SWITCH SYSTEM FOR TRANSFORMER GROUPS.

As is well known, though the magnetizing energy of a transformer is relatively small in amount, it is, nevertheless, a considerable item in the aggregate on a 24-hour circuit. The principle upon which this latter apparatus rests is that upon the breaking of the secondary circuit of a transformer, the primary coil of a small auxiliary transformer is automatically switched in series with the primary of the transformer by the action of a balance weight. The core of the auxiliary transformer is of such dimensions that it requires very little magnetizing energy.

The secondary coil of the auxiliary transformer is switched in series with the working secondary circuit, and also with four electromagnets of different numbers of turns, as shown in Fig. 5. If a receptive device is cut into the working circuit taking a small current, then the electromagnet having the greatest number of windings, M_1, overcomes the action of the balance weight, thereby short-circuiting the primary as well as the secondary coil of the auxiliary transformer—the working transformer, consequently, receiving the full working voltage. If the secondary current reaches .25 ampere, then the electromagnet M_2 having a less number of windings will operate and short-circuit the magnet M_1; and finally, at 15 amperes the electromagnet M_3 having the least number of windings, comes into operation and short-circuits M_2. In addition to the above electromagnets there is a fourth one, M_4, having a great number of windings, which is in series with a 100-volt, 50-cp incandescent lamp and connected with the 50-volt terminals of the working transformer. This magnet follows M_1 in operation and serves to prevent the current impulses, which otherwise would occur in the secondary circuit.

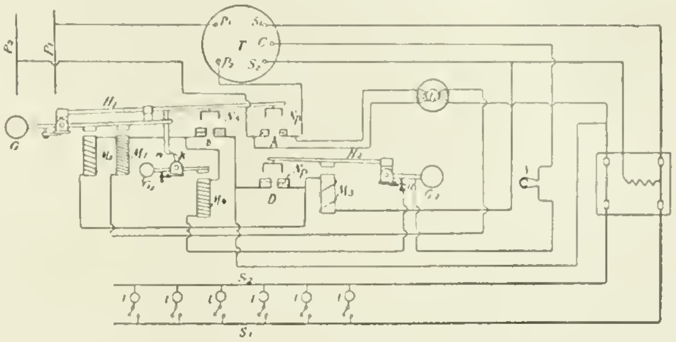


FIG. 5.—DIAGRAM OF SWITCH CONNECTIONS.

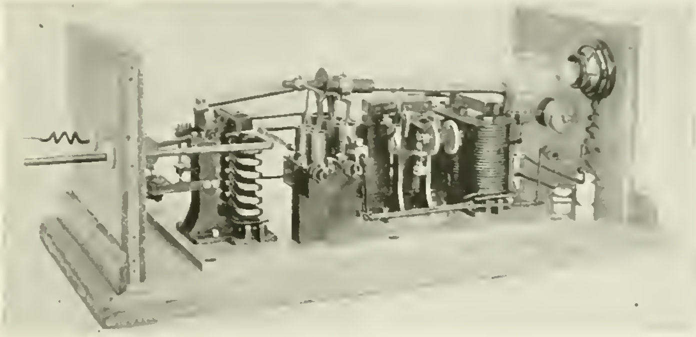


FIG. 6.—SCHLATTER SWITCH SYSTEM FOR TRANSFORMER.

The Schlatter switch used in connection with transformer groups is shown in Figs. 7 and 8. In such groups one transformer is always in circuit while the others are automatically switched in or out according to the requirements, so that during the period of small load only one transformer is consuming energy. The switch is composed of a double-armed lever, *S*, provided with a balancing weight. The weight tends to keep the secondary coil of the transformer out of circuit while the electromagnet, *M*, tends to overcome the influence of the weight and to switch in the transformer coils. If the load of the secondary circuit is greater than the capacity of the transformer, then the electromagnet overcomes the influence of the weight, and when the second transformer becomes fully loaded, then the third unit may be switched in. Part of the details of the cut relate to mechanism for obviating vibration of the lever *S* at the moment when it switches into circuit. The illustrations represent a single switch for a transformer of 2.5 kilowatts, and a group switch for two such transformers.

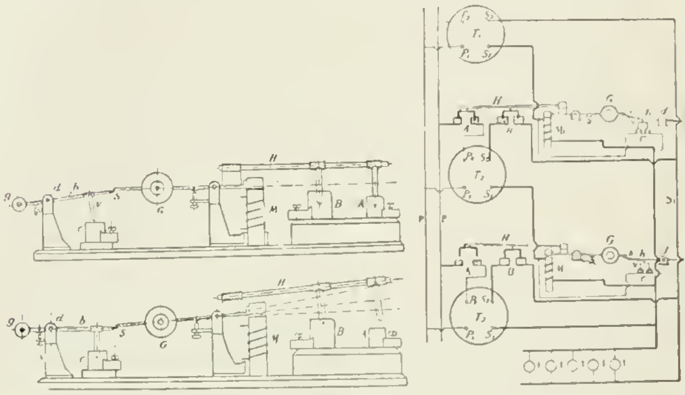


FIG. 8.—DIAGRAM OF SWITCH CONNECTIONS.

Submarine Signaling by Telephony.

From time to time note has been made in these columns of the work of Dr. Elisha Gray and his associate, Mr. A. J. Mundy, in the development of a new method of coast and deep-sea signaling. We are indebted to Mr. Mundy, of the Gray Telephone Company, for details of recent tests made in Boston Harbor and vicinity, the results being very satisfactory to the officials who tested his invention as elaborated by Dr. Gray. The tests have been made on board the "Seabell," whose exterior and interior are illustrated in Figs. 1 and 2. This boat was designed and built for the purpose. She has a well-hole cut in the center of the hull, through which the bell is lowered with apparatus for ringing it electrically. A 6-hp gasoline engine drives a small dynamo. The bell is lowered into the sea through the well-hole to any desired depth by a windlass, and an electrical mechanism enables the operator to ring the bell continuously as a church bell is tolled, or to sound any desired number of strokes at will. Hence, one can send intelligible messages if each letter of the alphabet be represented by a given number. On a keyboard similar to that of a typewriter the inventors have grouped seven keys connected by wires from the dynamo to a commutator operating the bell. On a tablet, in front of the keyboard, the letters of the alphabet duly numbered are shown, enabling an operator, either on shipboard or ashore, to send any desired message. The message, "All well here," for example, would be sent in this way:

x x x ALL x WELL x HERE x x x
12-12-12 22-33-33 12 51-21-33-33 12 15-21-32-21 12-12-12

Instead of suspending the bell from a vessel, it may be hung from a buoy and permanently anchored under water at any depth desired, and at varying distance from the shore. In such a case, the current for operating the clapper would be brought to the bell from the shore by a light submarine cable.

The picking up of submarine sounds is equally effective. Messrs. Gray and Mundy experimented with a great variety of receivers operated pneumatically, electrically and mechanically. The simplest mode of hearing such submerged bell signals on board ship is to go below into the hold of the vessel, as close to the keel as possible without any apparatus whatever, and simply listen. At a distance of a mile or more the sound of the bell may be distinctly heard by the unaided ear, and is recognized just as any local sound might be. Placing one end of a wooden rod against the skin of the ship, the other end being held against the ear, the sound is heard at even a greater distance. A common tin ear-trumpet, screwed onto the end of a piece of gas pipe, the mouth of the trumpet being sealed by a tin diaphragm, and submerged 6 ft. under water, enables the observer, at the upper end of the pipe, to hear the submerged bell at a distance of three miles. For greater distances an electrical receiver has been devised by means of which the bell has been heard distinctly a distance of 12 miles. The submerged end of this receiver may be lowered over the side of the ship, or attached to it on either side of the bow, under the water line, like a pair of ears.

The submerged portion of the receiver is connected by wires to a telephone receiver, which may be carried to any part of the ship.

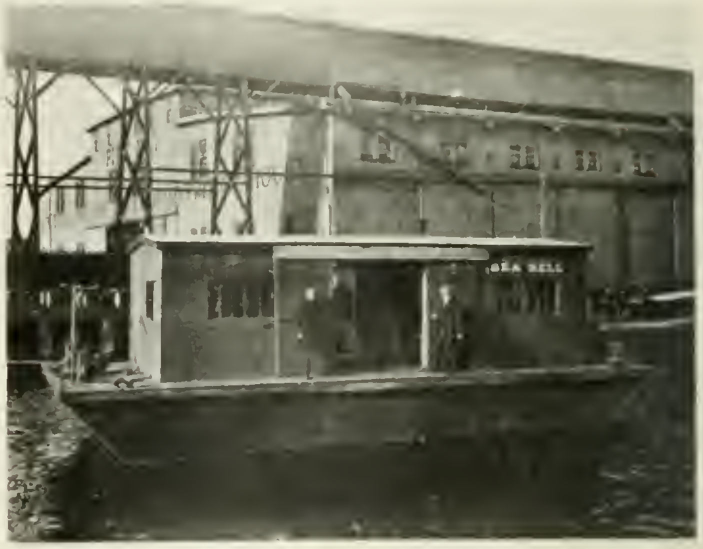


FIG. 1.—THE SEA BELL.

Professor Gray, before his death, devised an improvement for the electrical receiver by means of which a large gong will be rung automatically on the ship, whenever the submerged bell is rung. That is to say, the gong rings sympathetically, following the bell, stroke by stroke.

Mr. Mundy has invented recently an ingenious method by means of which a ship coming in from the open sea may find her way straight to the entrance of a harbor by simply feeling her way along until she finds herself in any position where the sounds from two bells, one on either side of the entrance, are heard simultaneously on board ship. These bells are placed at equal distances from the entrance and are rung by cable connection at precisely the same instant. As sound travels at a fixed speed in the water (just as it does in the air), the vessel must be equi-distant from the bells in order to hear them simultaneously. The bells have different pitches, so that if the navigator hears the higher toned bell first, he knows he is somewhat nearer to it than to the lower toned bell, and therefore somewhat to the north of the straight line shown on his chart which leads directly to the mouth of the harbor. If, on the other hand, he hears the lower toned bell first, he knows he is south of this charted line. The length of the time interval between the two sounds will give him an

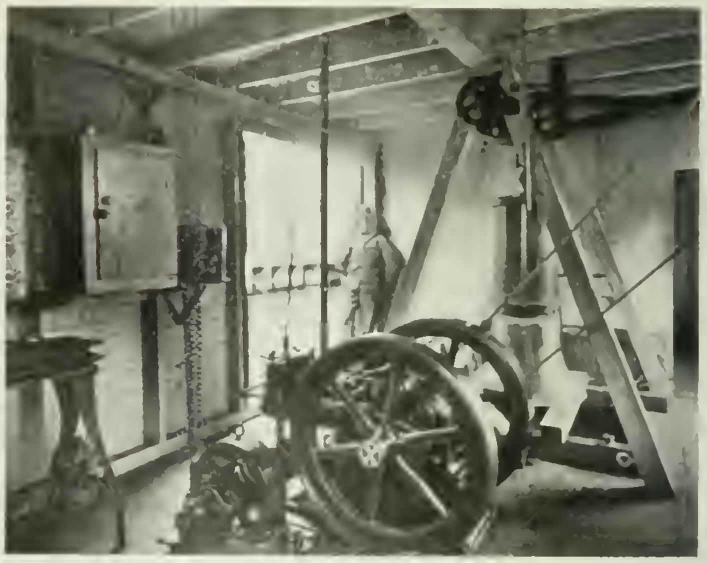


FIG. 2.—INTERIOR OF THE SEA BELL.

approximate idea of about how far away he is from this charted line. Thus guided, he bears either north or south, until he reaches this line where the two bells are heard simultaneously, and then his chart tells him the exact course by the compass to the mouth of the harbor, which he can maintain and verify by keeping the sound of the bells in simultaneous relation. This system does not require the use of the Gray receiver, but both methods can be employed.

A further elaboration of this principle, of "acoustic triangulation," is effected by the addition of a third bell placed in triangular relation to the other two.

Among those who have witnessed recent trials of this ingenious "wireless" system are Admiral Higginson, chairman of the United States Lighthouse Board; Naval Constructor Baxter, Colonel Stanton, U. S. A., and Constructor A. P. Nazro, the lighthouse inspector of the district. Captain L. Bayly, R. N., has been sent by the British Government to inspect and report, and the Canadian Government is also having the apparatus tested. A German engineer of high standing is also in Boston this week to make an inspection of the system

The Trolley in Cuba.

An interesting dispatch to the New York *Evening Post* of recent date from Washington, says:

How Sir William Van Horne has been able to prosecute his railroad enterprise through Cuba in defiance of all the precautions taken by the Administration and Congress to prevent the grant of franchises was revealed by Sir William to Secretary Root, in an interview arranged by the Secretary for the purpose.

The Van Horne undertaking rests, not upon the suspended general franchise law of Cuba, which, in its clauses relating to railways, provided means for condemning lands for rights of way, stations, sidetracks, etc., by the assertion of eminent domain, but upon a special enactment, still in full operation, permitting the owner of land to construct railroads on it without any one's interference. This was designed originally for the convenience of the sugar and tobacco planters to expedite the movement of their crops; under it they have built many short lines through their own premises.

Sir William has therefore bought, or is now buying, whole farms contiguous to each other, and along the route of the trunk line which he has planned from one end of the island to the other. In this manner he has secured his right of way far more expeditiously and probably with not much more expense than if he had gone through the usual process of condemnation for every mile of the way. Moreover, every Cuban municipality has authority, still operative, to grant rights of way through and over its streets, and Sir William has taken advantage of the fact to extend his lines into the towns along the route. The municipal officers seem anxious to meet him half way, the people having risen to the notion that their future welfare depends upon their having direct access to this great artery of the island.

In short, there is just one way open to the United States Government to interfere with the Van Horne railroad programme. As the rails pass from one plantation to another, they must cross, for the most part, over public highways, which are not under local control, but are treated by our Government as military roads. To cross these it is necessary to have a written permit from Secretary Root. The Secretary has authority to grant a revocable permit, a very different thing from the investment of a permanent right like a franchise. Thus far the Secretary has declined to say whether he will grant such permits; the matter has not yet reached the stage where his final decision is necessary. It is realized here, however, that if they are once granted and trains are running, they will never be revoked, for the Cuban populace will insist upon their remaining in force.

While the pigeon-holes of the War Department are becoming stuffed with petitions and applications for railroad franchises, signed and pressed by Yankees, who boast of their "enterprise," the British subject has skipped in under everybody and bought up about everything worth having. It is understood that he has acquired this control, at an average of not more than $8 an acre for the plantations, while the municipalities have granted the right to enter the towns and villages without exacting a penny in return—sometimes, indeed, offering a bonus, when there has been a fear that some place would be overlooked on its own merits.

Elements of Illumination—XXIV.

By Dr. Louis Bell.

The practical problem of adequately lighting the streets of a city is one which requires the local data for its solution. The amount and distribution of streets and the needs and distribution of the population are the controlling factors in the matter, and obviously these vary greatly from place to place. Then, too, the cost of lights and the funds available for the purpose depend on local conditions. In particular, the price of lights varies so much that it is difficult even to strike an average. Few topics offer less chance for certitude or are more unsatisfactory to investigate. It makes a great difference whether full arcs or half arcs (so-called) are in use, or incandescents, or Welsbachs, also whether the lights are burned all night and every night, every night until midnight or on "moonlight schedule," that is, on all nights and at all hours of the night when there is not clear moonlight. In large cities the tendency is toward the most powerful arc lights burning every night and all night, supplemented by incandescent lamps and by gas burners. In smaller cities and towns the smaller arcs are apt to be used, burned either on moonlight schedule or until 12 or 1 o'clock.

In the latitude of the Northern United States "all night and every night" public lighting usually means from 3800 to 4000 hours of lighting yearly, according to the treatment of twilight and dawn, and the weather. The moonlight schedule is carried out with various slight modifications, and evidently depends considerably upon the weather, but in practice it amounts to not far from 3000 hours per year, while lights run from dusk to midnight, or 1 a. m., usually will burn 2000 to 2200 hours per year. All night and every night lighting is, of course, the thing to be desired, but if economy is necessary, places of moderate size can be very satisfactorily lighted on a liberally administered moonlight schedule.

As between "full" and "half" arcs, the advantage economically lies, on the whole, with the former, provided the same total illumination is to be obtained in each case. The following table gives the spacing in feet required, for various radiants on an assumed minimum illumination of 0.02 candle-foot at a point midway between lights:

Kind of Light.	Distance between lights.	Lights per mile.
6.6-ampere enclosed D. C. arc....	340	15
9.6-ampere open D. C. arc........	315	17
6.6-ampere enclosed A. C. arc....	275	19
6.6-ampere open D. C. arc........	260	20
50-cp incandescent lamp, electric (or mantle burner)	100	53

The relative expense of lighting by these various radiants depends greatly upon circumstances not to be predicted. The price charged by lighting companies for public lighting is simply whatever the community will stand.

The relations between lighting companies and municipalities are, in most cases, mutually predatory. The former having acquired and utilized a public franchise can, in a measure, hold the streets against competition and maintain prices at the highest point that can be juggled through the city government without public scandal. The latter, through the earnest efforts of its practical politicians, can worry and threaten the former into yielding up a substantial annual rake-off in the form of jobs for heelers, contributions to campaign funds or plain cash. Occasionally simple and decent business relations are maintained.

The prices actually charged for public arc lights burned all night and every night range very widely, but usually between $75 and $125 per lamp per year. The former price is seldom reached or discounted, save in stations operated by water power or under very strong competition, and even then generally only for "half" arcs. The latter price is seldom exceeded, save where underground distribution is demanded or in case of very scattered service. Incandescent lamps of 50 candle-power, or thereabouts, usually bring $30 to $35 per year, and the former figure is a common one for mantle burners on the gas system. For equal minimum intensity of illumination there is not much to choose between the several illuminants at the prices mentioned, the choice between them being due to suitability. At the same total cost, however, the arc lights give a considerably higher average illumination, and experience shows that on the whole the arcs which have to be inspected at frequent intervals for the purpose of trimming are kept nearer their point of maximum efficiency than either incandescents or gas burners.

The real cost of public lighting is, of course, immensely variable, since amount and price are both variable. In the average New England city most of the lighting is by arcs,and there is an average of one arc for each 175 to 200 inhabitants. The total cost of public lighting is frequently from 75 cents to $1 per inhabitant, and sometimes rises to $1.50, and even to $2 per inhabitant. It is, therefore, no inconsiderable item of public expense.

Whether street lighting should be done by contract with a corporation or directly by the municipality is one of the mooted questions of economics. In theory, it would seem that such a public service should be done by the city or town itself on the same principle that all towns own their sewerage systems and most of their water works. But while experience seems to have shown that public water works are in every way desirable the same cannot be said of gas and electric plants. The arguments pro and con are about the same in each case, yet the average results seem to be different. In some municipal lighting plants, mostly small, the economic results have been excellent, in others they have been unmistakably bad.

If a municipality could start in *de novo* and erect its complete lighting system according to the best modern practice, and run that system anything like as economically as it would be run by a private company, it could unquestionably do its public lighting at a great saving in the majority of cases. But it can rarely start and operate thus freely. It often is compelled to buy out the existing plant by law, generally at a price far larger than would suffice to erect a modern plant, for the art has been changing rapidly. It is lucky if a plant, old or new, can be secured without furnishing pickings and stealings for somebody, and in its operation the finger of the politician is too often inserted for no honest purpose.

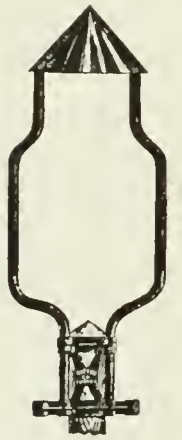


FIG. 1.—POLE TOP.

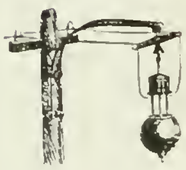


FIG. 2.—BRACKET.

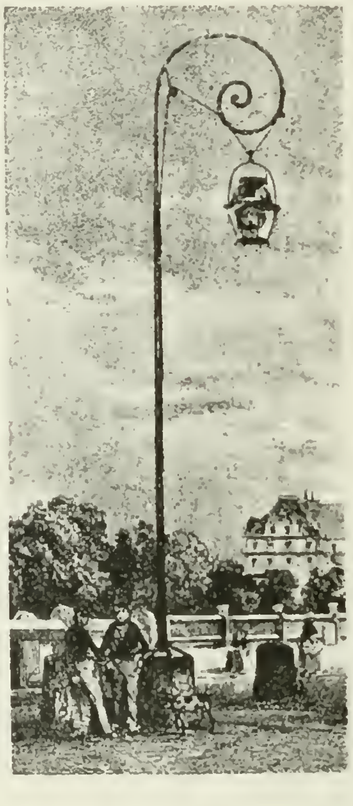


FIG. 3.—OLD POLE AND BRACKET.

In this matter of municipal plants statistics are even more utterly mendacious than usual, and conceal rather than disclose, the facts in the case. With respect to electrical plants at least, however owned, there is too often deliberate concealment or entire neglect of depreciation, both that due to wear and tear and the larger amount due to improvements in the art, so that from the books or reports it is almost impossible to figure the actual cost of furnishing the electrical energy. The matter may, on the whole, be summed up about as follows: If a municipality can both acquire a lighting plant and operate it at the ordinary current rates for apparatus, labor and material paid by private buyers and employers, it can effect a large saving in its cost of public lighting, but if the plant is touched by venal politics it will assuredly prove a costly failure.

Many improvements are possible in street lighting, but for the present the arc lamp must be the main reliance. At first thought the Nernst lamp would seem to offer advantages, but it does not readily lend itself to the distribution in series which is desirable in street lighting for the sake of economy. Improvements in mantle gas burners may bring them into a position of great usefulness, which they have not yet attained by reason of their rapid deterioration. But for the most part the electric arc is the most available source of light.

Contracts for arc lighting should never be drawn on the basis of a nominal candle-power. They should clearly specify the kind of arc to be installed, the amount of energy to be taken in each arc, and the kind of shades to be used. The nature of the fixtures should be specifically designated, whether pole tops, brackets, mast-arms or cross suspensions. These and the locations of the lamps should be designated by some one familiar with practical street lighting, following the general line of the data which have here been given. The hours of lighting should be distinctly stated with rebates for failure to provide continuous light within these hours. Such rebates should be merely nominal for deficiencies up to, say, 1 or 2 per cent of the total hours of lighting and punitive on an increasing scale for greater deficiencies.

The fixtures used for street lighting are of very various pattern, but fall into four general classes, pole-tops, brackets, mast-arms and cross suspensions. These have been, with the exception of the mast-arm in use for public lighting for a very long period, going back to the days of oil lamps and candles. The pole-top fixture is essentially a support for a lamp on the top of a post. In arc lighting it is generally combined with a protecting water hood to shield the top of the lamp from the weather and also to shield sometimes the individual switch for short circuiting the lamp. Fig. 1 shows a typical pole top such as is often used for enclosed arc lamps. The side rods are placed edge toward the arc to obviate shadows and the whole affair fits neatly upon the top of the pole, the arc lamp hanging from an insulated hook within the hood. The obvious objection to pole-top fixtures, whether for arc lights or for gas lamps, is that the light must be on the curb, and does not light the street properly. For open spaces where the pole can be out from the curb the pole tops work well and may be freely used.

A very obvious modification is the lateral bracket carrying the lamp well clear of the curb, yet not so far out as to make it difficult to trim the lamp from the pole without lowering it. Fig. 2 is a specimen of this class, which carries the lamp 2 ft. out from the pole. If longer than this the lamp should be supported by a rope and lowered for trimming. Such brackets in various forms have been in use for a long time, and a neat iron pole and bracket dating back some 75 years is shown in Fig. 3. It might be copied to advantage even now. A somewhat analogous type of bracket has been introduced and very extensively used by the Boston Electric Light Company. It is a hollow casting, fitted to the top of a neat wooden pole, and permits the line wires to be carried within it clear to the lamp without exposing them. For underground service the pole itself may be hollow, thus entirely eliminating exposed wires. The lamp can be trimmed easily from the pole, and a cut-out is fitted in the slight expansion near the base of the upright part of the casting. Fig. 4 shows this very neat and convenient fixture in outline.

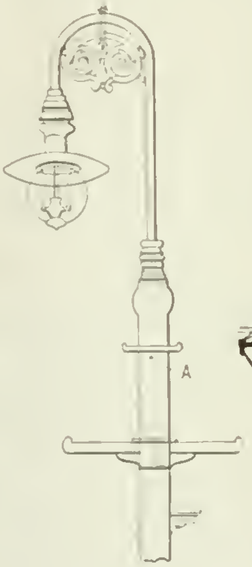


FIG. 4.—MODERN TYPE OF POLE.

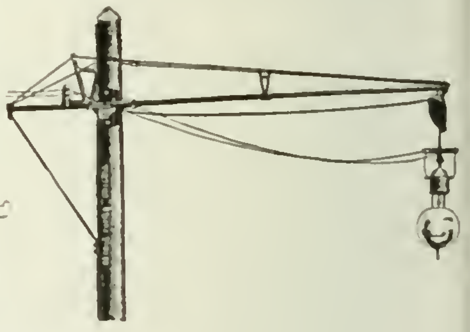


FIG. 5.—MAST ARM.

Mast-arms are really modified brackets lengthened so much as to bring the lamps nearly or quite to the center line of the street, and arranged usually to permit the lamp being readily lowered to the street for trimming. Now and then the lamp is carried on a trolley which can be pulled in to the pole for trimming, but the preference is generally for the former plan. Fig. 5 shows a common form of mast arm fitted for lowering the lamp. The lamp is usually carried some 14 or 15 ft. out from the pole, hence the truss form becomes necessary to secure the proper degree of strength and stiffness.

Mast arms furnish, on the whole, the best means of carrying the light out over the street. They call for but a single pole at the curb, and put the light exactly where it is wanted, and hold it there steadily. They are far from beautiful, however, and from the æsthetic standpoint the cross suspension is often to be preferred. This is a very old method of supporting lights, and consists merely of a rope stretched across the street and carrying midway a pulley from which the lamp is carried. Fig. 6 from an old French print, showing street lighting in Paris early in the eighteenth century, illustrates the principle as well as a more modern instance. To-day the rope is of wire strands and the lamp is an electric arc, but the rest has changed little.

In ordinary cases the cross suspension requires a pole set at the curb on each side of the street, which, except at corners where the pole lines cross, is somewhat of an inconvenience. Sometimes a tree is used for one support, but the practice is not to be encouraged, since it is both bad for the tree and renders the lamp rather unsteady in a wind. When conditions permit cross suspension, however, is a most useful and unobtrusive method of carrying the lamps.

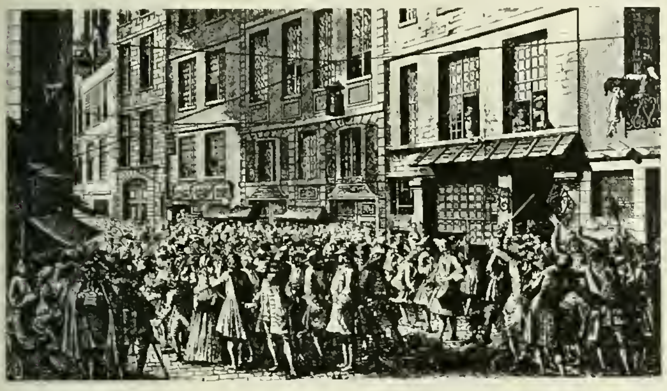


FIG. 6.—OLD CROSS SUSPENSION.

In general, where there is an underground distribution, either of electricity or gas, pole top and bracket fixtures are most useful for ordinary purposes. Fixtures like Fig. 4 lend themselves very readily to artistic treatment either for electric lights or for mantle or regenerative gas burners. In streets thickly shaded by trees recourse must generally be taken to mast-arms or to cross suspension in order to put the lights where shadows will not be troublesome. Sometimes even incandescent lamps are carried in the latter manner, though being rather closely spaced they, like mantle burners, give fairly good results if placed alternately on each side of the street and bracketed clear of the curb. Generally, the lighting of a town will call into useful service all the ordinary types of fixtures, and an attempt to adopt a single standard form will lead to considerable embarrassment in the effective lighting of certain localities.

An Electric Haulage System for Ships in Nova Scotia.

An interesting electrical installation of somewhat novel character has been made recently at Liverpool, Nova Scotia. It was devised for the purpose of hauling vessels out of and lowering them into the River Mersey, a distance of over 500 ft. on an incline having a grade of half an inch to the foot. Some years ago the Liverpool Marine Railway Company, Limited, had a slip of this kind in operation, whose motive power was horses. A framework carried two horizontal gears attached to which was a beveled gear with a vertical shaft projecting upward, and working on this were two long arms or sweeps. To these were hitched two or four horses traveling around on an upper platform, which was reached by a runway outside the building. This animal power was, of course, limited in its capacity, and extremely slow, it taking three to four hours to haul up a small vessel in the cradle. While the vessel was undergoing repairs, it was held from running back by a great dog in a ratchet. When the work was finished it was the custom to knock out the dog and let the cradle go "by the run" back into the water. It is almost needless to say that this crude method soon wrecked the cradle and the track as well. The result was that the whole plant fell into disuse and decay.

During the past year a new company was organized with the object of rebuilding and equipping the slip in an up-to-date manner, and when it came to the question of the best power it was decided to use an electric motor, there being, moreover, a lighting system in town driven by water power, from which the current could be obtained very cheaply. A Stanley or S. K. C. 30-hp induction motor has been installed, which will raise and lower ships of a burden up to 400 tons, over a track which is 600 ft. in length, in the remarkably quick time of 25 minutes. The equipment has so far proved a very economical and highly satisfactory investment. The motor is geared to a worm, which in turn operates a further train of gears, as illustrated in Figs. 1 and 2 herewith. On the shaft of the large and last gear is a sprocket which engages an endless two-inch chain that hauls the cradle. The whole thing is as simple as possible. It will, of course, be understood that the gears and sprockets are within the frame and not outside, and it may be added that the frame is much heavier than shown. It was found feasible to use much of the old gearing. The framework was set on a bed of concrete 3 ft. deep and fastened firmly into place by heavy rods running up through the concrete and frames. It also butts against the end of the slip, so that there is not the slightest chance for it to move.

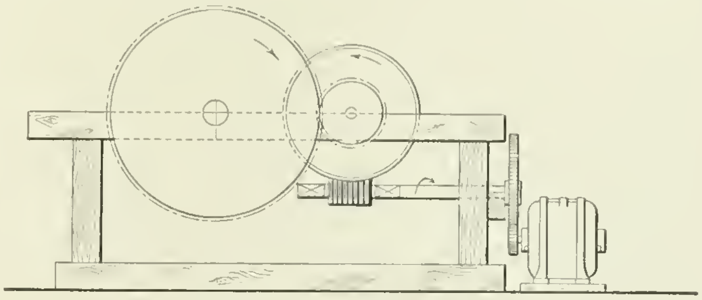


FIG. 1.—LIVERPOOL MARINE HAULAGE SYSTEM.

We are indebted for the data in regard to this interesting little installation, which it would seem might well be copied elsewhere, to Mr. C. O. Foss, engineer of the Central Railway Company, Limited, of Nova Scotia, and to Mr. T. R. Bartling, the secretary and treasurer of the Liverpool Marine Railway Company, Limited.

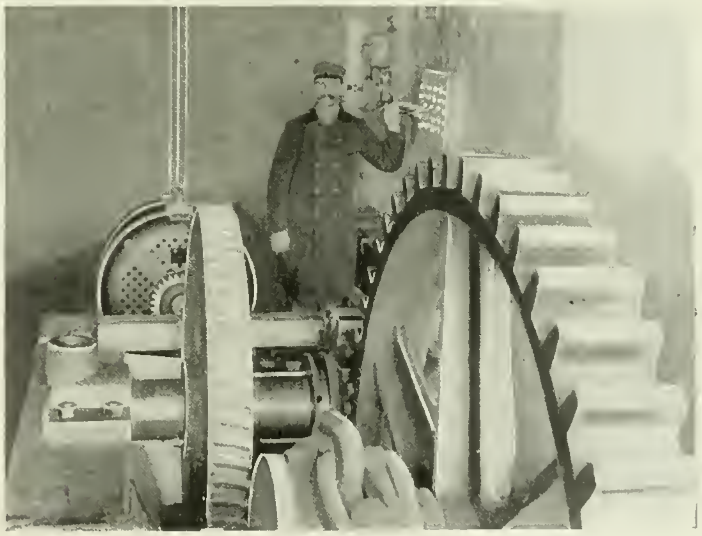


FIG. 2.—INTERIOR OF LIVERPOOL HAULAGE PLANT.

Street Car Strike in Madrid.

A dispatch from Madrid, April 25, states that a strike of the street car railroad employees is in progress in that city. No cars are running, and the police are guarding the property of the company.

Electricity at the Pan-American Exposition

A General Review of the Plans Executed and Under Way at Buffalo.

THE opening of the Pan-American Exposition at Buffalo, in spite of early boasts to the contrary, finds that enterprise no nearer completion than any of the other large expositions of the past ten years at a corresponding time. But a general review of the part electricity will play and the nature of the exhibits can be made now, leaving the statement of further details to the time when the progress of the exposition work makes them possible.

In the preliminary announcements sent out by the management of the exhibition the statements were made that it would excel all previous enterprises of the kind (1) in elaborate and beautiful lighting effects, using over 300,000 8-cp lamps; (2) in the splendor of its hydraulic and fountain effects; (3) in exquisite horticultural and floral embellishments; (4) in original statuary and plastic ornamentation; (5) in the richness of its color decorations, all buildings to be tinted in beautiful and harmonious shades; (6) in the magnificence of its court settings, the court area being much larger than at any former exposition. The visitor must admit that all of these claims have been made good. It is with the first and second of these propositions that the electrical and mechanical bureau under its chief, Mr. Henry Rustin, had to deal. Mr. Luther Stieringer, whose services have become invaluable in connection with any exposition enterprise by virtue of his long experience in such work, has acted as consulting electrical engineer. The electrical features of the Pan-American Exposition have been more widely advertised than any other, which fact is sufficient proof of the important part they will play in the entertainment of the general public. Much might and will be written from a popular standpoint about the beautiful effects that have been produced, but space requires that this article be confined mainly to a matter-of-fact statement as to how they are produced.

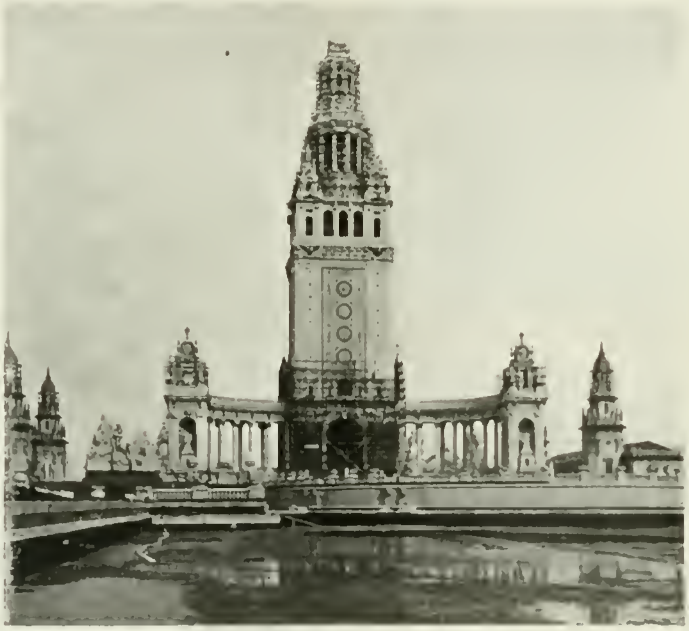


FIG. 1.—THE ELECTRIC TOWER.

The most distinctive feature of the decorative lighting aside from the great amount of power so expended is the use entirely of 8-cp lamps. Arcs are used only for useful service lighting in the buildings and about the grounds. The selection of the 8-cp incandescent lamp as the standard for decorative lighting was because of a desire to suppress as far as possible the individuality of each lamp and give the general effect that of areas rather than points of light. In this respect it marks the new era in incandescent lighting which seeks glow rather than glare. The place of honor among the buildings of the Exposition is occupied by the "Electric Tower," 391 ft. high, built expressly for electric decorative effect. Its location can be seen on the accompanying map of the grounds.

The general scheme of the main area lighting depends for its success on the arrangement of buildings with reference to the electric tower. There is a gradual increase of lighting beginning at the south end of the court, until it reaches a climax in the stately electric tower at the north end, where the lights are clustered the thickest. The number of lights and the quantity of light exceeds that of any other equal area before artificially illuminated, and as mentioned above, the light is evenly distributed. The results fully justify the expenditure for light, as the effects are truly wonderful and beautiful, and of a kind never before seen.

In the grand basin in front of the electric tower are 100 searchlights for use in connection with the fountains, but the main electric fountain is in the North Bay, as before explained. The fountains in the basin take 500,000 gallons of water per hour for their full operation. The fountain displays in the large court follow the same idea as the lighting and reach a climax in the basin below the electric tower. In the semi-circle around the "Fountain of Abundance," a bed of beautiful flowers is to be illuminated so as to bring out all their delightful colors. The lamps for this purpose will be concealed.

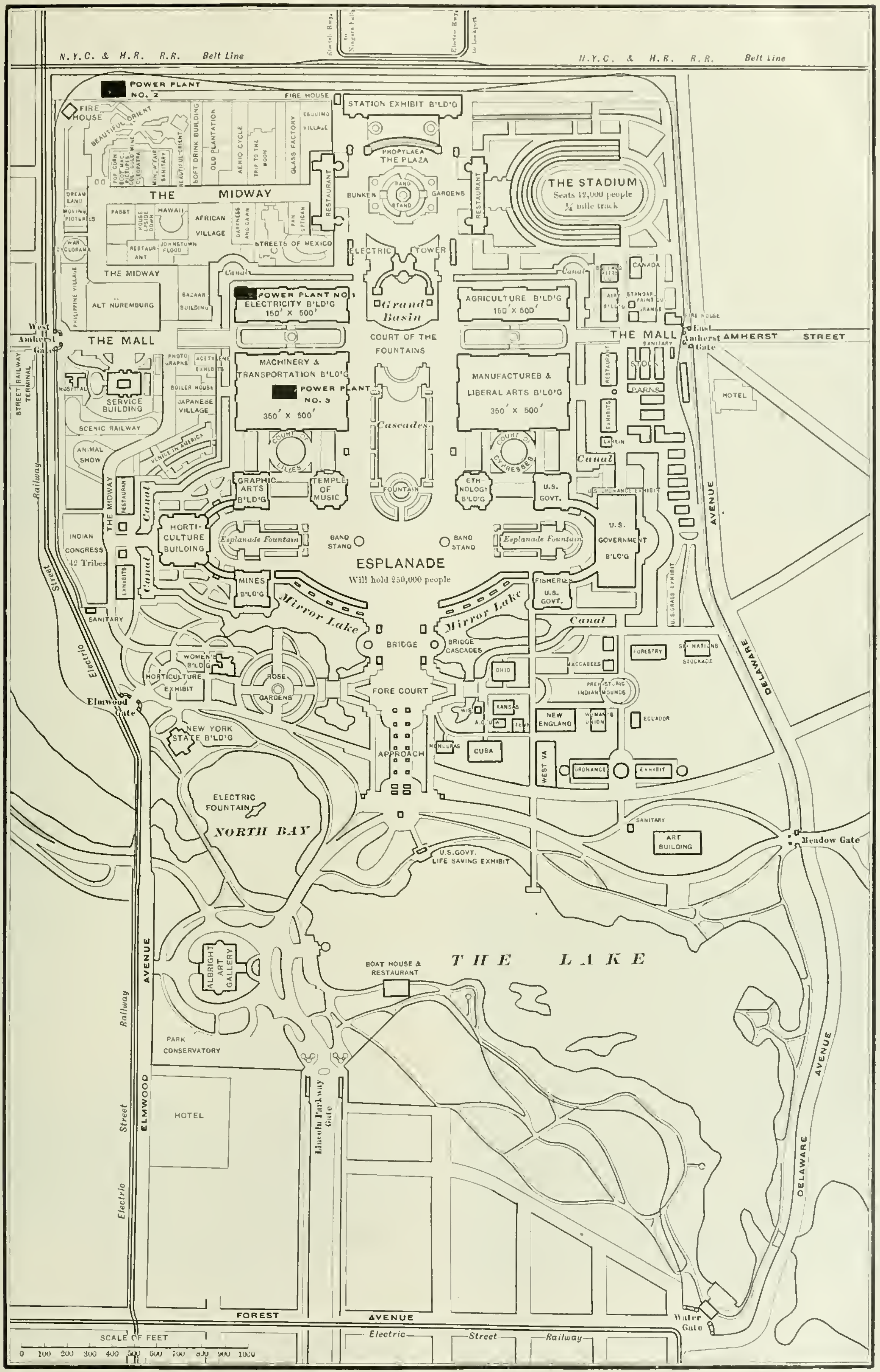
Next in importance in electric decorative effect after the incandescent lighting of the main area and buildings must be mentioned the electric fountains. They are placed in an appropriate setting in the middle of North Bay in the southwest corner of the grounds. This body of water is 800 ft. wide by 900 long, and has wooded banks sloping to the shore. A better location from an artistic standpoint could not have been found. The island on which the fountain is located is 160 by 80 ft., and stands 10 ft. above the water level. The main geyser jet is designed to throw a 1½-inch stream 250 ft. high. Around the central jet are 102 fountain orifices and 22 holophote orifices. The 22 searchlights used under the latter were made by Bogue of New York, and are 22-ampere arcs. The pumps for the fountain are electrically operated and located under the fountain deck.

Among other spectacular effects which are being prepared signaling by searchlight from the electric tower to Niagara may be mentioned. The plan will serve as an object lesson to the public of how searchlight signaling is done in the army. A 30-inch 80-ampere projector of General Electric make is being put up for the work at the 360-ft. level of the electric tower, and another will be put at Observation Tower in Niagara Falls. The installation of a searchlight at such a height with clear country around will give unusually good opportunities for studying its effects at a distance. In this connection may be mentioned the lighting of Niagara Falls themselves by searchlights placed on the banks during the Exposition. The preliminary experiments are reported to have been most satisfactory, and visitors to Niagara at night can hereafter enjoy something unknown to former generations. The illumination of the horseshoe fall from Falls View station on the Michigan Central was first successfully accomplished March 22 last.

At present writing it seems likely that Pan-American visitors will have an opportunity to see high-voltage discharge effects put to practical use as spectacular attractions. Paul M. Lincoln, of the Niagara Falls Power Company, and C. E. Skinner, of the Westinghouse Company, have designed apparatus for producing artificial lighting and storm effects in connection with electric signs, which will probably be used somewhere around the Exposition.

Electrical energy for the Pan-American Exposition is derived from three sources. One of them is a sub-station supplied from Niagara Falls, the other two are power plants on the grounds.

The Niagara sub-station, known as power plant No. 1, and so marked on the map accompanying this article, is in the northwest corner of Electricity Building. This is to be used entirely for decorative lighting about the grounds. It has an output of 4500 kilowatts, and contains 18 250-kw General Electric air blast transformers, with a nineteenth in reserve. These receive current from the Niagara Falls high-tension transmission line at 11,000 volts, and



ENGRAVED BY BORMAY & CO., N.Y.

Fig. 2.—Plan of the Pan-American Exposition.

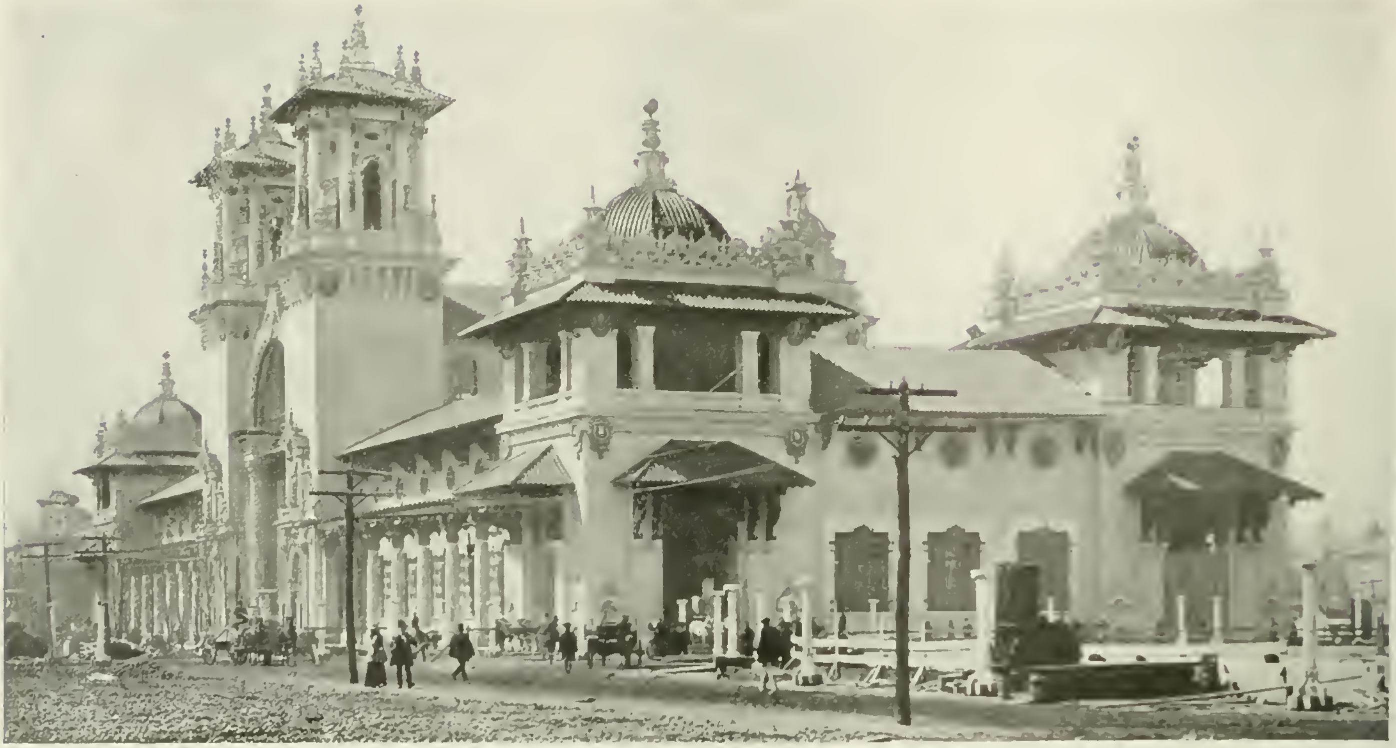


Fig. 3.—Electricity Building by Day.

deliver it to the distributing mains for the grounds at 1800 volts. This is 25-cycle current, but as the decorative lighting which it supplies is all incandescent and there are no arcs on the circuits, it serves the purpose as well as a higher frequency. The magnificence of the decorative lighting can easily be imagined when it is considered what an enormous amount of energy is being spent on it. One feature of considerable interest from an engineering and æsthetic standpoint, is the introduction of a water rheostat into the high-tension mains supplying the sub-station, for the purpose of bringing all the decorative lights on the grounds up to candle-power slowly (in about 80 seconds), and shutting them down equally slowly. This will be working the theater-dimmer idea on the largest scale ever attempted. The water rheostat is mounted in a building on high stilts near the entrance to the grounds and the plates are operated by electric motors so that they can be controlled at a distance. The 19 transformers in the sub-station plant in Electricity Building are shown herewith. They are set directly over a brick vault, which is supplied with air pressure by a Buffalo Forge fan maintaining one-half ounce pressure. The switching apparatus is typical of the best modern practice in the handling of high-tension currents. There is one motor-actuated oil-break switch in the 11,000-volt main circuit and hand-operated oil-break switches in each transformer circuit. The front of the switchboard carrying the oil switches on the transformer secondaries is shown in one of the accompanying photographs.

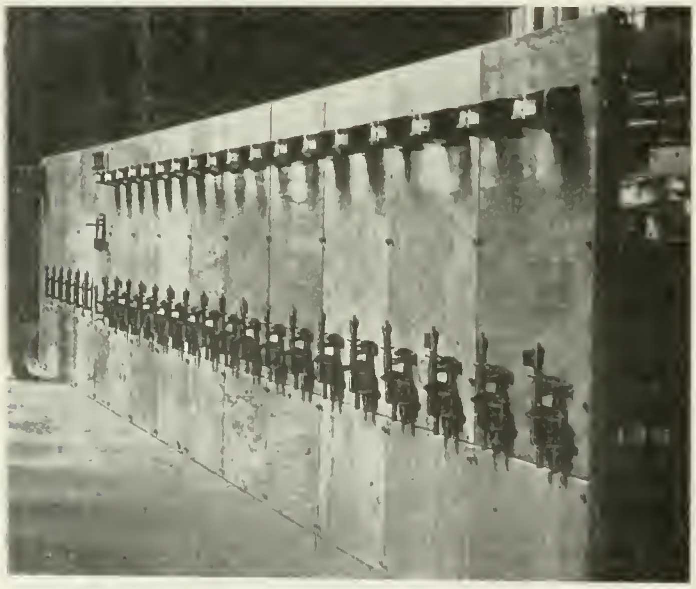


FIG. 5.—SECONDARY SWITCHBOARD IN ELECTRICITY BUILDING SUB-STATION

No. 2 power plant is known as the service plant, and was put in primarily for service rather than for exhibits. It has one Stanley 300-kw, two-phase, 1800-volt, 60-cycle generator driven by a Phœnix Iron Works engine; one Westinghouse 180-kw, two-phase, 60-cycle, 1800-volt generator driven by a Buffalo Forge Company engine; one Stanley frequency changer, changing from 25 to 60 cycles, with 80-kw capacity; one Warren 180-kw, two-phase, 60-cycle, 1800-volt generator driven by an Armington & Sims second-hand engine; four Westinghouse 500-volt, direct-current, 225-kw generators driven by second-hand Armington & Sims engines; two Westinghouse 90-kw, 110-volt, direct-current generators, driven by second-hand Armington & Sims engines; sixteen No. 8 arc machines driven by Armington & Sims engines. It will be seen that considerable 500-volt direct current will be used about he grounds for power purposes.

Power plant No. 3 is in the middle of the Machinery and Transportation Building, and is a combination service and exhibit plant. It contains two units installed by the D'Olier Engineering Company, Philadelphia. They have Erie Ball engines direct connected to Keystone 100-kw dynamos. These supply fountain searchlights and any excess is used for lighting the interior of the court in the Machinery and Transportation Building. A Skinner straight line engine belted to an Onondaga Dynamo Company's 100-kw, 100-volt generator runs motors in the Machinery and Transportation Building. An American Ball engine direct connected to an American Ball 110-volt generator runs arcs in the Horticultural Building. The wires are led

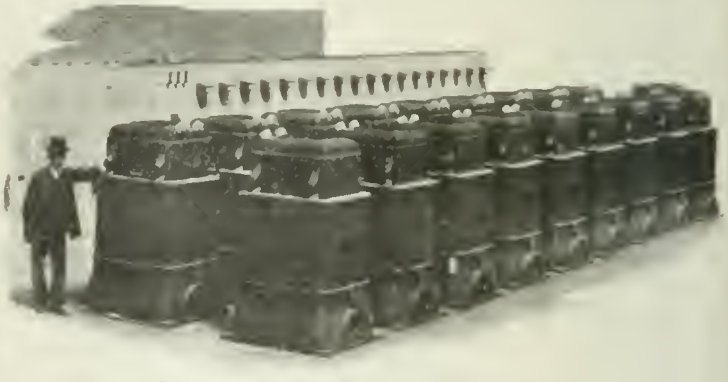


FIG. 6.—SUB-STATION IN ELECTRICITY BUILDING.

be run in connection with a manual or automatic exchange. As many telephones as desired can be connected to a metallic line and no subscriber can converse until "central" is first called up.

The Incandescent Electric Light Manipulator Company.—A corps of men will be employed throughout the different buildings of the Exposition for the purpose of cleaning and replacing the thousands of incandescent lamps which will be used during the Exposition, by means of the incandescent electric lamp replacers and cleaners manufactured by the company above named. These appliances have already been described in these columns. They are so constructed that they will unscrew or screw into place any shape or size of incandescent lamp at any height or angle. They are made of aluminum, and are consequently light in weight, and their use does away with the necessity and inconvenience of ladders, staging, etc. All of these appliances together with many others manufactured by the company, will be seen in operation at Section "M," Electricity Building. Mr. George Lighthart, the company's selling agent, will look after its interests at the Exposition and will give information on the subject of its devices.

The Eureka Tempered Copper Works, North East, Pa., will have an interesting and unique exhibit in Section "Q," in Electricity Building. It will be designed entirely to show the production of copper for electrical and mechanical purposes. The exhibit will also include a complete line of Eureka rail bonds, commutator segments, trolley wheels, etc.

The National Carbon Company, Cleveland, Ohio, will have a very complete exhibit of carbons in almost all forms for every imaginable use. Among the most important articles contained in the display will be the following: Cored and solid carbons for enclosed and open arcs, searchlights, headlights, focusing lamps and other electrical appliances; smelting carbons for smelting gold, silver, copper, aluminum, alloys and other metals; carbon electrodes for use in connection with large electrical furnaces, such as are used in the manufacture of carbide; carbon electrodes for chemical purposes used in connection with electric currents for the separation and purification of various liquid elements, and carbon brushes in all sizes, both flat and round, for fan and other stationary motors of all kinds, street railway motors, dynamos and generators of all sizes. In addition to the above, there will be a variety of carbon cups, carbon cylinders, tubes, plates of all dimensions, carbon buttons, carbon disks or diaphragms used in connection with telephones, transmitter carbons or back plates as they are sometimes known, granular carbon, globular carbon, also used in connection with telephones for transmitter carbon; carbons for lightning arresters, carbon pencils and boxes, and many other specialties.

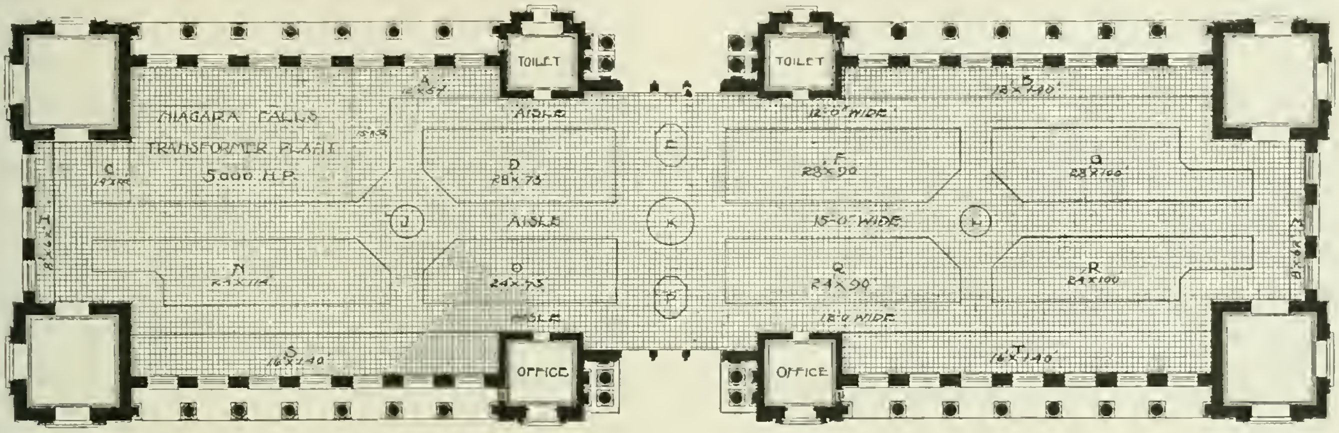


Fig. 9.—Floor Plan of Electricity Building.

The Sprague Electric Company.—Printers, electrotypers and others who visit the Exposition can see the practical operation of Lundell motors in connection with printing presses and other machines used in the allied trades. Among other exhibits will be one of the John Thomson Press Company, whose job presses will be operated by a Lundell 10-hp round-type motor; R. Hoe & Co. will operate all their electroyping machines by the Lundell motors, and the Dexter Folder Company will have several of its machines and also a Scott printing press operated by a Lundell motor.

The General Electric Company.—The space occupied by this company is in the northwest corner of the Electricity Building. adjacent to the 500-hp Exposition transformer plant. which is also an exhibit of this company. The company's reception quarters are in an handsome booth on the western end of the space. This comprises a conveniently arranged office, from which one may ascend to a comfortably furnished balcony overlooking the entire building. Between the transformer plant and the north side of the building is a well-lighted gallery of photographs. An excellent idea of the extent of the company's business in all branches can be obtained from this part of the exhibit. Passing out into the space, one finds apparatus of the latest type for generating, transforming and regulating electric current and electric lamps and motors of every type for its practical utilization. One of the exhibits in the Electricity Building is the model of the General Electric Company's works. This model is located at the eastern entrance to the exhibit on the main aisle of the building. This covers a floor space of about 12 by 24 ft., and represents accurately at a scale of 1 inch to 20 ft., the large manufacturing plants of this company at Schenectady, Lynn and Harrison. The lighting of this model is so arranged that day and night effects are produced alternatively. The night effect is accomplished by lights arranged under the model, which show through all of the windows of the buildings, presenting the appearance of the factories running in full operation at night. This company furnishes a great deal of electrical apparatus and supplies for use about the grounds by the Exposition Company and by exhibitors and midway concessionaires. About 300,000 incandescent lamps have been furnished by the company, beside many type "H" oil transformers. Electric motors of the General Electric make are found in exhibits in almost every building. An interesting example is found in the Government ordnance group, where the large gun mounted on a disappearing carriage is entirely operated by G. E. motors. The large searchlight located in the top of the Electric Tower is an exhibit of the General Electric Company. A similar one also furnished by this company is located at Niagara Falls, and it is expected signals will be exchanged between these searchlights, and that the one on the Electric Tower will flash signals nightly about the surrounding country.

The Ferracute Machine Company, of Bridgeton, N. J., will exhibit 12 of its presses, the heaviest being a large double-crank press, with friction clutch, for grinding armature disks, arranged to be driven by an individual motor, and it will weigh about 7 tons. It will have 8 power presses of various sizes and kinds, adapted for cutting, punching, forming and various other work. Among these is a notching machine for armature disks, which will be shown in working condition. Its total space is about 30 by 22 ft., fronting on three aisles. The whole outfit will be driven by electric motors.

The Submerged Electric Motor Company, Menomonie, Wis., will have an exhibit in Section "S," Electricity Building, of its submerged motor for small boats run by two or more batteries. The outfit is portable and will be used on the lagoon, where it will be seen in operation during the exhibition.

Mr. Albert Mann, Buffalo, N. Y., will have a collective exhibit, representing the Chase-Shawmut Company, for outlet boxes and nipples, the Richmondt Electric Wire Conduit Company for electrogalvanized conduit, and Mann Brothers, of Chicago, for washing machines and wooden ware, made with electrically welded wire hoops. The booth will be built of the Richmondt conduit and Chase-Shawmut boxes. The space is located in Section "S" in the Electricity Building.

The Morris Electric Company, New York, will have an exhibit in Section "B," Electricity Building, boards mounted with rail bonds, "Monarch" fare registers, hydraulic solderless splices and terminals, Anderson overhead line material, Keystone instruments, Garton lightning arresters and Anderson vehicle instruments. Besides these the company will show a large number of Keystone instruments, a hydraulic splicing machine, a hydraulic rail punching machine, some Potomac terra cotta conduit, "Wood" car gates, iron poles, brackets and various fittings for railway and lighting apparatus and a miscellaneous lot of supplies, such as street railways are continually using. The several members of this company will be present.

The Clark Automatic Telephone Switchboard Company, Providence, R. I., will occupy a space in the extreme east end of the Electricity Building, in Section "G." Its exhibit will consist of boards manufactured especially for exhibition purposes, wired to their full capacity, 12, 24, 48 and 72. The 24-point board will be used to demonstrate the principle of the apparatus, wiring to several different types of telephones which the company will have on the premises and showing the application of the system to magneto and push-button call instruments.

The Onondaga Dynamo Company, Syracuse, N. Y., will exhibit a 75-kw, 110-volt, direct-current dynamo, direct connected to a 15 by 13 straight line engine. This machine will be placed in the court of the Machinery and Transportation Building. It will be under the control of the Exhibition people, and is for lighting that building. In addition to this, and in the Electricity Building, in Section "N," the company will have a space 10 by 24 extending across that section, in which it will exhibit a line of enclosed motors, a multipolar "Clover Leaf" type, 12-kw and one 40-kw 6-pole ring type, both belt driven. The company also expects to display a switchboard with S. E. I. Company instruments upon it.

The American Vitrified Conduit Company, New York, is preparing an elaborate display of its products in vitrified clay underground conduits. This will include multiple ducts in forms from two up to 16, also self-centering conduit, single and single conduit with plain ends.

The Standard Underground Cable Company's Exhibit occupies the extreme western end of Section "F," immediately on the aisle. It is composed of four cases containing a display of samples of all of the various styles of rubber insulated, paper insulated covered cables and rubber insulated wires which are manufactured by this company. One case is devoted exclusively to the wires and cables, terminal heads and accessories as used in street railway work, including an assortment of the patented junction boxes as used and perfected by this company. Another case contains the telephone wires and cables manufactured by this company, also the company's patented terminals and lightning arresters. In the third case are shown cable wires and accessories used in electric light and power works, as distinct from street railway work, and the fourth case contains the cables, terminals, lightning arresters and accessories as used in telegraphic work and particularly in municipal work for fire alarm systems.

The Bossert Electric Construction Company, of Utica, N. Y., is located in Section "B," Electricity Building, between the exhibits of the H. B. Camp Company and the National Carbon Company. The exhibit consists of a display board wired as a switchboard with four panels, surmounted by an oak cornice and name board. The two center panels are white marble on which are mounted the company's regular type adjustable contact knife switches for switchboard work and also some samples of new "Imperial" switches which the company is just about to place on the market. Two samples of quick break switches embodying some new features, are shown. On the two outside panels there are mounted different types of steel-drawn wall boxes and steel junction boxes of various types and also samples of Erickson conduit insulators. The whole board is lighted by four two-light brackets, one at the top of each panel.

Victor Talking Machine.—Mr. Eldridge R. Johnson, of Philadelphia, Pa., will make an exhibit of the Victor talking machine.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, has two exhibits, one in Section "B," of the Electricity Building, and the other in Machinery Building. The former exhibit includes five motors, one of 2 horse-power, two of 10 horse-power, one of 12 horse-power and one of 30 horse-power, three induction motors and four generators, varying in capacity from 25 kilowatts to 150 kilowatts. On the other side of the space are shown five alternating-current Wagner motors of the Wagner Electric Company, St. Louis, ranging from one-fourth to 15 horse-power, also six Wagner generators ranging in capacity from 1½ kilowatts to 25 kilowatts. There is also one Wagner oil and water cooled transformer of 175-kw capacity, and one 100-kw air-blast transformer. Between the two sections of this exhibit are two switchboards, one controlling each section, and at the back of the exhibit is an electric sign whereon is the company's name. The Machinery Building exhibit includes one 6-hp, 220-volt, 400 r. p. m. motor, driving a planer in the exhibit of the American Tool Company, and one 6-hp, 110-volt, 400 r. p. m. motor in the exhibit of the Belmer Eames Tool Company. The Belmer Eames Company is also furnished a motor generator set for lighting the Government Building at the Exposition. This set will consist of one 65-hp type H, 500-volt motor mounted upon a solid iron base with a 42½-kw type H generator.

The Edison Manufacturing Company will make a general exhibit which will include phonographs as well as its particular line of goods all the way through. Later on it expects to exhibit Mr. Edison's new storage battery, possibly the thermopile that may come out later.

The C. J. Toerring Company, of Philadelphia, will show 50 lamps equipped with Holophane globes, which will light the court of the Manufacturers' Building. The company's individual exhibit will probably be associated with that of the D'Olier Engineering Company.

Electric Vehicles will be very much in evidence in the Transportation Building, where there will be fine exhibits of automobiles of all types by the Electric Vehicle Company, American Electric Vehicle Company, Buffalo Electric Vehicle Company, Woods Motor Vehicle Company and the De Dion-Bouton Motorette Company. The Electric Vehicle Company will have a particularly handsome space.

The E. G. Bernard Company, Troy, N. Y., will furnish a 125 hp 500-volt to 110-volt motor generator for the purpose of furnishing power for the electric fountain. This fountain will have 21 projections and will be the largest fountain of the kind ever built. The Exposition Company is putting up a special building for the Bernard Company's use near the New York City Building, which will contain its exhibit.

The Waite & Bartlett Manufacturing Company, of New York, will make a display of electro-medical and electro-surgical instruments and static machines. The exhibit will be located in Section "M," of Electricity Building, and the company intends to make a fine and practical working exhibit.

The Eureka Electric Company, Inc., of Chicago, Ill., has Messrs. G. B. Pratt and I. C. Woodford, of Buffalo, N. Y., as Eastern representatives. They will make no exhibit at the Exposition grounds, but will use for this purpose two of their large rooms in the Ellicott Building. The firm will have samples of all Eureka apparatus installed in the offices and in practical operation.

The Stanley Electric Company and the Stanley Instrument Company, of Pittsfield, Mass., and the Northern Electrical Manufacturing Company, of Madison, Wis., will have a joint exhibit in Electricity Building. The Northern Company will make a display of its apparatus, including one 3-hp motor direct connected to a Wood's propeller pump, one 7½-hp motor geared to start a synchronous motor, one 40-kw generator direct connected to a synchronous motor, one 10-hp motor operating a Stanley frequency changer, and various other motors, some of which will be direct-connected to machines of different kinds. The company will also have one motor generator set to operate the exhibit, a 75-kw engine type generator, and a switchboard. The company will have motors in the exhibits of different machine companies, used in driving machinery of other concerns.

The Crocker-Wheeler Company, Ampere, N. J., will occupy a floor space of 20 by 24 ft. in Section [illegible], Electricity Building. The space will be devoted to the exhibition of smaller machines of standard types of this company's manufacture, and no attempt will be made to illustrate special applications. The exhibit includes 3 3-hp, 7 7½-hp and 25 25-hp 4-pole motors of the semi-enclosed and completely enclosed types. There will also be shown a 5 hp. size 5 F motor and a size 7½ F motor dynamo consisting of two standard motors direct connected. To illustrate the large size of open type machines there will be a 10-hp and a 20-hp motor, and as an example of the Crocker-Wheeler Company's direct-connected engine type dynamo, there will be exhibited a size 34 D 30-kw 300 r. p. m. machine, mounted on a temporary foundation. This dynamo has an 8-pole magnet, with the Crocker internal flange magnet ring. There will also be exhibited a size 2½ enclosed type heavy torque motor suitable for crane service. This machine is of normal 2½ horse-power, but capable of working up to a much higher torque, and is commonly used for the trolley travel on smaller sized cranes. The Crocker-Wheeler magnetic brake mounted on a 5-hp motor will also be exhibited. The exhibit will also contain several styles of drum controllers, a knife-blade type of starter suitable for very large motors with automatic devices, and a ½-hp, 2-pole motor illustrating the smallest sizes of this form of machine manufactured by this company. The exhibit will be identified by a handsome metal sign bearing the name of the company in about 350 incandescent lamps.

One Telephone Exhibit at the Exposition will consist of a complete central office equipment of the latest design and in full operation. The switchboard and other equipment will be furnished by the Western Electric Company, and is to be patterned after the recent installations by the Bell companies in Boston, New York, Buffalo and elsewhere. It is to be of the common battery multiple type with lamp signals throughout. The switchboard will be equipped for about 600 lines, and will have positions for nine operators. In two of these positions will be placed the incoming trunk lines of the several exchanges of the Bell Telephone Company, of Buffalo. This office will be operated by the Bell Telephone Company of Buffalo, and will, in fact, constitute during the Exposition, one of the central offices of its Buffalo exchange system. The switchboard will be connected to lines extending to telephone stations located at all parts of the Exposition grounds. The wires have been placed underground. One of the features in connection with the telephone exhibit will be the Roar of Niagara, which was such a great attraction at the exhibition in connection with the convention of the National Electric Light Association in New York City a few years ago. It is interesting to note in this connection also that long-distance talking from the Exposition grounds will be effected by means of power developed by Niagara Falls.

Mr. W. Jac Marland, of New York City, as the curator of a collective electrical exhibit in Electricity Building, will represent the following concerns: Charles J. Bogue, New York; Edison-Johnson Electrical Manufacturing Company, New York; Dunn-Martin Electric Company, New York; Thomson Electric Welding Company, Lynn, Mass.; H. C. Cushing, Jr., New York; Prentiss Clock Improvement Company, New York; Power Installation Company, F. B. Sage & Brother, New York; The Diamond Arc Lamp Company, Harold P. Brown, New York; Emile J. Fardie, H. P. Cameron Electric Manufacturing Company, Syracuse, N. Y.; William Roche, New York; Smith & Hemenway, New York; Parsell & Weed, New York; Standard Welding Company, Cleveland, Ohio; Electric Contract Company, New York; Queen & Co., Philadelphia; Socket Extension Tap Company, Boston, Mass.

The Bettini Phonograph Laboratory, of New York, will have an exhibit of recording and reproducing machines in Section "T." of the Electricity Building, which will demonstrate the latest development in the recording and reproducing of sound. The Bettini booth will contain a fine exhibition of much that is new and worthy of public notice in the line of talking machines and attachments, as well as the full line of the Bettini products.

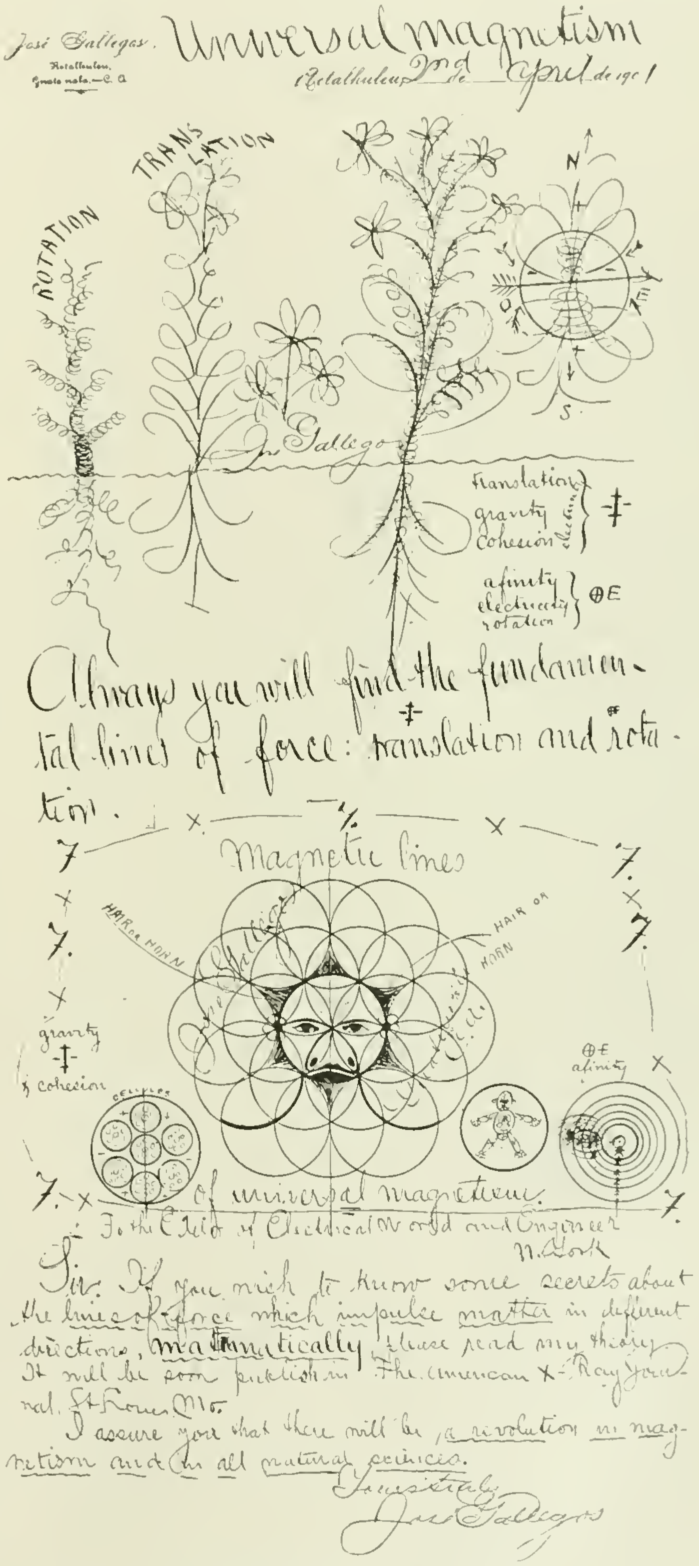
Moving the Stock Exchange Telephones.

A smart piece of work was done last week by the construction and maintenance departments of the New York Telephone Company in the removal of the 400-odd private line telephones used by the members of the Stock Exchange from the old Exchange to the temporary quarters secured at the Produce Exchange. Some weeks before the date of the removal the construction department ran a special 400-pair underground cable from the Stock Exchange to the Produce Exchange, by which to extend the brokers' private lines from the old terminal to the new. At the Stock Exchange the wires of this cable were bridged onto the working lines in proper order and at the Produce Exchange end they were distributed by 25-pair house cables to the positions to be occupied by the telephones. On Friday at 3.30 p. m. the maintenance force of 20 men began the work of dismantling the telephones at the Stock Exchange, and by midnight 430 telephones were in position at the Produce Exchange, connected up and ready for working. Fresh batteries had been placed in position beforehand, so that the work of removal was reduced to its simplest terms. As far as the telephone company was concerned the brokers might have gone right to work in their new quarters on Saturday morning. The removal of 411 telephones (19 of the 430 were new stations), and their connection ready for working at a new terminal within 8½ hours of starting the work is a pretty quick job. The work would actually have been done in less time, however, but for the fact that the backboard of every instrument had to be sawn off to fit under a ledge on the wall or partition of the Produce Exchange.

On testing out the lines the next day, when the brokers' offices were opened for the purpose of assuring communications with the new battlefield, there was found to be no defect in the new line, barring three minor instrument troubles. This well-planned and smartly executed removal speaks well for the efficiency of the construction and maintenance departments of the New York Telephone Company.

A Promised New Theory of Magnetism.

The following reproduction of a letter received is printed as an example of the freak communications which from time to time come to the editor's desk and offer new theories of electricity or magnetism.


José Gallegos.
Retalhuleu,
Guatemala.—C. A.

Universal magnetism

Retalhuleu 3rd de April de 1901

Always you will find the fundamental lines of force: translation and rotation.

Magnetic lines

of universal magnetism.

To the Edit of Electrical World and Engineer
N. York

Sir. If you wish to know some secrets about the lines of force which impulse matter in different directions, mathematically, please read my theory. It will be soon publish in The American X-Ray Journal. St Louis Mo.

I assure you that there will be a revolution in magnetism and in all natural sciences.

Yours truly
José Gallegos

THE LATEST THEORY OF MAGNETISM.

Electrolytic Treatment of Sulphide Ores.

The so-called "complex sulphide ores," and particularly those of the Broken Hill district, have long proved a stumbling block to metallurgists. These ores consist substantially of a mixture of zinc and lead sulphides with considerable silver, are difficult to roast by reason of the high percentage of lead, and have proven exceedingly refractory to after-treatment. The problem has been an attractive one for electrometallurgists, and we find associated with it the names of Watt, Diffenbach, Mohr, Hoepfner, Siemens and Halske, Ashcroft, Swinburne, Canelin, Lorenz, Ketchum and others. That their labor has availed little may be concluded from a recent statement that at present there are recovered from these ores but one-half of the lead, one-third of the silver, and no serviceable portion of the zinc. It is of interest, therefore, that a patent has just been issued (April 23) to Mr. Sherard Osborn Cowper-Coles for the following electrolytic treatment of the Broken Hill ores.

The ores are crushed, mixed with one-fourth to one-half their weight of zinc or copper sulphide, and subjected to a dead roast, the zinc blend serving to keep the mass open and porous during the operation. After screening and removal of dust, the ores are subjected to three distinct leaching operations. First, with dilute sulphuric acid to extract zinc and copper, then with a strong solution of caustic soda to dissolve the lead, and finally with cyanides whereby the precious metals are recovered. During the leaching with acid the ores rest upon an insoluble anode, and an electric current is passed through the bath to a superposed zinc cathode, contained in a porous protector. The solution, now nearly or quite exhausted of free acid, passes through a filter of mixed carbon and iron, or carbon and zinc, fragments, to precipitate any copper, and is thereafter electrolyzed to deposit zinc, employing a lead anode, and as cathode a cast iron cylinder which revolves slowly in the bath. The zinc may be recovered in compact form or as zinc sponge, according to the chemical and electrical conditions.

The alkaline solution containing the lead may be electrolyzed for recovery of the metal, or may be utilized for the production of white lead and sodium carbonate by the direct injection of carbonic acid gas as in the Meyrueis process. The cyanide solution containing the silver is electrolyzed or otherwise treated to recover this metal and any gold which may be present. The fine dust from the crushing is subjected to a separate treatment similar in all respects to the foregoing.

Mr. Cowper-Coles' success heretofore in the electrolytic treatment of zinc solutions and the fact as stated by him before the Society of Engineers that the process has been in successful experimental operation, encourage the hope that the procedure may afford a commercial solution of an extremely difficult problem.

Donations to the Institute Library.

The current issue of the *Transactions* of the American Institute of Electrical Engineers announces donations to the Institute Library aggregating almost 350 volumes. The most important of these are complete sets of the *Comtes Rendus* and the *Proceedings* of the Royal Society. For the purchase and binding of the former, numbering 125 volumes, it is announced that Mr. C. O. Mailloux donated $275. We learn, however, that the set will actually number more than 130 volumes, and that to defray the cost of a better binding than originally provided for, Mr. Mailloux has considerably increased the amount of the donation as printed. The set of the Royal Society *Proceedings* (41 vols.) was donated by Mr. Edward Caldwell.

The other donors on the list are the *Electrical Review, Electrical World and Engineer,* T. C. Martin, W. D. Weaver and Townsend Wolcott. Among the gifts are a number of sets of periodicals, some of which, from the rarity of the earlier volumes, are of great value. Following is a partial list of these:

Electrical Engineering, 1893-1898, Vols. 1-11; *Electricity,* 1891-1899, Vols. 1-17; *Journal of the Telegraph,* 1867-1881, Vols. 1-16; *The Telegrapher,* 1864-1876, Vols. 1-12; *La Lumière Electrique,* 1879-1884, Vols. 1-14; *Scientific American,* 1859-1886, Vols. 1-55 (Vol. 10, 1864, lacking); *Scientific American Supplement,* 1876-1886, Vols. 1-22 (Vol. 13, 1882, lacking); *Street Railway Gazette,* 1886-1893, Vols. 1-9; *Science,* 1880-1894, Vols. 1-8.

Among the books are two useful works of reference, Du Moncel's "Exposé des Principales Applications de l'Electricité (5 vols.), a valuable account of the art covering the epriod to 1873; and Dredge's "Electric Illumination" (2 vols.). The following works of historical value are also numbered among the gifts:

"Evidence in the Bain Suit." U. S. Circuit Court, Eastern District, Pennsylvania. B. B. French et al. *vs.* H. J. Rogers et al. Philadelphia, 1851. This was the personal copy of Professor S. F. B. Morse, and is copiously annotated in his own handwriting.

Nollet L'Abbe. "Recherches sur les Causes Particulières des Phenomènes Electriques." Paris, 1749. In this work the author lays down an electrical theory, according to which the cause of electrical phenomena is the "effluence and affluence" of a subtle fluid everywhere present. When a body is electrically excited it emits fluid of one sign and attracts fluids of another sign. Some interesting experiments with vacuum tubes are described.

"Rapport fait à la Classe des Sciences Mathematique et Physique de la Institut National sur les Experiences du Citoyen Volta." Lu le 11 frimaire, an 10 (Dec. 2, 1801). This is the original report, printed for the Institute, of a committee before whom Volta appeared, consisting of Laplace, Coulomb, Charles Biot, Monge, Foucroy, Vauquelin, Pellatan, Brisson, Guyton and Sabathier. In an appendix the phenomena of the Volta pile are made the subject of mathematical analysis.

New York Automobile Legislation.

Governor Odell, of New York, has signed the bill of Mr. Doughty, providing for registration of automobiles with the Secretary of State and allowing them to run on any highway in the State at a speed not to exceed 15 miles an hour, outside of incorporated cities and villages. The Doughty bill was drawn up by the Law Committee of the Automobile Club of America. The main idea was to secure for motor vehicles a uniform rate of speed throughout the entire State, as it was found that many towns and counties differed materially in their automobile regulations, some going so far as to fall back upon an old law regarding steam engines upon the highway, requiring a person to precede the machine and give warning. The automobilists found that in many instances they were not accorded equal rights with the drivers of horses, and the confusion resulting from these various laws led to the need of a uniform standard.

The Doughty bill regulates the speed of automobiles in cities and villages to 8 miles an hour and in open districts to 15 miles an hour. Municipalities cannot impose a less speed than 8 miles an hour, but they may permit a greater speed, if deemed advisable.

The original draft of the bill was amended in the Senate, securing to the Park Commissioners of New York City their jurisdiction over the speed and admittance of motor carriages in the parks or upon any streets controlled by the Park Department.

The Cable Service to Brazil.

Mr. Eugene Seeger, United States Consul-General at Rio Janeiro, Brazil, makes an interesting report on cable service with our sister Republic: Improvements of an important character, materially affecting the facility and cost of cable communication between Brazil and the United States, have been made by the Western Brazilian Cable Company. As a result of the new line opened by the Commercial Cable Company from New York to the Azores Islands, connecting with the line from Brazil via Lisbon, messages can now be sent without the delays incident to the crush of business in the London offices, which formerly had to handle all the Brazil communications. The managers of the large coffee houses in Rio, who use the service constantly in their business, say that the new lines have proved very beneficial. In addition to the increased facilities, an advantage has been gained in the cost of transmission. The rates have been reduced on an average 25 per cent. Formerly, the charge per word from Rio de Janeiro to New York was nearly $1.30; now it is about $1. The average time for a word in transmission between the two places is from 18 to 25 minutes. Messages have come through in 12 minutes. The company sends all messages by Lisbon and the Commercial Cable Company's line, unless another route is specified by the sender.

The consolidated company operating at Rio de Janeiro under the name of the "Western Cable Company" is a union of the Western Brazilian and the Brazilian Submarine. It has three cables from Pernambuco to Rio de Janeiro, two from Pernambuco to Para, two from Pernambuco to London, and one from Pernambuco to Lisbon.

The following rates may be of interest:

	Milreis.	
Canada, New York City, Boston, Baltimore, Philadelphia, Washington, Chicago, and New Orleans...	4.68 =	$1.00
Barbados	8.91 =	1.91
St. Thomas	9.18 =	1.96
Habana	5.45 =	1.16
Trinidad	9.27 =	1.98

Connections are made with all the important ports from Para to Montevideo. The charges per word are based on the average rate of exchange for every three months, as determined by the Brazilian Government. At present it is 900 reis to the franc (19.3 cents), and if exchange remains above 11d., it will soon be considerably less.

Submarine Torpedo Fighting.

In his recent lecture on submarine boats, noted last week, Mr. Holland discussed various features, such as the use of such boats for passenger travel. As to submarine fighting he said: "When the first submarine torpedo boat goes into action she will bring us face to face with the most puzzling problem ever met in warfare. She will present the spectacle, when used in attack, of a weapon against which there is no defense. You can send nothing against the submarine boat, not even itself. You cannot fight submarines with submarines. The fanciful descriptions of the submarine battles of the future have one defect. You cannot see under water. Hence you cannot fight under water. Wharves, shipping at anchor, the buildings in seaport towns, cannot run away. The sending of a submarine against them means their inevitable destruction. To-morrow, if we had a fleet of submarines big enough, they could protect New York Harbor against an attack by the combined fleets of the world. But our shipping and our city would still be at the mercy of the enemy, if they had only one submarine, manned by a fearless crew of experts. You could not mine against her, for she would countermine. You could not close the harbor against her, even with a network of torpedoes and chains stretched across the Narrows, reaching from the surface to the bottom of the channel. From a safe distance she could send a torpedo against the network that would blow it to pieces, giving her all the passageway she wanted to go in and out. You could not chase her with a fleet of your own submarines, because you could not find her under water. How the menace of the submarine is to be met nobody has at this time been able to say. The genius of scores of inventors is grappling with the problem, but so far without result. All are agreed, however, that in one direction at least she will forever remain unconquerable. She will make a close blockade impossible."

The Long-Distance Automobile Endurance Test.

The automobile test of 500 miles from New York City to Buffalo, under direction of the Automobile Club of America, will be held during the week beginning Monday, Sept. 7. The Automobile Club committee has now announced the date and details of the trial. The regulations include tests for five classes of vehicles. The classes are:

Under 1000-Pound Class—Four-wheeled motor vehicles weighing under 1000 lbs., in commercial running and operating condition, with tools, fuel and supplies on board.

1000 to 2000-Pound Class—Four-wheeled motor vehicles weighing between 1000 and less than 2000 lbs., in commercial running and operating conditions, with tools, fuel and supplies on board.

2000-Pound or Over Class—Four-wheeled motor vehicles weighing 2000 lbs. or over, in commercial running and operating condition, with all tools, fuel and supplies on board.

Motor Cycle Class—Motor bicycles, motor tricycles and motor quadricycles.

Public Service Class—Public conveyances and freight conveyances. These shall carry a minimum weight of 750 lbs., exclusive of their driver.

The test will occupy six days, and the speed conditions will be based on an average rate for the six days. Any competitor falling below an average of 8 miles an hour for any one period will receive no credit for that period, and no average speed exceeding 15 miles an hour will be recognized. Three grades of certificates of honor will be awarded—first, for an average speed of 12 to 15 miles an hour; second, for an average speed of 10 to 12 miles an hour, and, third, for an average of 8 to 10 miles an hour.

The route for each of the six days will be divided into the following six stages:

First Stage—From clubhouse to Poughkeepsie; approximate distance, 90 miles.

Second Stage—From Poughkeepsie to Albany; approximate distance, 70 miles.

Third Stage—From Albany to Little Falls, including a hill-climbing trial near Little Falls; approximate distance, 85 miles.

Fourth Stage—Little Falls to Syracuse; approximate distance, 85 miles.

Fifth Stage—Syracuse to Rochester; approximate distance, 90 miles.

Sixth Stage—Rochester to Buffalo; approximate distance, 80 miles.

The contest is open to all classes of self-propelled vehicles, but no manufacturer, agent, or private owner will be allowed to enter more than three vehicles in any one class.

The Trolley in Massachusetts.

The subjoined statistics give the development of the trolley system in Massachusetts during the last 10 years:

	1900	1890	Increase.
Number railways..........	118	78	40
Total mileage............	2,037	612	1,425
Electric mileage.........	1,908	160	1,748
Gross liabilities........	$95,062,946	$25,611,989	$69,450,957
Capital stock............	48,971,168	14,879,130	34,092,038
Total income...........	21,387,641	8,388,015	12,999,626
Net earnings.............	6,839,693	2,104,077	4,735,616
Capital earning dividend...	38,901,700	....	....
% earned.................	6.68	....	....
Capital without dividend...	10,069,467	....	....
% dividend all capital.....	4.92	6.77	*1.85
% expense to earnings......	65.80	74.80	*9.00
No. passengers...........	395,027,198	164,073,846	230,953,352
Gross per mile...........	$10,452	$13,632	*$3,180
Exp. per mile............	6,878	10,197	*3,319
Net per mile.............	3,508	3.435	73
Gross per passenger.......	5.06c	5.06c	....
Expense per passenger....	3.33c	3.79c	*.46c
Net per passenger.........	1.73c	1.27c	.46c
No. employees............	12,766	6,246	6,520
No. cars.................	6,531	3,247	3,284
Horses	455	11,241	*10,786

*Decrease.

Mileage has increased more than three-fold; investments nearly four-fold; income less than three-fold; passengers less than two-fold, and at the same time while gross earnings and expenses per mile declined largely, the net per mile was somewhat larger in 1900 than in 1890. The economy in operation is also reflected in the increased net earnings per passenger; 1.73 cents in 1900 compared with only 1.27 cents in 1890. The adoption of larger cars is shown in the increase of only about 100 per cent in number of cars and number of employees.

The reduction in horses from over 11,000 to less than 500 indicates the removal of the horse as the prime factor in street car transportation prior to 1890.

The net returns upon the total capital invested shows a decrease for the decade of about 1½ per cent. But if the Boston Elevated's capital is deducted the earnings upon the remaining capital would be above 7 per cent in 1900, an increase of about ½ per cent over 1890.

The Successful Scot in America.

Note was made in these pages recently of the appointment of Mr. H. G. Stott to the Manhattan Elevated Railway. Professor Andrew Jamieson contributes the following story to the Glasgow *Evening Times,* which is worth reproduction here: "I have just received a copy of your *Evening Times* of the 6th inst., containing an extract from the *Illustrated Buffalo Express*, which gives an account of my old student, Mr. Henry Gordon Stott, who has recently received the important appointment of superintendent of the motive power department of the great Manhattan Electric Railway Company in New York City. As the first technical adviser and stimulator in Mr.

Stott's career, I read your article with special interest and pleasure. Although I could give several instances of his pluck and perseverance, I shall only describe one of these at present. One day, in 1884, when engaged in my electrical laboratory at the College of Science and Arts, I received notice from a well-known Clyde shipbuilding firm that they desired to have the electric lighting installation in one of their new ships tested and reported upon. Being unable to leave my classes for such work until the following Saturday, and being desirous of having a preliminary test and report, I asked a fine young Englishman if he would go down the Clyde with my instruments and make the necessary tests, etc. He replied: 'Where shall I get my dinner, sir?' I shrugged my shoulders and turned to a Scotchman from the borders with the same query. He said: 'When shall I get home, sir?' In utter despair, I said to young Stott (whom I had brought from Orkney), 'Please go down the Clyde to the Gareloch with these instruments and come back when you have finished the tests.' The reply came instantly, 'Aye, aye, sir,' in proper sailor-like fashion. He appeared about 8 p. m. at my house with the results taken exactly as requested. I said, 'Have you had anything to eat?' 'Nothing, sir, since breakfast.' My wife soon provided a substantial supper for him, and there the preliminary canter ended.

"Within a week I had a letter from the general manager of the Anglo-American Submarine Telegraphic Company, asking if I could send a junior electrician to him at once, as their ship was leaving London very soon to repair one of the Atlantic cables. I went direct to Mr. Stott, and before all the other students who had heard of the previously mentioned case, I said: 'Mr. Stott, come here. Pack up at once and go to London. Take this letter to the general manager of the Anglo-American Cable Company, and let me know how you get on.' 'Aye, aye, sir,' was the reply, and away he went at once, after bidding good-bye to myself and his fellow students. I could give many other instances of my old students forging ahead to the top of the tree in different parts of the world, but none with a better moral for young Scotchmen than this one."

Trolley in the Canary Islands.

Mr. S. Berliner, United States Consul at Teneriffe, Canary Islands, writes the State Department as follows: The electric tramway connecting the port of Santa Cruz with the town of La Laguna will be open to the public on March 15, 1901. Besides carrying passengers, the managers have trucks for moving freight, principally fruit, which is the main export from this island. The power house is situated at La Cuesta, a little over half way (about 3 miles) between the two towns and at an elevation of 960 ft., La Laguna being 1804 ft. above the sea level and distant a little over 5.6 miles. The cars start from the mole at the port and run through the principal street up the main road, which is built on a zigzag plan on account of the grade. It is but a single track, with switches at every kilometer, except in the town of Santa Cruz, where it runs up one and comes down another street. It is an overhead-trolley system, the wires being strung on poles, some of wood and others of iron. In the towns, it is strung over the street from house to house by rivets driven into houses opposite each other and connected with a wire.

The concession for this road was granted at Madrid and includes the whole of the road between Santa Cruz and Orotava. From the present terminus, there will be a regular service of automobiles to the town of Orotava until the tramway is finished. The total length of the line will then be 27 miles. The company is known as Cia. Electrica de Tramvia de Teneriffe. It is a Belgian company, and is capitalized for 1,600,000 francs ($308,800). The rails, rolling stock and machinery were imported from Belgium, although part of the same was originally from Italy, France and the United States. It is a 3-ft. 3-inch gauge, and the concession provides that the road must be finished within five years.

There is also a concession for an electric tramway of double-track system between the ports of Luz and Las Palmas, in the island of Grand Canary, which has been granted to a Belgian company. The road will run along the seashore front and will extend from 4 to 5 miles. It will be a great improvement and no doubt a better paying investment than the Santa Cruz-La Laguna road, as Las Palmas is now virtually the principal town of these islands, and is doing about double the business of Teneriffe.

Tragic Death of Mr. I. H. Farnham.

THE LATE I. H. FARNHAM.

Consternation and deep regret were caused throughout telephonic circles by the receipt of the following dispatch on April 24 from Portland, Me.: "Insanity seems to be the only theory of the cause of the shooting in the New England Telephone Company's central office this afternoon, whereby Chief Electrician I. Henry Farnham, of Wellesley, Mass., met with instant death and three electricians were wounded, one of whom died later, by Geo. H. Brainard, of Boston, a foreman of a construction crew. Brainard's wife, who has made her home here with him during the three months he has been in charge of alterations in the telephone office, says he has been nervous lately, and that he slept hardly any in the last two nights. She says so far as she knows he had only kindly feelings toward the chief electrician and the crew. Seven men were at work in the upper story of the telephone office building when the shooting occurred. Without warning, Brainard drew a revolver from his pocket and rapidly fired three times at Chief Farnham. All three bullets took effect, one in the throat, another in the right side and the third entering the region of the heart and passing entirely through the body. When Farnham fell, Brainard opened fire on three other electricians in the room, wounding them all. Two men who were working behind the tall switchboard escaped, probably because the murderer was not aware of their presence in the room. At the hospital to-night it was reported that the two wounded were in a critical condition, with the chances against recovery. Deputy Marshal Frith, who grappled with and arrested the murderer, was shot at, but received only a trifling wound. The bullet passed through a package of letters in his coat pocket, and its course was diverted by contact with a pocket mirror."

Mr. I. H. Farnham, who was thus so cruelly and suddenly killed, was one of the most highly esteemed members of the electrical fraternity. He began in the telegraph field with the old American Company in 1866, and was with the Western Union Company for years. He had been actively engaged in telephony since 1879, and was for some time managing electrician, superintendent, etc., of the Maine Telephone Company. He took out several patents on improvements in the telegraphic and telephonic arts, and was noted for his skill and expertness as a telephone engineer. He joined the American Institute of Electrical Engineers in 1887, and his paper on electrolysis due to stray underground currents was probably the first authoritative treatise on the subject. It remains in continued demand up to the present time. Mr. Farnham was still a comparatively young man, having been born at Woolwich, Maine, Nov. 2, 1853. His loss is severely and deeply felt by his family and by a wide circle of appreciative friends. The portrait here shown is believed to be the latest and is taken from the group picture of the clam-bake of the American Electrical Works, at Providence, last summer. It is a sad coincidence that in the same row with Mr. Eugene F. Phillips sat Mr. Farnham on one side and Dr. Elisha Gray on the other

April Meeting of the American Institute of Electrical Engineers.

At the meeting of the Institute of Electrical Engineers, April 26, a proposed new constitution for the Institute was submitted, final action upon which will be taken at the annual meeting of the Institute in May. Two papers were read before the meeting, one by Professor Harris J. Ryan on "The Transformer for Measuring Large Direct Currents," and the other by Mr. F. W. Brady on "Electricity in Mountain Mines."

Professor Ryan in his paper described a method in which a low-reading ammeter may be used in the measurement of very large direct currents. The method is as follows: A special transformer has a coil of a number of turns, in the circuit of which is connected the low-reading standard ammeter and a water rheostat; a second coil of a single turn is connected in circuit with the large current to be measured. The two coils are so mounted on the special transformer that magnetic leakage is reduced to a minimum. Surrounding the magnetic circuit of the transformer are two smaller coils, one of which is connected with a source of alternating current, and the other with a galvanometer. When measurements are being made the amount of current passing through the standard low-reading ammeter is varied until the deflection of the galvanometer becomes a maximum. Since the alternating current is constant in value it follows that at this point the permeability of the magnetic circuit is at a maximum, and in order for this condition to exist there should be no flux in the circuit from the direct-current coils. In other words, at this point the ampere-turns of the single coil will be equal to the ampere-turns of the multiple coil in circuit with the low-reading ammeter. Knowing the ratio of the turns of the two coils, the large current flowing through the single coil will be that indicated by the standard ammeter multiplied by the ratio of turns.

The paper by Mr. Brady is descriptive of several electrical installations for mining purposes in the Rocky Mountains. The paper is interesting from the description which it gives of the manner in which the obstacles to transportation of machinery over rugged mountain trails were overcome, and from the indications contained as to the kind of installations that are suitable for the duty called for in the cases described.

Transformer Patent Litigation.

Judge Coxe, of the United States Circuit Court of the Northern District of New York, has handed down a decision in two suits of the Westinghouse Company against the Saranac Lake Electric Light Company, alleging infringement of two patents on transformers.

One of these patents was granted Sept. 24, 1889, to Rankin Kennedy on the use of transformers in parallel on a primary circuit. In June, 1883, Kennedy, in an article published in the *Electrical Review,* of London, relating to the use of transformers in parallel, says: "In parallel arc, however, the secondary generator is a beautiful self-governing system of distribution; but what about the size of the conductors for such a system? Prodigious!" In a letter published in the same journal, Nov. 19, 1886, Kennedy takes issue with Zipernowski and Deri concerning their claim that they were the first to make "the simple connection of secondary generators in parallel arc." He maintained that he was the first to do this, and wrote: "I then thought of and tried parallel arc connection and perfectly succeeded in obtaining self-regulation. There certainly is not much visionary about that; the visions of a monopoly I am afraid are all on the other side, and my experiments and published results are likely to somewhat mar the beauty of monopoly visions. * * * I do not know anything about 'rational methods of connections of transformers.' I know only two methods of connecting to the main—series and parallel—both of which methods it is open for anybody to apply to any form of transformer." The Court considers there is no escape from the conclusion that Kennedy intended that the public should have whatever he had contributed to the art in the 1883 articles referred to, and that the 1886 letter is to be construed as an abandonment of the invention.

The Stanley patent in suit was granted March 1, 1892, upon an application filed Aug. 15, 1888. The invention to which the patent refers was put in use at Great Barrington, Mass., March 16, 1886. The claims involved in the Stanley patent are the first and third, and relate to the use of transformers in multiple arc, each transformer being "made with a primary coil containing such length of wire exposed to magneto-electric induction that when operated by the dynamo with which it is to be used with its secondary circuit open the electrical pressure and counter pressure in the primary circuit shall be equal with incandescent lamps or other translating devices in the secondary circuits." The above quotation is from the first claim, and the following from the second claim. "Each converter is adapted to the dynamo operating the system by making its primary coil of such length that when supplied with its full proportional share of the entire normal e. m. f. of the machine, its secondary circuit being open, the electrical pressure and counter pressure in its primary circuit shall be approximately equal with translating devices in the secondary circuits of the converters, to be cut out of circuit when not in use without the introduction of any resistance in place of them."

The following is Judge Coxe's construction of the bearing of the above claims:

"Stanley's contribution to the art of electric lighting is an improvement upon the method described in the Kennedy patent. It still remained to discover a way to prevent the varying-candle-power of the lamps on a given transformer when a part of the lamps were turned off or on. If, for instance, there were 20 lamps on the transformer, and all were burning, the turning off of 10 would change the candle-power of the remaining 10, increasing the luminosity. If they were turned on again the candle-power of all would go down.

"The difficulty was a serious one and electricians generally were searching for a solution, but always along the same lines. Stanley found a solution by doing what no one had ever thought of doing before. He discovered that he could remedy existing faults by regulating the length of the wire on the primary coil of the transformer. The patent tells those skilled in the art how to accomplish this result. To the uninitiated Stanley's rule seems indefinite and obscure, but electricians have no difficulty in understanding it. He determines the correct length of the primary coil by winding on wire after the transformer, in circuit, is connected with a dynamo, until the loss of voltage represented by the formula C^2R equals the predetermined loss of energy to be suffered in the system. The length of the wire is varied until the desired results are attained.

"What Stanley did was an exceedingly valuable addition to the art. He remedied a serious defect; he secured, without unnecessary waste of current, constancy of secondary pressure as lamps were turned on or off; he struck out into a new path and brought back the prize, which, if he had continued upon the old paths, he never would have found. Such a discovery cannot be attributed to the 'skill of the calling.'"

The Court held that an article in the London *Electrical Review* of August, 1885, describing the Zipernowski and Deri plant at Budapest, in which transformers were employed in parallel, did not furnish an anticipation of the Stanley patent, for the reason that "the article in question imparts no information upon the one subject which is the all-essential feature of the Stanley invention—the length of the primary wire and the method of determining the same. * * * It fails to tell electricians how the length of the primary wire can be correlated to the voltage and alternations of the current supplied."

The Court sustained the Stanley patent.

Telephony in Mexico.

The annual report of the Mexican Telephone Company for year ended Feb. 28, 1901, has been issued. It is as follows:

	1900-01.	1899-'00.	1898-99.
Tel. in service	3,501	3,065	2,726
Rentals for year.......	$172,905	$149,137	$130,026
Gross earn. in Mex....	187,466	160,640	138,937
Gross exp. in Mex....	102,635	93,251	82,497
Net earn. in Mex	84,830	67,388	56,440
Operating expenses....	75,798	71,334	67,347
Maintenance	26,836	21,916	15,149
Construction	58,697	34,333	35,782
Taxes	8,052	7,398	6,709
Net rev. U. S. cur....	35,803	26,519	21,337

The average equivalent received for Mexican dollars for the year was 49.24 cents in gold. In the City of Mexico exchange 25,600 ft. of cable have been hung during the year, at a cost of $21,600. It will be necessary during this year to add about 24,000 ft. of new cable.

Another 300-line addition was made to the City of Mexico switchboard at a cost of $4,587. If the present rate of increase continues it may be necessary to make another addition to the switchboard the coming year. The plant has been improved to the extent of $58,697 the past year, and was never in better condition than at present. The gain per subscriber in the gross earnings in all the exchanges over the preceding year was 72 3-5 cents, the decrease in expenses per subscriber $1.3441, making a total gain per subscriber of approximately $2.07.

Long Distance Hypnotizing.

A test of hypnotizing over telegraph and telephone wires between Denver, Colo., and Pueblo, 120 miles, is reported by the Colorado papers. Apparently the ability to do such a thing has been proved once more, but the utility of it as a new industry was not clearly established.

CURRENT NEWS AND NOTES.

TROLLEY PARCEL TRAFFIC.—Attorney General Knowlton, of Massachusetts, has rendered an important opinion in relation to the question of the constitutionality of the bills authorizing street railways to carry merchandise in small packages. Mr. Knowlton has stated that the bills are constitutional.

THE BRITISH PACIFIC CABLE.—A San Francisco correspondent informs us that the western cable landing of the British Pacific cable has been located at Barclay Sound, on the west coast of Vancouver Island. A town will be laid out and cottages built for the cable employees on the 100-acre site.

GERMAN ELECTRICAL INVESTMENT.—The principal electric manufacturing companies in Germany with their finance companies, have a paid in share capital of about Mks. 369,300,000 and 205 millions bond capital. This makes in total a working capital of Mks. 574,300,000 or about 136 millions of dollars. The dividends paid last year, together with the interest on the bonds, amounted to something over ten millions of dollars.

TELEGRAPHONE TEST.—A successful test of the telegraphone in connection with long-distance telephonic transmission was recently made on a Boston-New York telephone circuit. Mr. T. D. Lockwood, of the Bell Telephone Company, spoke to the instrument in Boston and the conversation was recorded by the telegraphone and subsequently reproduced by it with great distinctness. A test between New York and Chicago was not so successful owing to its having been made during extremely wet weather.

FOUR-FIFTHS OF A MILE SPAN.—The Bay Counties Power Company has accomplished the feat of stringing four electric power cables across the Straits of Carquinez, near Benicia, Calif. It is claimed that the span of 4400 ft. between the towers is the longest of the kind in the world. The sag, or deflection from a horizontal line, is 135 ft. The cables were manufactured of plow steel, and are seven-eighths of an inch in diameter. They are insulated at both the towers and the anchors by special devices involving original methods in electrical engineering. These cables are the largest of their kind, and carry a higher potential than those of any similar span.

ELECTROLYTIC COPPER REFINING.—The New York papers last week contained despatches from London of a sensational character relating to a revolutionizing electrolytic process, the American rights of which, it was stated, had been secured by Senator W. A. Clark. According to the newspaper accounts the process will work a revolution in the copper industry, enabling a saving of $100 per ton to be made in transformation from the ore to the completed article of commerce. What little information concerning the process was given would appear to indicate that it is the well-known Cowper-Coles process, whereby instead of copper being deposited in the electrolytic bath as rough cathodes, commercial tubes, bars or plates are formed at the cathode in the process of electrolytic refining.

CALCIUM CARBIDE.—It is now well understood that the formation of calcium carbide may proceed to a very appreciable extent after the charge has left the arc or main heat zone of the furnace, provided the formed carbide be kept in contact with the unconverted raw material, at a sufficient temperature, and out of contact with air. In a patent issued April 23, Dr. Frölich, of Steglitz, Germany, proposes a means to this end consisting of an elbow-shaped tube connected with the tapping hole of the furnace, and provided with a suitable closure, which may be either a trapdoor or a flexible asbestos tube. The too rapid cooling of the product, which has a tendency to prevent the desired after-formation of carbide, is prevented by burning the reaction gases, consisting mainly of carbon monoxide, in an annular muffle surrounding the tube, the gases being withdrawn for this purpose through the tubular upper electrode.

WELDING ALUMINUM.—The thin surface coating of oxide always present upon aluminum renders it extremely difficult to effect a perfect union of two surfaces of the metal either by soldering or welding, and especially at the high temperature required for the latter operation. In a patent issued April 23 to Max Schmidt, of Berlin, Germany, it is proposed to accomplish this by effecting the decomposition of this oxide by electrolysis. To this end the aluminum surfaces to be joined, previously heated to a welding temperature, are placed in a slightly separated relation and connected as the cathode of a circuit of low voltage and high amperage. A rod of graphite or platinum, constituting the anode of the circuit, is then passed between and in contact with the edges of the seam, thereby removing the oxide layer, in part mechanically and in part by electrolytic reduction. The welding operation may then be effected without hammering or pressure.

WIRELESS TELEGRAPH PLANS.—A special cable dispatch from London of April 27 says: The Marquis of Londonderry, Postmaster-General, received a deputation of the directors of the Marconi companies yesterday. They ask for a license for the transmission of wireless messages within territorial waters between ships and land stations. The post office, which, of course, controls the telegraph, has a monopoly that extends to the three-mile limit. The deputation also asked on what terms the companies might organize sea telegraphy, expressing confidence that a business man at sea would like to maintain daily relations with the chief centers of trade, and that many passengers would like to communicate with their friends on shore, all of which would add to the revenue of the Post Office Department. They also asked for a license in order to arrange for dealing with telegraphs to and from foreign places and for land purposes. The Marquis of Londonderry promised to consider the matter and consult the heads of the various departments concerned. The reply was not considered very satisfactory.

STREET RAILWAY STANDARDIZATION.—The Committee on Standardizing of Street Railway Equipment, appointed at the recent meeting of the executive committee of the American Street Railway Association, has begun active work with a view to presenting a comprehensive report on the subject at the annual meeting of the association in October next. Mr. T. E. Crossman has been appointed secretary to the committee, and in conjunction with the members of the committee, he will visit some of the leading manufacturers of street railway equipment to ascertain their views on the subject of standards. The members of the committee are John R. Graham, Lynn & Boston Railroad Company, Boston; N. H. Heft, Meriden Electric Railroad Company, Meriden, Conn.; Frank G. Jones, Memphis Street Railway Company, Memphis; Willard J. Hield, Twin City Rapid Transit Company, Minneapolis; Conway F. Holmes, Metropolitan Street Railway Company, Kansas City. They request that all who are interested in the subject will correspond with the secretary of the committee, whose address is 1829 Park Row Building, New York, prior to May 20, at which time a meeting of the committee will be held in Buffalo. We trust our readers will communicate their views to the committee.

GERMAN LIFE-SAVING APPARATUS.—Consul-General Guenther, of Frankfort, March 20, 1901, informs the State Department of a recent improvement in the means for saving life at sea. It has often happened, says the Consul-General, that on account of darkness, life belts could not be seen when thrown to persons who had fallen overboard at night. Buoys with life belts attached and supplied with 8-cp electric lights have been constructed heretofore, but their use was confined to vessels equipped with electric-lighting plants, and their heavy weight, requiring three or four men to handle them, was a serious handicap. The new apparatus weighs but 33 lbs. and produces a light equal to 150 candle-power. The buoy is of a globular form, carries from two to four life belts, and supports a long cylinder of sheet tin having 12 compartments filled with carbide of calcium. These compartments are arranged at different elevations. When the apparatus is thrown into the sea the water passes through perforations in the bottom of the cylinder and, coming in contact with the carbide, generates acetylene gas. Each compartment is connected with a burner by a pipe, proper valves preventing the escape of the gas other than through the burner. When the volume of gas in the cylinder decreases, hydrostatic pressure opens the valves and allows water to enter the next compartment to generate an additional supply of gas. The gas is lighted electrically, and ignition takes place in about 25 seconds after the buoy is thrown into the sea. The flame is protected from the wind by glass and burns steadily and with great intensity for three or four hours. Cleaning and filling the apparatus require only a few minutes. The cost of a charge is about 12 cents.

TROLLEY FREIGHT.—An ordinance in Detroit allows the street railways to carry freight within the city limits.

AUTOMOBILE SPEED.—The State Department has been prevailed upon by those who believe there should be general restriction of the speed of motors in cities, to procure from consuls of the United States reports showing the rules in force in foreign countries that have been constrained to apply rules.

MARCONI STATION IN ENGLAND.—A London despatch states that Marconi's wireless telegraph company is erecting a station on the mainland of England nearest Fastnet Rock. All vessels fitted with the transmitter will be able to report themselves when they are many miles beyond the rock and thus avoid threading the passage separating it from the mainland.

CHEAP PRODUCER GAS.—A cable dispatch from London of April 29 says: The Daily Chronicle says it learns that Dr. Ludwig Mond has discovered a method of producing illuminating coal gas at twopence per 1000 feet, which will effect a revolution by cheapening electric power, and also as bearing upon the production of open-hearth steel.

GOVERNMENT TELEGRAPHS.—In an address before the Presidential Postmasters' Association, of Ohio, Congressman Dick, Chairman of the Republican State Committee, declared himself in favor of Government control of telephone and telegraph lines. All means of communication, he declared, should be under Government supervision, telegraphic and telephonic, as well as the mail system, and added that this is certain to come. The United States finds, he said, that the surplus of its products must be disposed of in the markets of the world. It must not only protect but aid its commercial interests, and in commerce it is an advantage that communication be not only swift but inexpensive. If a telegraphic communication can be sent by the Government for 5 cents, then a private corporation must not be permitted to charge and collect 25 cents for that service. The means of communication ought to be the Government's monopoly not that of a private corporation. Gen. Dick also declared himself emphatically in favor of a postal savings system.

DETECTING TELEPHONE LISTENERS.—A special dispatch from Stockholm, Sweden, of April 10, says: An employe of the Stockholm Telephone Company has invented a device by which the telephone user can tell when a third party is listening to his conversation. The visible part of the device is a small metal box with a glass front. This is attached to the wall or desk near the telephone instrument. The pressing of a button connects the "listener detecter," as it is called, with the telephone. The intrusion of "central" is indicated by the illumination of a red Maltese cross behind the glass of the "detecter," which remains lighted up as long as "central" is on the wire. The connection of the operator at the second exchange with the wire is indicated by the illumination of a white cross, so that the telephone patron can tell not only when and how long the operator is on the wire but also which exchange "cuts in" to ask him whether he is through talking or to listen to what he is saying. The device, including its installation, costs less than $2, and is being put in by a large number of business houses which use the telephone for transacting more or less confidential business.

LETTERS TO THE EDITORS.

Vacuum Tube Lighting by Metallic Vapor.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of April 27, 1901, there is an editorial on the Hewitt vapor lamp. I here state that the discovery of vacuum tube lighting by metallic vapor was not made by Mr. Hewitt. In my "Notes on Light," which have been appearing in one of your contemporaries for four years, such a lamp is described and figured, the mercury cathode being shown. This note was printed more than 15 months ago, and the experiment had been tried successfully in the summer of 1896, the same results being arrived at. Also in the *American Journal of Science* for November, 1900, in my paper on X-light, in which a brief account of some of my vacuum tube work was given, I spoke of the tube and said it gave a brilliant light. That an experimenter does not care to waste his time by going into commerce to exploit his observations unless they can be used to relieve human suffering is no reason why his results should be ignored and the work credited to subsequent inventors.

You speak of the probability that such tubes may be of scientific interest. This is quite true, for this form of tube has already served to disprove the theory that the cathode stream particles are the ultimate units of either matter or elecricity, and has thrown light on other difficult problems in physics. You also speak of the impossibility of using the light on account of its color. It is a simple matter to change this color by alloying the mercury.

Boston, Mass. William Rollins.

[Has Mr. Rollins actually demonstrated that it is a simple matter to change the color of the light by alloying the mercury, and at the same time retain the remarkable properties of the plain vapor lamp?—Eds.]

Instruction in Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs—I have read your recent editorial on "Electro-Chemistry" with great interest. I cannot agree with you that "in this country the instruction in electro-chemistry is evidently largely based upon the theories and methods current a quarter of a century or more ago," for I am sure that if you were to visit the large technical schools and universities you would discover that they are thoroughly conversant with the most recent ideas of the Arrhenius-Van't Hoff-Nernst-Ostwald school, and that excellent research work is being done in accordance with these views.

I do, however, concur with you in the thought that more attention should be given to undergraduate instruction in this field along practical lines. The future chemists and chemical engineers should receive drill in this direction as well as in other fields of chemistry. In our own University we began instruction in electro-chemistry as early as 1878. The direction taken was in analysis, in the extension and use of the current, with all the metals which would respond to it. The result has been that a number of useful, rapid, practical metal separations were developed, and have met with extended application.

It may perhaps be not improper to add that our seniors in chemistry study in our electro-chemical laboratory such problems as the dependence of fall of bath pressure in the electrolyte upon current density, concentration and temperature of solution; the influence of current density and concentration upon the course of electro-chemical reactions; the application of gas analysis to the study of electro-chemical reactions (formation of hypo-chlorites and chlorites); the electrolysis of hydrochloric acid with a diaphragm; ion transference; the formation of persulphuric acid; metal precipitations with soluble and insoluble anodes (copper refining); the Siemens' copper process; experiments with molten electrolytes; experiments with multipolar electrodes; the electrolysis of salt solutions with mercury cathode; the application of the current to the oxidation and reduction of organic compounds, and the study of reactions in the electric furnace. In the latter we have recently prepared a number of new and perhaps commercially valuable alloys. This sketch will afford you an idea of the direction in which we have been pushing, and, I may add, that graduate students are being attracted to the course.

As to the literature in the English language upon the above subject, I think that there is an abundance, one of the most recent contributions being Blount's "Practical Electro-Chemistry," which deserves favorable mention. Edgar F. Smith.

University of Pennsylvania.

Aluminum Wire for Interior Work.

To the Editors of Electrical World and Engineer:

Sirs—The Underwriters' rules for wiring forbid the use of smaller wire than No. 14 (B. & S. gauge), presumably on account of the lack of mechanical strength of the smaller sizes. In many cases, such as the supplying of current for a single lamp, or for more than one lamp on a 220-volt current, the current-carrying capacity of a smaller wire would be ample. Why might not an aluminum wire of No. 14 gauge be substituted for copper in such cases with economy? For inside wiring its strength would be sufficient. Its carrying-capacity is given by the 1901 rules as 10 amperes for weather-proof insulation, and 13 amperes for rubber covered (84 per cent of copper of same size). Its resistance would be nearly double that of copper, but for short runs this would not be prohibitory. Since aluminum weighs but 3-10 as much as copper, at twice the price per pound it would cost 6-10 as much for same size and length bare. The insulation would cost the same as for copper wire, hence if the insulation of No. 14 weighs the same as the copper, the final cost of weather-proof aluminum wire No. 14 would be 8-10 that of copper, or, say, $4 per 1000 ft. for aluminum as compared with $5 for copper. In the case of rubber covered wire the cost of the metal bears a smaller proportion, but the price of $14 rubber covered aluminum should be about $9 per 1000 ft. to $10 for copper.

To permit ready soldering, could not the aluminum wire be tinned just as the copper wire is generally tinned before being insulated with rubber? There is so much No. 14 wire used that a saving of from 10 to 20 per cent would be important. The above was suggested by the editorial regarding aluminum lines in your paper of April 20.

Morgan Brooks.

Lincoln, Neb.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Large Generators.—Pichelmayer.—A communication referring to the article of Robert (Digest, March 23). He says it is not yet decided whether the American designers are right in entirely neglecting the Arnold winding. Parshall's designs are not exclusively typical for American dynamo design. There are also the designers of the Westinghouse Company, "the machines of which are built according to the principle. Many lines of force and few windings. The whole development of the dynamo design consists to a large degree in a slow, but continuous increase of the intensity of the magnetic field, while in the first Siemens machine B was about 300, we have now already arrived at $B = 12{,}000$."—*Elek. Zeit.*, March 21.

REFERENCES.

Synchronous Converters.—Meyer.—An illustrated article on the calculations of synchronous converters. While in a synchronous converter a direct-current generator and a synchronous motor are combined, the more difficult part is that of building a good direct-current dynamo under aggravating circumstances. He discusses the choice of the frequency, number of poles and revolutions per minute, diameter, armature reaction, the allowable tension per commutator segment, current density in the armature wires, form of the slots and armature winding, flux of lines of force per pole and choice of the straying coefficient, choice of the density of lines of force in the single parts, determination of the breadth of the machines and of its parts, form of the pole shoes and length of the air-gap, exciting ampere windings per pole, commutator, efficiency. The article is concluded by some remarks on hunting.—*Elek. Zeit.*, April 4.

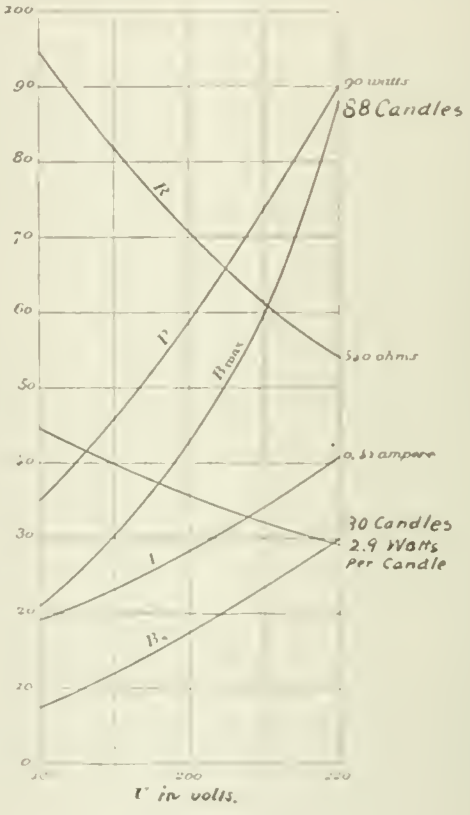
Calculations of Field Coils.—Osnos.—An article supplementary to his former one (Digest, Jan. 19). He gives a simple method of calculating the field coils of a new machine which is to be predetermined.—*Zeit. f. Elek.*, April 7.

Lights and Lighting.

Train Lighting.—Wallitschek.—A paper read before the Electrotechnical Society, of Vienna. In Europe there are at present more than 8000 cars electrically lighted, of which 620 are in Austria and Hungary. An Austrian railroad, which has used electric train lighting experimentally, gives the cost of a 6-cp lamp-hour as 0.6 cent. This railroad will continue to use electric train lighting. The German post office, which uses electric light for the mail cars, gives the cost of a 12-cp lamp-hour as 0.9 cent. On the Jura-Simplon Railroad the normal candle-hour costs 0.09 cent. He discusses the different systems of train lighting. He thinks the pure accumulator system will be the system of the future. In the discussion which followed, Dick said that the combined dynamo and accumulator systems is much cheaper than the pure accumulator system.—*Zeit. f. Elek.*, March 24, 31.

Electrolytic Arc Light.—Mueller.—A brief communication referring to the article of Rasch, noticed recently in the Digest. He says that an efficiency of 100 per cent, as claimed by Rasch on account of his result of 5.21 candles per watt, is impossible, as there are certainly losses in the form of heat. Besides, in his tests of the Bremer arc light, Wedding has found in one case 10 candles per watt, which is nearly double that claimed by Rasch.—*Elek. Zeit.*, March 28.

Nernst Lamp.—E. H.—An article, illustrated by diagrams, giving an account of experiments made by an "anonymous correspondent" with a 220-volt 80-watt Nernst lamp. He first gives in diagrams the results of photometric measurements made at 220 volts in one horizontal and two vertical planes, and then the results of experiments in which he varied the voltage between 220 and 180. The results of the latter tests are shown in the adjoining diagram. The abscissas represent the voltage, the curve I the current in amperes, the curve P the power in watts, the curve R the resistance in ohms, the curve B *max* the maximum luminous intensity in the axial direction of the lamp in candles, the curve B the average spherical luminous intensity in candles, the curve without designation represents the specific consumption in watts per candle. "It will be seen that a diminution of the voltage by 5 per cent causes a variation of the luminous intensity by 25 per cent. The specific consumption which is only about 1 watt per candle in the direction of the maximum, becomes 2.9 watts per candle for the average spherical luminous intensity. Below 180 volts the lamp is extinguished on account of the rapid increase of the resistance." It is thought that similar experience may cause the companies which own the Nernst lamp to hold it back, but it is believed that the difficulties will be overcome and that the Nernst lamp will be among the commercial lamps of the future.—*L'Ind. Elec.*, April 10.



NERNST LAMP TESTS.

Power

REFERENCE.

Electric Power in Coal Mines.—Ravenshaw.—A paper read before the Brit. Inst. Elec. Eng., in which he gives "some notes on the electrical transmission of power in coal mines." He discusses briefly the lighting installation, the generating plant, generators, switchboard, cables, switchgear for motors, motor starting switches, motors, pumping, haulage and coal cutting. He also describes briefly a number of accidents which have occurred in such installations.—Lond. *Elec. Rev.*, April 12.

Traction.

Electrolysis from Return Currents.—Krohn.—An account of measurements made by him in a town where in former years electrolysis of gas and water pipes had been observed. The power station is near the one terminal of one of the main lines, and the return current of nearly the whole network flows through the rails for a length of about 0.9 mile. Parallel to the rails, in the same street, there are water and gas pipes. These pipes had been destroyed by electrolysis at the points where the current must leave the pipes to reach the station which is 660 ft. from the rails. Later an artificial connection had been made at this point between the pipes and the rails. This prevented, of course, electrolysis at this point, but greatly diminished also the resistance of the circuit through the pipes, so that the stray currents through the pipes were greatly increased, and there was then a greater danger of electrolysis at points where two pipes are joined together. He measured the stray currents and found them to be 30 amperes in the average and to increase sometimes to 75 amperes in the gas pipes as well as in the water pipes. He, therefore, removed the artificial connection between the pipes and the rails. He then found the stray currents to be only 44 milliamperes in the average, i. e., about 700 times smaller. This result was so good that no special remedies against electrolysis became necessary. The good result is mainly due to the good rail-joints made in the last year, and to the fact that the rails had been placed upon a thick layer of sand and were thus separated from the earth. At the time, when electrolysis of the pipes had been observed, the electrical connection between the rails had been bad. He made an experiment with a Kapp inverse booster, by which half of the return current was sucked back to the station. He measured the stray current in the gas pipe again, and found it had also been reduced to one-half. The stray currents in the earth depend upon two circumstances: The voltage drop in the rails and the condition of the earth between rails and pipes. The latter condition is so important that he thinks it is unfair to give a strict rule concerning the voltage drop in the rails alone, as has been done in Great Britain. He recommends giving no other rules except the one that, after the railroad is in operation, in no gas or water pipe is a current allowed of more than 1 ampere per 3 cm diameter. Otherwise the railroad company must provide a remedy.—Elek. *Zeit.*, March 28.

Combined Trolley and Conduit System.—Connett.—The first part of an illustrated reprint in full of his paper, an abstract of which was noticed recently in the Digest. He first discusses the general type of conduit. He believes that from an operating standpoint the center slot is a better construction than the side slot. The inherent difficulty with the side slot is the switch at the junction of two slots. With the center slot, a comparatively light movable tongue can be hung or pivoted to the fixed tongue, its use being simply to guide the plough. With the side slot the tongue is much stiffer and heavier, because it must also guide the wheels of the car and support them in one position; i. e., the entire tongue is movable and its upper surface from point to heel must be level with the wheel rail. At its point it should have a certain thickness to give mechanical strength. Another objection to the side slot is that the flanges of the wheels throw water and mud into the conduit and onto the plough. The advantages of the side-slot conduit are that the additional band of iron in the street required by the center-slot rails is avoided, and that the maintenance of the paving is thereby simplified, every joint of a rail with the paving being a source of weakness in the life of the latter. He then discusses the mechanical and electrical details to be considered in the construction of a conduit. The ironclad porcelain insulator is strong, durable and cheap. There can be no hesitation about its use. The insulators should be vertical, so that they may not offer the chance for the accumulation of dirt, which can easily happen with one horizontally placed. He then discusses the method of attaching the insulator to the conduit construction, and gives some notes on the switches.—Lond. *Elec.*, April 12.

Electric Locomotive.—Drouin.—An illustrated description of electric locomotives built by Brown, Boveri & Co., together with a Swiss locomotive building firm, for a French railroad company, to be used on high grades near Lyon. At a speed of 5½ miles per hour they can draw trains of 28 tons, either on ordinary track on grades up to 6 per cent, or with the aid of rack and pinion on grades up to 19 per cent. The weight of the locomotive is 12 tons. For running on ordinary track and with rack and pinion, there are used two entirely distinct systems of motors. On ordinary tracks the locomotive is driven by the usual 25-hp tramway motors, which drive the axle by simple reduction. For the rack and pinion system a single 150-hp motor is used, running at 700 revolutions and driving the wheels by a double gearing. This latter motor is placed inside in the frame so that it can be left open in order to facilitate ventilation. It is excited in shunt, and the excitation is variable. The increase of excitation is utilized as well in starting as on down grades, the motor being used as brake and furnishing current to the line. Current at 500 volts is supplied to the locomotive by two trolley poles.—*L'Elec.*, April 6.

Tramway Motor.—An illustrated description of a new tramway motor of the Gen. Elec. Co., of Berlin. The observation has been made that in the tramway service the increase of temperature is generally higher in the magnets than in the armature, although the usual workshop tests with a voltage of 500 volts, gives the increase of temperature about equal in magnets and armature. In the design of the new motor larger dimensions have therefore been chosen for the magnet coils. At 500 volts and 60 amperes it gives about 35 horse-power at 490 revolutions. The efficiency is 87 per cent at full load and 89 per cent at three-quarter load.—*Elek. Zeit.*, March 28.

Automobiles.—Mueller.—A long, mathematical investigation of the influence of the wheel diameter upon the power consumption of automobiles. He finds that the power consumption is smallest when the weight of the automobile is equally distributed upon both axles, and if all four wheels are as large as possible. He thinks 2.5 meters is the largest wheel diameter that can be used with safety; 50 watt-hours per ton-kilometer is said to be the best that can be achieved at present with heavy automobiles having iron tires.—*Centralblatt f. Accum.*, March 15, April 1.

REFERENCES.

Indiana.—A long illustrated article on the power generating and distributing system of the Union Traction Co., of Indiana. There are 163 miles of track. Three-phase transmission is used, with converter sub-stations.—*St. R'y Jour.*, April 15.

Surface Contact Systems.—An illustrated article on surface contact systems, with detailed descriptions of the Westinghouse and the Dietto systems.—*Eng. News*, April 18.

Installations, Systems and Appliances.

Modern Central Station Practice.—C. F. Scott.—A paper read before the Franklin Institute on "Apparatus for power distribution from central stations." After some general remarks on modern tendency of consolidation, and on the development of the direct and the alternating-current systems in recent years, he describes the construction of the modern alternator. He discusses at some length parallel running of alternators with the aid of a mechanical analogy, by comparing the action of two similar engines carrying similar alternators upon their extended shafts which are connected to common bus-bars, and supply an outgoing circuit, with the action of two similar engines carrying similar gear wheels upon their extended shafts which drive pinions upon a common shaft which supplies power to an outgoing belt. He then deals with the synchronous converter. Alternators driven by belt or by waterwheels tend to give more favorable conditions than those directly connected to engines for driving generators which supply current to rotary converters, as the angular speed will usually have greater regularity. Other rotary converters and synchronous motors, as they are generators of e. m. f. in common with the alternators, may become disturbing elements, and a converter which may run smoothly under other conditions may behave very badly when a synchronous motor or another converter connected to the circuit at some distant point is not operating properly. This is, however, not true of induction motors. They have an opposite effect, and their presence on a system facilitates the operation of the rotary and also the parallel running of the generators. He then speaks of the induction motor, and emphasizes its effectiveness in service and mechanical reliability. It is ideal in that it admits of no adjustments or tampering by the ignorant or curious.

While the alternator will certainly be the generator of the future central station, there may be a divergence of practice in the consumption circuit, as the alternating current and the direct current are both adapted for this service. In practice it is necessary to utilize as far as possible the apparatus which now exists. It is, however, "obvious that the system and the apparatus which is most simple and reliable in its operation, is that which will probably be adopted ultimately. The alternating system, therefore, has naturally the first claim to consideration, and upon the broad principles of simplicity it is the one which has the first place, and the burden of proof lies with the direct current to show adequate compensation for the cost and complication which its introduction involves." He finally refers to the great possibilities of gas engines.—*Jour. Frank. Inst.*, April.

Polyphase Machinery in Sub-stations.—Eborall.—The last part of this paper, in which he concludes as follows: Given, that it is required to convert polyphase current into direct current by means of converting sub-stations, he draws the following conclusions: For power work and for those cases in which the amount of lighting to be done is relatively small, rotary converter sub-stations operated at 20 to 30 cycles are preferable. For lighting work the use of motor generators, operating at 40 to 50 cycles in the sub-stations, will give the best results. This is also the case when the lighting load on the sub-station forms a considerable proportion of the total output of the latter. Of the two classes of motor generator sub-stations, the one which is equipped with synchronous machinery is, on the whole, unsuitable for work of any magnitude. An account of the discussion which followed is also given.—Lond. *Elec. Eng.*, April 12. The paper is also continued in Lond. *Elec.*, April 12.

REFERENCES.

Automatic Switch.—Dary.—An illustrated description of an automatic switch, devised by Claude Raymond, for automatically closing and breaking an electric circuit at predetermined hours, especially for switching in lights automatically during certain hours.—*L'Elec.*, March16.

Batteries in Central Stations.—Abraham.—An article in which he describes some cases in which batteries in central stations were very badly treated in practice and gives some rules for handling a battery properly.—Lond. *Elec. Rev.*, April 12.

Wires, Wiring and Conduits.

Electric Wiring.—Clark.—A paper in which he first gives a comparative table representing, by figures, the values of the different properties of a perfect system, and the extent to which these properties are realized in several systems in practice. When the perfect system is characterized by the figure 100, he characterizes the system of screwed tubes by 65, simplex wires by 52.5, lead covered twin by 75, wood casing by 46. An installation of wiring should be complete in itself without the fittings, and the fittings attached so that they may be taken down at any time when painting or papering, or for cleaning the fittings themselves. He speaks in favor of standardization.—Lond. *Elec.*, April 12.

REFERENCES.

Equalization Mains.—Teichmueller.—A mathematical article on the mathematical theory of "equalization mains." He calls attention to the importance of the calculation of a network in such a way that a certain drop of voltage is not surpassed. An "equalization main" connects two points, the voltage of which is to be kept as nearly equal as possible under any circumstances; i. e., at any load. He first gives the general formulas of the problem, applies them to networks, and gives a numerical example.—*Elek. Zeit.*, March 14, 21, 28.

Wiring Rules.—Broadbent.—A paper deploring the lack of uniformity in the rules and regulations issued by British fire insurance companies, supply companies, etc., and urging that uniformity should be secured by the Brit. Inst. Elec. Eng. The same subject is discussed in an editorial.—Lond. *Elec.*, April 12.

Underground Cables.—Devey.—A long abstract of a paper read before the Glasgow section of the Brit. Inst. Elec. Eng. He discusses the following three systems: First, laying cables direct in the ground, armored or unarmored; second, pipe or conduit systems; third, solid systems. He thinks that probably the best system would be armored cable laid solid in wood troughs, with a minimum thickness of bitumen in 1 inch all around, the trough and covers to be of 1 inch thickness also. An account of the discussion which followed is also given.—Lond. *Elec. Rev.*, April 12.

Electro-Physics and Magnetism.

Leakage of Electricity from Charged Bodies at Moderate Temperatures.—Beattie.—He had already studied the leakage of electricity from insulated plates covered with different substances, the plates being charged with positive electricity to a potential of between 200 and 100 volts at a temperature between 300 degs. C. and 400 degs. C. In the present paper he gives an account of a number of additional observations at potentials of 1 or 2 volts, and with positive and negative charges. An examination of the various results given for small voltages shows that the effect produced in the heated atmosphere surrounding certain insulated substances, is of the same nature as the effect produced in the atmosphere surrounding bodies on which salts of thorium or of uranium are spread. The difference of potential between the mutually insulated metals depends on the nature of the metals, but not on their distance apart. The difference observed also changes sign when the substance, instead of being on the "one mutually insulated" metal, is placed on the other. With potentials of 200 volts there is a one-sidedness in the discharge from certain heated substances which does not show itself in the case of thorium or of uranium salts. This peculiarity may be compared with the discharge due to ultra-violet light. Here, however, it is the positive charge which leaks away, while the negative is retained.—*Phil. Mag.*, April.

REFERENCES.

Induction Experiments.—Guagini.—A description, illustrated by diagrams, of a series of experiments in which he endeavored to show "that it is possible to obtain in an induced circuit a current producing the same effect as a continuous current."—Lond. *Elec. Eng.*, March 29.

Röntgen Rays.—Peckham.—An illustrated summary of the present state of Röntgen-ray work.—*Sc. Amer.*, April 20.

Electro-Chemistry and Batteries.

Sulphuric Acid in the Lead Accumulator.—The first part of an article in which he calls attention to the great differences in practice of several German accumulator manufacturers regarding the concentration of the sulphuric acid which they use. He gives a list compiled from 15 price lists of different companies. This list shows that the concentration of the sulphuric acid used by these companies varies between 19.85 and 29.84 per cent. One company increased the concentration in recent years from 21 to 29 per cent, while another diminished it from 29 to 25. Sulphuric acid has a maximum conductivity at a concentration of 31 per cent. All manufacturers require the use of a concentration below this point. He then refers to the fact that the concentration of the acid increases during charging and decreases during discharging. If, therefore, only the conductivity of the acid is considered, the concentration must be chosen so that it is above 31 per cent after the charging and below 31 per cent after the discharging. He calculates that theoretically 1 ampere-hour corresponds to the production of 3.85 gr. lead, 4.44 gr. peroxide of lead, and 3.65 gr. sulphuric acid, and to the disappearance of 11.27 gr. lead sulphate, and 0.67 gr. water during charge. He shows numerically that a variation of the concentration is of great importance. He then begins to give an account of experiments which he has made. —*Centralblatt f. Accum.*, March 1.

REFERENCE.

Per-Iodate of Potassium.—Mueller.—An account of an experimental investigation of the electrolyic production of per-iodate of potassium.—*Zeit. f. Elektrochemie*, March. 21.

Units, Measurements and Instruments.

Electric Meters.—Janet.—An abstract of a paper read before the Internat. Soc. of Elec. on the electric meters at the late Paris Exposition. He discussed time meters, coulomb meters and energy meters. There is nothing new to be said about the meters of the first two classes. Regarding the O'Keenan meter he remarks that it is now used for counting telephone calls and for clocks with automatic winding. He exhibited a clock of this kind that will run for about 10 years without needing any care. The energy meters can be divided into three classes: First, the motor meters, which can be divided into meters with coils, as the Thomson meter, and the rotary field meters; second, oscillating meters, as the Aron meter; and meters with discontinuous integration as the Siemens type. The type of meters with discontinuous integration which were to be seen in great number in the Exposition of 1889, seems now to be supplanted more and more by the motor meter type. He discusses several of the special meters shown in the 1900 Exposition.—*L'Eclairage Elec.*, March 2.

Influence of the Wave Form Upon Measuring Instruments.—Benischke.—A brief article illustrated by diagrams and giving an account of experiments in which he investigated how far the readings of alternating-current instruments depend upon the wave form. He found that the "normal induction instruments of the Allgem. Elek. Ges." are almost entirely independent of the wave form, while electromagnetic instruments, according to the Kohlrausch system, in which a thin iron core is attracted into a solenoid, depend largely upon the wave form. The results of his measurements are given in diagrams.—*Elek. Zeit.*, April 4.

REFERENCES.

Industrial Magnetic Measurements.—Montpellier and Aliamet.—Continuations of their illustrated serial. These parts deal with industrial permeameters and magnetic balances.—*L'Elec.*, March 23, April 6.

Galvanometer.—Aliamet.—An illustrated description of a portable universal galvanometer of Siemens & Halske.—*L'Elec.*, March 16.

Rheostat.—Franke.—An illustrated article on a new form of sliding rheostats for measuring purposes.—*Elek. Zeit.*, March 28.

Three-Phase Meters.—Stern.—An illustrated communication on the mathematical formulas for the energy of a three-phase system with three or four wires.—*Elek. Zeit.*, March 21.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Baudot System.—Grallert.—A very long and well illustrated paper read before the Electrotechnical Society, of Berlin, in which he describes in great detail the Baudot type printing apparatus for multiplex telegraphy.—*Elek. Zeit.*, March 28.

Telephony.—Canter.—A brief illustrated article on the connection of telephone systems to Morse lines.—*Elek. Zeit.*, April 4.

Telephone Switchboard.—An illustrated description of the new switchboard of the Bell Telephone Company, at Buffalo, N. Y.—*Elec. Rev.*, April 20.

MISCELLANEOUS.

Electric Soldering of Zinc Pipes.—Calmeau.—A description of a method in which the soldering iron is heated electrically. The usual copper portion of the soldering iron is surmounted by two sections or chambers one above the other, and insulated from one another by a partition of asbestos. The upper section carries a carbon pencil capable of being raised and lowered by means of a screw cut on its holder, and connected with the negative terminal of the source of the electric current, while the bottom of the lower section is formed by the copper portion of the soldering iron, which copper is connected with the positive terminal. The carbon pencil passes through the asbestos partition into the lower section, and being first brought into contact with a slight prominence on the copper and then slighly withdrawn, an electric arc is produced which heats the copper. The article is illustrated in detail.—*Ass. Ing. El. Liege, Bull.*, Aug. 14, 1900; abstracted in *Science Abstracts*, March.

REFERENCES.

Elektrotechnische Mitteilungen.—This is a new illustrated German monthly, edited by J. Zacharias, and published by W. Knapp in Halle. It is a journal not for electrical engineers, but for educated laymen who are interested in electricity. The January number contains the following articles: On the abolition of the accumulator traction on the Berlin tramways; what is electricity? on electric meters; rules for making a galvanic battery; the electric incandescent lamp; on electric clocks; danger of fire from electric installations; the joining of the tramway rails; lightning-rods; an electric launch. The February number contains an illustrated article on the question: What is magnetism? two illustrated articles by Ruhmer, on the Slaby-Arco system of wireless telegraphy, and on acoustic phenomena of the electric arc; an illustrated description of several new electric meters; also shorter articles on the storage battery, electricity on main lines, etc.—*Elek. Mit.*, Jan., Feb.

Electrical Laboratory.—Steinthal.—An illustrated description of the electrical equipment of the new physical laboratories of Owens College, Manchester.—Lond. *Elec. Rev.*, April 12.

Artificial Carbon.—Zellner.—A review of the historical development and the present conditions of the manufacture of artificial carbon, with many references to original patents and articles.—*Zeit. f. Elektrochemie*, March 28.

Manufacturing Plant.—An illustrated description of Nalder Bros. and Thompson's Dalston works, where parts of instruments and complete switchboards and circuit breakers are made.—Lond. *Elec. Rev.*, March 29.

Manufacturing Plant.—An illustrated description of the works of the Eddy Elec. Man. Co.—*Elec. Rev.*, April 13.

Paris Exposition.—Jovignot.—A very long and well illustrated paper read before the Int. Soc. of Elec. in Paris on the moving platform of the last Exposition.—*Bull. de la Soc. Int. des Elec.*, Jan.

Korda.—An illustrated description of three-phase alternators of Brown, Boveri & Co.—*Elek. Zeit.*, April 4.

A continuation of the illustrated serial. This part deals with several measuring instruments.—Lond. *Elec.*, April 12.

New Books.

American Street Railway Investments, 1901. Cloth. Large quarto. 288 and xxxiv. pages, 29 maps. Street Railway Publishing Company: New York City. Price, $5.

This valuable and interesting compilation of the street railway statistics of America once more makes it appearance, to find its way to the desk of every one interested in the financial development of street railways, whether bankers, brokers and capitalists, or those who operate the systems. The book is unique in the fact that it gives details with regard to the district in which each street railway is situated, and furnishes a vast amount of information as to the capital stock, funded debt, receipts, expenses and balance sheet of almost every system in the country. In addition to this the names and positions of the officers of each road are given and a large variety of information as to the physical equipment of the system is presented, together with the date at which the report was made. This data is not thrown down in a confused mass, but is carefully and systematically arranged, and one can quickly arrive, from consulting it, at a fair idea of the value of any street railway security, as well as the extent to which the system subserves the transportation necessities of the locality in which it operates.

In addition to the 300 pages of information of this character, the work is prefixed by some valuable comparisons of no fewer than 224 of the street railway properties included in the work. These properties are included in five different groups on the basis of their gross receipts, and then the figures are given for each road, comparing 1900 with the preceding year. It is encouraging to see that throughout these systems a general high average of increase was reported. In one of the groups the average of increase for 1900 was not less than 21.83 per cent, whereas the average increase in 1899 was but 10.2 per cent. The study of this as well as of the whole volume strengthens the conviction that the street railway developments of the country are, as a whole, being carefully and conservatively managed and are constantly rising in the scale of staple, permanent investments. We can heartily commend this manual to all of our readers who make a study of industrial and financial topics, and especially to those who are interested in ascertaining the capabilities of street railway properties.

BOOKS RECEIVED.

Telephone Lines and Their Properties.—By William J. Hopkins. Revised and enlarged. New York and London: Longmans, Green & Co. 307 pages, illustrated. Price, $1.50.

Elementary Questions in Electricity and Magnetism. By Magnus Maclean, D. Sc., M. I. E. E., and E. W. Marchant, D. Sc., A. I. E. E. London and New York: Longmans, Green & Co. 59 pages. Price, 35 cents.

Inventor's Manual. How to Work a Patent to Make it Pay. Revised and enlarged edition. New York: Norman W. Henley & Co. 115 pages. Price, $1.

An English Electrical Instrument and Switchboard Factory.

Our London correspondent sends the following account of a recent visit to the Dalston works of Nalder Brothers & Thompson, which company, owing to the rapid progress of its business, had to establish works at Kingsland Green, Dalston, in addition to the factory at 34 Queen Street. These works are devoted to the manufacture of the parts of instruments and complete switchboards and circuit breakers. The assembling of instruments and testing of same is still carried on at Queen Street, as previously.

The ground floor of these works, in which we noticed at the entrance a Rochester time recorder, is devoted first to stores and timekeeping departments, the engine room and dynamo room, the dynamo being provided for the purpose of lighting the works as well as for furnishing current for motors instead of relying on long-belting transmissions for the upper floors. In addition to this the painting shop and lacquering shop are here, both of which have the very best of light, and in this respect we must say the whole of the works is exceptionally good. In the erecting shop on the ground floor for the larger class of switchboards the illustration shows a portion of the Luton central station board. This erecting shop is fitted with all the most modern tools for slate drilling and for dealing with large bus-bars, a number of which for another important station board are seen in the foreground.

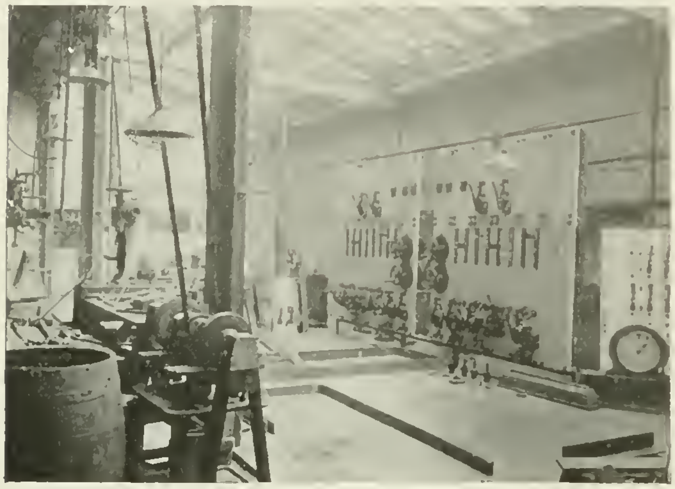


FIG. 1.—ERECTING SHOP.

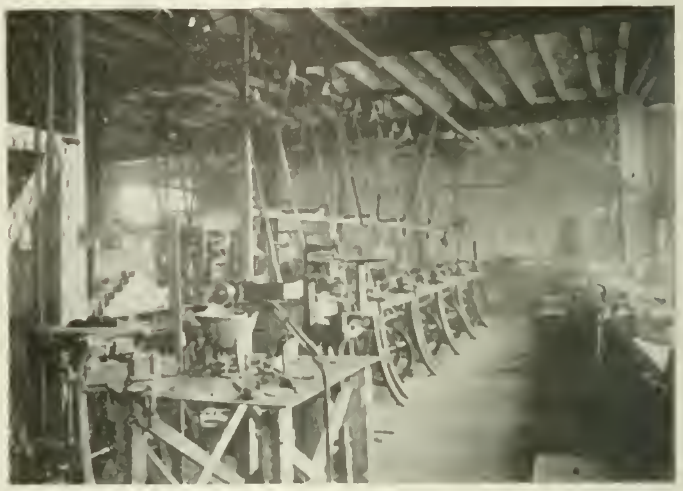


FIG. 3.—ASSEMBLING ROOMS, LATHES AND DRILLING MACHINES.

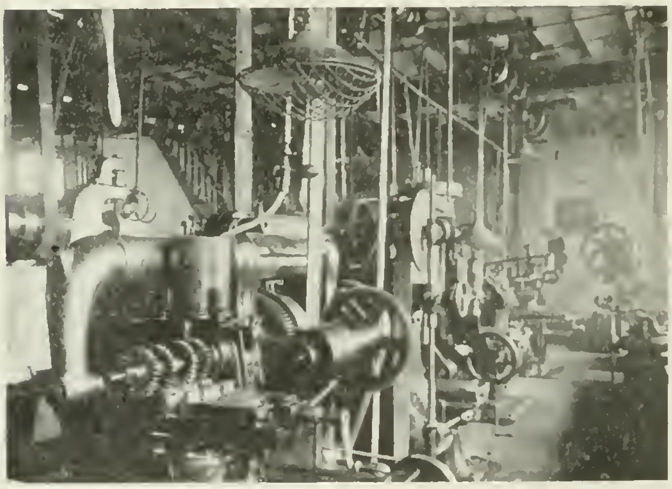


FIG. 2.—MILLING MACHINES.

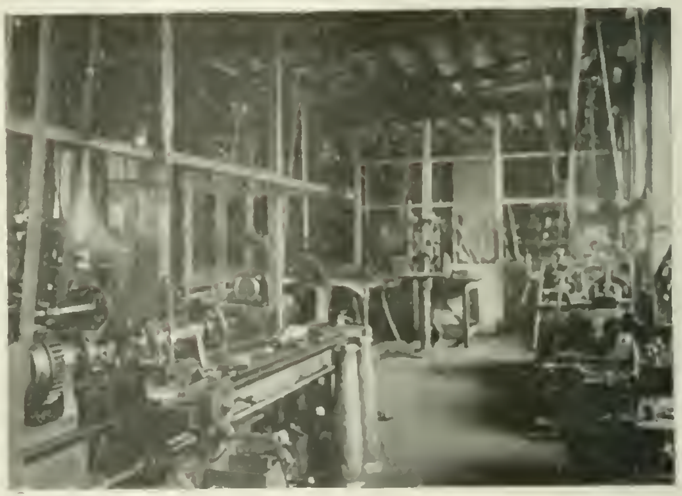


FIG. 4.—TURRET AND ENGINE LATHES.

Views of English Electrical Instrument and Switchboard Factory.

On the first floor the machine shop proper is situated. One view shows the west side, which is devoted almost entirely to milling machines. On the east side, of which there is also a view, the turret and engine lathes are situated. The drilling machines are placed in the middle of the shop, and as far as possible all machines of a kind are grouped together.

The suds and oil for the whole of the machinery on this floor is supplied to each individual machine from a tank situated at the top of the building, all the lubricant running from the machines into open troughs placed below the floor whence it runs into another tank, out of which it is continually pumped to the upper tank, already referred to. Nearly the whole of the work carried out on this floor is done systematically to special jigs and fixtures. We noticed, we may mention in passing, that many of the tools here were of American make, and the system of keeping the shop in a cleanly condition as well as the heating by suspended steam pipes is in accordance with the practice now more generally obtaining. At the far end of the shop a tool room is situated. In this shop the tools are not only stored for serving out, but all operations for fitting in connection with them are carried through here. In addition to the lathes for particular work in this shop, a gas furnace is provided for hardening and tempering the more delicate tools. The blower which serves this also furnishes compressed air to the various blow pipes throughout the building.

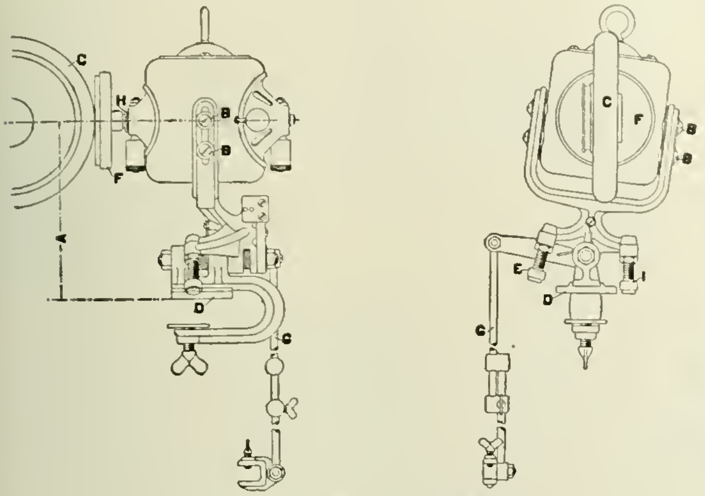
Adjacent to the tool room is the grinding room, which is provided with Brown & Sharp's universal grinding machine, surface grinding machine, Cincinnati universal cutter grinder and a Washburn twist drill grinding machine.

On the second floor the assembling of switches and circuit breakers and small parts is generally carried out. This is provided with numerous lathes and drilling machines in the body of the shop and also an engraving machine which is observed in the foreground illustration. All around are arranged benches with vices. In addition on this floor all finished work is taken into store.

The third floor is devoted also to fitting and assembling work, and large switchboards are erected here, as there is plenty of head room and splendid light. This is more easily accomplished insomuch that in the middle of the building a power operated elevator is provided which passes from the bottom of the building to the top. Ample bench and vice accommodation is also provided. At the time of passing through the shops we saw a considerable amount of heavy switchwork and quantities of parts going through for general stock.

Sewing Machine Motor.

The accompanying illustrations show a method of operating sewing machines by means of electric motors. This method possesses the following characteristics: Absence of belting, no rheostat, the transmitters can be applied to any machine without special fitting, the motor runs only when the sewing machine is in operation and takes power in proportion to the amount of work being done, the speed, which is variable, is under the control of the operator, and the range of the operation of the machine is from two stitches per minute up to 2000. The machine head is driven positively at all times, and the variable speed is obtained by means of a variable leverage, so that any degree of work, no matter how heavy, may be accomplished by allowing the machine head to operate at a sufficiently low speed.



FIGS. 1 AND 2.—SEWING MACHINE MOTOR.

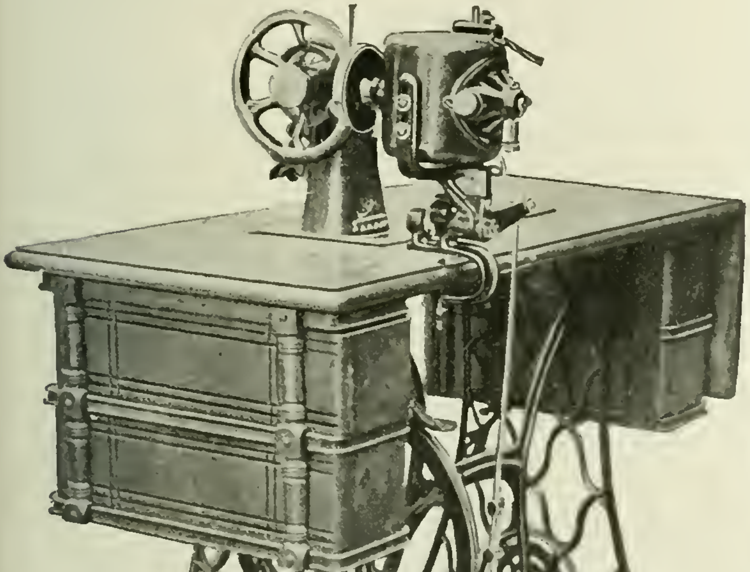


FIG. 3.—MOTOR ATTACHED TO SEWING MACHINE.

These transmitters are at present made in two sizes, for both alternating and direct current. The No. 1 size is for household work, and the No. 2 for factory work. They are manufactured by the Paragon Fan & Motor Company, 572 First Avenue, New York. Figs. 1 and 2 give different views of the transmitter, and Fig. 3 shows a transmitter attached to a sewing machine.

Steel Conduits and Fittings.

The two illustrations herewith represent (Fig. 1) a water-tight switch, and (Fig. 2) an enameled screwed steel conduit, manufactured by the Simplex Steel Conduit Company, Coventry Street, Birmingham, England.

The Simplex steel conduit system for the interior wiring of electric light and power installations consists of a combination of enameled or galvanized steel tubes and malleable cast iron fittings and accessories. The conduits or tubes are made in four grades, viz.: Enameled steel conduits, enameled brazed steel conduits, galvanized steel conduits and enameled screwed conduits. The first three grades are made in light gauze steel for socket-jointing, and the fourth is a heavy gauge conduit for screwed junctions. In each of these grades the conduits are made in eight sizes, having external diameters, ranging from ½ inch to 2 inches.

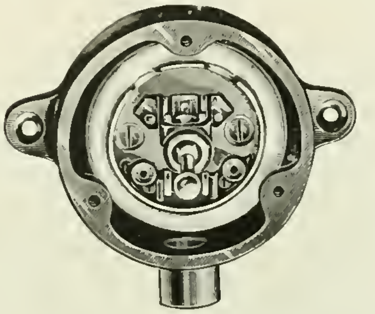


FIG. 1.—WATER-TIGHT SWITCH.

The advantages claimed for this conduit are high economy in first cost, installation cost and maintenance; mechanical strength combined with lightness and durability; electrical efficiency; neatness, compactness and accessibility. It is said to be suitable for all conditions of wiring work, except in exceptionally damp situations.

The Simplex enameled screwed steel conduits being screwed are made from considerably heavier gauge strip than the other grades, and therefore they are much stronger. They are suitable for special work where there is a likelihood of their being roughly handled or damaged, as, for instance, in the holds of steamships, in breweries, railway stations, car sheds, inspection pits, engine rooms, etc. The conduit is made for use with screwed fittings, and is particularly adapted for electrical purposes, on account of its smooth interior. In the Simplex system there are upwards of 400 fittings and accessories. These are applicable to each class of conduit, and have been designed with the primary object of efficiency combined with economy.

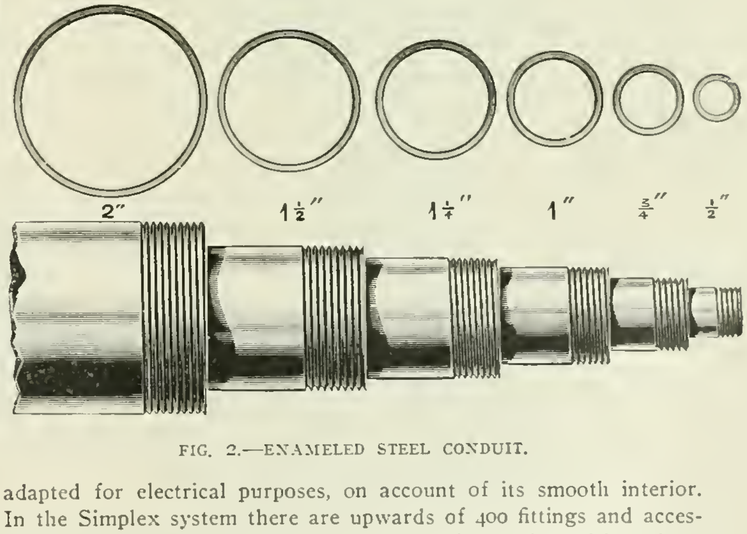


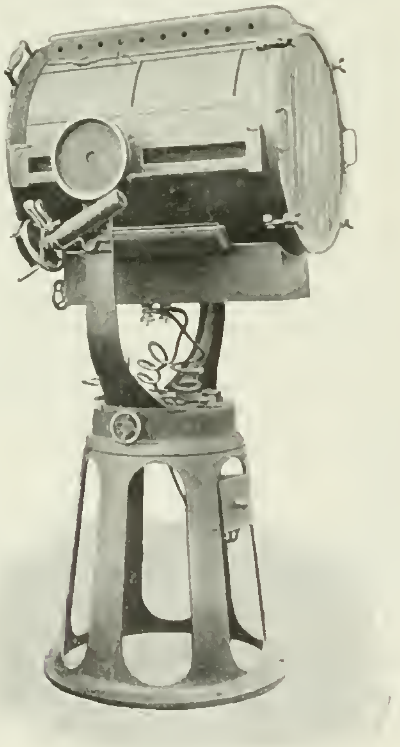
FIG. 2.—ENAMELED STEEL CONDUIT.

The switch illustrated has been specially introduced for use in conjunction with the Simplex emigrant. corridor and subway fittings. The box of the switch has been designed to take and can be fitted with any of the ordinary tumbler or turn switches in general use. The cover and the nipple are fitted with rubber rings, and the bottom of the porcelain is kept about ⅜ inch off the base of the box to allow for the wiring connections, which can be made before the switch is screwed down.

Searchlights for the Navy.

We have from time to time described the various types of searchlight projectors used in the United States Navy, and in this issue we show an illustration of a type of hand-controlled projector which is being furnished to a number of the new destroyers and cruisers, by the Carlisle & Finch Company, of Cincinnati. The accompanying illustration shows an 18-inch projector, but the 24-inch and 30-inch projectors of the same manufacturers are identical in construction except that they are, of course, larger and heavier.

The specifications of the navy require a much better projector than is necessary for ordinary commercial use. In the first place, no iron or steel is used in the construction unless absolutely necessary, such as magnet cores, etc., where no other material would answer. The carbon feeding mechanism must be capable of working in any position, and to feed the carbons the entire length without any apparent difference in the voltage across the arc. The cylinder or the barrel of the projector must be capable of rapid rotation by hand or gradual rotation by means of gearing. A vertical elevation of 70 degs. above the horizontal, and 30 degs. below the horizontal is required; added to these requirements, the entire projector must be constructed in the best possible manner and be absolutly reliable in its every part.

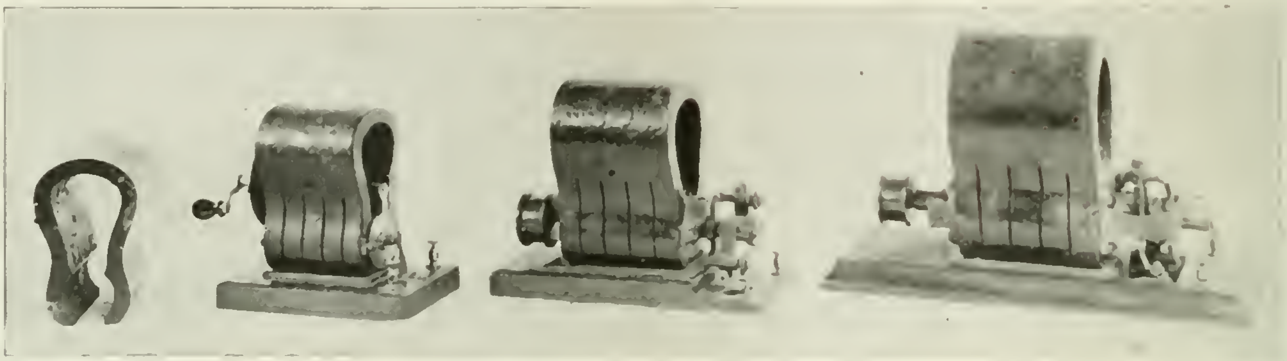

SEARCHLIGHT.

The projector shown is required to pick out a white object 10 ft. by 20 ft. at a distance of 4000 yards, and the larger projectors at distances of 5000 and 6000, respectively. Parabolic mirrors or Mangin mirrors may be used, and the projector is so constructed that either can be inserted in a few minutes. In case of an attack by torpedo boats, the light would be used at close range, and is required to cover as great an area as possible. To do this, a special front cover is supplied, which is fitted with a set of dispersion lenses. These lenses spread the light out horizontally, but not vertically, so that the water is illuminated for a wide range.

The mechanism for transmitting vertical motion to the cylinder consists of a worm and worm wheel which may be thrown in or out of mesh like the back gear of a lathe. The trunnions for supporting the cylinder are adjustable.

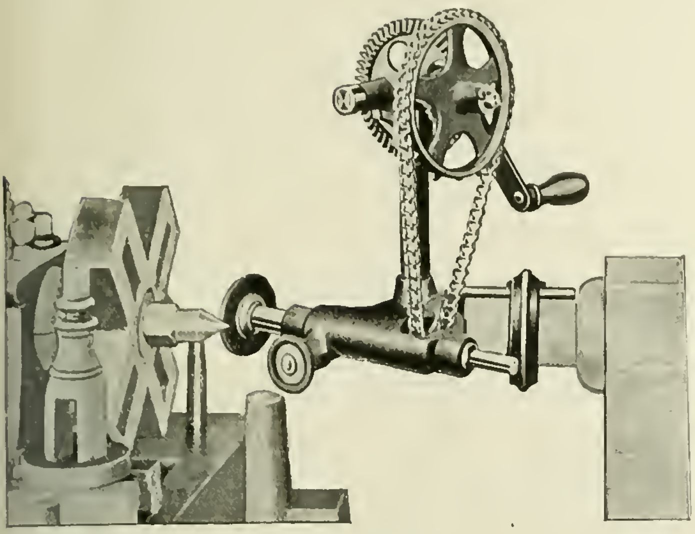
Magnetos for Special Work.

The field for the use of magnetos so far from diminishing seems to be decidedly on the increase, and considerable ingenuity is therefore being spent on their improvement. Among those who have devoted their attention to this specialty is Mr John E Fuller, P. O. Box 237, Brooklyn, N. Y., who has taken out several patents on the subject during the last few years, and whose principle of slotting the magnet frame is illustrated herewith in Figs. 1, 2, 3 and 4. The magnets are cast in one piece, as shown in Fig. 1, and then cored and slotted, this constituting, it is said, a notable economy in manufacture. Fig. 2, here shown, is a gas engine spark igniter, which will give a full bright spark of 1 to 1½ inches at medium speed. Fig 3 is a similar type of machine. Fig 4 is a generator intended for telephone work, and will, it is stated, ring through 100,000 ohms resistance. The armature carries an automatic switch which cuts out the armature wire and switches in the line wire, instantaneously, when the user has finished ringing. It is interesting to note that Mr. Fuller has been experimenting on types of these machines for bicycle lamp purposes. In this case the generator weighs about 1 lb., giving a brilliant light at low speed, and at high speed cutting in a resistance which protects the little lamp from burning out, a trouble experienced hitherto in this class of work.


Figs. 1, 2, 3 and 4.—Magneto Generators.

Lathe Centre Grinder.

The lathe centre grinder illustrated herewith is manufactured by L. S. Heald & Son, Barre, Mass. It is designed to be sold at a low price, and to have its work just as effective as that of more complicated machines in which the wheel is driven by power obtained either from the face plate of the lathe, or from a friction roll running on the largest step of the cone. This grinder is clamped directly on the tail spindle and carries a grinding wheel at such an angle that it will grind the center to the angle of 60 degs. without possibility of error and without any delay from the cut and try method of setting up. It does not matter what the size of the tail spindle is, or whether the lathe happens to have on a large or small face plate or any face plate at all; and as it uses hand power there are no connections to make to get power. It does not matter either whether the tail stock happens to be set over for turning tapers or not, as the correct angle will be given the center just the same. The grinding spindle is driven by sprocket wheels and chain, making it easy to get plenty of speed for the wheel, and this construction makes a very easy running machine without the bother of slipping belts or the noise of several gears.



LATHE CENTRE GRINDER.

The sliding bearings are separate from the rotary bearings, so there is none of the lapping out process that ruins many machines of this kind. The rotary bearings are never uncovered, and therefore the entrance of grit is wholly prevented. The particular advantages of this machine are its simplicity and ease of setting up.

Static Ground Detectors.

In many switchboard installations a very convenient and efficient piece of apparatus has been omitted on account of the danger to switchboard attendants accompanying its use. The instrument in question is the ground detector, and in some instances, while they have been provided, they have been located in some obscure and seldom frequented place because of the noted disadvantage. Another characteristic defect of the early type of ground detectors was the necessity of first introducing a temporary ground occasioning increased danger to linemen and the possibility of short circuiting the system.

The S. K. C. high-voltage ground detector herewith illustrated and described is designed and said to be the first instrument to combine thorough reliability at all times with absolute immunity for switchboard attendants from danger of shock. It is especially adapted for high voltages and use on single-phase, two-phase 4-wire and three-phase 3-wire circuits.

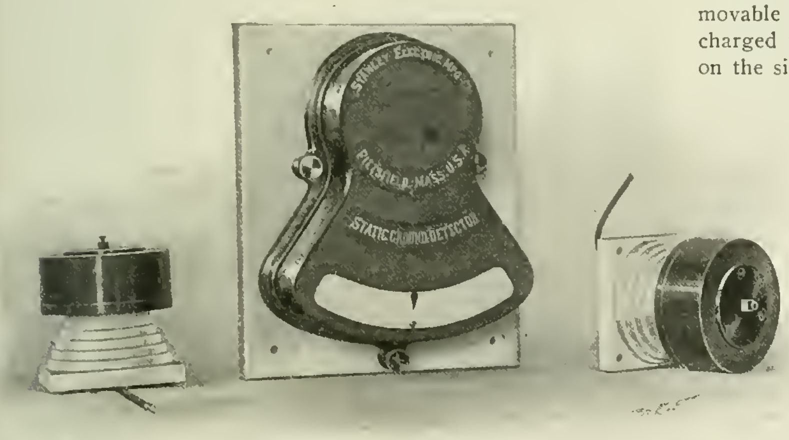


FIG. 1.—HIGH-VOLTAGE GROUND DETECTOR.

The instrument case is entirely of hard rubber, molded to the required form. Inside the case, four fixed vanes are arranged around a movable vane, as in Fig. 2. The movable vane is made of aluminum, is carried on jeweled bearings and attached to the pointer. The fixed vanes are connected diagonally in pairs, and each pair is charged statically by one of the line wires through the medium of a condenser. The condensers are independent of the instrument and generally mounted behind the switchboard, as in Fig. 2. The instrument has three binding posts, from which connection studs extend back and serve to support it on the marble. The binding posts at the sides each connect a pair of the fixed vanes with the secondary of one of the condensers. The lower binding post serves to connect the movable vane to the earth. The connection studs serving jointly as back connections and as supports, minimize the labor required for installing and removing from the switchboard. The number of holes required in the marble is also minimized.

The movable vane is acted upon inductively by the fixed vanes, so that the stress produced by each pair is equal, but opposite. The movable vane, in consequence, takes a position equally between the fixed vanes. This position is the same whether the instrument is charged or not, and the pointer stays at zero, indicating no ground.

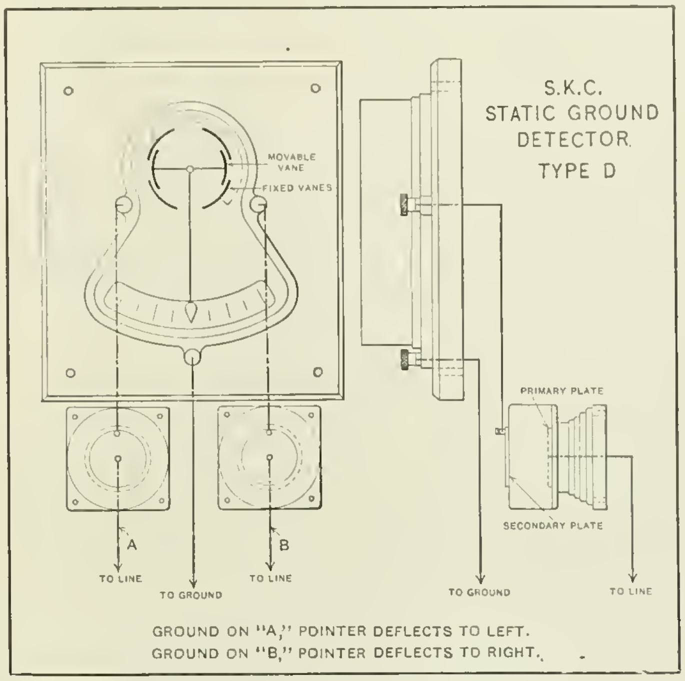


FIG. 2.—DIAGRAM OF GROUND DETECTOR.

If, however, the primary plate of one of the condensers and the movable vane become electrically connected, as happens in the event of a ground, immediately the pair of fixed vanes, which lead to that condenser, assume with the movable vane a like polarity, and the latter is repelled. At the same time the action of the other fixed vanes is to attract. The two forces acting in the same direction, the movable vane takes a position entirely within the vanes oppositely charged to it, and the pointer takes a position indicating a ground on the side of its deflection. Absorbing no energy in operation, the instrument is kept permanently connected, and ofttimes an instrument on each circuit, may be used advantageously.

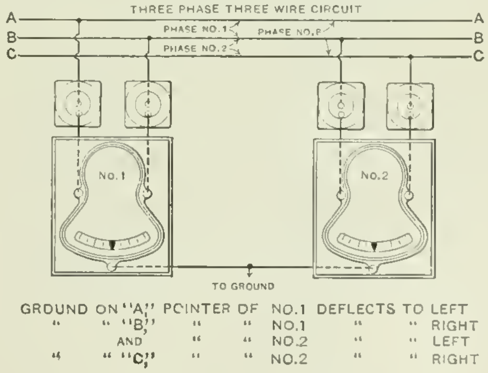

THREE PHASE THREE WIRE CIRCUIT
A
B
C
A
B
C
PHASE NO.1
PHASE NO.2
PHASE NO.2
NO.1
NO.2
TO GROUND
GROUND ON "A," POINTER OF NO.1 DEFLECTS TO LEFT
" " "B," " " NO.1 " " RIGHT
AND " " NO.2 " " LEFT
" " "C," " " NO.2 " " RIGHT

FIG. 3.—DIAGRAM OF CONNECTIONS.

The two condensers which are used with each instrument are made as follows: The primary plate, which is connected to the line, is entirely imbedded in a hard rubber block. On top of this hard rubber block is placed the secondary plate, which is connected to the fixed vanes of the instrument. Each rubber block is then mounted on a large procelain insulator.

Instruments for different potentials are exactly alike, the adjustments for the different voltages being made in the condensers. Fig. 1 shows the general appearance of the S. K. C. ground detector and its separate condensers for 20,000 volts.

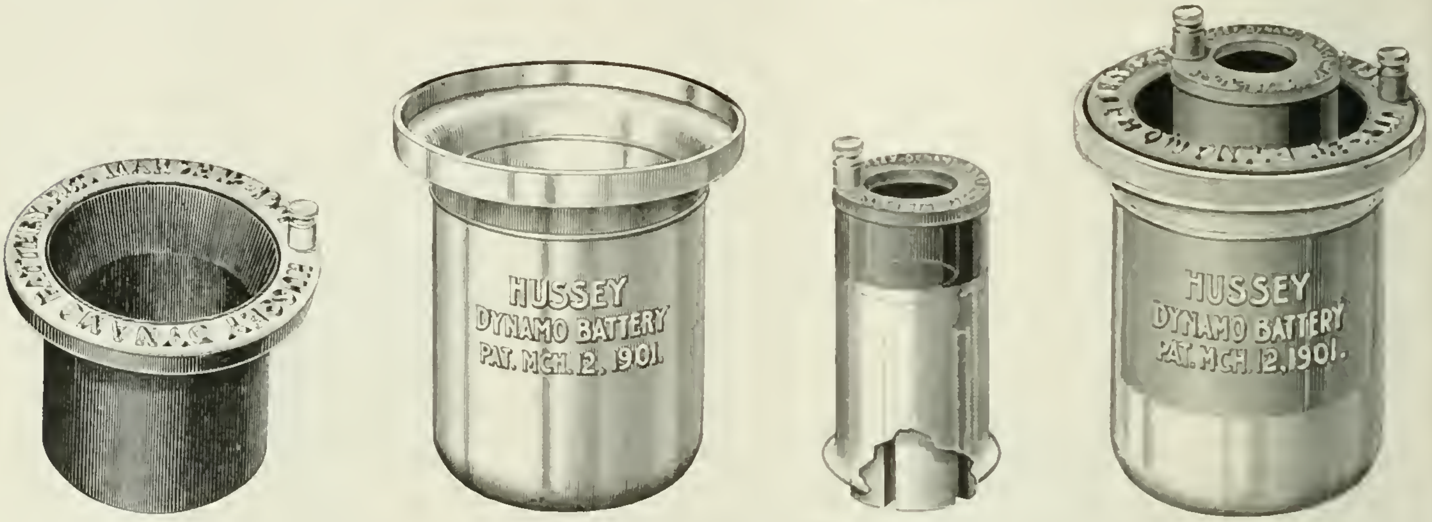
The use of separate condensers for charging the fixed vanes keeps all high potentials out of and away from the instrument, and as the instrument case is made entirely of hard rubber, the insulation is perfect. The use of separate condensers also has the advantage of allowing the instrument to be mounted wherever convenient, without regard to the location of the line wire. All that is necessary is to connect the secondary plates to the fixed vanes of the instrument by means of fine wires. The condensers can be located at or near the line wires, and insulated from each other by as great a distance as is thought necessary.

The dielectric of the condensers being hard rubber and having the primary plate imbedded in it, there is absolutely no danger of a lightning discharge going to "earth" through the instrument; in fact, there is never any connection in the instrument between the line wires or between either of the line wires and the ground.

The instrument is entirely automatic in its action indicating grounds when they occur, and returning to the zero position when they are removed. Fig. 2 shows the instrument and its condensers connected to a single-phase circuit, and Fig. 3 represents the connections for a three-phase three-wire circuit, two instruments and four condensers being used.

A Bisulphate of Mercury Primary Battery.

Now that the spring has arrived, and that warmer weather is beginning to make itself felt, the demand for fan motors arises once again, and more extensive preparations than ever are being made to meet it. It happens, however, and this condition will probably continue for a long time to come, that a large proportion of the inquiries and applications come from people who are not reached by electric circuits, and the result is that their wants have to be met if possible by some form of storage or primary battery. The storage battery is in many respects handy, but facilities for recharging are necessary; and still, all too frequently, these do not exist. There thus remain, not only throughout this country but in various parts of the world, particularly the tropics, large regions where the fan motor is highly appreciated, but can only be enjoyed through the intervention of some primary battery. It has been the aim of inventors for some time past to furnish a cell that would answer all the requirements of such work. One of the most interesting types of this character is that which has recently been put on the market by the Hussey Dynamo Battery Company, of 39 Cortlandt Street, New York City. This cell, which is the invention of Mr. Charles A. Hussey, who has been actively engaged in the improvement of primary batteries for at least a quarter of a century past, has been named by him the "Hussey dynamo battery" on account of its large amperage and the general ease with which it can be handled. The aim of the inventor was to produce a battery in which the oxidizing agent in the form of a salt could be gradually renewed as it is used up, without trouble, so that the cell would not be liable to polarize. In this cell Mr. Hussey employs bisulphate of mercury, and the battery is built up in the tubular form indicated by the accompanying cuts, which show also the outer special containing jar and the cell complete. The jar, of course, may be of glass or rubber, and the elements, zinc and carbon, are made in annular form as shown, thus presenting a very large surface to the action of the electrolyte. The upper connector of metal parts shown resting on the rim of the flanged battery carbon are of aluminum, which is not attacked by the mercury bisulphate. As will be noted, the lower end of the carbon is made with an inner flange, giving it somewhat of a cup form, thus enabling it to hold the porous cup, which has an outer flange extending outwardly and resting on the carbon flange, without, however, constituting a liquid-tight joint. In the porous cup placed within the carbon is suspended the circular zinc, which, as will be noted, is made in two portions, an upper and a lower ring connected by bars or straps. When the battery is assembled the porous cup is inserted into the cylindrical carbon so as to rest on the internal flange, as stated above. The annular space between the carbon and the porous cup is then filled with the bisulphate of mercury up to the flaring portion of the carbon indicated in one of the cuts. When this has been done, the carbon and the cup are inserted into the glass jar. The glass jar is then filled through the hole in the top of the zinc with nothing but plain water, until the water reaches within one inch of the top of the glass jar.



Figs. 1, 2, 3 and 4.—Bisulphate of Mercury Battery

In the operation of the battery the mercury bisulphate is decomposed so as to set free sulphuric acid, while the oxygen given off unites with the nascent hydrogen liberated from the zinc, forming water. The metallic mercury being precipitated and passing between the carbon and the porous cylinder, at the bottom, collects on the floor of the containing jar. Salts of zinc are formed also by the action of the battery, and these are gradually dissolved in the exciting solution. The renewal of the oxidizing bisulphate of mercury is accomplished by inserting another supply through the flare or wide funnel-shaped opening in the carbon, and thus a great advantage is secured in being able to renew or recharge the battery and maintain a constant current without dismounting it or taking out the parts or suspending work. As those who are familiar with handling primary batteries are aware, there is often considerable annoyance and trouble in renewing primary batteries, and one of the reasons they are not in more frequent use for heavy work is the bother and expense which often attends this operation.

When the exciting solution has become unduly saturated with the salts of the zinc the nozzle of a syringe can be inserted into the cup through the hole in the top of the zinc, and the saturated solution taken off. The metallic mercury which has collected by gravity at the bottom of the jar can also be removed from time to time, and having a value may probably be worth while to collect. Water is then supplied to the porous cup, or such other renewal of the solution may be made as it is the practice of the user to employ.

Drawing upon the fund of experience given him by years of study in this field, Mr. Hussey has not only produced a battery for which he claims unusual cleanliness, economy, efficiency, simplicity and easy operation, but he has put it together in such handy shape as to render it convenient for use in running fans. For this work he uses the larger size, the jar being 8 inches high and 7 inches across the top of the flange. With two of these batteries in series any fairly well constructed fan motor taking from 10 to 15 watts will send a breeze across any dining table, sittingroom or bedroom. When the battery is not in use it has very little local action and maintains its internal resistance and e. m. f. substantially unimpaired, while the fact that it does not have to be separated and then reassembled for further renewal makes it a very convenient form. The company will supply complete fan motor outfits with all the necessary adjuncts neatly put together, or will furnish the single cells, through its agents in various parts of the country. Mr. Hussey has also worked out the same form of battery for use in telephone work, for which it appears to have many advantages, and the company is already experiencing a large call in this direction. The voltage of the cell is 1½, and from tests which have been made it would appear that the small charges of the bisulphate of mercury, which comes in neat packages, will drive the fan continuously at a constant speed if the bisulphate of mercury is supplied as fast as it lowers in the space between the porous cup and carbon, on the same principle as a self-feeding stove.

It may be added that in addition to operating fan motors, telephone circuits, etc., Mr. Hussey is putting out these batteries for gas engine work, for jewelers' light work, dental operations, etc., and will be glad to receive inquiries as to its application.

An Automatic Telephone Meter.

The measured rate is undoubtedly one of importance to all interested in telephone matters, and the telephone company standing as it does in a position between the subscriber and the investor and being expected to satisfy both, very naturally welcomes inventions calculated to produce these results. No subscriber could reasonably offer objections to a measured service, provided the scheme for keeping account of his calls is of a nature that appeals to him as accurate and free from complications. The present measured service adopted by some of the large companies has proved a decided success, but the system lacks the confidence that a scientific, automatic counting device would inspire in the average mind.

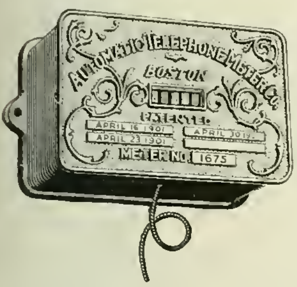


FIG. 1.—TELEPHONE METER.

Actual tests made in one of the large cities by a leading telephone company using the measured rate plan show that a very large percentage of the connections made are not recorded against the subscriber as they should be. On the other hand, it is the usual experience of the telephone managers who have adopted the measured rate to have a large number of their bills contested by subscribers who feel that they have been charged for more connections than they actually use; therefore, while a measured rate plan is admitted by all to be the fairest method of charging for telephone service the difficulties of keeping such a record are great and have prevented its natural development.

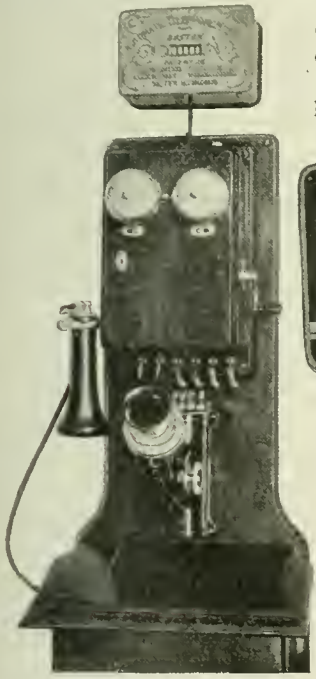


FIG. 2.—METER ATTACHED TO TELEPHONE.

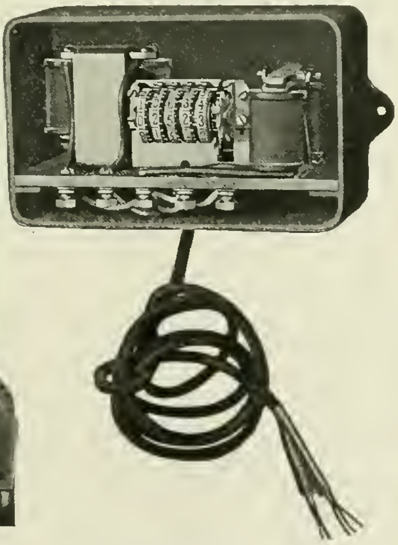


FIG. 3.—INTERIOR VIEW OF METER.

The Automatic Telephone Meter Company, of Boston, Mass., has gotten out an instrument for automatically recording telephone connections. The instrument, Fig. 1, is placed at the subscribers station, the readings being in clear view of the subscriber at all times. The size of the meter is 4 by 6 inches, and it is quite ornamental in appearance. In operation no additional movement is made by the subscriber or the exchange operator, yet this meter records exclusively outgoing calls and then only on completion of a connection. It operates equally well on both the central energy and magneto call systems and the company claims that while it depends upon the joint movements of the subscriber and operator it is impossible for either one to influence its action by any means short of injury to the apparatus. The instruments can be used on party lines with equal advantage. Fig. 2 shows the method of attaching the instrument to a telephone.

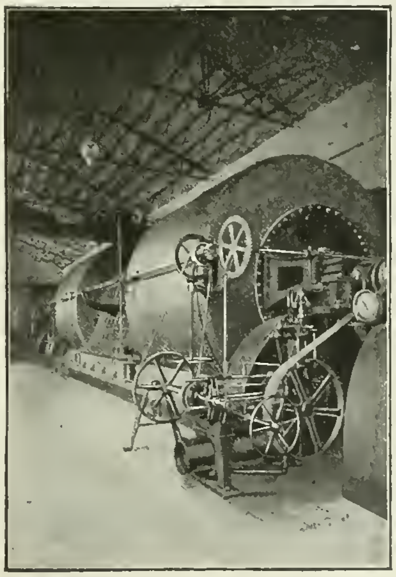
An interior view of the meter is shown in Fig. 3. The coils at the right belong to a selective device which discriminates between outgoing and incoming calls. The coils at the left operate a simple counter, which locks automatically and operates only once for each connection actually secured.

This metering system appears to be rendered complete by the time element being included in its sphere of usefulness, and when it is arranged to charge by actual time of conversation instead of number of conversations, the counter operates at a certain pre-determined speed, so long as the conversation is continued.

Every detail of the instrument has, it is stated, been thoroughly worked out and tested under actual working conditions, and in its present state it seems to meet every requirement of modern telephone service. The claims made for it may be briefly summed up as follows. 1st, it will record accurately and positively each conversation actually secured by the calling subscriber, and it is impossible for it to register an in-coming call; 2d, it is automatic and will register only when the usual movements of the calling subscriber, the operator and the called subscriber have been performed; 3d, there is no impedance to conversation whether the meter be used as a connection counter or as a time register, and no additional complication or rearrangement of circuits is necessary at the switchboard or subscriber's station; 4th, as there are no springs, clockwork or local battery required, the expense of maintenance and inspection is trifling, and, 5th, it is equally well adapted for the magneto, central energy and party line systems without change in design or adjustment.

Turbines in Mining Plant.

The illustration herewith represents two single horizontal-shaft, 54-inch McCormick wheels in an iron case discharging into a cast-iron draft chest. These turbines are operating in the power plant of the Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Mont., and develop 2800 horse-power. The power is used for driving a generator and air compressor. The speed is regulated by a Lombard waterwheel governor.



HORIZONTAL SHAFT TURBINES.

This is said to be the heaviest pair of waterwheels ever built in America. The weight of the outfit is 280,000 lbs., not including power connections, pipes or draft tubes. These turbines were made by the S. Morgan Smith Company, York, Pa.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in good demand, with fair supply. Rates were 4 per cent for 90 days and 4½ per cent for longer periods. Mercantile paper was quiet and supply limited. Rates, 4 per cent for 60 to 90 days' indorsed bills receivable, 4@4½ for choice four to six months' single names and 5@6 for others. In the stock market the activity continued on an enormous scale during last week. Early in the week irregularity with some heavy selling and declines prevailed, due to the gold shipments caused by the large subscriptions here aggregating $150,000,000 to the new British war loan. From the speculative standpoint the situation was the most interesting which the bull market has yet exhibited. On Tuesday the dealings in stocks aggregated nearly 2,400,000 shares, which surpassed all previous records. United States steel stocks were at one time weak in the face of the strength in other quarters, the common falling to 45½ and the preferred to 93½. There was a sharp rally, however, in both these securities on the advance of steel rail quotations and on the statement showing the company's very large surplus over charges for March. During the present week, the Exchange, having moved to temporary quarters in the Produce Exchange for one year, while its own home is rebuilt, celebrated the change of base by dealing in nearly three million shares on Monday, and by breaking other records in every direction as to prices, single orders, rise in quotations, etc. There were no marked features last week in traction or electric stocks, and with the exception of Brooklyn Rapid Transit, trading was about normal in the entire list. Metropolitan Street Railway closed with a net loss of 1⅛ points, the sales for the week aggregating 111,100 shares. The sales of Brooklyn Rapid Transit reached 269,000 shares, and the stock closed with a net loss of 1½ points. General Electric made a net gain of 1½ points, the sales aggregating 3206 shares. Western Union was quiet, the sales amounting to 17,600, the stock closing with a net gain of ¼ of a point. Following are the closing quotations at the four exchanges named:

NEW YORK.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
General Electric	223½	225	Electric Vehicle	12	—
Brooklyn Rapid Transit	86¾	85¼	Electric Vehicle, pfd	20	—
Metropolitan Street Ry	174	172⅞	General Carriage	2½	—
American Tel. & Cable	100	—	Illinois Elec. Veh. Tran.	⅞	—
Western Union Tel	93¼	93½	Hudson River Tel	—	—
American Dist. Tel	—	35	N. E. Elec. Veh. Tran.	2½	—
Commercial Cable	179	180½	N. Y. Elec. Veh. Tran.	4½	—
Electric Boat	17	—	Tel. & Tel. Co. of Am.	5	—
Electric Boat, pfd	47	—	N. Y. & N. J. Tel	—	—
Electric Lead Reduc'n	4½	4⅝			

BOSTON.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
New England Telephone	—	—	Erie Telephone	60	61
Mexican Telephone	3	3	General Electric, pfd	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel.	176½	176
Westinghouse Elec., pfd.	—	75½	Boston Electric Light	—	—

PHILADELPHIA.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
Electric Storage Battery	69¾	69	Philadelphia Electric	6⅜	6½
Elec. Storage Bat., pfd.	74	74	Pa. Electric Vehicle	1¼	1⅜
Elec. Co. of America	9⅜	9⅛	Pa. Elec. Veh. pfd	1	1⅜
General Electric Auto	—	—	Am. Railways	42¼	44½

CHICAGO.

	Apr. 20.	Apr. 27.		Apr. 20.	Apr. 27.
Chicago Edison	155	—	Chicago Telep. Co	—	—
Chicago City Ry	—	—	Union Traction	—	—
National Carbon	—	15¾	Union Traction, pfd	—	—
National Carbon, pfd	—	85	Northwest Elev. Com	—	38

* Asked.

THE VAN CHOATE SWINDLE.—A special dispatch from Boston, of April 25, says: The inside history of an enterprise which cost the poor people of New England millions in the aggregate, and of which there is scarcely an asset left, is given in the report filed today of Stephen H. Tyng, appointed by the United States Circuit Court Auditor in the case of W. L. Clark vs. the Van Choate Electric Company, to pass upon claims presented by creditors of the company. Mr. Tyng says that when the company was organized its only assets consisted of rights and property turned over by Van Choate for 599,900 shares of the stock received by him. "The actual, tangible property turned over," says the report, "was so inconsequential in amount and value as to be scarcely worthy of consideration, and that any sane person would pay $6,000,000 for what he turned over is simply preposterous." Mr. Tyng says Van Choate and his associates were perfectly conscious of the fact that the corporation was vastly overcapitalized. He finds that none of the inventions had been determined to be a practical commercial success, or really had any pecuniary value whatever, and that the company from its inception was in an insolvent condition.

ELECTRIC COMPANY OF AMERICA.—It is stated that during 1900 the Electric Company of America has received 70 propositions for the purchase of plants. Fifty of these were rejected and 20 were examined by the company's experts. The Bridgeport, Ohio, plant was purchased June 1. The company has a 10-year lighting contract there. The power is supplied from the Wheeling (W. Va.) works across the Ohio River. The Rockford, Ill., property was purchased Nov. 1. It is reported as having a good steam and water power business. Power is supplied to the Rockford Railway, Lighting & Power Company and to the Interurban Company. Extensions are contemplated to both the Atlantic City and the Conshohocken plants. Franchises have already been obtained for South Atlantic, Ventnor and Longport, to be lighted from the Atlantic City station. The Atlantic City Gas & Water Company, in which the Electric Company of America has a large interest, has been moved to the Atlantic City Lighting Company plant. A franchise has been obtained for Spring Mills, which will be served from the Conshohocken plant.

AMERICAN TELEPHONE & TELEGRAPH.—Kidder, Peabody & Co. offer for subscription $2,500,000 American Telephone & Telegraph Company collateral trust 4 per cent bonds at 100½ and accrued interest. The bonds are included in the outstanding issue of $15,000,000 collateral trust 4 per cent bonds, under an indenture which permits the issue of $100,000,000 bonds. There are now outstanding $10,000,000 American Bell Telephone A 4s and $15,000,000 collateral trust 4s, a total of $25,000,000 4 per cent bonds. These bonds call for an annual interest disbursement of $1,000,000 per annum. The net revenue of the company for 1900, after deducting interest and taxes, amounted to $5,486,057. The cost of replacement of the company's assets, it is estimated, would be much more than the par value of the securities outstanding, and much could not be replaced.

THE UNITED TRACTION COMPANY, of Pittsburg, Pa., reports gross earnings for March of $157,792, an increase of $9,783 as compared with the same month of last year, and net $70,741, an increase of $5,230. For the nine months ending March 31 the gross earnings were $1,434,145, an increase of $112,087, as compared with the corresponding period of last year, and net $634,423, an increase of $30,269.

BAY COUNTIES POWER COMPANY.—It is understood that the Bay Counties Power Company, San Francisco, has given a second mortgage in the sum of $750,000, covering all of its property, to secure a bond issue to that amount. These bonds are to run for 30 years, and are at 6 per cent, payable semi-annually. They are redeemable at any time at 110. It is said that the greater part of the bonds has been placed in San Francisco.

DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1½ per cent on its assenting stock, payable May 15.

Commercial Intelligence.

THE WEEK IN TRADE.—General trade, according to reports to the mercantile agencies, manifested a strong underlying tone last week, which seemingly lacked only the advent of better weather to become buoyant. In some directions, activity is pronounced, as, for example, in iron and steel, where apparently production is taxed to its capacity, though apparently more to meet existing requirements than for new orders. Railway gross earnings continue to show substantial gains, the current receipts of the Southwestern lines being the best in their history, and Western and Southern roads are doing almost as well. The failures during the week as reported by *Bradstreet's*, numbered 214, as against 212 the week previous and 182 the same week a year ago. There was very little activity in copper, and no change in prices. The controlling interests still adhere to 17 cents for lake and 16⅝ cents for electrolytic. During the week the Government bought 300,000 lbs. of lake at 17 cents, delivered in Washington.

ENGINE BUILDERS' CONSOLIDATION.—A little more light is thrown this week on the engine builders' consolidation. It is now said that the new company will be known as the Allis-Chalmers Company. The E. P. Allis Company, of Milwaukee, the Frazer & Chalmers Company, of Chicago and London, the Gates Iron Company, of Chicago, and the Dickson Manufacturing Company, of Scranton and Wilkesbarre, are the companies to be conducted under one management. The deal was consummated Saturday. It is understood that the locomotive works of the Dickson Company are to be operated as an entirely distinct concern for the present. In Philadelphia Mr. William L. Elkins, Jr., stated that the Allis-Chalmers Engine Building Company, had been formed with $12,500,000 preferred stock and $20,000,000 of common stock. Mr. Elkins said he had resigned from the presidency of the Pennyslvania Iron Works Company, which had not been taken into the combination. Mr. Elkins has also resigned as a director of the company. He is authority for the statement that large works will be built in the vicinity of Philadelphia, and the new concern when running full handed will employ about 15,000 men. Mr. Elkins is the only Philadelphia director of the new company.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York, for the week ended April 10: Antwerp—15 packages electrical material, $546; Argentine Republic—133 cases electrical material, $6,569; 3 cases motor vehicles, $1,850; 18 packages electrical machinery, $4,121. British Possessions in Africa—39 packages electrical material, $2,180. British East Indies—3 cases electrical material, $158. British West Indies—13 packages electrical material, $454. Bristol—6 packages electrical machinery, $2,030. Bolivia—9 packages electrical material, $160. Bremen—1 package electrical material, $75. Brazil—182 packages electrical material, $7,536; 50 packages electrical machinery, $36,667; 1 coil cable, $105. Cuba—3 packages electrical machinery, $57; 410 packages electrical material, $2,242; 1 reel cable, $137. Canada—20 cases electrical material, $180. Chili—1 case electrical material, $12. Central America—68 packages electrical material, $2,409; 1 case electrical machinery, $270. Dundee—5 packages electrical material, $520. Ecuador—82 packages electrical material, $1,476. Glasgow—1 case electrical machinery, $100. Hayti—9 packages electrical material, $149. Hamburg—28 packages electrical material, $2,142; 8 packages motor vehicles and parts, $5,000. Havre—7 packages electrical material, $100; 1 case motor vehicles, $600. Huddersfield—2 cases electrical material, $32. London—165 packages electrical material, $1,724; 32 packages electrical material, $1,668; 5 cases motor vehicles and parts, $3,820. Liverpool—175 packages electrical machinery, $20,375; 25 packages electrical material, $1,854; 5 packages motor trucks, $325. Marseilles—8 cases electrical material, $587. Mexico—66 packages electrical material, $1,368; 5 packages electrical material, $44. Newcastle—26 packages electrical machinery, $3,500; 1 package electrical material, $15. New Zealand—2 packages electrical material, $16. Peru—16 cases electrical material, $825. Preston—3 cases electrical material, $157. Ramsgate—2 cases electrical machinery, $200. Rotterdam—1 crate motor vehicles, $150. Siam—34 packages electrical material, $11,212. Southampton—7 packages electrical machinery, $1,300; 3 packages electrical material, $1,109; 6 cases motor vehicles, $3,000. United States of Colombia—4 packages electrical material, $113; 3 packages electrical machinery, $340. Venezuela—139 packages electrical material, $1,010; 1 package electrical machinery, $36. Vienna—16 packages electrical material, $792.

ORDERS FOR ELECTRIC HOISTS AND CRANES are reported as below by the Milwaukee firm of Pawling & Harnischfeger. They state that the outlook is very bright. They are receiving inquiries that indicate the influx of a large volume of new business. The recent sales are: American Sheet Steel Company, Wellsville Works, Ohio, one 30-ton, with 5-ton auxiliary hoist, and one 10-ton; Anheuser-Busch Brg. Assn., St. Louis, Mo., one 20-ton for power plant and one 5-ton for pumping station; American Clay Working Machinery Company, Bucyrus, Ohio, two 20-ton and one 15-ton; American Bridge Company, Philadelphia, Pa., one 8-ton for Post & McCord Branch, Brooklyn, one 25-ton and one 8-ton for Trenton branch; A. & P. Roberts Company, Pencoyd, Pa., one 25-ton, with 5-ton auxiliary hoist; Curtis Sheet Steel & Corrugating Company, Zanesville, Ohio, one 20-ton; Frankford Steel & Forging Company, Eddystone, Pa., one 10-ton; Oesterreichisch-Alpine Montangesellschaft, Vienna, Austria, one 5-ton; La Belle Iron Works, Steubenville, Ohio, three 5-ton, 100-ft. span, and two 5-ton, 80-ft. span; New York Shipbuilding Company, Camden, N. J., one 15-ton double trolley; Nordberg Manufacturing Company, Milwaukee, Wis., two 30-ton and two 10-ton; Philadelphia & Reading Railway Company, Pottsville, Pa., one 25-ton, with 5-ton auxiliary hoist, and one 30-ton double trolley; Puget Sound Naval Station, Bremerton, Wash., one 10-ton; Wheeling Steel & Iron Company, Wheeling, W. Va., two 10-ton; Sharon Steel Company, Sharon, Pa., one 5-ton; Parkersburg Steel & Iron Company, Parkersburg, W. Va., one 25-ton, with 5-ton auxiliary hoist; North Mount Lyell Copper Company, Crotty, Kelly's Basin, New Zealand, one 40-ton, with 5-ton auxiliary hoist; Laughlin Hall Company, Wheeling, W. Va., one 20-ton; Chandler & Taylor Company, Indianapolis, Ind., one 10-ton.

MACHINERY EXPOSITION AT FRANKFORT.—Consul-General Guenther writes from Frankfort, March 7, 1901: "On the 5th instant, a meeting, largely attended by the members of the technical and other societies, took place at Frankfort to receive the report of a committee charged with the duty of investigating the subject of a permanent exposition of machinery and models in this city. Plans for a suitable building and estimates of cost for the same were submitted; $50,000 was the estimated cost, but many thought the amount inadequate. After a long and animated discussion, the following motion was adopted unanimously: 'In view of the importance of Frankfort-on-the-Main as the center of a district rich in industries and commerce and of an immense passenger traffic, this meeting, called by the representatives of the Technical Society, the Frankfort branch of German engineers, the Electro-Technical Society, the Frankfort Society of Technical Engineers, the Society for Social Economy, the Agricultural Society, etc., deems a permanent exhibition of the trades and industries an urgent necessity and an efficient means to further the commerce, the industries, and the agricultural interests of Frankfort-on-the-Main. We therefore request the proper authorities and the general public to aid in its establishment.'"

W. R. BRIXEY, the well-known manufacturer of kerite cable, has just received notification from Washington, D. C., that he has secured the contract for supplying the submarine cable to be utilized for the purpose of connecting Juneau, the capital of Alaska, with Skagway, which is the southern terminus of the White Pass Railway. The contract will entail an expenditure in the neighborhood of $75,000. It is, apart from its monetary value, an important contract, as under existing circumstances Juneau is cut off from communication with the outside world, except by steamer from Seattle, from which point it takes four days to reach the far northern city. The cable, weighing about 600,000 lbs., will be shipped by rail from Seymour, Conn., to a point not yet determined on the Pacific Coast. From there it will be carried in a specially chartered steamer to Alaska. The line will be laid and in operation prior to Aug. 1, when it will be possible to telegraph Juneau from any cable office.

THE KAWASAKI DOCKYARDS, one of the principal undertakings of its kind in Japan, are about to place some more orders for American electrical equipment. The plant already consists of two 250-hp engines built by the Ball Engine Company, of Erie, Pa., which were purchased through the Frank M. Pierce Engineering Company, of New York City, and two 150-kw generators furnished by the Westinghouse Electric & Manufacturing Company. The dock authorities now call for a 500-hp Ball engine and a 500-kw Westinghouse generator.

WESTINGHOUSE, CHURCH, KERR & CO., of New York City, report receipt of cable advice from Noyes Brothers, of Sydney, New South Wales, one of the principal concerns handling American machinery in the antipodes, requisitioning for 30 compound type engines averaging 50 horse-power each. Ten belted generators, aggregating about 800 kilowatts, were ordered at the same time by the firm. These will be manufactured by the Westinghouse Electric & Manufacturing Company. The equipment will be utilized for general power purposes in the British colony.

THE PASSAIC ROLLING MILLS, of Paterson, N. J., which concern is said to have decided on the conversion of its motive power from steam to electric transmission, is at present placing some fair-sized orders rendered necessary by such change. The Harrisburg Foundry & Machine Works have been allotted an order for two 150-hp standard single-valve automatic engines, to be direct connected with two 100-kw generators. These dynamos will be built by the Crocker-Wheeler Company, of Ampere, N. J.

THE PELTON WATERWHEEL COMPANY, New York offices, 143 Liberty Street, has secured a contract calling for 10 miles of riveted steel pipe, which will be utilized by a large tin mining company in the Malay Peninsula. The pipe varies from 8 inches to 24 inches in diameter and will aggregate a weight of 900 tons, approximately. The contract stipulates for completion of shipment within six months.

THE HARRISBURG FOUNDRY & MACHINE WORKS, Harrisburg, Pa., have secured an order, through their New York office, for a 100-hp tandem compound engine, driving a fan load in one of the principal hotel establishments located in Minas, Brazil. The requisite generator—a 60-kw machine—together with several large fans, is being supplied by the General Electric Company.

MESSRS. R. ROGERS ET CIE., of Paris, France, have placed an order with Westinghouse, Church, Kerr & Co., of New York City, for one 80-hp and one 55-hp compound engine, together with a 30-hp simple engine, to be used for electric light purposes in the French capital.

J. J. REIDY, New Haven, Conn., reports that the War Department has just shipped eight cases of his Donnelly improved steel climbers, complete with straps, to the Philippine Islands for use by the Signal Corps there.

THE AKRON ELECTRICAL MANUFACTURING COMPANY, Akron, Ohio, expects to double its capital stock in the near future, owing to its increased business.

THE HAINES & NOYES COMPANY, Chicago, reports a steady growth of business. Among the contracts closed through its private telephone plant department are a complete local and long-distance telephone system for the new Beaumont Hotel at Beaumont, Texas. This includes a 100-drop annunciator switchboard. The drops are of the target type, and the switchboard contains the company's latest clearing-out drop. This board is equipped with two trunk lines to the city exchange. The telephones are the "Style 41," which are very small and compact, and are for local and long-distance use as well as for interior use. The annunciator switchboard and telephone backboards are all in golden oak. Messrs. Miller & Tuggle, of Beaumont, are to install the system. Another large private plant has been installed in the works of the American Car & Foundry Company, Chicago. This company is also equipping the Hahnemann Hospital and the R. A. Waller High School, Chicago, with complete plants. Through the St. Louis Electrical Supply Company and the Lindsey Electrical Supply Company they have recently installed several large plants in St. Louis. They have also closed several contracts for exchanges during the past week; among them may be named Elma, N. Y.

CALCIUM CARBIDE.—For years past the electricians of the world have been experimenting with electric furnaces with a view of making them successfully continuous. If reports are true, it would seem to have fallen to the lot of an American to achieve success where electricians of many countries have failed, even though he did not live to enjoy his success. In April, a patent covering an improvement in electric furnaces was issued to F. J. Patten, the well-known electrical engineer who died in this city last November. The patent which is owned by the Columbian Carbide Company, of New York City, is of the open hearth type, and in the opinion of the electrical experts who have examined it, fully satisfies all the requirements of a strictly continuous furnace. The company owning it is about to build a large plant, where its secret processes in conjunction with furnaces of the above type will be employed in the manufacture of calcium carbide upon a huge scale. We regard this move as a most important one, and with our readers shall watch the result with interest, in view of the fact that the carbide industry of this country has hitherto been in the hands of one company which seems to have had a monopoly of the trade.

KELLOGG TELEPHONE SALES.—The Kellogg Switchboard & Supply Company, of Chicago, is busy over several new contracts for large telephone exchanges. Among the recent orders for small switchboards, varying in size from 50 to 300 lines, are the following: Williamsburg, Pa.; Russell, Iowa; Somerset, Pa.; Chrisman, Ill.; Webster, S. D.; Grandbury, Texas; West Chester, Pa.; Bartelsville, I. T.; Bishop Hill, Ill.; Woonsocket, S. D.; Tama, Iowa; Royersford, Pa.; Columbus Junction, Iowa; Little Rock, Ark.; Marco, Ind.; Shawnee, Ohio; Canadian, Texas; Troy, Ind.; Savannah, Ill.; Chadwick, Ill.; Black River Falls, Wis.; Astoria, Ill.; Concordia, Kans.; Ashland, Ky.; Blue Rapids, Kans.; Greenleaf, Kans.; Huntingburg, Ind.; Virginia, Ill.; Logan, Kans.; Hurley, S. D.; Sparta, Ill.; Miltonville, Kans.; Scandia, Kans.; Streetsville, Ohio; Lexington, Miss.; Story City, Iowa; Versailles, Mo.; Dalton, Ohio; Doylestown, Pa.; West Grove, Pa.; Westphalia, Ind.; Linton, Ind.; Clifton, Kans.; Sanborn, Ind.; Estelline, S. D.; San Francisco, Calif.; Joy, Ill.; Blue Earth, Minn.; Augusta, Ill.; Sullivan, Ind.; Dawson, Minn.; Wellsboro, Pa.

RAILWAY SHOPS.—The Lake Shore & Michigan Southern Railway Company has completed plans for immense repair shops to be located at Collinwood near Cleveland. The locomotive shops and the blacksmith and car machine shop will be of steel construction, and bids for their construction will be asked for within a few days. There are to be three other buildings of large size, including a power house. All machinery will be electrically driven, and the power equipment will consist of boilers of 1800 horse-power, with engines to correspond; one 400-kw direct-current generating set; one 80-kw generating set, one 1300 cubic-foot air compressor. Bids for the three buildings and the power equipment will be called for in the near future. Contracts for four large cranes have been placed with the Philadelphia Engineering Company, Philadelphia, as follows: One 100-ton electric traveling crane, one 30-ton, one 10-ton and one 7½-ton crane. A large amount of machinery will be required, but bids will not be called for for some months.

THE AMERICAN STOKER COMPANY reports receipt of contracts for automatic underfeed stoker equipments for installation in the Monterey and Asclentes (Mexico) plants of the American Smelting & Refining Company. Seven equipments, each having a capacity of 2000 lbs. of coal an hour, will be utilized in the first-named plant, while three machines of similar description have been ordered for Asclentes. The United States Government has also requisitioned for three stokers to be shipped for the new pumping station at Havana. These equipments will have an hourly capacity of 800 lbs. of coal each. The largest domestic order recently obtained was received from the Cincinnati Edison Electric Company, which is to be furnished with no fewer than 26 automatic stokers for installation in its principal power station. These machines are each to have a capacity of 2000 lbs. an hour.

MATERIAL FOR ECUADOR.—Dr. José Maria Borgia, former Consul-General and Acting Minister to the United States from Ecuador, who has been in New York City for some time, has started for home. Before leaving he said: "I have been making arrangements for the shipment of machinery for the better development of our gold fields. In a few months we shall have more than 300 dredges there worked by electricity. Orders have also been placed with the American Bridge Company for more than $2,000,000 worth of bridge material, to be used in the completion of the Guayaquil & Quito Railroad, a very necessary adjunct to the successful working of the mines. We consider our gold fields, when fully operated, will prove the richest in the world."

ORDERS FROM BLOOMINGTON, IND.—The Bloomington Light, Heat & Power Company has placed an order for 5000 lights transformer capacity with the Kuhlman Electric Company, of Elkhart, Ind. It has also let a contract to the Fort Wayne Electric Works for a 100-kw alternator and to the General Electric Company for 100-light capacity on the Hartford arc system. It will put in Chandler & Taylor boilers, Stillwell-Bierce heaters and Gardner pumps. It will use the Cutter mast-arm for street lights, and the Cutter absolute cut out. Mr. A. M. Barron is general superintendent.

THE BROWN HOISTING MACHINE COMPANY, of Cleveland, Ohio, has practically completed plans for the erection of a new plant to take the place of the one destroyed by fire some months ago. The main plant will cover almost an entire square 500 by 312 ft. There will be seven buildings, each of which will be covered by a crane. All the machinery will be electrically driven. There will be an independent power house equipped with three units of 250-kw capacity each. Contracts have not yet been placed.

TEXAS TROLLEYS.—E. P. Roberts & Co., of Cleveland, Ohio, engineers for the Northern Texas Traction Company, have closed contracts for the equipment of the power house at Dallas. It will consist of two 600-kw alternating-current generators, two 300-kw rotary transformers, two 400-kw rotary transformers, all of Westinghouse make, and two 900-hp Cooper Corliss cross compound engines.

ELECTRICAL MACHINERY IN MEXICO.—Mr. Charles E. Sharp, of St. Louis, representing an electrical supply house of that city, has been making his semi-annual business tour of Mexico. He reports that the demand for electrical machinery in that country is constantly increasing. He says that his company will establish a supply house at some large distributing center in Mexico in the near future.

POWER COMPANY.—The Connecticut Senate has passed a bill giving permission to the Consolidated Lake Superior Power Company to engage in operating railroads, steamers, express business, furnishing water and electric light, etc. The company has a capital stock of $20,000,000, and Mr. Lynde Harrison, of New Haven, is president.

GREAT DEMAND FOR RAILS.—A representative of the Cambria Iron & Steel Works is quoted as saying that the great activity in the construction of electric lines has swamped rail mills with business. The Cambria Company is refusing orders for rails for earlier than October delivery, and other rail mills are reported to be in even worse condition.

THE AMERICAN BRIDGE COMPANY has been awarded a contract for the erection of the buildings for the plant of the Youngstown Engineering Company at Youngstown. The latter company will engage in the manufacture of electric cranes and heavy castings.

TROLLEYS IN ILLINOIS.—The Aurora, Elgin & Chicago Electric Railway Company has placed contracts for four 2200-hp Cooper Corliss engines, 8000-hp Edgemore boilers and General Electric Company generators.

A 12-POINT AUTOMATIC TELEPHONE SYSTEM for use in Colombia, South America, has been purchased by the United Fruit Company from the Clark Automatic Telephone Switchboard Company, Providence, R. I.

THE EXETER MACHINE WORKS, Pittston, Pa., are at present installing their gravity system of coal conveying, etc., at the Twenty-ninth Street station of the New York Gas, Electric Light, Heat & Power Company, New York City.

BALL ENGINE CONTRACT.—The Mount Washington Electric Light & Power Company, Mount Washington, Md., is installing a 350-hp tandem compound direct-connected engine, purchased from the Ball Engine Company, Erie, Pa.

THE IBERIA ELECTRIC SUPPLY COMPANY has been formed at New Iberia, La., and will do a construction and supply business. Mr. A. G. Nauch, president, writes us that the company will be glad to receive catalogues, price lists, etc.

Special Correspondence.

ENGLISH NOTES.

London Office, Electrical World and Engineer, April 20, 1901.

THE SOUTH WALES ELECTRICAL POWER DISTRIBUTION COMPANY, which succeeded in getting its bill through Parliament last year under certain restrictions, is taking steps to exercise the powers it possesses. Negotiations are proceeding for the land required for stations at Pontypool, Pontypridd, and Neath, and from these centres it intends to supply electricity for lighting or motive power to local authorities at a cheap rate. Matters have now so far advanced that offices have been taken opposite the Park Hotel, Cardiff, and practical operations will soon be commenced.

THE ELECTRIC TRAMWAY EQUIPMENT COMPANY, of Birmingham, recently got an order from the Southport corporation for overhead line material to be delivered, one-half in two months and one-half in four months, imposing a penalty for late delivery of £1 a day for the first half and 10s. per day for the second half. The corporation, however, very justly offered a like premium as an inducement for early delivery, and it is interesting to note that the company referred to, having secured the contract, delivered the first half in one week and the second half in two weeks and so earned for itself a very satisfactory premium, in addition to the price which it had already received. This goes to show that English manufacturers can rise to the occasion when there is a necessity for it and speaks volumes for the management of this energetic young company in the manufacture of insulating material for overhead line purposes.

BRUSH ELECTRICAL ENGINEERING COMPANY.—At the twelfth annual general meeting of the Brush Electrical Engineering Company, Limited, Mr. J. B. Braithwaite, Jr., M. I. E. E., chairman of the company, said that the large extension to its factory upon which work has been carried on for the past year is now completed. The new car shops are completed and fully equipped for work. The company is now in a position to turn out electrical cars of British manufacture throughout. That is to say, that the Brush Company manufactures at its own works, not only the car bodies, but the motors, controllers, the frames and the trucks themselves, the last item being an entirely new departure for the company. The most important event which the chairman referred to was the working agreement which had been entered into between the Brush Company and the British Electric Traction Company. That agreement has only been in force for a short time, but had, the chairman believed, already brought them important orders for engines, electric generators, and electric tramway rolling stock, etc.

ELECTROLYSIS AT SHEFFIELD.—The Sheffield corporation met with very determined opposition recently when its bill for electric tramway extensions came before the House of Lords committee, and the bill has only been allowed to proceed with the following clause inserted, and which was requested by the Sheffield United Gas Company: "Provided that, notwithstanding anything contained in the said acts or this act, if it be proved that any injury, or damage to any mains, pipes, or apparatus of the Sheffield United Gaslight Company shall have resulted from fusion or electroyltic action caused by any currents generated or used for the purpose of electric traction or any of the tramways for the time being belonging to the corporation, nothing in the said acts or this act shall relieve the corporation from any liability to make compensation for such injury or damage which would have existed but for the passing of the said act and this act." Mr. A. L. Fell, the corporation electrical engineer, protested that every precaution had been taken, and that there was no danger of electrolytic action, while both Mr. H. F. Parshall and Mr. Robert Hammond confirmed Mr. Fell's opinion, and stated that the present Board of Trade rules were ample to insure safety. Professors J. Perry and W. E. Ayrton, however, maintained that great danger of electrolytic action did exist, and the committee finally decided as stated above.

THE LONDON UNDERGROUND.—There is a growing impression in London that Mr. Charles T. Yerkes has really secured the control of the Metropolitan District Underground Railway. A large amount of stock in this railway has recently been bought up, and it is now only a question of time when a satisfactory announcement is made as to what will ultimately be done with this underground system. The old Metropolitan and District Railways in London form a very valuable property, and the mere fact that they are not deep down in the ground, like the "tube" service, appeals to a large class of people. Were the Underground Railway converted to a system of electric traction and run on slightly different principles there is no doubt but what a much larger business could be done and that a dividend could be paid on the stock. It does not seem to the casual observer that the full service is got out of the tunnels penetrating London, and by thoroughly renovating the line, introducing newer and more modern styles of rolling stock, giving a quicker acceleration, and therefore a more frequent car service, the old London Underground would undoubtedly prove a much more formidable rival to the new tube method than is at present the case. In the meantime it is interesting to note that the District Company has announced a wholesale reduction in fares, the granting of third class season tickets and a number of other accommodations forced by competition.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—A telephone line extension is projected from Gold Hill, Oregon, to Crescent City.

SAN FRANCISCO, CALIF.—The Oakland, Calif., city council has directed the auditor and treasurer to collect at once an annual ground rental of $2.50 for each telephone and telegraph pole in that city. The companies owning such poles have heretofore failed to comply with the ordinance passed in 1894 imposing the tax.

CITY OF MEXICO, MEX.—The long distance telephone movement is having a rapid growth in Mexico. Among the lines recently constructed and now in successful operation is that connecting Jalapa with Janacapa, Astapa, Cacaos and Puebla Nuevo, and which will soon be extended from the latter place to San Juan Bautista, the capital of the State of Campeche. A telephone line has also recently been completed connecting Comalcalco with Teculutilla and Aldama.

MINNEAPOLIS, MINN.—The Twin City Telephone Company, which lately bought up the St. Paul and Minneapolis exchanges of the Mississippi Valley Telephone Company, is about to expend over $500,000 on improvements on its telephone system in Minneapolis alone. The improvements will consist of the erection of a main exchange building, the entire cost of which will be about $100,000; the erection of a sub or branch exchange, to cost nearly $30,000, and the erection of an east side exchange, which will involve an expenditure of nearly $100,000.

HENDERSON, N. C.—The stockholders of the Henderson Telephone Company have authorized an increase in their capital stock to $100,000, in order to meet the demands of increasing business.

CHARLOTTE, N. C.—The Charlotte, N. C., Telephone Company, the old "Queen City Company," recently purchased by the Curtis Syndicate, of New York, has been chartered with $30,000 capital. J. B. Curtis, of New York; J. I. Taylor and A. A. Miller, of Charlotte, are the corporators.

CADIZ, OHIO.—The Cadiz Home Telephone Company will commence operations in the near future with 125 subscribers.

WINDHAM, OHIO.—The Ravenna Home Telephone Company is trying to secure a franchise here. The Bell Company is building a line from this place to Garrettsville.

WAUSEON, OHIO.—The Northwestern Ohio Telephone Company is preparing to install sub-exchanges at Tedrow and Pettisville. The National Automatic system will be tried as an experiment.

FINDLAY, OHIO.—The Findlay Home Telephone Company is rushing work on its exchange, and it is expected that it will be connected up shortly after May 1, as originally planned. Business will open with about 750 subscribers. Rates are $18 per year for residences, $24 for offices, $30 for business houses and $18 for farmer's lines and village connection.

COLLINWOOD, OHIO.—The Collinwood Home Telephone Company held its annual meeting recently, when the company was reported to be in excellent financial condition. There are 320 telephones in operation with 22 on a waiting list. A 2½ per cent. dividend was declared and arrangements made for new equipment. The officers were re-elected as follows: J. M. Hart, president; W. G. Griswold, secretary-treasurer; directors, E. L. Barber, W. F. Parsons, Dr. J. S. Wood, S. O. Davis, J. M. Hart and W. G. Griswold.

CLEVELAND, OHIO.—Mrs. M. A. Brett, who assisted her husband in the management of the old independent exchange at Detroit, and who since the death of Mr. Brett some time ago has been promoting independent exchanges in Texas, was in this city recently interesting local capitalists in the organization of a company to build an exchange at El Paso, Texas. Mrs. Brett has secured the franchise and has contracts from about 75 per cent. of the telephone users in that city. Her Cleveland mission was successful and the exchange will be built at once.

PITTSBURG, PA.—The Bell Telephone Company, of Greenville, Pa., has raised the rates 33 per cent. for the district embracing Greenville, Sharon, Sharpsville, Mercer and Grove City. This has caused the subscribers to get up an indignation meeting, and a committee has been appointed to confer with the independent telephone company to ascertain whether it means to maintain the present rate. So far they have not been able to get any satisfactory reply, and it is rumored that both companies are about to consolidate.

RICHMOND, VA.—It is said that the question of a consolidation of the various telephone companies at or in the vicinity of Newport News, Va., especially the long-distance lines to Richmond, seems to be approaching a crisis. The officials have nothing to say, but the statement is made that it is not to be doubted that the two companies have come to the conclusion that there is little possibility of both lines being able to live, while a combination would render the stock a paying investment.

KENOSHA, WIS.—The city is trying to force the Wisconsin Telephone Company to put all its wires underground, in the business district of the city.

ELECTRIC LIGHT AND POWER.

ARKADELPHIA, ARK.—J. W. Urlson, of Arkadelphia, has bought the plant of the old water and light company for $12,000. Five dynamos will be installed at once and for a light and water service will be resumed at an early date.

WILMINGTON, DEL.—A charter was issued at Dover to the General Engineering Company of Brooklyn, which is to construct, maintain, and operate gas and electric works; capital, $250,000.

SAN FRANCISCO, CALIF.—The Truckee River General Electric Company is reconstructing the lines of the local electric lighting system, recently purchased by that company.

SAN FRANCISCO, CALIF.—The Hale & Norcross tunnel on the Comstock Lode, Virginia City, Nev., has been connected with Truckee River General Electric Company's lines. Electric power will be supplied to drive ventilating fans and to light the tunnel.

SAN FRANCISCO, CALIF.—It is reported that the Woodland Consolidated Electric Light, Gas & Power Company, of Woodland, Calif., has sold all of its holdings and business to the Woodland Gas & Electric Company. The last-named company will distribute the current furnished by the Bay Counties Power Company's electric transmission lines.

SAN FRANCISCO, CALIF.—The Ventura Water, Light & Power Company was recently incorporated, with Los Angeles, Calif., as the principal place of business. Directors: J. H. Adams, T. W. Phillips, T. W. Brotherton, J. M. Gardner, F. E. Trask, Los Angeles; W. R. Staats, J. S. Torrence, Pasadena. Capital stock, $500,000; all subscribed.

SAN FRANCISCO, CALIF.—The Black Diamond coal mine, in the State of Washington, is being improved by the installation of electric hoists and an electric motor haulage system. A new 8-foot ventilating fan is now in operation. Electric haulage has also been introduced at the Roslyn coal mines, operated by the Northern Pacific Railroad Company in Western Washington.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company has commenced supplying current for commercial purposes to the various sub-stations along the lines of the Standard Electric Company, including the Oakland and San Jose stations. The main generating station, on the Yuba River, is 140 miles from the end of the lines and the current will be transmitted at 40,000 volts. On account of the delay in completing the Standard Company's system, the Yuba supply will be depended upon for six or eight months. The Bay Counties Power Company will soon have its own commercial circuits in operation to Vallejo, Oakland and elsewhere, and the line voltage will be increased to 50 and then to 60 kilovolts as load increases.

BRAZIL, IND.—The city is taking steps to put in and operate an electric light plant. A company of Indianapolis men offer to establish the plant, to be paid for in installments.

RICHMOND, IND.—The Richmond City Council has decided to locate the power-house of the municipal electric light plant on ground owned by the city in the river bottoms instead of in the city parks.

CARTHAGE, IND.—The city council has granted a franchise for an electric light plant and contracted for lighting for ten years, at the expiration of which the city shall have privilege to buy it at a fairly appraised value.

RICHMOND, IND.—In the suit brought by local taxpayers to prevent the construction of a municipal electric light plant and enjoin its location in the city park, Judge Fox ruled in favor of the city. This is thought to be the last move of the opposition, and the plant will now be speedily constructed at a cost of $144,000.

INDIANAPOLIS, IND.—The city engineer is preparing specifications for a new public electric lighting contract, and the Board of Public Works will receive bids and let the contract within the next sixty days. The fact that the present contract with the Indianapolis Light & Power Company does not expire for two years arouses some curiosity, but the board says it is for the purpose of giving the successful bidder sufficient time to put in a plant. The Home Heating & Lighting Company, now constructing a plant, will be a bidder.

NEW ALBANY, IND.—A joint meeting of the committees from the commercial clubs of this city and Louisville was held recently, and steps were taken toward utilizing the immense water power of the Falls of the Ohio at this point. The plan is to dig a canal on the Indiana side of the river from a point at the head of the falls above Jeffersonville to a point just below this city, where it will empty below the falls. This power will be utilized to generate electricity for the three cities, the street railway companies and the surrounding country.

CITY OF MEXICO, MEX.—The contract which the city council of the town of Culiacan, the capital of the State of Sinaloa, Mexico, made with a firm for the electric lighting of that place, has been rescinded owing to the failure of the contractors to fulfil the stipulated conditions.

CITY OF MEXICO, MEX.—The large electric generating plant operated by water power owned by Sebastian Robert & Company, of the City of Mexico, is now furnishing lights for the suburban towns of Tlalpam, San Angel, Coyoacan and Mixcoac. The plant is located at Tizapan.

CITY OF MEXICO, MEX.—Good progress is being made in the construction of a large electrical plant on the top of a mountain near Oblate, in the State of Jalisco, Mexico, by an American syndicate. The plant will supply power to factories and other industrial concerns located in towns of that section. At Las Juntas power from this plant to the amount of 18,000-hp has already been contracted for.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has nearly completed moving its sub-station into new quarters on Fifth Street. The storage battery plant remains to be moved, and will be enlarged when re-installed in the new building. The work was begun at 12 o'clock on a Saturday night and on the following Monday one-half the equipment, consisting of 1500-hp of transformers, rotaries, switchboards, etc., was moved, underground cable connections made, and again put into service. The other half of the equipment was moved on the following Sunday.

ST. LOUIS, MO.—The Collins Electric Company has been incorporated, with a capital stock of $100,000, all paid, by William F. Kemper, Ulysses L. Collins, F. William Gunnamann and Wm. S. Cowan.

ST. LOUIS, MO.—The National Electric, Gas, Water & Power Company, through its president, Geo. A. Gable, has filed an application with the County Court asking for a franchise to lay pipes and conduits on various streets in St. Louis County. As a compensation it offers the county 1 per cent. of its earnings for the first four years, 2 per cent. for the next three years and 3 per cent. for the other forty-three years of the franchise.

CHARLOTTE, N. C.—The street and finance committees of Charlotte have decided to pass an ordinance on May 6 granting a franchise to F. Van Deventer and others, provided a $10,000 indemnity bond shall be given, to develop power at Mott's Falls, thirty miles from Charlotte. The contemplated work will cost about $800,000.

EGG HARBOR CITY, N. J.—The power house of the Egg Harbor City Electric Light plant was totally destroyed by fire on April 19. The loss is about $10,000.

ALBANY, N. Y.—The Hudson River Electric Company has been incorporated, with a capital of $1,000,000. The company is organized to construct dams across the Hudson River in Saratoga, Warren and Washington counties and elsewhere, and on other streams; and to furnish light, heat and power to cities, towns and villages in Saratoga, Washington, Fulton, Montgomery, Rensselaer, Albany, Schenectady, Essex, Clinton, Franklin and other counties. The directors are C. H. Peddrick, Jr., and J. M. Warren, of Spier Falls, Saratoga county, and Henry W. Williams, Robert DeLong and F. R. Baker, of Glens Falls.

CONNEAUT, OHIO.—The municipal lighting plant here has been overhauled and new equipment installed.

NILES, OHIO.—The citizens of this place have voted against the issuance of bonds to purchase the Niles Electric Company's plant, which is running in opposition to the municipal lighting plant.

HAMILTON, OHIO.—The municipal lighting plant is greatly overloaded, and as there are no funds to provide for additional equipment, the director of public works has been authorized to rent or lease an extra generator.

MARION, OHIO.—The Marion Electric Light & Power Company has contracted for equipment to double its present capacity. A new 200-hp generator will be installed about June 1, and other equipment soon after.

CRESTLINE, OHIO.—The Crestline Electric Light Company's plant was sold at sheriff's sale in Bucyrus recently. It was bought in by the First National Bank, Crestline, and John A. Roebling's Sons Company, of Trenton, N. J. The price paid was $16,667. The plant will continue in operation.

COLUMBUS, OHIO.—Engineer Ellicott, who was retained by the council lighting committee, to prepare estimates on the cost of a plant to furnish lights for the entire city, has submitted a detailed report giving approximate figures for the cost of the equipment, the total amount being $100,275, exclusive of considerable available equipment in the present plant. Among the items are the following: Two 800-hp cross compound engines, $16,000; two 500-hp water tube boilers, $8,400; three 160-light arc generators, $9,000; 600 all-night service arc lamps, $7,200; poles, wire, brackets, etc., $30,000; building and stack, $18,000. Mr. Ellicott calculates that lights could be furnished from such a plant for $45 per year, and that in three years the saving over present prices would pay for the plant. In view of these figures the board of public works has decided to reject the bids for lighting submitted a short time ago by several companies, the lowest figures being $78 per year for all-night service on a ten-year contract for not less than 850 lamps. It is reported that a new company will be organized, in case the bids are rejected, which will agree to furnish all the lamps necessary at $70 per year, giving bond to the city of $100,000 for the faithful performance of the contract. In addition it will agree to purchase the present municipal plant at figures fixed by appraisers.

YORK, PA.—The Susquehanna Electric Power Company has been organized with the following directors: John K. Cowen, Alexander Brown, John Henry Miller, George K. McGaw and J. B. Ramsey. The capital is $12,000,000. The power house will be one of the largest in the world and will be located at Peach Bottom, York County. The United Railways of Baltimore have contracted for 20,000-house power, with the privilege of increasing to 40,000 horse power.

SEATTLE, WASH.—An ordinance has been introduced in the city council requiring all wires in paved streets to be placed underground. Also, all wires are to be placed in underground conduits in streets hereafter paved.

MILWAUKEE, WIS.—The Fred Miller Brewing Company will install an electric power plant, consisting of a 75-kw direct current direct-connected unit, switchboard and 10 to 15 motors.

MILWAUKEE, WIS.—The Consolidated Current Company has contracted for an electric lighting and power plant at its works. There will be a 25-kw generator, switchboard, three motors and electric light. Julius Andrae & Sons Company, of this city, have the contract.

MILWAUKEE, WIS.—Kroeger Bros. will install a complete electric power and lighting plant in their new department store. The plant will consist of one 75-kw, and one 35-kw, direct-connected units, switchboard, two electric elevators, electric ventilator and arc and incandescent lights. Iron conduit will be installed.

THE ELECTRIC RAILWAY.

SPRINGFIELD, ILL.—The Secretary of State has licensed the Freeport Electric Railway Company, with a capital stock of $50,000. The principal office is at Rockford, Ill. The incorporators and first board of directors are: Thomas M. Ellis, John H. Catlin, George A. Wilson, Thomas E. Reber and Frank L. Puffer, all of Rockford, Ill.

BALTIMORE, MD.—A forty-year franchise has been granted to C. E. Fink and Dr. F. T. Shaw at Westminster allowing the use of the streets for an electric railway system.

BALTIMORE, MD.—The incorporators of the Washington & Annapolis Electric Railway Company are trying to interest Philadelphia capitalists and the Johnson Street Railway syndicate in a plan to construct a trolley line from Philadelphia to Baltimore. The scheme contemplates a continuous trolley system from New York to Washington by way of Philadelphia, Wilmington, Del., and Baltimore.

EAST ORANGE, N. J.—Essex County capitalists, among them Francis M. Eppley, are trying to secure rights of way for a new trolley line between Bloomfield and Irvington.

JERSEY CITY, N. J.—President David Young, of the North Hudson County Railway Company, Hoboken, states that his company has consolidated with the Jersey City, Hoboken and Paterson Street Railway Company.

NEWARK, N. J.—The Bergen Turnpike Company has borrowed $1,000,000 and will build a trolley from Hoboken to Hackensack.

ALBANY, N. Y.—The New York & Port Chester Railroad Company has been incorporated to operate an electric street surface road twenty-five miles long, from the Harlem River at Port Morris through the Borough of the Bronx to Mount Vernon, Pelham Manor, New Rochelle, Larchmont, Orienta, Mamaroneck, Milton, Rye, and Port Chester, to the Connecticut line, with a branch to Classon's Point, on the East River. The company has a capital of $250,000, and the directors are Charles Heinecke, of Whitestone; M. F. Germond, of Dumont N. J.; W. H. Heath, of Brooklyn; M. W. Baldwin, E. D. Mailloux, Mesmore Kendall, Christopher Kaiser, C. O. Mailloux, of New York City, and Ernest Muller, of Westfield, N. J.

ALBANY, N. Y.—It is rumored that the Albany & Hudson Electric Railroad Company is contemplating a branch of its road from Brookview to Castleton.

RAVENNA, OHIO.—The city council has granted a franchise to the Northern Ohio Traction Company.

MARTIN'S FERRY, OHIO.—The Steubenville & Monroe Traction Company has asked for a franchise in this place.

SPRINGFIELD, OHIO.—The Columbus, London & Springfield Railway Company has secured its franchise in this county.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company has increased its capital stock from $30,000 to $1,000,000.

CLEVELAND, O.—The Everett syndicate, of Cleveland, which recently acquired the Detroit Street Railway system, has purchased the Detroit & Toledo Shore Line.

MT. GILEAD, OHIO.—The Commissioners of Morrow county have granted a franchise through the county to the Mansfield, Mt. Gilead, Cardington & Delaware Railway Company.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Railway Company has secured a 90-day option on the properties of the Delaware Electric Street Railway Company.

ZANESVILLE, OHIO.—The Newark, Zanesville & Coshocton Railroad Company has been incorporated by J. M. Ickes, Charles H. Hunt, J. K. Hamill, C. H. Geidel and W. O. Littick.

AKRON, OHIO.—The Akron South Side Belt Line Railway Company, capital $10,000, and the Akron & Barberton Belt Line Railway Company, capital $15,000, have been incorporated.

SEBRING, OHIO.—Several prominent local people have secured an option on the franchise of the Alliance, Sebring & Salem Railway Company, and are endeavoring to raise funds to build the road.

DAYTON, OHIO.—The Dayton & Xenia Traction Company has been incorporated by C. J. Ferneding, H. L. Ferneding, O. O. Ozias, J. E. Carson and Edward Canby. Capital stock, $800,000.

BUCYRUS, OHIO.—The Central Ohio Traction Company has been granted a franchise to build a road from Galion to Crestline. Another company holds a similar franchise and has commenced construction work.

CLEVELAND, OHIO.—A syndicate of Eastern capitalists, headed by A. L. Johnson and Martin Mullen, are seeking to establish a rival street car system in this city. Their purpose is to parallel the present routes and bid for patronage with a 3-cent fare as inducement.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Electric Railroad Company has been incorporated by S. T. Everett, J. W. Holcomb, J. E. Latimer, T. A. Simons, of Cleveland and Lyman Gardner, Richard E. Jones, D. C. Beggs, H. C. Park and F. D. Simons, of Columbus. The company was incorporated for $1,000, but this was increased a day later to $1,000,000.

TOLEDO, OHIO.—A deal is said to have been practically closed whereby the Toledo, Bowling Green & Fremont Railway passes into the hands of George B. Kerper and John Kilgour, Cincinnati capitalists, who own the Findlay Street Railway Company of Findlay, and an extension now being built to North Baltimore. The two lines will be joined at Trombley, the present terminus of the Toledo line, and the extension from Bowling Green to Fostoria will be built.

BAVARIA, OHIO.—The county commissioners have granted franchises to the Cincinnati & Eastern Railway Company, which proposes to build a line from Cincinnati to New Richmond; to the Cincinnati & Hillsboro Electric Railway for a line from Cincinnati to Hillsboro, and to the Cincinnati & Columbus Railway Company, which is promoting a direct line from Cincinnati to Columbus.

FINDLAY, OHIO.—The Toledo & Findlay Traction Company was incorporated a few days ago by George B. Kerper, Henry Bushold, G. B. Kerper, Jr., E. V. Bope and Charles F. Smith. Later the name was changed to the Toledo, Bowling Green & Findlay Traction Company. The capital stock of the company is $1,500,000. It is stated that a large power house will be erected at Findlay.

PHILADELPHIA, PA.—It is reported that Philadelphia and New York capitalists have secured wharf rights in Philadelphia for $450,000 and are to use it as the terminus of an electric railway.

HARRISBURG, PA.—The State Department has issued charters to the West Chester & Wilmington, Chester, Wayne & Norristown, Philadelphia, Wayne & West Chester, Parkersburg & Coatesville, Coatesville, Downington & West Chester, Philadelphia, Norristown & Phœnixville, and Philadelphia, Media & Wilmington street railroads. The total capitalization of the companies is $199,500. Albert B. Kelly, of Philadelphia, is president of the companies. They will build suburban lines in Chester, Delaware and Montgomery counties. Charters were also issued to the Jersey Shore Street Railway Company, Jersey Shore, capital $25,000, and the Reading, Birdsboro & Pottstown Railroad Company, Reading; capital, $10,000.

CHATTANOOGA, TENN.—Clarence P. King and J. H. Jefferis, representing Philadelphia and New York capitalists recently arranged a deal to buy the different Lookout Mountain railways. The purchase price was $92,500. The deal embraces both inclines up the mountain, and the broad gauge railroad. As the result, the northern capitalists now control every means of reaching the mountain. The inclines will have a new equipment and the old broad gauge railroad will be made into an electric railway. The deal also embraces the electric railways on top of the mountain.

FORT WORTH, TEX.—The Northern Texas Traction Company has been incorporated with a capital stock of $1,500,000. The company recently acquired the street railway system in this city and proposes to build an extension to Dallas. The road will be operated on the high tension system, and contracts have been placed with the Cleveland office of the Westinghouse Electric & Manufacturing Company for the power-house equipment and sub-station equipment, consisting of two 600-kw, 100 r. p. m., 400-volt, three-phase alternating current generators; two 250-kw rotary transformers, two 300-kw rotary transformers; two 400-kw rotary transformers; a 14-panel station switchboard and two two-panel sub-station switchboards. A contract has also been closed for two 900-hp Cooper-Corliss engines. E. P. Roberts & Co., of Cleveland, are engineers for the road.

NORFOLK, VA.—A deal by which Baltimore capitalists acquire control of the Berkley Street Railway has been consummated. The road will be operated hereafter in harmony with the Williams syndicate, of Richmond, which controls the Norfolk street railway system, and it is stated the two roads will be connected physically by a line across the Elizabeth River over Camposter bridge.

TACOMA, WASH.—It is believed here that the construction of the new Seattle-Tacoma electric line is a southward movement of James J. Hill, having for its object the ultimate construction of the Great Northern line to Portland, obviating the slow-going run by ocean steamer between the Sound and San Francisco.

SHEBOYGAN, WIS.—The common council has granted to John M. Saemans and P. Brueckhauer the right to construct tracks for the use of the Sheboygan, Plymouth & Elkhart Lake interurban line.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN AUTOMATIC FIRE ALARM COMPANY has been organized at Cleveland, O., with a capital stock of $1,000,000.

THE PORTER BATTERY COMPANY, of Waukegan, Ill., has been incorporated. Capital, $300,000. Incorporators: Blewett Lee, Max J. Spiegel and Samuel Adams.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY has been incorporated at Chicago. Capital, $2,400. Incorporators: W. Clyde Jones, Keene H. Addington, Curtis B. Camp.

PIXLEY ELECTRICAL COMPANY.—Milton A. Pixley, Chas. F. Prior, of Cincinnati; Holstein W. Webb, John F. Pixley and R. Fullerton have incorporated the Pixley Electrical Company at Columbus, Ohio.

THE KINGSTON AUTO-ELECTRIC FIRE ALARM COMPANY, of Kingston, N. Y., has been incorporated. Capital, $30,000. Directors: I. M. Block, J. W. Brewster, of Kingston, and William F. Rafferty, of Rondout.

THE EDISON MANUFACTURING & CHEMICAL COMPANY, of New York, has been incorporated with a capital stock of $400,000. [Note.—We are informed that nothing is known of this company by Mr. T. A. Edison.]

THE LEOKOS COMPANY has been incorporated in New Jersey to carry on the business of supplies of light, heat, and power, with gas and electricity, and to act as carriers of passengers and goods by land and water. Capital, $200,000. Incorporators: Alfred George Brown, Edward B. Hawkins, and Edward T. Magoffin.

THE ESSEX ELECTRIC COMPANY has been incorporated in New Jersey. Capital, $700,000. Incorporators: W. Campbell Clark, Franklin Conklin, Henry Dickson, Bernard Strauss, Jacob Haussling, Richard C. Jenkinson, Julius H. Lebkeucher, Simon Scheuer, Robert H. McCarter, Moses Straus and J. Broadhead Woolsey.

PERSONAL.

MR. STEPHEN L. COLES, who recently resigned as managing editor of the *Electrical Review*, of New York City, after twelve years' service with that journal, announces that he has associated himself with Mr. M. J. Shaughnessy, of New York City, in the business of preparing and publishing technical and trade literature and advertising for manufacturers and others who wish really helpful assistance in such matters. The relation between these gentlemen and their clients is very similar to that between lawyer and client. Mr. Shaugnessy is well known among general advertisers. He organized the advertising department for John Wanamaker when the latter began business in New York City. He also prepared and placed advertising for the first Electrical Show at the Grand Central Palace, New York, in 1896, which will be recalled as a great success. Mr. Coles has many warm friends and acquaintances in the electrical and allied industries. Through his long experience in technical journalism and other newspaper work he is thoroughly posted as to the needs of manufacturers and others seeking the widest and best publicity for their product. Messrs. Shaughnessy and Coles are established in Temple Court, 5 Beekman Street, New York City, where the friends of both will be welcome.

Stephen L. Coles.

M. J. Shaughnessy.

MR. E. D. ADAMS, the banker, of Niagara power fame, has gone abroad for a recreation trip of some weeks' duration.

MR. PHILIP H. TROUT, the city electrician of Lynchburg, Va., has been a visitor in New York City during the past week.

MR. H. F. TATE has opened an office at 416 Rookery, Chicago, as Western representative of the National Conduit & Cable Company.

MR. C. C. CUTTRISS, electrician of the Commercial Cable Company, has just returned to New York, after a trip across the water to the Old Country.

MR. ROBERT S. TODD, general manager of the Cincinnati Traction Company, was recently married in New York City to Miss Charlotte Louise Vinal.

MR. CLARENCE H. MACKAY was injured at polo last week while playing at Lakewood, N. J., his collarbone being fractured. He was able to leave for his country home at Roslyn, L. I.

MR. HINSDILL PARSONS, whom Mr. Coffin speaks of as the "able head of the law department at Schenectady," has recently been elected fourth vice-president of the General Electric Company.

MR. CESARE PIO, an Italian electrical engineer who is known in this country through his contributions to the technical press here, is now visiting New York, Niagara and other points of electrical interest.

MR. RAY D. LILLIBRIDGE, who is making a distinct success as an editor of advertising matter of all kinds, has just issued from his office at 20 Broad Street a very neat little pamphlet on his work as a "systematist" in this field of work.

MR. G. WESTINGHOUSE has sailed for Europe, with Mr. H. S. Loud, managing director of the British Westinghouse Electric Company, who has been buying machine tools here for the new shops in England. Mr. Loud will return shortly.

MR. EARL BULL delivered an amusing address recently before the advanced and elementary classes of the Dayton, O., Y. M. C. A., on the subject of the future of electricity. He sees several new branches of electricity in full operation by 1950.

MR. MAURICE HOOPES, formerly of the General Electric Company, who had charge of the work in building and starting the third rail road between Albany and Hudson, in New York State, has now joined the staff of J. G. White Company.

PROF. DR. AUG. RAPS, of the Berlin works of the Siemens & Halske Company, of Germany, is now visiting this country and looking up telephonic development here, that being the branch of electricity to which he is devoting special attention.

MR. J. E. WIDENER, son of Mr. P. A. B. Widener, was seriously hurt in Philadelphia last week by the overturning of a four-in-hand, whose wheels caught in some car tracks. He is the second son of the street railway magnate and is 29 years old.

MR. W. J. HAMMER lectured before the electrical section of the Franklin Institute, Philadelphia, on April 18, on the electrical features of the Paris Exposition of 1900. It was well illustrated and, as might have been expected, a valuable review of the subject.

MR. T. G. GRIER, Western manager for the American Circular Loom Company, has moved his offices to the Electrical Building, 128 West Jackson Boulevard, Chicago. The old quarters at 141 South Clinton Street, have been taken by the Aaron Electric Company.

MR. EDWIN HOLMES, late president of the Holmes Protective Company, who died last January, is being remembered by his associates in various ways. The resolutions of the company, beautifully engrossed for the family, are on view at Gorham's downtown establishment.

ECKERT—MATHEWS.—The marriage is announced of Miss Helene Jane, daughter of Mr. W. H. Eckert, president of the Knickerbocker Telephone Company, to Mr. A. E. Mathews. The ceremony was performed at the residence of the bride's father by the Rev. N. P. Carey.

MR. R. E. JENNINGS has recently accepted the presidency of the Menominee Electric Manufacturing Company, Menominee, Mich. Mr. Jennings is one of the leading business men of the city, and consequently the future of this company is assured. Affairs will be pushed with energy and persistence.

MR. R. B. HAMILTON has succeeded Mr. E. E. Carey as manager of the Packard Electric Company, Limited, the latter resigning from ill-health. Mr. Hamilton has been acting manager for some little time past, and his technical and business qualifications ensure a satisfactory administration of affairs. Mr. G. A. Powell will take the management of the Packard sales department.

MR. H. WRAY WELLER, formerly of the Sprague and General Electric engineering staffs, and for some time past representing the interests of the Babcock & Wilcox boiler for Canada, was a welcome visitor in New York last week. Mr. Weller, who is an English civil engineer, finds himself very much at home in Canada and has succeeded remarkably well in his present work.

MR. GUGLIELMO MARCONI is engaged to be married to an American girl. His fiancée is Miss Josephine B. Holman, a cousin of the late Congressman W. G. Holman, of Indiana, known as "The Watchdog of the Treasury." Her father was the late Justice J. A. Holman, of the Supreme Court of Indiana. Mr. Marconi met his intended wife on board ship in his recent trip to this country. He sailed for Europe last week, but it is said that the ceremony will be performed in this city in the Fall.

MR. GEORGE W. FOWLER, of the engineering department of the C & C Electric Company, left last week for the Pacific Coast, where he will supervise the installation of several C & C series-parallel equipments for operating newspaper presses. His company will be glad to hear from any parties on the Coast who are contemplating the installation of any direct current electrical machinery, especially electric power transmission plants, and Mr. Fowler will call on those interested, while out on the Coast.

MR. ALFRED HAY, who has lately received the D. Sc. degree in "Engineering Science" from the Edinburgh University, and who was lecturer on electrotechnology at Liverpool University College, has just been appointed professor of the same subject at the Royal Indian Engineering College, Cooper's Hill. Dr. Hay was one of Professor Andrew Jamieson's old students and assistants at the College of Science and Arts, Glasgow, as well as an apprentice with Mr. McWhirter, at the Faraday Works, Govan.

MR. R. W. RYAN, for many years past the official stenographer of the American Institute of Electrical Engineers and of other technical bodies, has just secured one of the prizes of his profession in the appointment as official stenographer in the New York Supreme Court. Mr. Ryan was No. 1 on the Civil Service eligible list, which will not surprise any one who knows him. He is not only an accomplished stenographer, but a member of the New York bar, and remarkably well informed on all technical subjects. The position is one for life and carries with it a good salary. It is understood that Mr. Ryan will not have to drop all his technical reporting, a matter of congratulation to the societies he has served so long and so ably.

MR. DUNBAR WRIGHT, vice-president of the Automobile Club of America, gave an illustrated lecture at the club on April 30 on Japan, Honolulu, Mexico, the Yosemite Valley, and other picturesque localities of the United States. The feature of the talk was the large number of beautifully colored pictures illustrating the scenes described by Mr. Wright, which he took and colored himself. The Japanese views were particularly delicate in tone, but among the pictures which attracted marked attention were a series of about twenty illustrating a bullfight in the City of Mexico taken by Mr. Wright during the past year. He showed them last night for the first time. It was the first illustrated lecture on a subject other than of technical automobile interest given in the new rooms, and the attendance was the largest that has turned out since the Tuesday night talks were inaugurated.

HUTCHINSON—DIMOCK.—The wedding of Dr. Cary Talcott Hutchinson, the well known electrical engineer, and Miss Susan M. Dimock, daughter of Mr. and Mrs. Henry F. Dimock, and a niece of William C. Whitney, was celebrated at 25 East Sixtieth Street, the New York residence of the bride's parents, on April 30. The Rev. Arthur H Judge, of St. Matthew's, was the officiating clergyman. The bride had no attendants, and her father gave her away. Her gown of cream-white satin had its bodice trimmed with old lace and embroidered in pearls. A flounce of the old lace sprinkled with orange blossoms went about the skirt of the gown and met the long train. The bridal veil was of the same old and sheer lace, and was fastened to her coiffure with orange blossoms. Her bouquet of white orchids and lilies of the valley was arranged in a shower. Mr. Hutchinson's best man was his brother, Christy Hutchinson, of St. Louis. There were no ushers. The house was decorated with many long stemmed American Beauty roses. The wedding was a very small one, and outside of relatives but a few intimate friends were asked to it. The honeymoon will be spent at South Coventry, Conn.

Trade Notes.

REMOVAL.—The Calculagraph Company has moved its offices from 2 Maiden Lane, New York, to 9-13 the same street.

MR. D. S. HOLCOMB, 51 Dey Street, New York, has increased his facilities and floor space, and is now carrying a very large line of new and second-hand electrical machinery.

THE PENCOYD PLANT, of the American Bridge Company, shipped during March 7339 tons. We believe this is the largest shipment ever made by any bridge shop in the world.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY has moved its offices and salesrooms to Fisher Building, Chicago, and its factory from Chicago to Winthrop Harbor, Ill.

MAPS.—Geo. W. Lord, 2238 North Ninth Street, Philadelphia, is issuing pocket maps of the United States, Porto Rico and the Philippines. Any of our readers can get a set by applying for them

THE GEERLINGS-BECKER COMPANY has been formed in Milwaukee, Wis., for the purpose of maintaining a first-class repair shop for electrical machinery and apparatus, and to manufacture commutator segments.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, Providence, R. I., has contracted to supply the Stanley Electric Company with a 48-point automatic telephone system for its new plant at Pittsfield, Mass.

THE CENTURY ELECTRIC COMPANY is the name of a new firm of electrical engineers and contractors, located at 31 Second Street, San Francisco. L. D. Hitzeroth is the president and S. H. Weidenthal secretary of the company.

WESTINGHOUSE PLANT SUBMERGED.—The plant of the Westinghouse Electric & Manufacturing Company, at East Pittsburg, Pa., suffered damage by the recent floods in that section. The buildings were submerged for twenty-four hours.

LARGE EXHAUST HEADS.—Two of the largest exhaust heads in the country, one 30-inch and one 36-inch, were recently installed by the Edison Electric Illuminating Company, of Boston, Mass., in its new station. They are of the Sturtevant centrifugal type, built by the B. F. Sturtevant Company, of Boston, Mass.

FIREPROOF OFFICES.—The Crane Company, Chicago, manufacturer of valves, fittings, etc., has decided to erect a modern fireproof building exclusively for offices. It will be about 90 ft. x 100 ft., five stories and basement, and will be located in the vicinity of its large cast iron and malleable fitting and valve works, at Canal and Twelfth Streets.

THE HARTFORD FAIENCE COMPANY, Hartford, Conn., is doing some fine work on delicate porcelain pieces for electrical uses. It has a plant of a large capacity and is at present keeping three 10 ft. 6 in. kilns busy on electrical porcelains. It is devoting its energies to the specialties difficult of production rather than to the simpler pieces, and the results shown appear to justify this course.

DRIVER-HARRIS WIRE COMPANY, of Newark, N. J., writes us: "We are making a new resistance wire which we call 'S. B.' alloy. It is made particularly for measuring instruments and other work requiring great accuracy. Its properties are as follows: Resistance, 33 times copper; temperature, coefficient .00002. The thermo-electric effect against copper is almost as low as that of manganin.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is compiling a new fan motor catalogue for this season, in which it has listed Falcon, Diehl, General Electric, Tuerk, Westinghouse, Central, Empire and Battery fan motors. A copy of this catalogue will be sent to any one upon application. This company has also a new complimentary order book which it will send, postpaid, to any customer who so desires."

ITALIAN ELECTRICAL INSTRUMENTS.—Camillo Olivetti, of Ivrea, Italy, in a recently issued catalogue describes and illustrates in detail a line of electrical measuring instruments of his manufacture, which are listed under the heads of scientific and industrial instruments. The former include galvanometers of the Thomson and D'Arsonval type, and the latter consist of a line of hot-wire and Weston type ammeters and voltmeters.

THE UNION HARDWARE & ELECTRICAL SUPPLY COMPANY, which was burned out of its store on Weybosset Street, Providence, R. I., on March 27, has established itself temporarily around the corner on Eddy Street, where, after disposing of its damaged stock at special sale, it has put in a large new stock. It started its traveling men out again on April 22. The burned-out building is being refitted for it and it hopes to be back in its former quarters about June 1.

HYDRAULIC BENDERS.—The Watson-Stillman Company, 204 East Forty-third Street, New York, has issued a catalogue of its hydraulic benders. These machines are used for bending heavy metal forms, rails, electric conductors, etc. The catalogue is fully illustrated, and includes a telegraph code and an index of illustrated sheets issued by the company. The Watson Company's printing matter includes over 500 illustrated sheets, covering machinery for a great variety of purposes.

THE SIMPLEX STEEL CONDUIT COMPANY, Limited, Birmingham, England, will be glad to forward a copy of its catalogue, which has recently been issued, on receipt of inquiry. All interested in the question of conduit wiring are invited to write for a copy of this book, which is full of valuable information respecting the subject with which it deals. The company's English addresses are Coventry Street, Birmingham; Mansion House Chambers, London, and 1 Peel Street, Manchester.

THE HAINES & NOYES COMPANY, Chicago, is manufacturing new styles of telephones, and it is making some valuable improvements to its apparatus, all of which is described in its new bulletins. It informs us that it is now prepared to bid on installations of any size, and that its new factory is fully equipped with machinery which will enable it to make up any special apparatus. It makes a specialty of private telephone plants and of manufacturing special apparatus for the trade.

THE EXETER MACHINE WORKS, of Pittston, Pa., who are engaged in manufacturing a high grade line of hoisting engines, mining, elevating and conveying machinery are laying special emphasis on the coal handling machinery as applied to the unloading of coal at the dock and conveying to its proper destination; and also to the coal and ashes conveying machinery as applied to electric light stations and street railway plants. Their apparatus, which is being installed in lighting and power plants, is illustrated in pamphlet and catalogue, which can be obtained on application.

EXHAUST FANS.—The Emerson Electric Manufacturing Company in Bulletin No. 3029 briefly outlines its alternating and direct-current exhaust fans, direct connected. An illustration shows an 18-inch direct-connected, alternating-current exhaust fan. The Emerson Company has also issued a reprint of a letter addressed to the Committee of the City Council of Fostoria, Ohio, from Mr. W. D. Marks, president of the City Light, Heat & Power Company, of that city. The subject of the letter is, "Rates for Electric Service," and the figures given will be very valuable to every one interested in this subject.

THE GENERAL ELECTRIC COMPANY, LIMITED, 67 to 92 Queen Victoria Street, London, in a recent catalogue gives a long list of fire alarms, electric clocks, telephones and accessories, electric locks, water level indicators, etc. The catalogue is very complete and contains many illustrations of the apparatus referred to. In another catalogue issued by the same company is listed electric light supplies, switches, switchboards, cut-outs, lamp holders, incandescent lamps, etc. This also is very completely illustrated, showing the various styles of machines and apparatus of these various classes manufactured by this company.

TELEPHONE CABLES.—The Central Electric Company, of Chicago, is distributing a folder on National Telephone Cables, which contains many points of interest to users of this material. The paper used in insulation is said to be purer, heavier and ⅛-inch wider than that used in other cables. This makes the cable larger in diameter, thereby making it necessary to use more lead in the casing. The result of this is the cable is not so apt to break when bent. It is also the cause of the cable weighing more per foot than other cables. A single thickness of paper used in these National cables offers a resistance of 500 megohms per mile.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, of London, England, has recently issued a handsome catalogue of its electric traction department, including both power plant and rolling stock. The pamphlet is well illustrated by views of the well known Brush apparatus. A number of the pages are devoted to the electric traction trucks made by this company, and considerable space is given to the open and closed cars which it manufactures. The descriptions are rather short, but are arranged in an attractive manner and bring out the good points of the apparatus without surfeiting the reader with a large amount of self-praise.

SEARCH LIGHTS.—The United States Government has recently ordered a number of search light projectors for naval vessels from the Carlisle & Finch Company, of Cincinnati, which has established a wide reputation as manufacturer of search lights. It is making a line of search lights for all classes of seagoing and river steamers, and while not so expensive nor complicated as the navy standard projectors, are nevertheless fitted with the same carbon feeding mechanism and the same high grade mirrors. The commercial type projectors are finished in dead black brass, polished brass or white enameled iron, according to the wishes of the purchaser. A beautifully finished 9-inch diameter projector is made for yachts and launches.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, reports a steady increase of business in all departments. A few months ago 10,000 square feet of additional floor space were added to its already large and well equipped factory, and arrangements have been recently made for the addition of 21,000 more. This will be equipped with the most modern machinery, and will facilitate the handling of orders with even greater promptness than heretofore. The small switchboards of the "Express" type which this company recently put on the market have proven very popular and are in great demand, orders for over fifty having been received since March 15. In order to meet the demand for silk and cotton-covered wire and switchboard cable, the insulating department has been increased to double its former capacity, and is prepared to fill orders for any size or kind of silk or cotton-covered wire on short notice. The company also announces that it owns 90,000 of the finest cedar poles in Michigan, which it is prepared to supply in carload lots at lowest prices.

FRINK REFLECTORS.—The merits of the Frink special patent window reflector are so well known, that its success would seem to be a foregone conclusion. We note with interest that this enterprising and progressive house is not only lighting the finest department stores in this country, but is reaching out after foreign trade as well. Among the latest installations in the show window line are that well known firm, the J. E. Manix Dry Goods Company of Nashville, Tenn., and the show windows of the large department store of Señor Tomas Mendirichaga, Monterey, Mexico, who also uses a large number of cluster reflectors for lighting the store interior, with the most happy results. A large order has also been received for the show windows of one of the best known houses in Dublin, Ireland. For the thorough diffusion of an even light over the entire window space without glare in the eyes of the observer, there is nothing equal to it; it makes the ideal light for show windows. We might also call attention to the line of cluster reflectors manufactured by this firm for the lighting of store interiors, etc., which give a splendid light, make an exceedingly nice appearance, and are very durable. The firm, I. P. Frink, 551 Pearl Street, New York, will cheerfully furnish any information desired on request.

THE DE DION-BOUTON "MOTORETTE" COMPANY, Brooklyn, N. Y., is making final preparations for placing on the American market a De Dion motor of eight horse-power. This motor is a genuine De Dion, and it will be offered to the American trade exclusively. The success of the five horse-power motor that has now been on the market for some time, assures the success of the eight horse-power machine. The tendency both in France, England and America is for vehicles of higher power. This motor has a cylinder bore of 100 millimetres and a stroke of 110 mm. It weighs 110 pounds complete, without the extra flywheel, and 140 pounds including this flywheel and the friction clutch, the clutch being a part of the flywheel. This eight horse-power new De Dion motor forms the power equipment of the "Paris" type motorette, which is now under construction at the Brooklyn works. The "Paris" type motorette will be ready for the market on or about May 15. It embodies all of the very latest French ideas in automobile construction. Another new motorette is the improved "Brooklyn" type, which really is a modification of the "Paris" model. The "Brooklyn" will have the motor in front, the power being either a 3-hp De Dion motor or one of 3½-hp. This vehicle is reasonable in price, and already indications are that it will have a very large sale. The Motorette Company now has a full line from small tricycles up to the new 8-hp.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that the success with which it has met in introducing its new G. I. flush push button switches is extremely gratifying. This switch is designed to obviate many of the difficulties encountered in other switches. The mechanism is of a peculiar construction which insures absolute certainty of a quick make and break of the contact parts. After the button has been pushed to a certain distance, the making and breaking of the contact is absolutely beyond the control of the operator's hand. This special construction of the moving parts is a further advantage in avoiding the possibility of the switch being left on any dead centre. The company states that the business in its lighting supply department has never been better. Its salesmen report that business is opening up from all over the country in a most satisfactory manner. It has also got out an electric time switch by the use of which the lights, in connection with the clock, can be set to turn off and on at any time required. When once set it operates continuously, needing no attention except winding every eight days. The switch is especially adapted for show windows, store rooms, advertising signs, etc. It is claimed that by the use of this switch the cost of lighting will be reduced at least 75 per cent. Every merchant using electricity will certainly be interested when he is shown this feature, as the switch readily pays for itself in two or three months. The switch is operated by a handsome eight-day clock with double spring lever and large eight-inch dial, mounted with an attractive nickle-plated case. Catalogues and descriptive matter will be mailed upon application.

MR. WILLIAM ROCHE, 42 Vesey Street, New York, manufacturer of the New Standard dry battery, has just received from the Naval Torpedo Station at Newport, R. I., an excellent and gratifying letter showing the results of a test made of his batteries at that station by Lieut. Commander Hodgson, U. S. N. The letter, which is signed by N. E. Mason, Commander, U. S. N. Inspector of Ordnance, in charge, says in part: 1. "Referring to tests made of the Roche Standard dry cell. 2. The tests made show that the manufacturer sustains the reputation he has acquired for producing a most excellent and satisfactory dry cell. In recuperative power it shows a marked advance over previous cells. It was placed on a dead short circuit for 30 hours and when taken off was dead, reading only 0.1 on voltmeter. After remaining on open circuit for 9 days it was tested and showed 1.2 volts with an internal resistance of 1.1 ohms, quite enough current to fire a primer. On this date, 8 days later, though the internal resistance has increased to 1.6, the cell is still able to do the work that would be required of it in a firing battery." Business has increased to such an extent with Mr. Roche that he has three times increased his factory to take care of his rapidly extending business. In addition to his regular line of dry batteries of various sizes, his gas engine generator set for automobiles and other purposes to which a gas engine is put, is meeting with exceptional success. Many new features having been added since it was first brought out, patents for which were issued to Mr. Roche on April 16, 1901. This is a new departure in ignition plugs. In plugs heretofore used bridging was of common occurrence. This will be eliminated in the new plug. Sparking externally is prevented by a tail of the insulating material or plug proper of which the insulator is composed.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 23, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

672,236. ELECTRICAL RESISTANCE WITH SMALL HEATING CAPACITY; Karl Ochs, of Berlin, Germany. App. filed Sept. 16, 1899. A coil of wire adapted to being approached to a white heat is thinly coated with a heat-conducting insulating body which expands and contracts under the heat generated, at the same rate as the conductor. (Issued April 16.)

672,445. ACTUATING MECHANISM FOR AUTOMATIC RAILWAY APPLIANCES; S. W. Huff, Baltimore, Md. App. filed Jan. 17, 1898. This device, which is to be attached to the track in a manner to be operated by the wheels of a train for the purpose of transferring the motion to a signal or other apparatus, is constructed so that the first impact of the wheels will not be transmittted to the signal, thus avoiding the shock which would otherwise be imparted to the signal apparatus.

672,449. ELECTRICAL CONDUCTOR; W. A. Markey, Saginaw, Mich. App. filed Aug. 31, 1900. The conductor is a porous body having particles of silver distributed uniformly throughout its pores.

672,451. ELECTRIC LIGHT VACUUM TUBE; D. M. Moore, Newark, N. J. App. filed March 26, 1898. The tube is devoid of interior electrodes, but its extremities are roughened and electroplated with a conducting material.

672,452. ELECTRIC LIGHT APPARATUS; D. M. Moore, Newark, N. J. App. filed April 15, 1898. This improvement relating to vacuum tube lighting consists of a circuit interrupter having a number of points of interruption controlling separate branches of a circuit of induction, and an induction coil, the primary of which receives the discharges of said circuit.

672,459. MEANS FOR SUPPLYING POWER FROM STATIONARY RAILS TO VEHICLES MOVING ON THE RAILS; R. C. Sayer, Bristol, Eng. App. filed Aug. 3, 1899. The rail is tubular and provided at short intervals with valved openings, the rim of the wheel carries plungers which open the valves and at the same time rotate the valve stem in a manner to make contact with the conductor in the tube and close the circuit to the motor.

672,489. SUPPORTING DEVICE FOR ELECTRIC LAMPS; E. J. McAllister, A. D. Page and L. C. Werner, Newark, N. J. App. filed Jan. 11, 1901. Electric sign lamps are connected together by clips in the form of the figure eight, which embrace the sockets of the lamp and permit them to be shifted in position with respect to one another.

672,513. ELECTRIC SWITCH; J. Reid, Jr., Watervliet, N. Y. App. filed Jan. 28, 1899. Details.

672,524. AMALGAMATOR; G. Ghiglieri and J. M. Schofield, Stockton, Cal. App. filed Aug. 4, 1899. Details.

672,546. TELEPHONE METERING SYSTEM; D. M. Bliss, Lowell, Mass. App. filed Nov. 27, 1899. A method consisting in impressing upon the line a slow pulsating current while the telephone is in use to operate a recording instrument, the current being incapable of affecting the telephone instrument.

672,563. ACCUMULATOR BATTERY; P. Marino, Brussels, Belgium. App. filed April 10, 1900. Details.

672,588. ELECTRICAL SWITCH; W. F. Bossert, Utica, N. Y. App. filed Dec. 4, 1900. The clip to receive the blade is made of a metal strip doubled upon itself, the loop forming a foot piece of double thickness through which the fastening screw passes.

672,589. INTERIOR CONDUIT CAPPING; W. F. Bossert, Utica, N. Y. App. filed Feb. 13, 1901. The capping furnishes a rounded bead at the outlet of the tube.

672,597. ELECTRIC ARC LAMP; A. De Puydt, Liege, Belgium. App. filed Dec. 4, 1900. The magnet oscillates and moves an actuator for the carbon holder.

672,601. TAPPING DEVICE FOR ELECTRIC FURNACES; O. Frolich, Steglitz, Germany. App. filed May 15, 1899. (See Current News and Notes.)

672,603. SYSTEM OF ELECTRIC DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed March 13, 1901. Counter-acting coils are provided to control the field of a dynamo by which a motor moving an end-cell switch is actuated so that when the equilibrium is disturbed the end cells of the battery are cut in or out until the equilibrium is restored.

672,604. COMMUTATOR BRUSH AND BRUSH HOLDER; R. Lundell, New York, N. Y. App. filed Oct. 10, 1900. Two or more commutator brushes of different resistance are secured in independent portions of a brush holder, and in such relation to each other that a high resistance brush is located at the leaving edge of the low resistance brush.

672,607. GLOWER SUPPORTING PLUG FOR ELECTRIC LAMPS; J. Van Vleck and W. N. Stevens; New York, N. Y. App filed April 27, 1900. The glower supporting plug is of non-conducting material having the external form of an Edison lamp base. One end of the plug has a conical surface and the glower is supported in close proximity to this surface.

672,608. INSULATED RAILROAD RAIL JOINT; G. A. Weber, Stamford, Conn. App. filed Dec. 7, 1900. Structural details of a rail joint and chair.

672,621. TELEPHONE TRANSMITTER; C. C. Hughes, Baltimore, Md. App. filed April 14, 1900. Details.

672,626. RAILWAY SIGNAL; J. D. Price, Aurora, Ill. App. filed April 11, 1900. An arrangement of circuits in a block systhem whereby the signals are displayed in the engine cab.

672,629. TELAUTOGRAPH; G. S. Tiffany, Highland Park, Ill. App. filed Aug. 26, 1898. In order to send over the line impulses of opposite polarity which are less affected by the static capacity of the conductor than impulses of light polarity, it is proposed to transmute the movements of the transmitting pen into high tension induced impulses at the transmitting station.

672,630. TELAUTOGRAPH; G. S. Tiffany, New York, N. Y. App. filed Nov. 22, 1900. The pen point rests upon and is sealed by, a cushion when at rest, to avoid drying up of the ink.

672,631. TELAUTOGRAPH; G. S. Tiffany, New York, N. Y. App. filed Nov. 22, 1900. When the sender has finished sending a message, an alarm is automatically sounded until the main switch is moved to cut out the transmitter.

672,639. CONDUCTOR AND CONTACT FOR ELECTRICAL GLOW LAMPS; J. A. Halford, Bayswater, Eng. App. filed Jan. 21, 1901. The lamp carries a pair of spikes adapted to penetrate the conductors and the socket is provided with means for attaching the lamp to the molding at the same time the electrical connection is made.

672,640. AUTOMATIC BOOSTER IN CONNECTION WITH MULTIPLE WIRE SYSTEMS; J. S. Highfield, St. Helens, Eng. App. filed Feb. 2, 1901. Applies to a three-wire circuit supplied from a storage battery. A booster is interposed between each terminal of the battery and the corresponding bus-bar; the booster has a double-coil field magnet, of which one coil is a fine wire and connects the pole of the battery to which the booster is connected to the armature of an exciter driven at constant speed by an electric or other motor, which also drives the booster.

672,642. ELECTRIC INCANDESCENT LAMP; L. J. P. Hollub and H. Mignal, Paris, France. App. filed Nov. 8, 1900. Details.

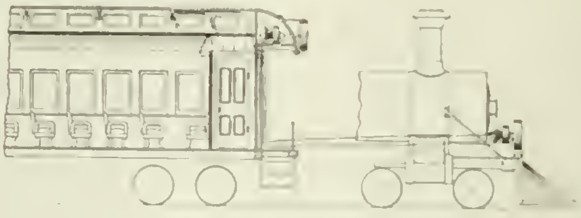
672,653. TROLLEY FOR ELECTRIC RAILWAY CARS; A. Schneider, Lexington, Ky. App. filed Oct. 16, 1900. V-shaped arms to aid in guiding the wheel onto the wire.

672,662. DESK TELEPHONE; A. K. Andriano, San Francisco, Cal. App. filed Sept. 25, 1899. A desk set having a sliding switch in the base for co-operation with an automatic exchange.

672,712. SYSTEM OF ELECTRODYNAMIC PROPULSION, L. Rosenfeld, C. Zelenay and J. Dulait, of Charleroi, Belgium. App. filed Jan. 31, 1900. The induction element of a polyphase motor is suspended on the vehicle and the inductor element extends along the track.

672,715. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed Oct. 30, 1900. A device for application to the cell adapted to support both elements.

672,727. MEANS FOR PROTECTING COMMUTATORS, A. D. V. Baldwin, New York, N. Y. App. filed Feb. 14, 1901. A cylindrical casing of insulating material surrounding the commutator and having openings for the brushes.



672,877.—Electric Lighting System for Railway Cars.

672,741. ELECTRIC RAILWAY TROLLEY; C. H. Myers, Buffalo, N. Y App. filed Nov. 30, 1897. Details of construction of a trolley arm over which the main and return conductors pass, the arm carrying two separated wheels making contact with the main and return conductors respectively.

672,770. ELECTRIC ARC LAMP; C. Holmok and J. Holmok, Cleveland, Ohio. App. filed Jan. 21, 1901. The magnet is constructed with the smallest possible air gap, to permit of the use of less magnet wire in order to obtain the required density of magnetic lines.

672,830. RAILWAY SIGNAL SYSTEM; W. W. Hoffman and F W. Powers, West Lafayette, Ind. App. filed June 6, 1900. The trains carry a trolley which runs in contact with a signalling wire running to the various stations along the road.

672,831. TROLLEY; W. W. Hoffman and F. W. Powers, West Lafayette, Ind. App. filed Oct. 1, 1900. The trolley is attached to the side of the car in such a manner as to be in control of a person on the inside of the car.

672,841. ELECTRIC MALLET OR HAMMER; C. D. Olsen, Denver, Colo. App. filed Jan. 18, 1900. Details.

672,851. ELECTRIC TRANSMISSION OF MOTION FOR STEERING SHIPS OR FOR OTHER PURPOSES; H. A. Spiller, Boston, Mass. App. filed Oct. 30, 1891. In connection with a shaft driven by an electric motor, is a circuit interrupting switch, and means are provided for determining the extent of movement of the shaft from any one of a number of selected localities.

672,877. ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS, J. W. Guillott, Chicago, Ill. App. filed May 15, 1896. The dynamo feeding lights or other devices on a train is driven by a windmill exposed to the rush of air caused by the moving train.

672,878. ELECTRIC LIGHTING SYSTEM FOR RAILWAY TRAINS; J. W. Guillott, Chicago, Ill. App. filed July 20, 1896. The generator is regulated by a fan exposed to the speed of the train.

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J. C. HENRY.

Death has been active in electrical ranks lately, and now has removed from among us John C. Henry, whose name must ever be included among those of the men who helped to create the great modern electric railway industry. Out on the Western frontier he discovered many things for himself that had he been in the East would have made no little noise in their day, and had he enjoyed better health his later years would doubtless have been as productive of ideas and improvements as his old days of pioneer inventing in a raw region of a new country. Considering his opportunities, Mr. Henry went far.

HEAVY ELECTRICAL MANUFACTURING.

So far as we can ascertain, all the electrical factories are busy and prosperous, although, of course, prices in some respects might be better. But an order for three million dollars' worth of apparatus, such as went to the General Electric Company last week, for the Manhattan equipment, is still unusual enough to attract and deserve special note. As time goes on, and more of the domain of light, power and traction is conquered by electricity, especially the branch which concerns main railroad operation, these orders will assuredly become larger and more frequent. We note also this week some very heavy Westinghouse work, of which the news is now made public for the first time. Not only is this work interesting from its very magnitude, but because, as will be observed from a perusal of the article, it is all virtually special. Now, one of the characteristic features of American electrical work of late years has been that it was principally standard as contradistinguished from special; and one of the reasons assigned for leadership over Europe in production was the fact that nearly every European equipment was individual. But here in these immense Westinghouse machines, it will be seen that the tendency is to build specifically for the conditions, rather than make the order fit the standard apparatus. How far this tendency can go without increasing cost of production is a question of no little moment, but it is offset by great skill and economy in processes of manufacture. The growing size of these units is also a remarkable fact, the generator as it gains in capacity being kept company by the rotaries and motors to which it furnishes current. There are many motors now running which are bigger than the generators once deemed riskily large for central power plants, but they operate smoothly and efficiently, and nobody bothers about them.

PROTECTING NIAGARA.

The news that the Niagara Power Company is now to develop its work on the Canadian side of the Falls will doubtless be noted with horror by those who would leave the great cataract alone in its glory, without the touch or stain of any human industry. But as a matter of fact, there is an awful exuberance of rhetoric over the "destruction of the Falls," and those who are trying to reclaim part of the energy that has been wasted for years, have to endure no small amount of obloquy. It is, of course, true that some of this utilization is unnecessarily and sinfully ugly, but it is not worse than Nature often wreaks on her own domains. Of the later plans for getting power from Niagara, away from its finest scenery, it can only be said that they are both scientific and preservative of her beauty. In reality, a stiff wind up the gorge does more to keep the

Falls dry than man will be able to do in the next 50 years; and God Himself in one frost does more to break down the cliff over which the river plunges than man can do in a thousand years. The present work, indeed, by diverting part of the water is tending to preserve the Falls, a view of the subject we venture to commend to the *Outlook* and its contributor, Miss Hartt, to whom we venture to deny a love of natural grandeur and scenic beauty in anywise superior to our own.

TELEPHONIC GROWTH.

We have had the pleasure of publishing recently some articles on the development of telephony on the Pacific Coast, the third of which appears in this issue. As illustrative of the ideas and methods of the man who has on account of their success just been advanced to one of the most important positions in the Bell telephone service, these articles have an unusual value. It is always interesting to know how any success is achieved, although the secret is apt to elude the observer even in the telling. It is obvious, however, that Mr. Sabin has had at least two great virtues. He has lots of push, and he believes in advertising. He knew he had a good thing to push, and he left no opportunity untried for getting new business. Neither did he neglect the technical side of his art, for while proclaiming the utility of telephony he did all in his power to render the service cheap, swift and efficient. That he has his reward and that the people of the Pacific Coast have the best all-round telephone service in the country, need not therefore awaken surprise. To see how Mr. Sabin succeeds in the Central States will now be an exceedingly instructive study. The public there is certainly destined to be the beneficiary of the keen struggle between him and the independents, who have been building up a great network and doing admirable work from Indiana to Iowa, and from Minnesota to Missouri. It would be a pity, however, to see the competition degenerate into a mere money-losing contest on the part of the rivals, for when in the long run one or the other system rules supreme, as it probably must, if the old theories stay good, then the public will as usual have to foot the bill for all the losses incurred in the meantime. The situation is indeed of striking interest to all engaged in telephony

ELECTRICAL ENGINEERS UNDER FIRE.

The pages of the *Journal* of the British Institution of Electrical Engineers contain an account of an attack made upon a party of electrical engineers engaged in reconstruction, railroad and telegraph work in South Africa last June. This appears in a paper read by Colonel Crompton, who had charge of the corps. Several of the men were killed in the attack, which was made under De Wet, who summoned the party to surrender. The electrical engineers, forming about one-third of the available force, defended themselves so well that the Boers drew off, after making a few prisoners.

One of the most interesting features of the paper is the evident value of the steam traction engine for use in military and particularly in artillery field operations. It is stated that with the aid of a traction engine a 12½-ton gun was hauled to an elevation of 1300 ft. up a mountain, over an average slope of 10 per cent. A number of interesting photographs accompany the paper. The scene of the attack is photographed after the Boers had withdrawn, and a photograph is also shown of two men firing their rifles from a railway van. The enemy is, however, evidently supposed to be at a conveniently considerable distance. In getting to the "front" our English cousins were more fortunate than those of us who went under General Griffin in the Volunteer Engineer Regiment to Puerto Rico, hot for the fray, and on getting there found there was a front without a firing line. Our boys had all the ardors of the campaign and none of its bloody fun.

THE PARIS EXPOSITION MOVING SIDEWALK.

A full description of the conditions which had to be met in the erection and operation of this well-known sidewalk appear in the January number of the *Bulletin de la Société Internationale des Electriciens.* It was at first proposed to drive this sidewalk by three-phase motors. It seems that the difficulties feared lay in the simultaneous starting of all these 170 machines. The starting torque of the sidewalk was, in fact, nearly three times the full-load running torque. It was feared that in order to provide sufficient starting current, the power station which was also a large electric lighting station, might suffer to the extent of seriously affecting the pressure regulation on the lighting circuits. For this reason the plans for installing three-phase motors were abandoned, and direct-current motors employed, using converters at the sub-station Some of the plans proposed for starting the three-phase motors in order to meet the starting difficulty, are ingenious and interesting. The road as operated has been very fully described and illustrated in these pages.

ALTERNATING-CURRENT METERS.

In the current number of the *Bulletin de la Société Internationale des Electriciens* appears an interesting paper by M. Janet, upon the electricity meters which were exhibited at the Paris Exposition of 1900. While but little change has manifested itself in the art of constructing and designing direct current meters during the last decade, there has been a considerable increase in the number and variety of alternating-current watt-hour recording meters. Of those which were exhibited at Paris, of 1-kw capacity, as noted by M. Janet, it seems that the average no-load waste or consumption was very little in excess of 3 watts, while the average starting current for the same size of meter was a little less than 90 milliamperes. This represents a very marked improvement in recent years. When the first altrnating-current watt-hour meters were produced and used in this country, they usually consumed about 10 watts, or more than five times as much as the above average; in fact, the principal objection to the meters of that time was the large annual amount of energy collectively wasted in their shunt circuits on an electric light system.

The principal existing objection to recording watt-hour meters lies in their initial friction, whereby they underindicate on light loads. Ninety milliamperes of starting current is satisfactory enough, but such results are more likely to be obtained with new instruments under laboratory tests, than with instruments that have been installed for several years under commercial conditions. In most of these instruments, a few turns of shunt winding are applied to the series field coils, so as to give the apparatus an initial starting tendency. The danger of this proceeding, which is theoretically excellent, is that in buildings subject to mechanical vibration from passing vehicles, or from working engines, the tremor may cause the instrument to start without any load, and thus to produce an unduly large bill. This creeping of meters may give rise to a serious error in the course of a month, and is objectionable, since it is almost sure to be detected by the customer, and to weaken his confidence not only in the instrument but also in the supply company. On the other hand, if no shunt turns are employed, increase of friction is apt to take place with time, to the undue diminution of the bills, and the leakage of power through the meter in the case of a very small load, steadily maintained, may be considerable.

A peculiarity to which alternating-current watt-hour meters are subject, is the tendency to underindicate on low leading-current power factors. This is due to the small inductance in the shunt winding, which is assumed to be non-inductive, whereby a small lag occurs in the shunt current. This has a negligibly small effect upon the indications of the instrument on ordinary non-inductive load. If the power factor of the load is markedly reduced with leading currents as on condenser loads, the error established by this small lag may be very considerable. Such loads are, however, rare.

An ingenious means for reducing this error, when it is likely to make its appearance, consists in placing a short-circuited turn, or coil, within the series field winding, whereby a small induced magnetic flux is set up, tending to cause the resultant field flux to lag. The lag so produced can be adjusted into substantial equality with the lag in shunt circuit, so that the two are restored to their proper cophasal condition.

In alternating-current meters of the induction type, the correct phase relation between the shunt and series currents is quadrature, instead of cophase, and the corresponding error in these instruments lies in the imperfect quadrature phase relationship on non-inductive load, such that on a reduced power factor the error becomes very noticeable. Several ingenious methods are described for compensating this error, and restoring the required normal quadrature between the series and shunt fluxes.

LIGHTNING PROTECTION.

The season draws nigh in which the station manager begins to think of the "wrath to come," and furbish up his lightning arresters. As lines have grown longer and voltages higher it has steadily grown harder to deal with lightning, until at the present time lightning protection is one of the most serious problems that confronts the electrician, especially in cases of the long power transmission lines in a mountainous country. So long as voltages were low and distances short ordinary means sufficed to secure a certain degree of immunity from damage, but modern conditions are quite otherwise. Some there are who, when the question is raised, tiptilt the nose of scorn towards the source of fulminations, and suggest that if all lines were underground all would be well. Others intimate that if their particular form of patented arrester were used, lightning would come across three counties for the pleasure of coursing over them to earth; and still others consign all arresters to a region where, we trust, electricians will be scarce, and pin their faith to barbed wire. Now, even the first-named remedy, drastic as it is, hardly strikes one as a panacea in view of the fact that during the late brush with Spain, a couple of submarine mines in the Potomac region were simultaneously exploded by lightning during a single storm in spite of the fact that they were in independent groups attached to separate cables. As to remedy No. 2 the scrap heap raises a voice of dissent, while as to the third, sometimes it works and then again it doesn't.

Seriously, we know of few matters more deserving of careful study and experiment than the protection of high-voltage lines from lightning. No solution of the problem as yet presented seems to be in any way general enough in its applicability, and lightning is today about the most serious menace to continuity of service that the station manager has to fear. Let us analyse the conditions a bit and see where the matter really stands. Lightning discharges, as manifested on aerial lines, are broadly of two kinds: First, direct strokes from the thunderbolt, taking the line as part of its tremendous leap to earth; and, second, induced discharges or those springing in various forms from violent changes of air potential, either with or without a lightning stroke, properly so called. From the practical standpoint, these two classes vary mainly in their severity, the former being much less frequent but much more to be dreaded than the latter. In either case, the problem is to divert the discharge to earth so that it may not work havoc with the insulation of lines or apparatus, including, of course, the arresters themselves, which must remain ready for action at all times. In continuous-current systems the task is comparatively easy, for one can pile up reactance enough to be practically impenetrable so far as lightning is concerned, and fairly drive the intruding discharge to earth. If the current attempts to follow, it can quite easily be checked before it has time to do material damage. But with high-voltage alternating lines the case is very different. Reactance can be and is used with great advantage, but it can be employed only to a limited extent without interfering with the regular service, and it is far from easy to break the following arc. On polyphase lines in particular there is an excellent chance of the lightning starting a discharge across two phases followed by an arc with the full force of perhaps a thousand kilowatt-machine behind it. In this case the most carefully schemed methods of preventing or breaking the arc are very apt to fail, and something comes to grief suddenly. At best, there is a temporary short circuit, and the results may be far more serious.

To protect the generating apparatus the natural tendency is to make the arresters rather tender, i. e., with spark-gaps to an amount just sufficient to hold up the maximum working voltage. If much in excess of this amount, there is a very fair chance of lightning getting by them to the apparatus. But, on the other hand, tender arresters are apt to be hypersensitive and respond frequently to trifling disturbances due to resonance, or to the so-called static discharges—a name which covers a multitude of sins. And these minor affairs may cause frequent and annoying short circuits. Now the lesson which we wish to draw from this state of things is the necessity of intelligent study of the local conditions and adjustment of the arresters. It does not do to order and put up in blind faith even the best system of arresters yet devised—if anybody could name it. The careful electrician should know his arresters as he knows his switchboard, and particularly should know by cautious experiment at just what voltage the spark-gaps will break down. He should know, too, just how much his line will do at all seasons and stages of load in the way of abnormal sparking distance, and how far he can trust his arc-breaking devices. Most of all, he should have his arresters where they can be frequently cleaned, tested and inspected. We have seen the arresters on a 10,000-volt circuit stowed away in a wooden wire tower where the condition of the spark-gaps could not be examined even in clear weather without imminent danger to the investigator's life. Such construction cannot be too strongly condemned from every point of view, and it is pretty certain to defeat the object for which lightning arresters are installed. The main problem in the improvement of such apparatus is to develop an entirely reliable means for stopping the arc which may follow a discharge, and to arrange the apparatus so that it will, to a certain extent at least, discriminate between trivial static effects and really dangerous lightning. The former matter has been the subject of many inventions, some of them of great merit, but none quite what it should be. The latter subject will bear considerable study and experiment. But in the last resort much has to depend on the man on the ground, who should know his system from end to end, where and what the dangers are, where barbed wire will help him and where it will not; how much his arresters will stand and where they may play him false.

Heavy Machinery from the Westinghouse Works.

That the electrical manufacturing industry in all of its branches is enjoying a period of unexampled prosperity is plain to every one who would see, but the extent of the manufacturing operations incident to this situation is doubtless little realized by those who do not have opportunities for direct observation. Such an opportunity was recently afforded the writer by a visit to the East Pittsburg Works of the Westinghouse Electric & Manufacturing Company, which, though recently greatly enlarged and now employing 7000 men, are barely equal to the demands upon it to which the present era of prosperity has given rise. As an illustration of the magnitude and character of some of the work now in hand, a list of several of the more important recent contracts will be given further on. Lack of space at present prevents us from giving details concerning the apparatus mentioned, but it should be noted that most of the large generators are of special design. This fact renders an inspection of the Westinghouse factory at the present time of particular interest to the technical man, for many of the larger machines contain new features of special interest, an account of which we hope to give shortly in these columns. The departments manufacturing standard types of apparatus are also congested with work. The railway motor department, for example, is turning out machines in enormous numbers—more than 8000 equipments being called for alone in the orders of which mention is made below.

It goes without saying that the very large proportion of special work now under construction at East Pittsburg, usually of enormous size, has severely taxed the engineering staff and the works' management—the former in the preparation of designs of apparatus of progressively increasing size and special requirements, and the latter in devising for its execution workshop arrangements of a kind and magnitude far beyond what can be obtained by purchase from makers of workshop equipment.

When less than six years ago the enormous works at East Pittsburg were completed, there could have been little thought that its facilities would soon prove inadequate for the handling of the largest electrical machinery. This nevertheless has come to pass, and a large addition to the factory has, as a consequence, been necessitated. The main building, recently lengthened from 745 to 1200 ft., has a height of 67 ft. in the main bay, but the crane headroom was found insufficient for the Manhattan generators. To provide for the emergency thus created and also for the future, an alley way about 80 ft. wide between the main building and a line of storehouses has been roofed over, and a powerful traveling crane installed, which provides considerably more head room. In designing the original factory, future requirements as to size of electrical machinery could only be surmised, but as the castings of some of the large machines now under construction have reached the upper limit for railway transportation, the new buildings, being planned for these, can with more confidence be expected to prove equal to future demands—at least over an extended period.

A considerable part of the machinery to be used in the new bay will be portable, the machines being moved to the work instead of the work to the machines. To provide for this condition several large sections of the floor of the building are in the form of a metal bedplate with the usual grooves for holding-down bolts. Some of the portable machine tools have been fitted up in the factory, and all will be driven by induction motors, which are installed within the base casting of the tools; the disproportion between the size of the motors and that of some of the enormous tools forms a striking illustration of the advantages of the former for machine tool operation by direct connection.

An interesting feature of the design of the new generators of large size is the evidence given of a reversion to the simplicity inherent in electrical machinery. The 5000-hp Shawinigin revolving-field generators, for example, are in appearance in striking contrast in this respect with the Niagara generators of the same power, both field and armature being plain ring castings, with dovetail grooves for the field and armature laminations.

The largest work now under way is part of the order for the Manhattan Elevated road, the amount of which will aggregate about $5,000,000. The items are as follows: Eight 5000-kw, 11,000-volt, three-phase generators; 26 1500-kw rotary converters and 78 500-kw step-down transformers. The castings for one of the generators are now on the floor. The stationary armature is cast in six sections, the largest of which weighs 90,000 lbs., and the smallest 25,000 lbs. The parts of these machines are so large that owing to the limitations of railway transportation, they will have to be assembled in the power station at New York. Owing to the design of the machine this, however, will be a relatively simple matter. Both the field and revolving armature laminations dovetail in the castings and the windings will consist of large copper bars. The portable tools used in planing off the surfaces of the castings weigh about 25 tons. The casting is secured to the bed plate above referred to, and the tool then transferred by the overhead crane in position, where it is also clamped and is then ready for operation.

Another large order now under way is for the St. Lawrence Power Company, comprising 15 5000-hp, 2200-volt, three-phase rotating field machines. One of these generators is almost finished. An order from the St. Louis Transit Company called for four 2250 kw, direct-current, 550-volt railway generators, three of which have been completed. This order also included 750 motor equipments.

Castings are being made for four 2700-kw, three-phase, 6000-volt revolving field generators for the Brooklyn Heights Railway Company. The order from this company also includes three 2700-kw railway generators; 126 150-hp elevated railway motor equipments; 1700 55-hp street car motor equipments; 11 1000-kw and 5 500-kw three-phase rotary converters; 30 400-kw and three 200-kw air-blast transformers.

One 2700 575-volt direct current generator for the Boston Elevated road is now under way, and two others are to follow. The order from the Boston road also included 200 250-hp motor equipments and 2500 motor equipments of various sizes.

The first shipment of a large order from the New York Gas, Electric Light, Heat & Power Company will be made in September. This order is for 10 1000-kw and two 500-kw, six-phase rotary converters; 30 400-kw, 6 200-kw and 3 200-kw air-blast transformers, and 3 100-kw oil-insulated transformers. An order for two 2850-kw, three-phase generators for the Kings County Traction Company has just been completed, and one of two 3750-kw generators for the Shawinigin Water & Carbide Company has recently been shipped.

An order for seven 1500-kw railway generators for the Union Traction Company, of Philadelphia, is nearing completion, six of the machines having been shipped. The order from this company also includes five 750-kw railway generators and about 2500 complete 50-hp car equipments. One 2000-kw and one 1050-kw railway generator for the Toledo Traction Company are under way, and one 1050-kw machine has been shipped The order from this company also included 214 50 hp street railway motors.

Among other large work under way are the following: One 1050-kw railway generator for the Scranton Railway Company; also 238 40-hp motor equipments for the same. A 1000-kw, two-phase, 1040-volt revolving field generator for the Northern Ohio Traction Company. A 1500-kw railway generator for the Detroit United Railway. A 1000-kw revolving field, 220-volt, three-phase generator for the Wheeling Steel & Iron Company.

Electrical Apparatus in India.

Mr. R. F. Patterson, United States Consul-General at Calcutta, writes the State Department under date of March as follows:

"The following clipping from the *Calcutta Englishman* of March 9, 1901, shows a possible opportunity for our manufacturers of electrical machinery to secure the contract for the proposed electric plant in Lahore, the capital of the Punjab.

"Mr. Arthur Gray, barrister at law, and Mr. F. C. Remington, Bombay Tramway Company, are negotiating with the Lahore municipal committee for a concession of the monopoly of the supply of electric light and power within the municipal limits, for 30 years, on the general lines of the Calcutta concession. Their proposals also include an electric tramway line between the city and the railway station, with a possible extension to Mian Mir. The municipal committee has agreed to enter into negotiations, provided that local government concurs and that satisfactory guaranties and an agreement on the general lines of the Calcutta license be entered into."

Besides Lahore, which has a population of about 200,000, the following large cities of India have no electric plants: Madras (260,000), Delhi (115,000), Lucknow (150,000), Allahabad (100,000), Agra (200,000), Sawnpore (120,000), and Benares (225,000). Madras, it is true, has one for tramways, but not for lighting.

Electric lighting, though only introduced into Calcutta last year, is coming into general use. A contract has also been let for changing the tramways from horse to electric power.

Features of Pacific Coast Telephony.

THE rapid development of telephony on the Pacific Coast has been made the subject of two recent articles by the present writer, who notes as an interesting coincidence the prompt promotion to work in the Central States of President John I. Sabin, who has been the inspiring leader of Bell activity in California and the adjacent States. The writer believes that further details of Mr. Sabin's work will therefore be of timely interest, and presents herewith some further jottings from his notebook, on features not previously discussed.

In the main office exchange at San Francisco of the Pacific States Telephone Company the method of handling long-distance calls is of considerable interest to visitors. When a local subscriber in San Francisco wishes to talk out of the city he calls for "long distance," and the operator connects him with a long-distance clerk in the main office long distance-room. The long-distance clerk makes a written memorandum of the town and party wanted and the calling subscriber's name and number. This ends the long-distance clerk's connection with the message. She then puts the memorandum on an endless conveying belt, which drops it in front of the proper operator, and when the operator secures the desired connection she calls up the local subscriber wanting the connection. The essential feature to the successful and rapid handling of messages in this way is the endless belt machine. The long distance clerks occupy an elevated booth in the center of the long-distance room, as shown at the right in Fig. 1 and at the left in Fig. 2. From this booth or balcony the conveying belts radiate to the different operators. The conveyors consist simply of two belts running back to back, which carry the memorandum slip between them. It is an exceedingly rapid method of conveying messages, as the clerk has only to hand the messages to the conveyor and they are delivered at the proper operator's desk in the short time it takes the belt to travel that distance. The connection desired and party calling is down in black and white, and the plan works excellently and without confusion.

The telegraph is used very extensively by this company on its long-distance lines. The telegraph instruments are connected to the middle point of a retardation coil or coils bridged across the lines, the other terminals of the telegraph instruments being grounded. In some cases the telephone is connected the same way on short lines. Most of the company's own business over the long distance lines is done by telegraph, so as not to interfere with the regular long-distance telephone business.

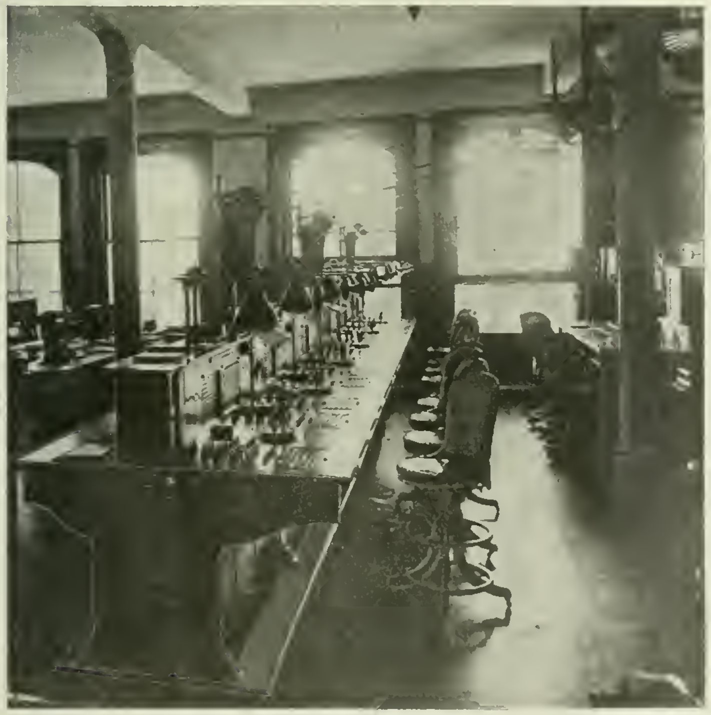


FIG. 1.—WEST PART LONG-DISTANCE ROOM, SAN FRANCISCO.

The business in San Francisco is divided among eight exchange offices. Main office, 8631 subscribers; West, 3379; East, 2748; South, 2567; Mission, 1974; Park, 1704; Butchertown, 64; Chinatown, 257; total, 21,324. Some of the exteriors and interiors have already been shown.

Fig. 3 is a unique feature of the telephone business in San Francisco, the Chinatown exchange. This exchange is patronized and operated entirely by Chinamen. On Jan 31, 1900, it had 257 subscribers all on individual circuits. The Chinaman has no use for party lines. Another peculiarity of the Chinese character is shown by the fact that it is next to impossible to get them to use numbers in calling for a connection. They give names and the operators must carry the Chinatown telephone directory in their heads. Not only must they remember the names and numbers of subscribers, but also the names of ten or a dozen employees or neighbors that are likely to be within reach of each telephone. However, the Chinese operators seem to be equal to the task. The interests of the Chinatown exchange are looked after by Loo Kumshu, a Chinaman of ability, who has the confidence both of Chinatown and the company.

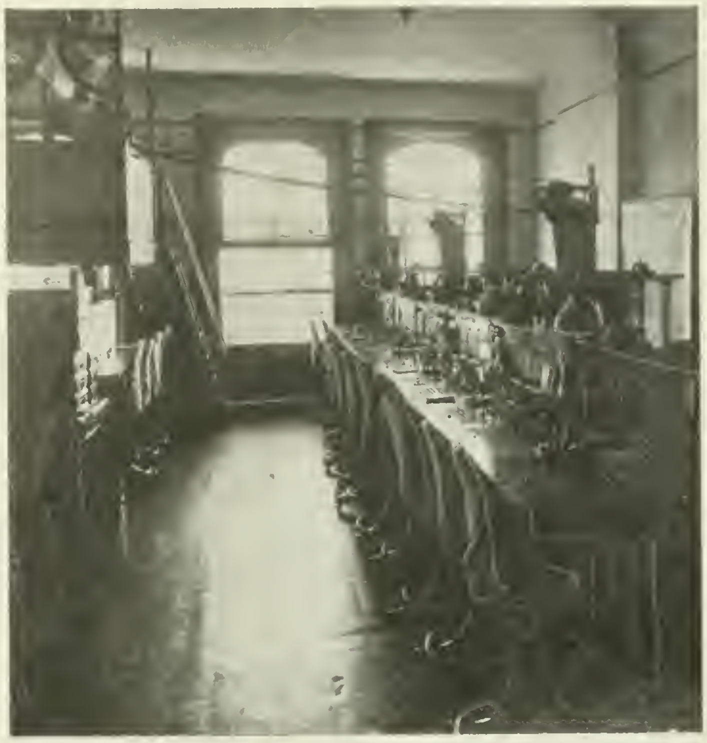


FIG. 2.—EAST PART OF LONG-DISTANCE ROOM, SAN FRANCISCO.

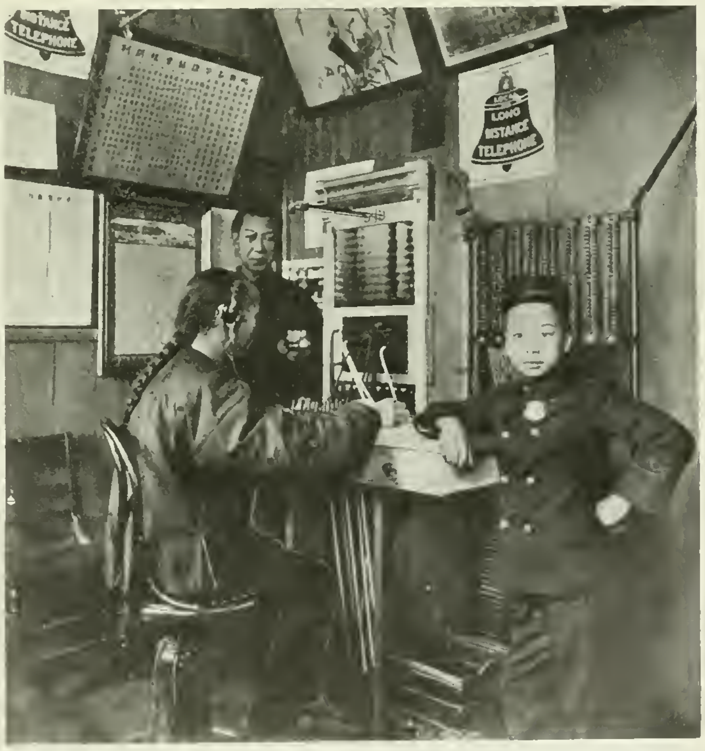


FIG. 3.—CHINATOWN EXCHANGE.

An interesting feature of the main exchange in San Francisco is a small exchange board by itself, formerly known as Buyers & Sellers Exchange, and now designated as Business Exchange No. 1. At Los Angeles there is also a similar feature. Its idea is to group together on one small board a number of firms who have a large amount of business with each other, and who wish instantaneous connections. The Business Exchange telephones are offered at a low rate, and have no connection with the other part of the exchange. The object is to afford quick connection and low rates to a class of firms having much business with each other. At Los Angeles, the Business Exchange is limited to 100 subscribers at $3 per month, and at San Francisco 150 subscribers. In making up an exchange of this kind the company is guided by the recommendations and wishes of the subscribers to the exchange. The idea is to get men together who want to talk to each other frequently.

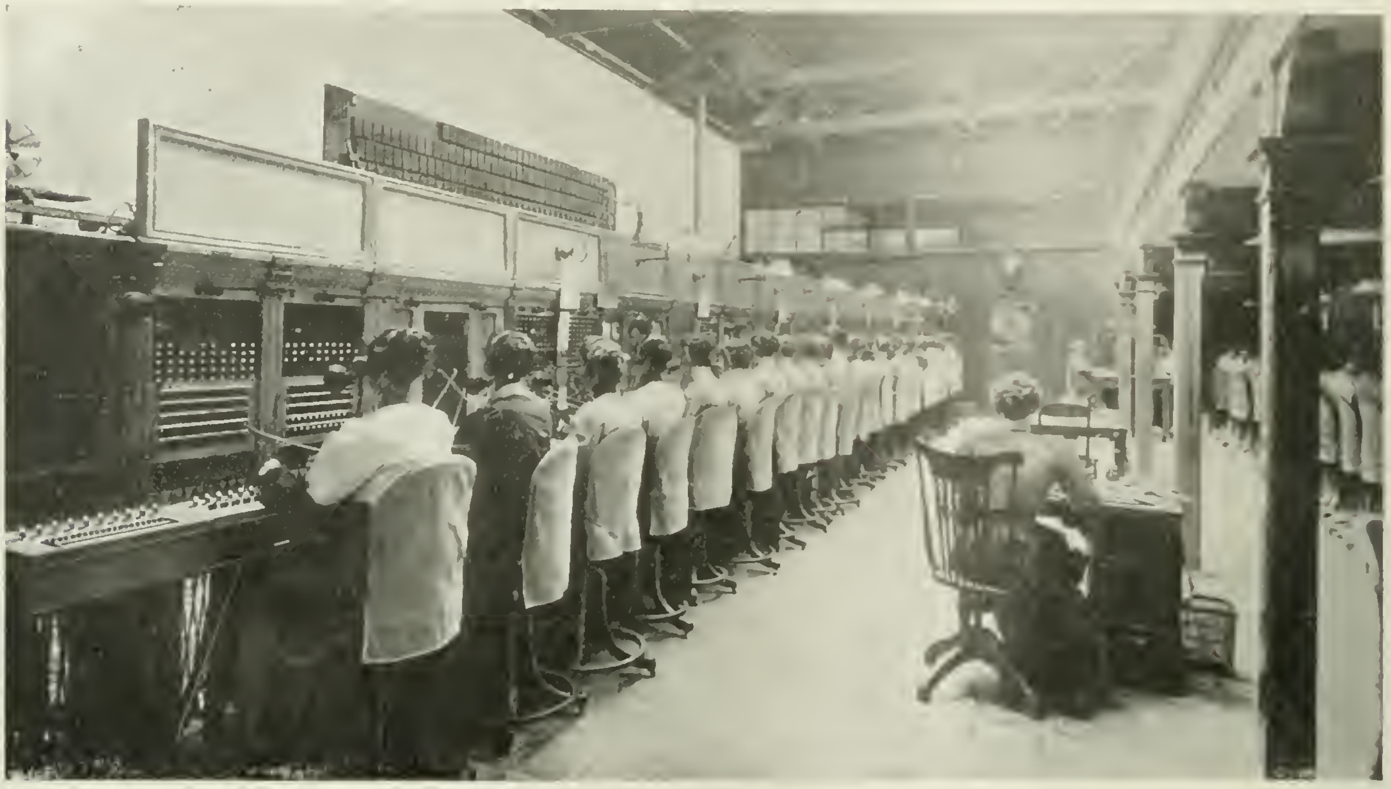


Fig. 4.—Main Operating Room, Los Angeles.

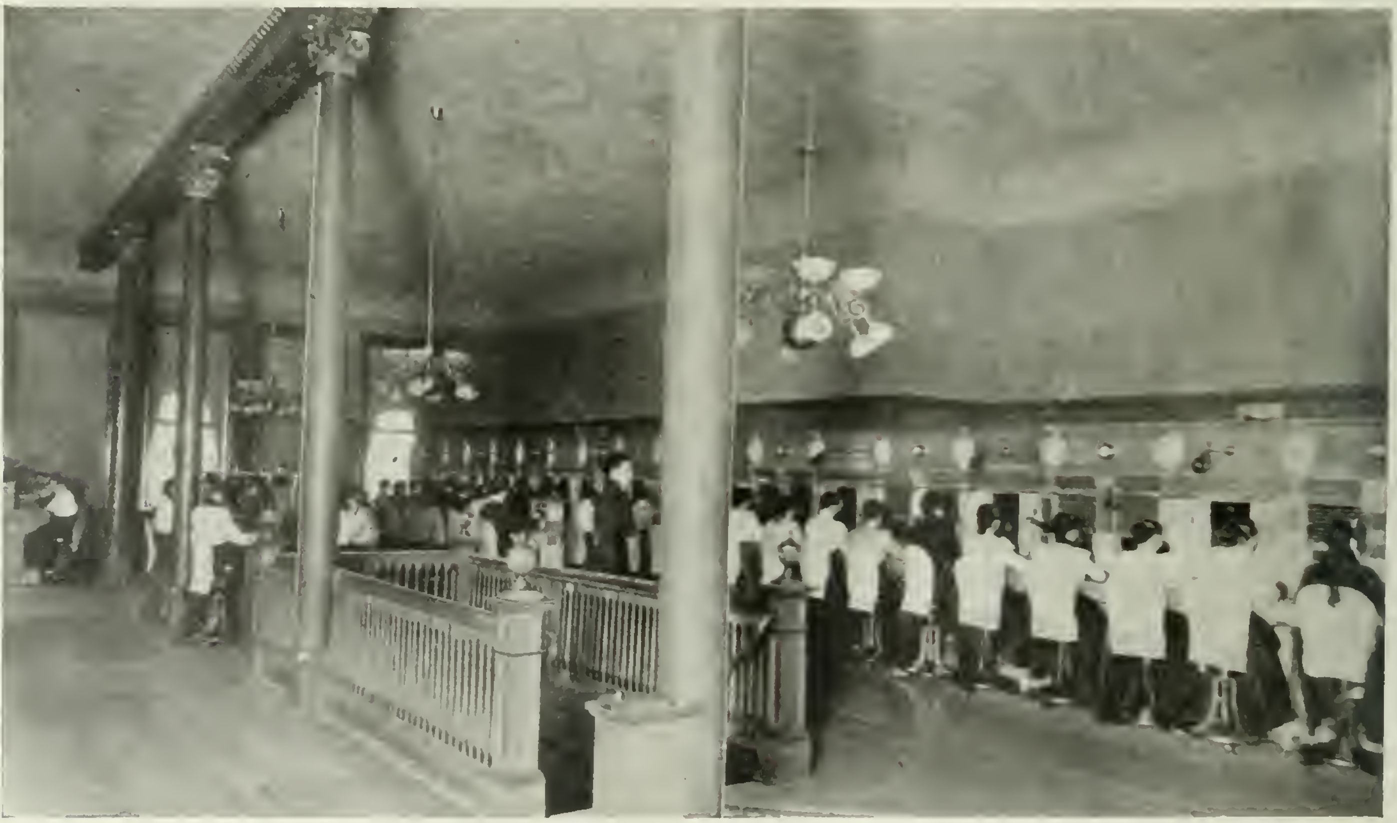


Fig. 5.—Main Operating Room, Seattle.

The two sides of the party lines are given different designations in different branch exchanges. As colors soon gave out as designations, the names of streets in the vicinity of a branch exchange are sometimes taken, thus red and white would be the designation in one exchange and Polk and Larkin in another, for example.

In addition to the exchange switchboard already shown, Fig. 4 is one-half of the main operating room at Los Angeles, where a mixed board is used, as at San Francisco, but lamp signals are used at Los Angeles. The Seattle main operating room is shown in Fig. 5. The latter exchange has had more than it could keep up with in the way of increased business on account of the rapid growth of Seattle and the enormous number of calls per subscriber on business telephones, running sometimes as high as an average of 60 per day. This has led to the policy of taking nothing but measured service business customers after Jan. 1, 1901. The old flat rate was $6 per month for business telephones. The new rate is $5 per month for 100 calls or less, and 2 cents per call for all in excess of 100 calls.

Fig. 7 completes the set of Portland operating room views by showing the long-distance board. Exchange equipments and all technical electrical matters are in charge of F. W. Alston, electrician.

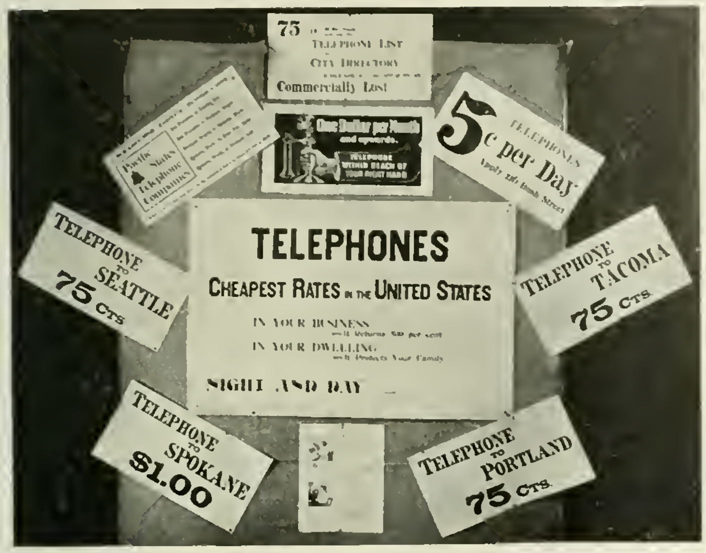

75
Telephone List
City Directory
Commercially Lost
Pacific States Telephone Companies
One Dollar per Month and upwards.
5c per Day
Telephones
TELEPHONE TO SEATTLE 75 CTS
TELEPHONES
CHEAPEST RATES IN THE UNITED STATES
IN YOUR BUSINESS
IN YOUR DWELLING
NIGHT AND DAY
TELEPHONE TO TACOMA 75 CTS
TELEPHONE TO SPOKANE $1.00
TELEPHONE TO PORTLAND 75 CTS

FIG. 6.—ADVERTISEMENTS.

This company has never, in the past few years at least, acted on the theory of some companies enjoying a monopoly, and assumed that all the business possible would come without any solicitation on the company's part. A constant and vigorous effort is made to keep the convenience and importance of telephone service before the public. The public is being constantly reminded that there is a telephone company doing business in the town. What the independent movement is doing in the East to educate the public to the general use of the telephone the Pacific States company has done on the coast by its own push. The management has never lost faith in the future of the telephone, and has never believed that its present application is more than a small fraction of what is to be. Herein un-

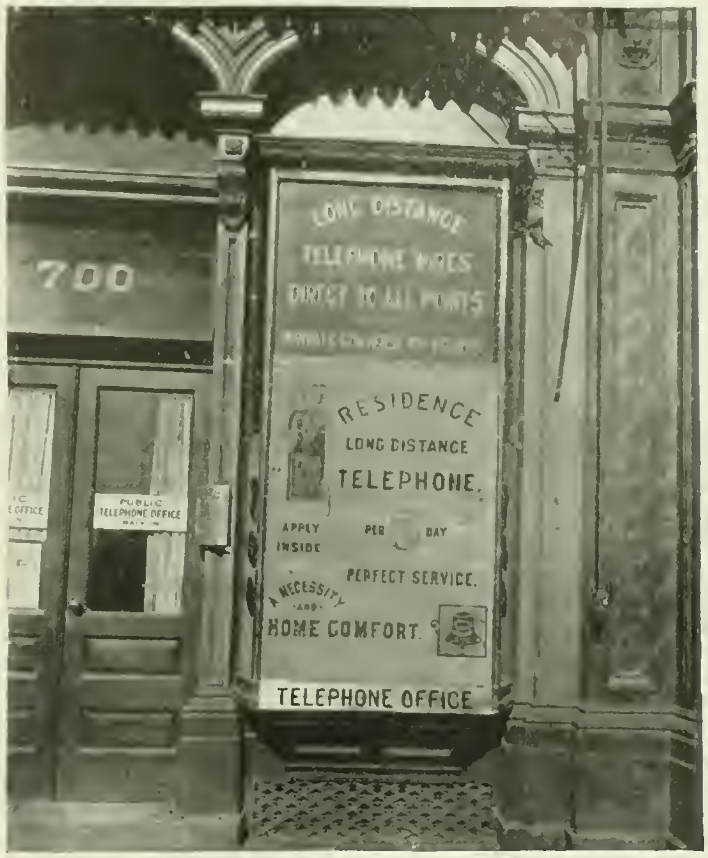


FIG. 8.—WINDOW OF PUBLIC OFFICE, SAN FRANCISCO.

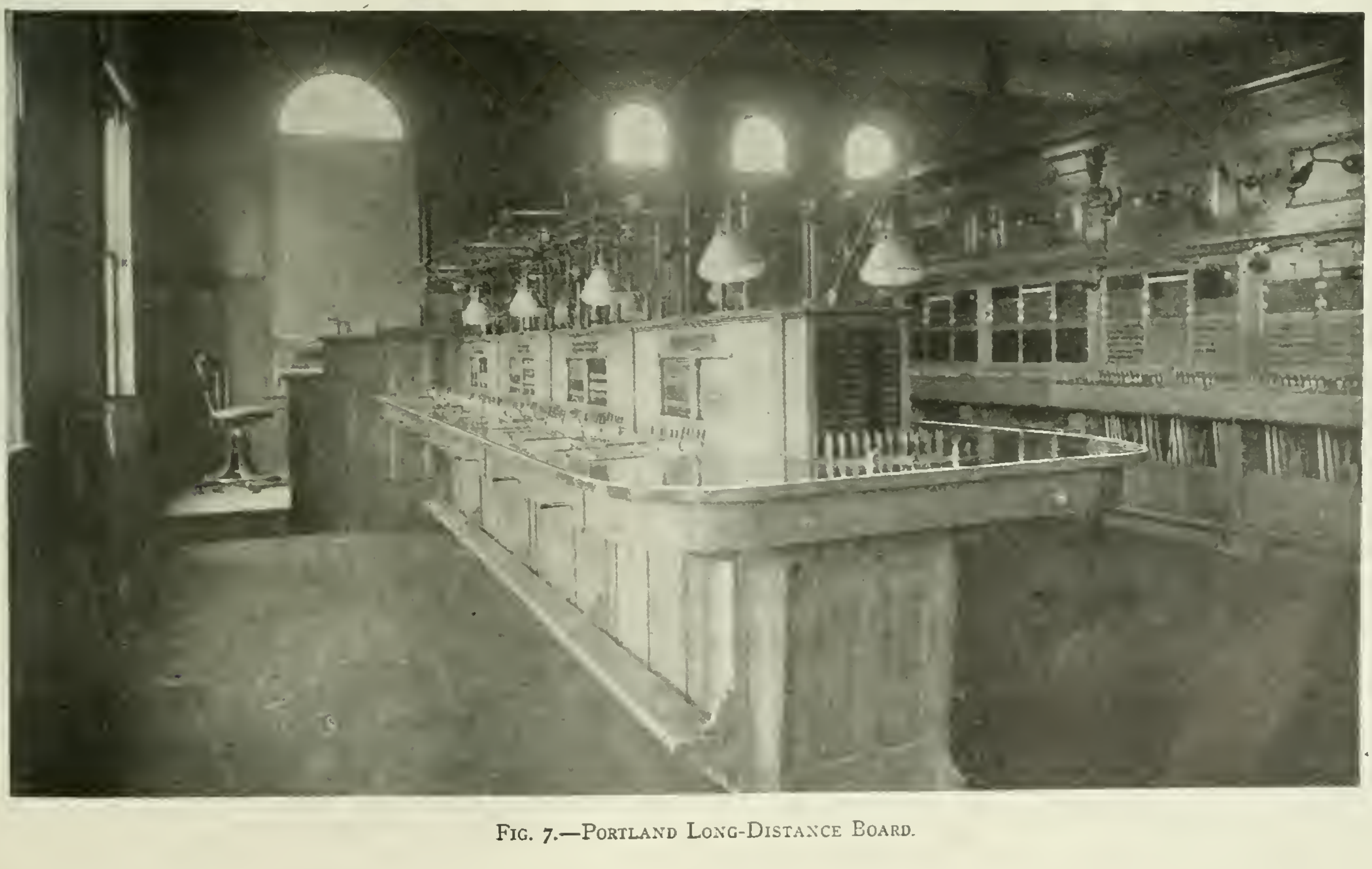


FIG. 7.—PORTLAND LONG-DISTANCE BOARD.

doubtedly lies much of the secret of the extensive use of the telephone on the Pacific Coast, and this also accounts for the small number of independent exchanges. Just how strong the independent movement will prove in the future on the Pacific Coast is hard to determine.

It is difficult to give an idea of the extensiveness and force of advertising methods at a distance, but some of the accompanying illustrations show the way the telephone is brought to the attention of the public. Fig. 6 shows a group of some of the catching advertisements used. Figs. 8 and 9 show two public office windows, which are fair examples of their class. The advertising value of such windows with the handsome lettering used is considerable. The telephone directory is liberally used as an advertising medium as well as the daily paper. The following paragraph appears on the front cover of the last telephone directory, and in numerous other places:

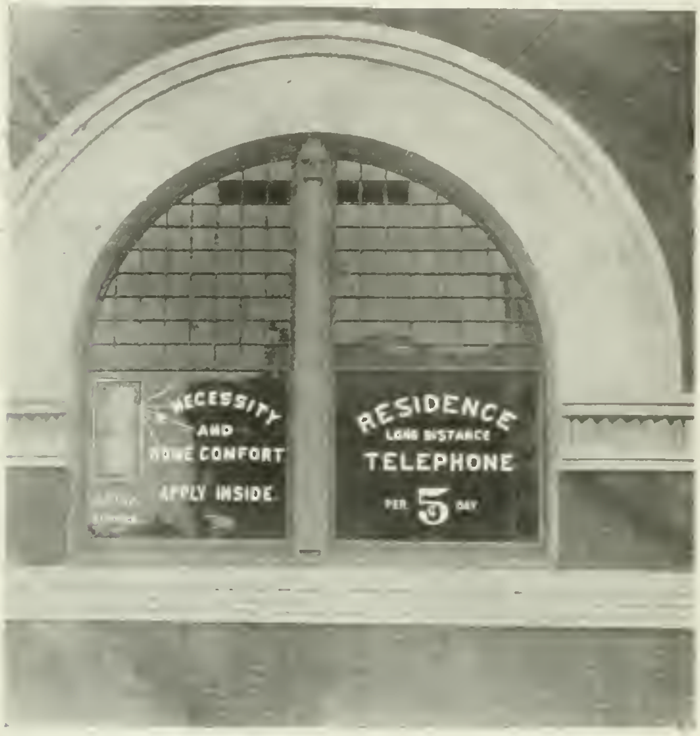


FIG. 9.—WINDOW OF WEST OFFICE, SAN FRANCISCO.

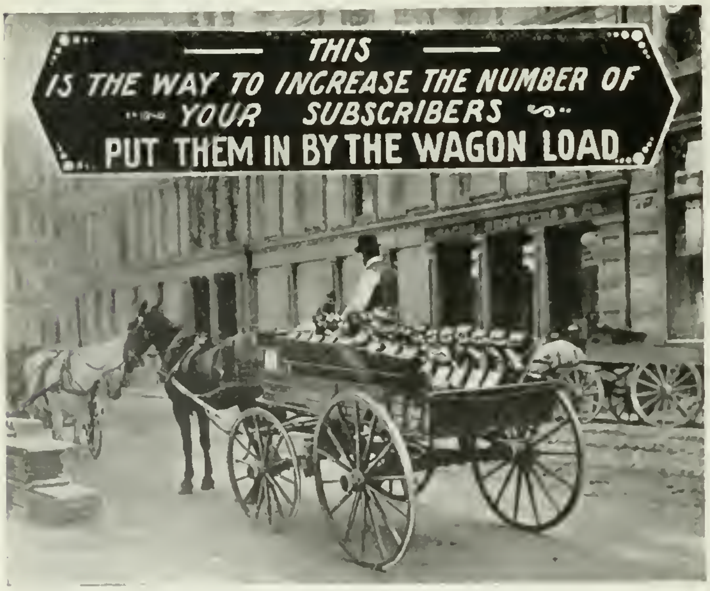

THIS
IS THE WAY TO INCREASE THE NUMBER OF
YOUR SUBSCRIBERS
PUT THEM IN BY THE WAGON LOAD

FIG. 10.—PRESIDENT SABIN'S ADVICE.

EXPANSION.

It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout the Pacific States; and in all of the cities and towns, to put a telephone, at the most reasonable rates, within easy and immediate reach of every person whose income is sufficient to permit him to ride on street cars.

When a subscriber's line becomes so crowded with business that the line is frequently busy when called for, a memorandum is kept of the number of times a day this happens, and the next day the following card is received by the subscriber filled out with the proper name and number:

SAN FRANCISCO.........................
To...
Telephone No...............................

Our operating department reports being compelled to say, "Line is busy, call again"..... ....times during business hours yesterday.

We have special rates (very low) to remedy this trouble and probable loss of business to you by subscribers (finding *your* doors practically closed) going elsewhere.

Telephone or write the undersigned and an agent will be sent to explain the system.
L. H. JACOBI,
Telephone, Main 298. *Contract Agent.*

In closing this article, one cannot do better than to offer the advice President Sabin, with his characteristic humor, offers to other telephone officers in the photograph, Fig. 10.

The thanks of the writer are due to the officers of the Pacific States Telephone & Telegraph Company for the very courteous treatment and full information received at their hands when he was recently on the Pacific Coast, especially to President John I. Sabin, and also to E. J. Zimmer, assistant to the president, for information as to the company's business methods; to F. W. Alston, electrician, who has charge of all exchange equipment and apparatus, and to A. J. Steiss, engineer in charge of all construction, lines and buildings. It is proposed to close this series by some data on the company's line construction.

Power Development in British Columbia.

The Stave Lake Power Company has recently acquired a valuable franchise from the city of Vancouver, giving it the right for 50 years to do business as a power company within the corporate limits of the city of Vancouver. The water rights on Stave River were taken up some two years ago by J. B. Ferguson and George C. Hinton, of that city. They were met by some adverse claims, and the first summer was spent in a legal contest, which finally resulted in the rights going to Messrs. Ferguson & Hinton, who organized the Stave Lake Power Company with a capital of $1,000,000. They were required, under the Water Clauses Consolidation Act, to file their plans of operation with the Government, and to do a certain amount of work the first season, which has been done. Their next difficulty arose in obtaining the franchise to come into the city of Vancouver under favorable terms, as they were met at once by opposition from vested interests, which proved very strong, and it looked for a long time as if the company was not going to obtain the privileges which it sought. This difficulty has now been overcome, and it is expected that the company will soon start operations.

The power is situated 31½ miles from the city of Vancouver, and about 25 miles from the city of New Westminster. The engineer of the company reports that 17,000 horse-power can be developed at the Falls, and that this amount of power can be duplicated at another point lower down on the stream. There is at the present time about 20,000 horse-power in use by various industries at New Westminster and Vancouver and along the line of Burrard Inlet. It is hoped that about half of this power can be secured for the company.

Cable Connections with the Madeiras.

Consul Jones, of Funchal, states that the Eastern Telegraph Company has just finished laying a cable from Falmouth to St. Vincent, Cape Verde Islands. It passes through the office of the Western Telegraph Company, Limited, at Funchal, and is worked in connection with the Cape-St. Helena route. The latter company has landed four cables at Funchal—two at Lisbon and two to St. Vincent. One of the Lisbon cables is continued to Brazil and connects that country with Europe. The direct cable route from Funchal to the United States, adds the consul, is via Lisbon and the Azores. The tariff to New York is about 50 cents per word.

Frequency Converters.

By A. S. McAllister.

FOR the satisfactory operation of arc lamps a frequency higher than 40 p. p. s. is required, while when the frequency is much below this value incandescent lamps show a decided fluctuation in brilliancy. The output of transformers may be shown to vary as the three-eighth power of the frequency. These are among the causes for the fact that in the older lighting stations a frequency as high as 133 p. p. s. was quite common.

With later increase of magnitude and range of service, it was found that a lower frequency improved the operation of alternators in parallel, while the line regulation was also benefited by the change from the higher frequency. This led to the adoption of a periodicity of about 50 to 60 p. p. s. With the advent of the long-distance power transmission circuits, the advisability of the adoption of a still lower frequency became apparent, while the successful use of rotary converters for railway work practically necessitates a frequency as low as 25 cycles. This is the present standard frequency for such service.

The lowest frequency proposed up to the present date is 15 p. p. s. for use with gearless induction motors for traction purposes. The economy of its adoption is questionable from the standpoint of both the generators and the transformers. That the frequency of 25 cycles will remain for general power purposes seems quite probable.

When lighting is to be done from energy supply at 25 cycles, some means must be provided for altering the nature of the current before it can be applied to the lamps. A most satisfactory method of accomplishing this result is by means of alternating-current motors, of either the induction or synchronous type, driving lighting generators. Where only high-voltage alternating currents are available this method requires the use of step-down transformers, a motor and a generator, each carrying the full load. When the pressure at hand is sufficiently low, step-down transformers may be dispensed with, but a double equipment and double transformation of energy is still necessary, with consequent low efficiency and high cost of installation.

A recently developed method for changing the lower frequency to a value suitable for lighting purposes is by the use of "frequency converters," which constitute a special adaptation of induction motors as secondary circuit generators.

In the ordinary induction motor the frequency of the secondary current is not that of the supply, but it has a value represented by the product of the percentage slip of the secondary from synchronous speed and the frequency of the primary current. It is only when the slip is unity, or at standstill that the primary and secondary frequencies are equal. Under this condition the windings are in a true static transformation, and, with the secondary clamped to prevent relative motion, current at the primary frequency can be drawn from the secondary windings. Obviously, the air-gap renders the induction motor for such purposes much inferior to a static transformer, on account of magnetic leakage between the coils.

If, now, the secondary be given a motion relative to the primary there may continue to be drawn from the secondary current at a frequency determined by the slip from synchronous speed. If this slip be greater than unity—that is, if the motor be driven backwards —the frequency of the secondary current will be greater than that of the primary. By properly proportioning the rate of backward driving, the secondary current can be given a frequency of any desired value.

In order that the secondary frequency may bear a constant ratio to the primary, it is necessary that the relative slip from synchronism be constant, which condition can conveniently be obtained by driving the secondary with a synchronous motor operated from the same supply current as the primary.

Evidently the synchronous motor will demand power from the supply in addition to that demanded by the primary circuit of the frequency converter. The amount of this power is determined by the speed of the synchronous motor and the torque exerted by the frequency converter. When the slip of the converter is unity, the power demanded by the synchronous motor is zero; when, however, the slip is two—that is, when the frequency of the secondary is twice that of the primary—the power demanded by the synchronous motor is equal to that demanded by the primary of the converter. A further analysis will show that the power supplied by the frequency converter bears to the total output the ratio of the primary frequency to that of the secondary, the remaining power being supplied by the synchronous motor.

Since the total output appears at the secondary of the converter it behooves us to ascertain in what manner the power supplied by the synchronous motor enters the converter windings.

Let the ratio of primary to secondary turns be unity, and let us consider the secondary current in phase with the secondary e. m. f., and let it be counter-balanced by an equal current in the primary in phase with its e. m. f., then

$I =$ primary current,
$I =$ secondary current,
$E =$ primary impressed e. m. f.,
$SE =$ secondary generated e. m. f., where $S =$ slip in per cent,
$IE =$ primary power,
$ISE =$ secondary electrical power.

In the ordinary induction motor, where S is less than unity, the secondary generated power (SIE) is dissipated in the copper of the secondary windings, while the remaining power received from the primary ($IE - SIE$) is available for mechanical work. When SE is equal to unity the secondary generated power (IE) is totally available as electrical energy, which may be lost in the resistance of the secondary windings or usefully applied to external work, while the mechanical power of the secondary is zero. When S is greater than unity the total secondary generated power (SIE) is available at the secondary terminals. Of this power (IE) is supplied by the primary, while the remainder is supplied by the synchronous motor.

We thus see that the effect of driving the secondary backwards is to increase the secondary pressure above that of the primary, and that the power for such increase is derived from the synchronous motor.

A moment's reflection will show that there is only partial double transformation of energy with a frequency converter, and that the sum of the capacities of the synchronous motor and the converter must just equal the output plus the inevitable losses in each machine. A numerical example will show this quite plainly. If we assume a lighting load of 60 kilowatts to be changed in frequency from 25 to 60 cycles, then the capacity of the frequency converter proper must be 25 kilowatts, and that of the synchronous motor 35 kilowatts, as shown above. It should be noted, however, that while the iron loss of the converter primary is the same as that of a 25-kw induction motor on 25 cycles, the iron loss of the secondary of the converter is that of a 60-cycle, 60-kw generator, and thus very materially greater than that of a 25-kw induction motor, which latter, in fact, is usually quite negligible.

By over-excitation the leading component of the current demanded by the synchronous motor may be adjusted to equal the lagging component due to the exciting current of the frequency converter, so that the external apparent power factor of the equipment may be kept quite high.

An Electric Typewriter.

By B. C. Washington, Jr.

THE application of electricity to operating a typewriter has converted it into a power machine, utilizing the operators merely in the capacity of a director, and practically relieving them from all physical work. The mechanical construction of the machine is extremely simple, and the trend of each operation is very easily followed by any one, whether familiar with machinery or not. Fig. 1 is a sectional view intended only to show the method of applying the electricity, and the manner in which it performs its work. The amount of current required to operate the machine is very small indeed, and is obtained in a variety of ways.

In Washington, the home of the company, where a large number of these machines are now in daily and constant use, current is, as a rule, taken from circuits of the city light and power company, by inserting a plug in a lamp socket, or by making a special connection, and leading the flexible twin cable to the binding posts at the rear of the machine. The electrical equipment of the machine is protected by inserting a quarter ampere fuse in the fuse block.

Another effective plan of securing power is by using a battery of six Harrison's No. 1 primary cells. Four cells are all that are required. The extra cells are a reserve to be connected up when the battery weakens. The portable battery box for the six cells has the following inside dimensions, 10¼ by 6⅝ inches in depth. Two small storage battery cells also furnish ample current for operating the machine.

By referring to Fig. 1 it is seen that the depression of the front end of the key lifts the back end, and the little foot there pushes upward the push piece or latch, thus raising the horizontal arm of the bell crank lever, whose vertical arm by means of a link moves the pendant into the path of the motor frame. While this movement is taking place the horizontal arm of the bell crank lifts the horizontal arm of the circuit-closing frame, pushing forward its lower arm and pressing the platinum point in the contact spring against the contact point carried in an adjustable screw. The instant the circuit is closed, the armature of the electromagnet pulls up the motor frame, and through the pendant, which has been moved forward into the path of the motor frame, lifts the inner end of the reed or lever, throwing down the outer end, which, through the pull-down wire, throws the type bar against the platen. Fig. 1 also shows a small adjustable link connecting the motor frame and the knockout or releaser frame, so that the latter, when the motor frame has raised the pendant the desired distance, knocks the push-piece or latch off the foot of the key depressed, and thus breaks the electric circuit.

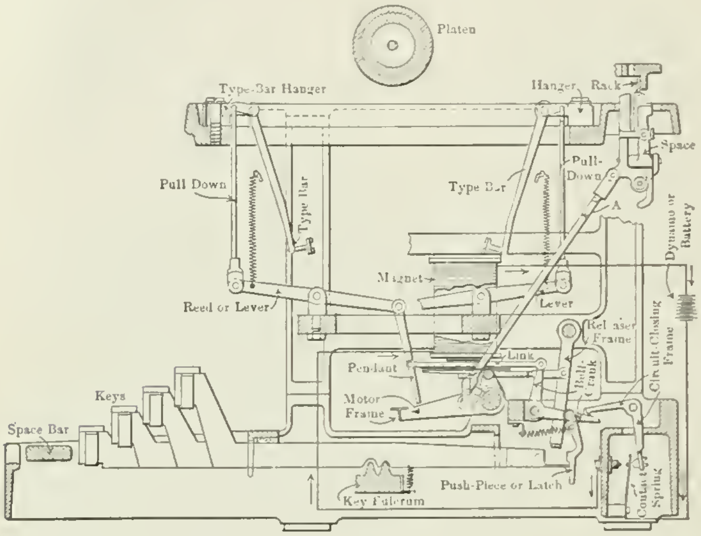


FIG. 1.—SECTIONAL VIEW OF ELECTRICAL TYPEWRITER.

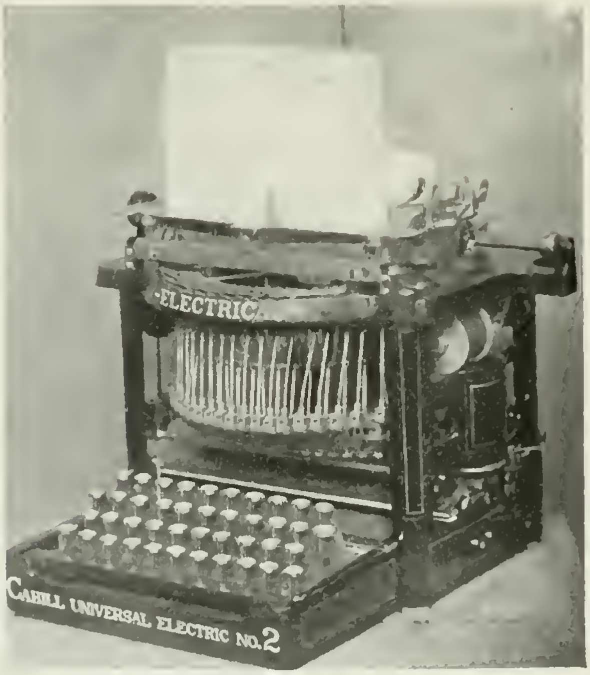


FIG. 2.—VIEW SHOWING MAGNET AND RHEOSTAT.

The breaking of the circuit allows the motor frame, push piece, bell crank, link, pendant, reed, or lever, pull-down wire, type bar and space mechanism all to return to their normal positions independently of the key, though it may still be held down by the finger of the operator. While it requires considerable time to describe these operations, they are all performed by the machine in an instant, and so very quickly that the motions of the parts cannot be followed by the eye.

When the circuit is automatically opened and the parts have returned to their normal position, another key may be depressed without waiting to release any other key which may be down. It is in this manner that the running legato touch is obtained in a type-bar machine. This has never been accomplished before. A glance at Fig. 1 shows that there is but one electromagnet for operating all the type bars in the machine—that there is but one motor frame—that there is but one contact frame, and but one place where the electric circuit is closed and opened. The power is transmitted practically through just one lever between the motor frame and the pull-down wire; that is, from the place where the power is applied (the motor frame) to the type bar, the path for the power is just as direct as in the very simplest and most direct non-electrical typewriter. In the non-electrical machines, the finger usually presses the finger piece on one end of a reed or lever, which pulls down the pull-down wire, and so throws the type bar against the platen. In this electrical typewriter the motor frame presses the reed or lever through the pendant and the other end of the reed draws the pull-down wire, which throws the type bar against the platen.

The ribbon mechanism (not shown in Fig. 1) is also impelled from the motor, and not by the finger or carriage mainspring. The power of the electromagnet is controlled by a small rheostat having six contacts The handle of the rheostat is back of and below the electromagnet in easy reach of the operator. The power of the electromagnet is under ready control, and a copy of perfectly uniform distinctness is made, since every type bar strikes the paper with exactly the same force. These machines can be operated by direct or alternating current, by a storage or primary battery, and can be regulated to take current ranging in e. m. f. from 4 volts to 500 volts. Ordinarily a very weak current is used, but this is increased when carbon copies are being made. From 18 to 20 perfectly distinct carbon copies are made at one time, an accomplishment not yet attained by non-electrical typewriters A touch of from two and a half to four or five ounces is quite sufficient to operate the keys, which are depressed about one-third as far as the keys of non-electrical typewriters.

Greater speed and better work are the results secured, without any wearying or enervating effects on the operator.

The arrangement of the spacing mechanism is such that the striking of the space bar simultaneously with the last letter of a word makes the space. As words ordinarily average five letters, this arrangement makes a clear speed gain of 20 per cent. The importance of the electrically operated typewriter has been recognized by the Patent Office, and readers of the ELECTRICAL WORLD AND ENGINEER who attend the Pan-American Exposition at Buffalo will find this machine included by request in the Patent Office exhibit.

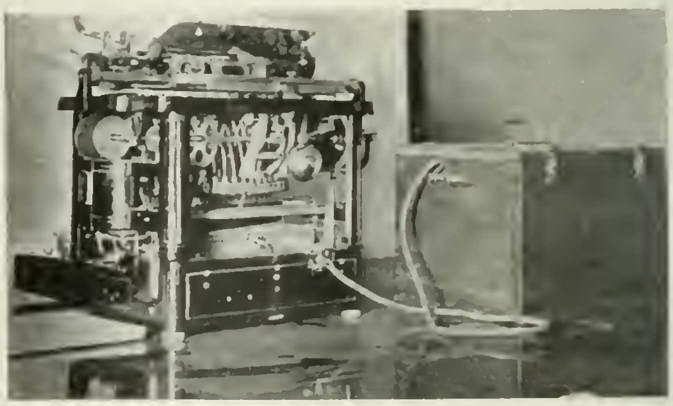


FIG. 3.—REAR VIEW, SHOWING ELECTRICAL CONNECTIONS.

The offices and factory of the Cahill Electric Typewriter Company are at the corner of Eleventh and G Streets, Washington, D. C.

Bleaching at the Anode by Electro-Chemical Action.

By Woolsey McA. Johnson.

BLEACHING of coloring matter is caused by action of nascent oxygen on the organic substances. The result is that the coloring matter is oxidized to colorless products. This can be attained by the use of chlorine water, ozone, hydrogen peroxide, sodium oxychloride, bleaching powder with acid, etc. All these substances bleach because they liberate nascent oxygen. As a current of electricity liberates nascent oxygen at the anode it should be theoretically possible to bleach by the agency of electrolytic action at the anode.

With this end in view I performed the following experiments at the Jarvis laboratories of Trinity College, Hartford, Conn. A current was passed through a piece of paper written upon, soaked in an acidified solution of sodium chloride between two electrodes. The result was that wherever the current passed the ink was erased by the action of the nascent oxygen liberated by the current and by the secondary chemical action of the chlorine set free.

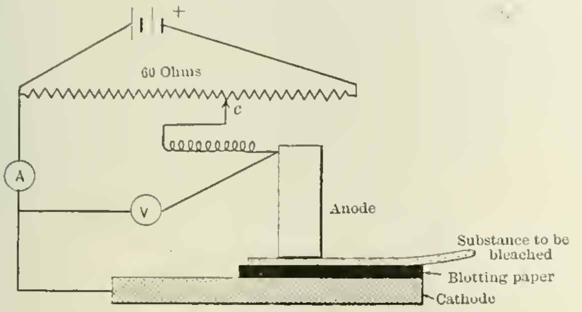


FIG. 1.—DIAGRAM OF CONNECTIONS.

The details of the process are as follows: Two Leclanché cells are closed through a 60-ohm circuit, enabling us to apply to the shunt circuit any potential by the variable contact *c*. In the shunt circuit are found a pair of electrodes separated by a piece of blotting paper. The electrodes can be made of any substances not attacked by the products of electrolysis. Carbon electrodes are well adapted for this purpose. The cathode was flat, and about 4 inches square. The anode can be of almost any dimensions, according to the size of the substance to be bleached.

If a small stain, it might be convenient to have the electrode of the size of the stain. The solution can be of various strengths, according to the refractoriness of the stain. I used a saturated solution of sodium chloride acidified with 1 per cent hydrochloric acid in most of my experiments. The voltage applied was 2 volts for rapid work, with a current density of 0.05 ampere per square centimeter. For fine, delicate work the voltage was about 0.2 volt above the "Zersetzungspunkt" of normal HCl $1.31 + 0.2 = 1.51$ volt. With this voltage the current is reduced to very small limits, and the bleaching is complete only at the end of 2 or 3 hours. The two independent variables are the resistance of the solution, and the voltage applied. The dependent variable is the current. The "Zersetzungspunkt," or critical decomposition voltage for a normal solution of hydrochloric acid, is 1.31 volts. This, however, is considerably lowered, because the stains act as depolarizing agents and prevent complete anodic polarization. This fact is very important, because it shows that a disproportionately large part of the current goes to stains or impurities to be bleached. The action of the impurities is reducing, and the e. m. f. of polarization is reduced at these points, consequently the lines of current flow converge to these points. The result is that the bleaching is extremely efficient because the current density is highest, where the current has the largest amount of work to do. This asymmetrical efficiency is greatest when the current is very small. The behavior of the current in this case is exactly like the deposition of zinc and copper out of the same solution, and is very simple in explanation. In any electro-chemical system—that is, an electrode and electrolyte—there are several "polarization points" due to the several distinct chemical reactions that are possible. Each of these reactions has its own chemical "dissolution-pressure," which is measured by its voltage against a standard electrode. When the e. m. f. applied to the electro-chemical system just exceeds the lowest "polarization-point," the first reaction proceeds isothermally and reversibly. When, however, the e. m. f. exceeds the second polarization-point or the second "Zersetzungspunkt," to use the expressive German term, we have the reaction proceeding to a higher chemical potential or to a higher state of chemical separation. Some unpublished researches made by me as a pupil of Professor Nernst, of Gottingen, show this quite clearly.

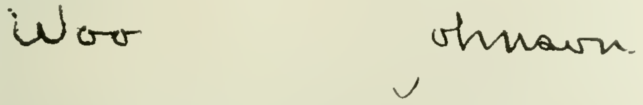


FIG. 2.—PARTIAL BLEACHING OF SIGNATURE.

As a result of this principle, it is seen that the current works very effectively, provided the e. m. f. is kept below the second point of polarization, 1.67 volts, which is the voltage of the OH ions. As a matter of fact, in this electro-chemical system which we have there are three "polarization-points," viz.:

$$\left.\begin{array}{r}1.08 \text{ volts for O ions.}\\ 1.31 \text{ volts for Cl ions.}\\ 1.67 \text{ volts for OH ions.}\end{array}\right\}\begin{array}{l}\text{for normal}\\ \text{concentrations.}\end{array}$$

And three secondary "polarization-points" caused by the reducing action of the impurities on each of the above points. The tendency is to lower each of these three points by reduction. Probably the most important point of polarization is the 1.08 volts, as shown in the researches of H. Zehrlaut, Vol. 7, page 501, *Zeit. f. Electrochemie.*

Keeping these principles in mind, a little practice in manipulation of the electrode, which can be held in the hand, and observation of the voltmeter and ammeter readings enables one to do good work in erasing ink-stains, bleaching cloth, etc. The cut herewith was my name, which I partially erased to show the action of the bleacher to a friend. Here delicacy and fineness of action were sacrificed to speed. The voltage was 2 volts, the current 0.02 amperes, and the time only 2 minutes, instead of several hours.

Modern Telephone Engineering—II.

(Concluded.)

By Kempster B. Miller.

AN interesting feature about such trunking systems is the means which the incoming trunk operator at the second office informs the calling subscriber and the regular operator that line called for is busy. When she finds on testing that a line is busy, she inserts the trunk line plug into the "busy back" jack, which jack has connected in its circuit a machine giving an interrupted current which gives a peculiar, familiar, and, to most subscribers, an extremely disagreeable sound. This sound is heard by both operator and subscriber at the first office, and the disconnection is made.

There is probably no method of determining the relative activity of any city at different times of the day or on different days, so well as by watching the telephone exchange in that city in operation. For keeping track of their business and being able to handle it to the greatest advantage, telephone companies usually make at frequent intervals what they term "peg counts." These show the total number of calls received and connections made during each of the 24 hours of the day. These results, if plotted in the form of a curve, in which the abscissæ represent time and the ordinates represent total number of calls per hour, show graphically and in a striking way the amount of telephone business being transacted at any given hour.

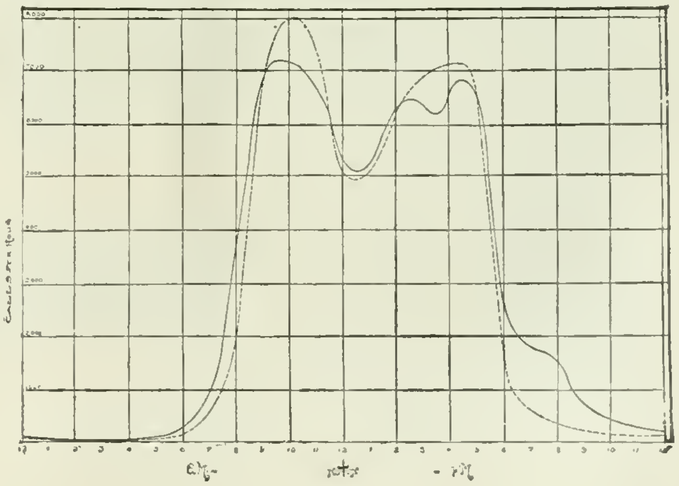


FIG. 7.—LOAD CURVE.

The curves (Fig. 7), show what I believe has never been shown before—that is, peg counts, taken the same day, of two opposition exchanges in the same city. These exchanges have about the same number of subscribers, not far from 6000. The dotted curve represents the telephone activity in the Bell exchange, while the solid curve represents that of the independent exchange. The rates of the Bell exchange are considerably higher than those of the independent, and from this fact we are enabled to draw several conclusions from the form of the two curves.

It will be noticed that from 12 at midnight until 6 o'clock both curves are very low, and gradually fall until 3 o'clock, after which they slowly rise until 6. This shows conclusively that the hour of 3 a. m. is that of least business activity, except, perhaps, in those lines, such as burglary and other allied industries which seldom require the use of telephone service. From the hour of 6 a. m. each of the curves rise rapidly, corresponding to the awakening of the city, reaching a maximum for the day in the neighborhood of 10 o'clock a. m. They then fall off to a minimum, corresponding to the lunch hour, between 12 and 1, and again rise to a second maximum between the hours of 4 and 5 in the afternoon, after which they rapidly fall during the evening hours. The fact that the independent exchange has cheaper telephones than the other will, perhaps, account for the fact that its subscribers begin work a little earlier in the morning, reach their maximum activity at a little earlier hour, take a little shorter time for lunch, go home a little later in the evening and work a little more all night, all of which facts are indicated by these two curves.

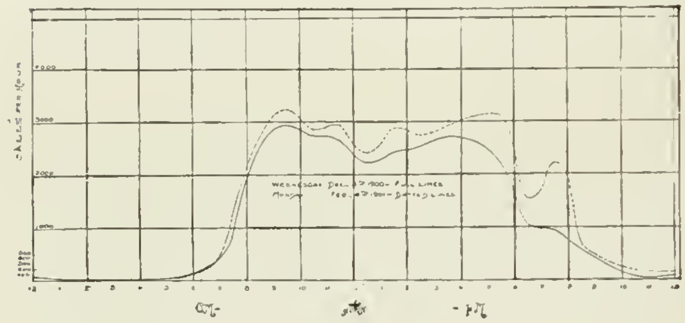


FIG. 8.—LOAD CURVE.

In Fig. 8 I show two curves representing telephonic activity of the same city on two different dates. It will be noticed that the dotted curve, which represents a Monday, shows a greater number of calls than the solid curve, which was taken on a Wednesday. It is usually true that Monday is about the busiest day in the week in telephonic exchanges. It would be interesting to trace the significance of the different humps or characteristics of these curves, but it will be noticed that whatever hump is on one is present, or at least suggested on the other. The pronounced hump on the dotted curve at the extreme right is undoubtedly due to the theater business, between 7 and 8 in the evening. Probably the reason why this was more pronounced on one curve than on the other was that there was a special attraction or special set of attractions, in the entertainment line, on the particular day on which the curve was taken. Such curves as these have been said by some one to represent the pulse of a city, and I think that the longer one thinks about it, the more apt this term appears. Every city has a heart in its telephone exchange, and this heart is throbbing with as great a regularity as that of any living creature.

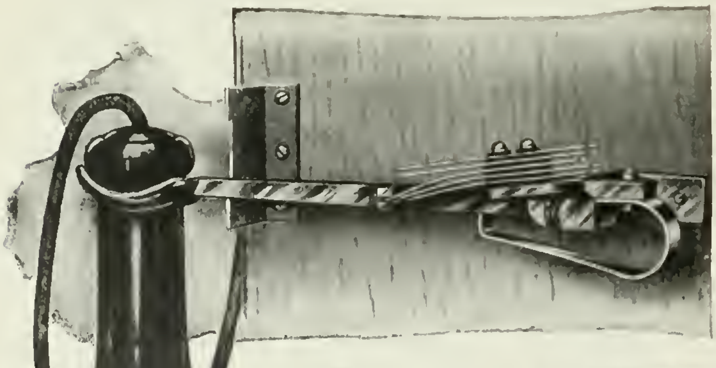


FIG. 9.—HOOK SWITCH.

Mr. Miller during his lecture illustrated by means of lantern slides many views of switchboards and telephonic apparatus, some of which are reproduced herewith. In Fig. 9 is shown a subscriber's automatic switch-hook with the receiver upon it, and in Fig. 10 the same hook with the receiver removed. It will be seen that the long lever serves to bend the central spring into engagement with the lower or upper set of springs according to whether the telephone is in use or not. This accomplishes the changes of circuit by which the operator is automatically called and by which she is later given the signal to disconnect, which changes are made, of course, entirely without the volition or knowledge of the subscriber.

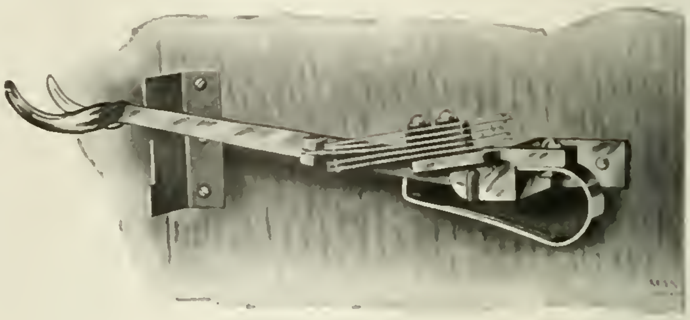


FIG. 10.—HOOK SWITCH.

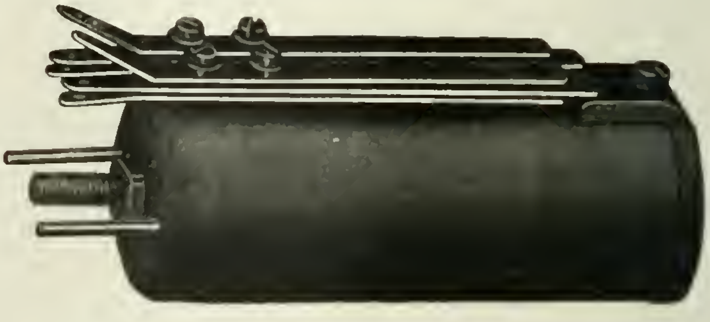


FIG. 11.—SINGLE CUT-OFF RELAY.

Fig. 12 shows a strip of line relays similar to the ones used in the Pittsburg exchange. These relays are mounted 20 per strip, as shown.

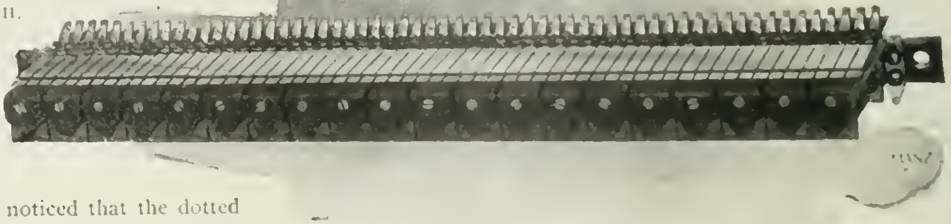


FIG. 12.—STRIP OF LINE RELAYS.

A single line cut-off relay is illustrated in Fig. 11. The magnet of this is enclosed in an iron shell which forms a portion of the magnetic circuit. The armature of this relay, when attracted, causes the two long springs to break contact with the lower springs, and to make contact with the two upper springs. All contacts in the best relays of this description are made of platinum. These relays are about 1¼ inches in diameter, and the shells are of soft iron about ⅛ inch thick.

In the latest Kellogg exchanges the line and cut-off relays are mounted side by side on the same strip. Fig. 13 shows such a strip which contains 20 such relays, the line relays being the smaller of the two. This strip represents a unit of 20 lines, which unit is carried throughout the entire scheme of wiring in the central office. Fig. 14 shows the opposite side of this relay strip, showing the connecting wires from the various terminals. These terminals pass through walls in the iron mounting strip and are readily accessible for soldering in the wires. In mounting the line and the cut-off relay in such close proximity, many of the wires which would otherwise have to be formed up in cables are reduced to the short, stiff bare wires clearly shown in this picture.

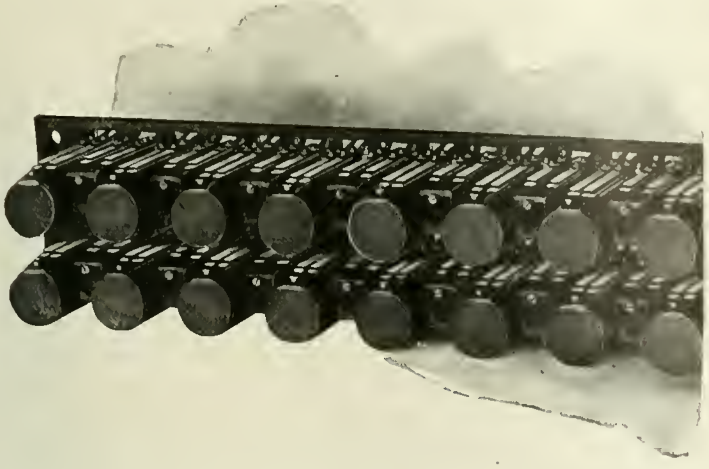


FIG. 13.—STRIP OF LINE AND CUT-OFF RELAYS—REAR VIEW.

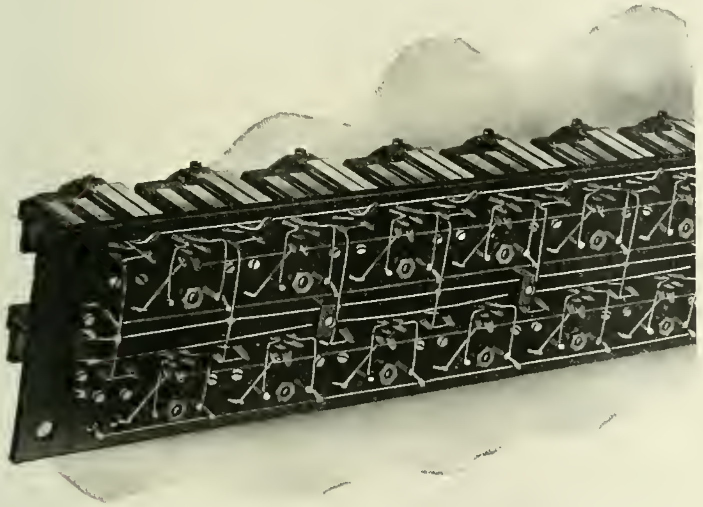


FIG. 14.—STRIP OF LINE AND CUT-OFF RELAYS—FRONT VIEW.

Coming now to the line signals themselves in this picture is shown a strip of drops (Fig. 15), these being mounted on ½-inch centers so as to correspond to the spacing of the jacks. These were used before the adoption of the line lamp signals by the Kellogg Company, a strip of which signals is shown in Fig. 16. This strip is formed from a single piece of hard rubber about 10 inches long and ½ inch thick. The lamps, one of which is shown in the front of the view, are so arranged as to slide into their sockets between the jack springs in such manner as to make the proper circuit connections. In front o each lamp is a little lens, usually of opalescent glass, this lens bein carried in a spun brass cap. The advantages of the line lamp signal over the old form of mechanical signal is obvious, the principal ones being the absolute freedom from complexity, cheapness, and the fact that they may be removed instantly if found defective and replaced by good ones. A defective line lamp may be taken out and another one substituted in less than one-half minute. Another beauty of the line lamp is that when it is out of order it may be thrown away, which is much easier than repairing a mechanical drop. These lamps usually operate at 20 or 24 volts, take about ¼ ampere, and give approximately 1/3 candle-power. The calculated life of these lamps, with their present degree of perfection and with the average rate of use, is about 30 years, but, of course, this figure remains to be verified by actual service, for unfortunately the telephone business is not yet old enough to prove the statement.

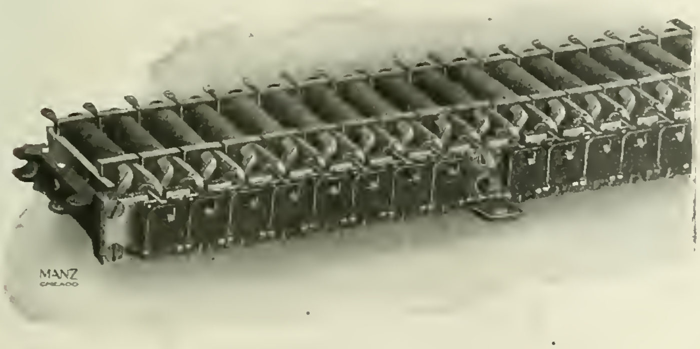


FIG. 15.—STRIP OF DROPS.

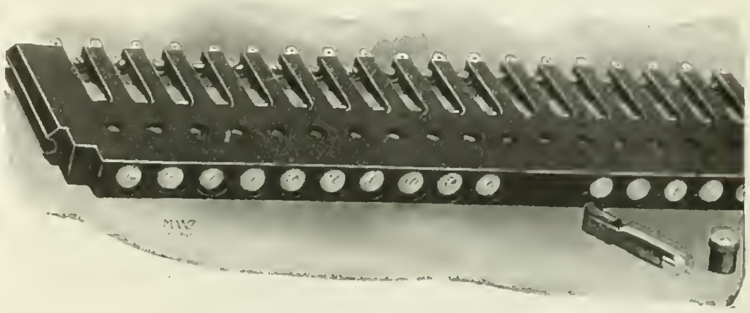


FIG. 16.—STRIP OF LAMPS.

In Fig. 17 is represented by all odds the most important piece of apparatus in a telephone exchange—the spring jack. This is a strip of the two-point jack already referred to, and it will be seen that they are mounted 20 to a strip on spaces corresponding to those of the lamp jack. The same jack is used for both answering and multiple. This strip is built up of hard rubber, brass and German silver, the front being a solid piece of hard rubber, slightly over 10 inches long, and drilled for receiving the sleeve contacts. The rear of the strip

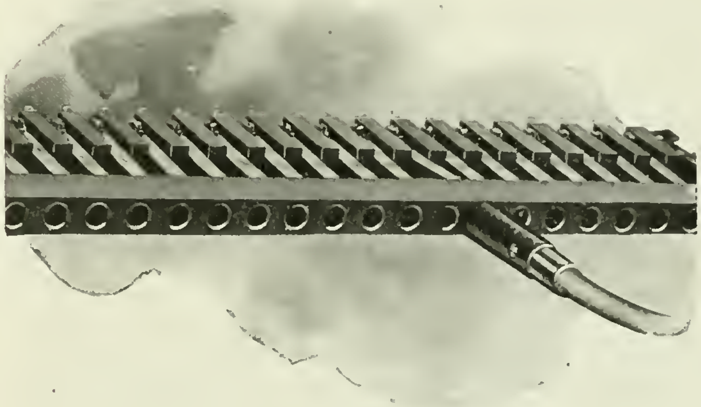


FIG. 17.—STRIP OF JACKS.

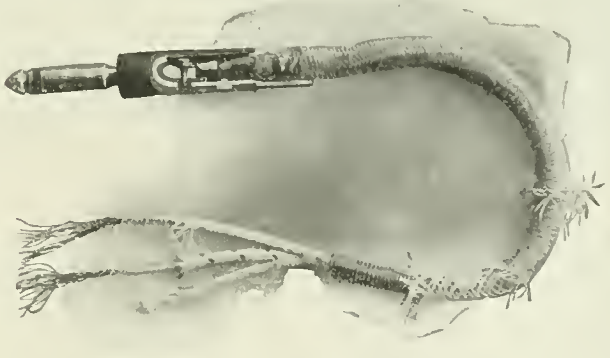


FIG. 18.—SECTION OF CORD AND PLUG.

is a piece of hard rubber milled to receive the line springs and the rearwardly projecting lugs from the sleeve contacts. This rear strip is reinforced by a heavy brass strip, into which the screws holding the line springs are threaded. In this particular strip the jacks are one ½-inch centers, the strip being 7/16 inch high. The spacing with this same construction is readily reduced to ⅜ inch. Where a smaller spacing than this is required, as in a board of extreme size, a somewhat different construction would be used.

Fig. 18. shows a cord and plug, the plug being cut away to expose the method of attaching the cord, the cord having its various layers removed to better show its construction. This plug has two contact points instead of three, as described in connection with Western Electric or Bell system. It will be noticed that the two strands of the cord are composed of twisted tinsel, over which a wrapping of floss silk and a braid of cotton are placed. Thus insulated, the two conductors are bound together by a wrapping of cotton, after which they are enclosed in a spiral of brass wire for protection. Over the spiral of wire are placed two layers of linen braiding throughout the entire length of the cord, and for about 10 inches back of the plug a third reinforcing layer is put on. These cords vary in length, according to the size of the multiple board, this length being anywhere from 36 inches up to nearly 100 inches.

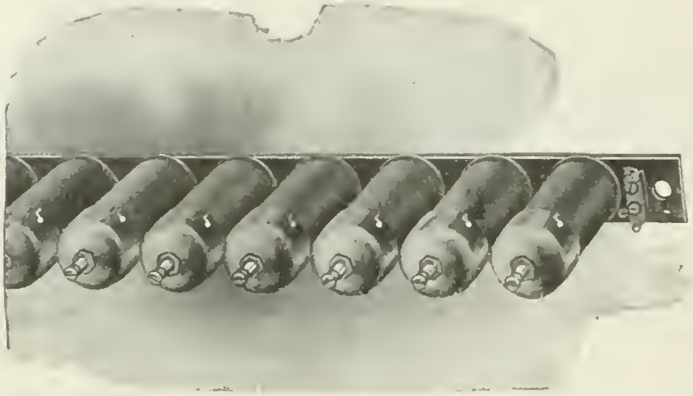


FIG. 18.—STRIP OF SUPERVISORY RELAYS.

The next view (Fig. 18) shows a strip of supervisory relays, these relays being the ones used in connection with the cord circuit for controlling the supervisory lamps. These are iron clad, being made in the same shell as is used for the cut-off relay. The armature, a disk of iron about 1¼ inches in diameter, is suspended in front of the poles of the electromagnet by a thin leaf spring. The working parts of the relay, including the armature and contact points, are enclosed in a brass cap, which cap locks on the shell with a bayonet joint.

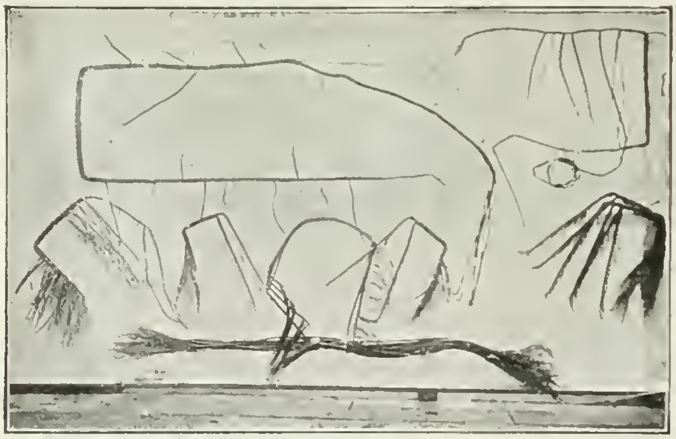


FIG. 19.—CABLES FANNED OUT.

The final cut (19) shows a few of the cables used in switchboard work, as they are formed up in the factory. Some of these are made from standard 21 and 41-pair cables in long lengths with their ends formed and laced to fit the particular portion of the switchboard for which they are required. Some of the other cables are formed by hand, exactly as shown, directly from the insulated wire, which is usually twisted in pairs. These cables, as you will see, remind one more of diagrams of nervous systems, sometimes seen in medical books, than anything else I can think of.

Central Stations and Automobiles.

The interest which local electric light companies are taking in the erection of charging stations in the large cities in the suburbs and even in the more remote localities connecting points popular for automobile touring is extending the radius of action for electric vehicles to many places which a couple of months ago it was impossible for this type of automobile to reach. In an electric vehicle one can now go from New York to Philadelphia, from Philadelphia to Atlantic City, from New York to Morristown, N. J., from New York to the popular resorts along the Jersey coasts as far as Spring Lake and to a score of other points of interest about New York. Charging stations are now being installed in the following places in New Jersey, near this city, where vehicles can be charged at a rate amounting to less than 1 cent per mile for power:

Newark, 27 Mechanic Street; Elizabeth, livery stable of John Keron & Son, Morris Avenue; Morristown, 39 Washington Street; Orange, 17 Railroad Place; Jersey City, 544 Communipaw Avenue; Hoboken, Bloomfield and Fourteenth Streets.

In a recent communication to the Electric Vehicle Company, W. H. Johnson, of the Philadelphia Electric Company, writes as follows: "The following automobile charging stations are being established: Station of the Germantown Electric Light Company, Aramat and Cumberland Streets, Germantown; Germantown Cricket Club, Germantown: Philadelphia Country Club, Chestnut Hill; Philadelphia Country Club, West Philadelphia. Others will be established from time to time as the sale of electric automobiles progresses, so that there will be no trouble whatever in getting automobiles charged in Philadelphia or its vicinity.'

This same company, which is interested in the Philadelphia charging stations, has recently purchased a Columbia runabout for the use of the superintendent for looking after the details of his work. Of this service Mr. Johnson writes as follows:

"I would state that our electrical engineer, Mr. W. C. L. Eglin, was enabled by means of his electric runabout to go over two circuits in the suburbs and only took two hours from the time he left the office until his return. It took fully two days by the other methods. You see at once the time saving factor to important men. Our intention is also to place this vehicle in the hands of all our superintendents and electrical people, so that they will become accustomed to the operation and handling of vehicles and be prepared intelligently to take care of this business when the boom hits us. Every electric lighting station in the country should be buying vehicles for just this purpose, as sooner or later they will be called upon by some disabled fellow for assistance, and should be in a position to handle the matter intelligently."

Police Telegraph Operators.

Mr. George McAneny, secretary of the Civil Service Reform Association, has sent a letter to Governor Odell, of New York, on behalf of that organization, asking him to withhold his signature from the bill relative to the status of telegraph operators in the Police Department of the city of New York. The letter says that under the existing law the police telegraph operators, 14 in number, have a permanent tenure in common with the members of the uniformed force, and are paid at the rate of $1,850 per annum. The bill proposes to add to section 276 of the Greater New York charter the words "the telegraph operators to rank as sergeants of police." The letter adds: "The effect of this would be, apparently, to incerase the salaries of the operators to $2,000 annually—the salary fixed for the rank of sergeant—and to give to them all other rights of sergeants, including the right to compete for promotion to captain. In the latter respect the bill clearly contravenes the purpose of the Civil Service law, for the reason that it would permit persons who have not been trained for police work—and who have not passed the physical and other examinations required to qualify them for the lower police grades—to compete for this high rank. While the number of cases in which it might be attempted to promote members of the telegraph force to captaincies might, for a while, be small, there can be no doubt that an opportunity would be offered for serious abuse in the future, for, whenever a police commissioner chose to circumvent the law, to get in men of his own choice as captains, who are not qualified physically or by police training, he might have them, after relatively brief training, qualify as telegraph operators, and subsequently advance them to position of command.

Heating of Electrical Machinery Under Two Regularly Alternating Conditions of Load.

By EDWIN RUST DOUGLAS.

WITH the multiplying applications of electric power, the problem of proper rating for an electric machine under regularly varying load becomes of much importance, for it will frequently happen that full output may be demanded for a brief time, while a considerable period of light load follows. It is well understood that, in these conditions, a smaller machine may be used than would be necessary if the heavy load were to be borne a larger part of the time, but the estimation of a machine's capacity under such circumstances is usually a matter of guesswork based on the memory of previous experiences.

The purpose of this article is to show that, from a knowledge of certain constants of a machine, its performance under any unusual conditions of load may be predicted with accuracy, and to explain the determination of those constants.

At the close of the mathematical analysis the formulæ derived will be collected for convenient reference, with sufficient explanation to make them independently intelligible.

While these formulæ, in their present shape, with their derivation, are here published for the first time, they were originally worked out, in slightly different form, for the use of the Crocker-Wheeler Company, and the substance of the latter conclusions was issued by them as a typewritten suppliment to their Bulletin No. 8. The confirmatory experiments referred to in this article were conducted in their laboratory.

Suppose the machine to alternate regularly between *two* conditions of speed, load, etc.,

Let s = time, considered as a variable,

s_1 = length of time, in minutes, through which each recurrence of the first condition endures.

s_2 = length of time through which each recurrence of the second condition endures.

t = temperature of the machine at any time, considered as a variable.

t_0 = temperature of the surrounding air or other cooling medium.

t_l = limiting temperature reached by the machine for a continuous run under the first condition.

t_l^1 = limiting temperature for a continuous run under the second condition.

c = specific heat of the machine.

q = heat generated per minute in the machine under the first condition.

q^1 = heat generated per minute under the second condition.

$\alpha\,(t - t_0)$ = loss of heat per minute under the first condition, proportional to the elevation of temperature above the surrounding air.

$\beta\,(t - t_0)$ = loss of heat per minute under the second condition.

Of course, either condition may be the one of greater load, etc., or one condition may be of no load, or even of absolute rest. In the latter case q^1 will be considered as becoming 0, and this is the case most likely to be met in practice, but the general proposition will be considered first.

Under the first condition the temperature rises at the rate

$\frac{q - \alpha\,(t - t_0)}{c}$ degs. per minute.

Now, $q = \alpha\,(t_l - t_0)$. Therefore, the rate of rise becomes

$$\frac{dt}{ds} = \frac{\alpha}{c}\,(t_l - t)$$

Integrating,

$$s = \frac{c}{\alpha}\int_{t_0}^{t}\frac{dt}{t_l - t} = -\frac{c}{\alpha}\,.\ \text{hyp log}\ \frac{t_l - t}{t_l - t_0}$$

Whence

$$t_l - t = (t_l - t_0)\,.\,\varepsilon^{-s\frac{\alpha}{c}} \qquad (1)$$

Now, at the end of the first condition in the first cycle

$s = s_1$ and let $t = t_1$

Put

$$A = \varepsilon^{s_1\frac{\alpha}{c}} \qquad (2)$$

Then at that time the temperature is

$$t_1 = t_l - (t_l - t_0)\,\frac{1}{A}$$

At the time $s = s_1$ the second condition ensues and the rate of rise of temperature becomes

$$\frac{dt}{ds} = \frac{\beta}{c}\,(t_l^1 - t)$$

Integrating,

$$s - s_1 = \frac{c}{\beta}\int_{t_1}^{t}\frac{dt}{t_l^1 - t} = -\frac{c}{\beta}\,.\ \text{hyp log}\ \frac{t_l^1 - t}{t_l^1 - t_1} \qquad (3)$$

$$t_l^1 - t = (t_l^1 - t_1)\,.\,\varepsilon^{-(s - s_1)\frac{\beta}{c}}$$

Now, at the end of the first cycle $s = s_1 + s_2$ and let $t = t_1^1$

Put

$$B = \varepsilon^{s_2\frac{\beta}{c}} \qquad (4)$$

Then

$$t_1^1 = t_l^1 - (t_l^1 - t_1)\,\frac{1}{B}$$

Or, substituting the value of t_1,

$$t_1^1 = t_l^1 + (t_l - t_l^1)\,\frac{1}{B} - (t_l - t_0)\,\frac{1}{A\,B}$$

When $s = s_1 + s_2$ the first condition re-ensues. As before,

$$s - (s_1 + s_2) = -\frac{c}{\alpha}\,.\ \text{hyp log}\ \frac{t_l - t}{t_l - t_1^1} \qquad (5)$$

When $s = 2s_1 + s_2$ let $t = t_2$

$$t_2 = t_l - (t_l - t_1^1)\,\frac{1}{A}$$

Substituting the value of t_1^1

$$t_2 = t_l - (t_l - t_l^1)\left(\frac{1}{A} - \frac{1}{A\,B}\right) - (t_l - t_0)\,\frac{1}{A^2\,B}$$

When $s = 2s_1 + s_2$ the second condition re-ensues. As before,

$$s - (2\,s_1 + s_2) = -\frac{c}{\beta}\,.\ \text{hyp log}\ \frac{t_l^1 - t}{t_l^1 - t_2}$$

At the end of the second cycle $s = 2\,(s_1 + s_2)$ and let $t = t_2^1$

$$t_2^1 = t_l^1 - (t_l^1 - t_2)\,\frac{1}{B}$$

Substituting the value of t_2

$$t_2^1 = t_l^1 + (t_l - t_l^1)\left(\frac{1}{B} - \frac{1}{A\,B} + \frac{1}{A\,B^2}\right) - (t_l - t_0)\,\frac{1}{A^2\,B^2}$$

It will be unnecessary to carry the formation of values of t and t_1 farther, as the law of the series becomes apparent. The general terms evidently are

$$t_n = t_l - (t_l - t_l^1)\left(\frac{1}{A} - \frac{1}{A\,B} + \frac{1}{A^2B} - \frac{1}{A^2\,B^2} + \ldots\right.$$
$$\left.\ldots + \frac{1}{A^{n-1}\,B^{n-2}} - \frac{1}{A^{n-1}\,B^{n-1}}\right) - (t_l - t_0)\,\frac{1}{A^n\,B^{n-1}} \qquad (6)$$

and

$$t_n^1 = t_l^1 + (t_l - t_l^1)\left(\frac{1}{B} - \frac{1}{A\,B} + \frac{1}{A\,B^2} - \frac{1}{A^2\,B^2} + \ldots\right.$$
$$\left. - \frac{1}{A^{n-1}\,B^{n-1}} + \frac{1}{A^{n-1}\,B^n}\right) - (t_l - t_0)\,\frac{1}{A^n\,B^n} \qquad (7)$$

The former is the temperature attained at the end of the first condition of the *n*th cycle. The latter is the temperature at the end of the *n*th cycle.

These series may be summed. For the former,

$$\frac{1}{A} - \frac{1}{A\,B} + \frac{1}{A^2B} - \frac{1}{A^2B^2} + \ldots + \frac{1}{A^{n-1}\,B^{n-2}} - \frac{1}{A^{n-1}\,B^{n-1}}$$

$$= (B - 1)\left(\frac{1}{A\,B} + \frac{1}{A^2B^2} + \frac{1}{A^3B^3} - \ldots + \frac{1}{A^{n-1}\,B^{n-1}}\right)$$

$$t_n = t_l - (t_l - t_l^1)(B-1)\sum_{j=1}^{j=n}\frac{1}{A^j B^j} - (t_l - t_0)\frac{1}{A^n B^{n-1}} \qquad (8)$$

Now let n increase indefinitely

$$\underset{n=\infty}{L}\sum_{1}^{n}\frac{1}{A^j B^j} = \frac{1}{AB-1}$$

and

$$\underset{n=\infty}{L}\; t_n = t_m$$, the maximum value t_n can reach. Also

$$\underset{n=\infty}{L}\frac{1}{A^n B^{n-1}} = \underset{n=\infty}{L}\left(\varepsilon^{-n s_1 \frac{\alpha}{c}} \cdot \varepsilon^{-(n-1) s_2 \frac{\beta}{c}}\right) = 0$$

Therefore

$$t_m = t_l - (t_l - t_l^1)\frac{B-1}{AB-1} \qquad (9)$$

In a similar manner

$$t_n^1 = t_l^1 + (t_l - t_l^1)(A-1)\sum_{1}^{n}\frac{1}{A^j B^j} - (t_l^1 - t_0)\frac{1}{A^n B^n} \qquad (10)$$

$$t_m^1 = t_l^1 + (t_l - t_l^1)\frac{A-1}{AB-1} \qquad (11)$$

The series in equations (8) and (10) converge for all values of AB greater than 1, and since $AB = \varepsilon^{s_1 \frac{\alpha}{c} + s_2 \frac{\beta}{c}}$ it must always be greater than 1.

If, however, it be desired to shorten the periodic time $(s_1 + s_2)$, the ratio $\frac{s_1}{s_2}$ remaining constant, and n increasing so that the total time elapsed, $n(s_1 + s_2)$ is unchanged, there enters a question of double limits and convergence. The steps in the analytical consideration of this question will be omitted here, and merely the result given which is expressed by the equations

$$t_i = \frac{t_l \frac{k}{100-k} \cdot \frac{\alpha}{\beta} + t_l^1}{\frac{k}{100-k} \cdot \frac{\alpha}{\beta} + 1} \qquad (12)$$

and $$(t_i - t_s) = (t_i - t_0)\,\varepsilon^{-\gamma_n} \qquad (13)$$

where

t_i = limiting temperature after a long run under these conditions.

t_s = temperature at s minutes from the start.

k = per cent of time during which the first condition lasts, or

$$\frac{k}{100} = \frac{s_1}{s_1 + s_2}$$

and where $$\gamma_n = \frac{1}{100}\left[k\frac{\alpha}{c} + (100-k)\frac{\beta}{c}\right]s \qquad (14)$$

This expression is of exactly the same form as (1), showing what might also have been apprehended, that the curve approached when the alternations of load become rapid is of the same class as that for continuous load of one character.

We now have, in equations, (8), (9), (10), (11), (12) and (13), the means of finding the temperatures reached under any disposition of two regularly alternating conditions of load after any number of alternations.

In these equations there are involved the quantities A, B, α, β, γ, and c, with t_0, t_l, and t_l^1.

The latter three are easily found by direct experiment. To determine the former proceed as follows:

If starting with the machine at any temperature t_a and running a time s_a under the first condition, the temperature rises to t_a^1, then by (5)

$$s_a = -\frac{c}{\alpha} \cdot \text{hyp log}\,\frac{t_l - t_a^1}{t_l - t_a}$$

$$\frac{\alpha}{c} = \frac{1}{s_a} \cdot \text{hyp log}\,\frac{t_l - t_a}{t_l - t_a^1} \qquad (15)$$

Also if starting with the machine at any temperature t_b and running a time s_b under the second condition of load, the temperature rises (or falls) to t_b^1, then by (3)

$$s_b = -\frac{c}{\beta} \cdot \text{hyp log}\,\frac{t_l^1 - t_b^1}{t_l^1 - t_b}$$

$$\frac{\beta}{c} = \frac{1}{s_b} \cdot \text{hyp log}\,\frac{t_l^1 - t_b}{t_l^1 - t_b^1} \qquad (16)$$

A, B, and γ_n being found by (2), (4) and (14), the values of t_n, t_m, t_n^1, t_m^1, t_s and t_i are completely defined.

There is also a shorter method of finding the expression $\frac{\alpha}{\beta}$ From (15) and (16) we have

$$\frac{\alpha}{\beta} = \frac{s_b}{s_a} \cdot \frac{\text{hyp log}\,\frac{t_l - t_a}{t_l - t_a^1}}{\text{hyp log}\,\frac{t_l^1 - t_b}{t_l^1 - t_b^1}}$$

If then, we make $t_a = t_l^1$, $t_b = t_l$, and $t_b^1 - t_l^1 = t_l - t_a^1$, which may readily be done in experiment, and double the subscripts to distinguish these special values from those in the previous formulæ, the logarithms become equal and

$$\frac{\alpha}{\beta} = \frac{s_{bb}}{s_{aa}} \qquad (17)$$

DIRECTIONS FOR TESTS AND COMPUTATION.

By formulæ (1) to (5) it is evident that if t_l be the limiting temperature reached by a machine after a long run under any given condition of load, the curve of changing temperature during the run is an exponential one asymptotic to the value t_l. In Fig. 1 the full lines show the forms of such curves, starting at temperatures below and above t_l. The curve for cooling is of the same form as the curve for heating under that condition of load and asymptotic to the same value of temperature, but inverted.

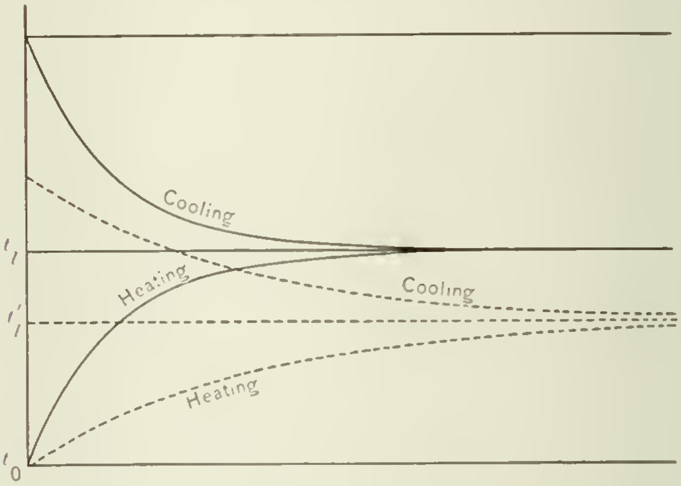


FIG. 1.—HEATING AND COOLING CURVES.

For a different condition of load t_l would be different, and the curves might be very different in proportions, as indicated by the dotted lines in Fig. 1.

Results of experiments made to determine the laws of heating and of cooling of machines agree very well with these theoretical curves, so that we may apply the theory to the investigation of more complex cases.

A machine run alternately under two or more conditions of load will heat or cool irregularly, its heating curve being made of fragments of the several complete curves belonging to those conditions. This is shown in Fig. 2, where the performance of a machine under two conditions of load is exhibited.

Here t_l and t_l^1 are the limiting temperatures under the first and second conditions, respectively. Curve 1 is the heating curve under the first condition, and curves 2, 2 are the heating and cooling curves for the second condition. The broken curve A is for 30 minutes under condition 1 and 15 minutes under condition 2, alternating regularly. Curve B is for 15 minutes under condition 1 alternating with 30 minutes under condition 2, leading to materially lower temperatures than with curve A. We will call $o\ a\ b$ the first cycle, $b\ c\ d$ the second cycle, and so on. Then $o\ a$ is the first condition of the first cycle, $c\ f$ the second condition of the third cycle, etc.

This will explain the nomenclature of the article.

In any cycle the machine rises or falls between two limiting temperatures, t_n and $t_n{}^1$, which vary from one cycle to another. After a great number of cycles the machine rises and falls continuously between two constant limiting temperatures, t_m and $t_m{}^1$.

If the alternations be rapid, the curve approaches to smoothness, as shown in Fig. 3. Here conditions 1 and 2 endure only 5 and 10 minutes, respectively, or one-third of the values for curve *B* (Fig. 2). A comparison of the two is instructive.

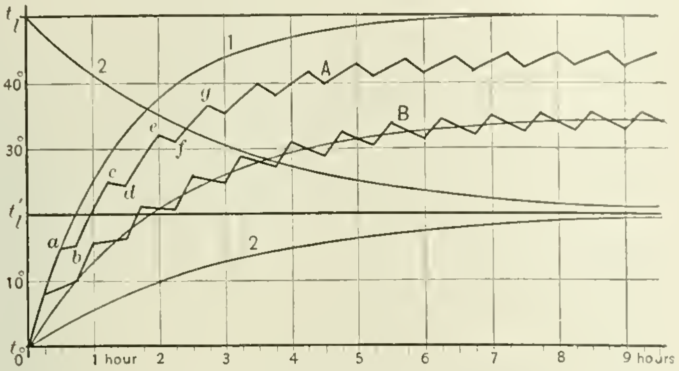


FIG. 2.—COMPOSITE HEATING CURVES.

The amount of rise and fall being so small, it may be sufficient to determine a mean curve running between the limiting temperatures. This mean curve is of the same exponential character as those for continuous heating or cooling, but is asymptotic to a limiting temperature between those of its component curves.

The application of these formulæ is simple. It is quite feasible to determine, by experiment on any machine, a set of constants for that machine, one for each of a number of conditions of load, as for absolute rest, running free, quarter, half, full load, etc., from which, at any future time, its performance under any regularly recurring combination of those conditions may be determined.

Thus, to determine the constant for any condition:

First.—Starting with the machine at any temperature t_a — which may preferably equal the room temperature, but must not be very near to t_l as found by the next test—run it under that condition of load for any convenient length of time s_a, as 30 minutes and immediately note its temperature $t_a{}^1$.

Second.—Run the machine continuously under that condition of load for several hours, or until stationary temperature is reached. Note this limiting temperature t_l.

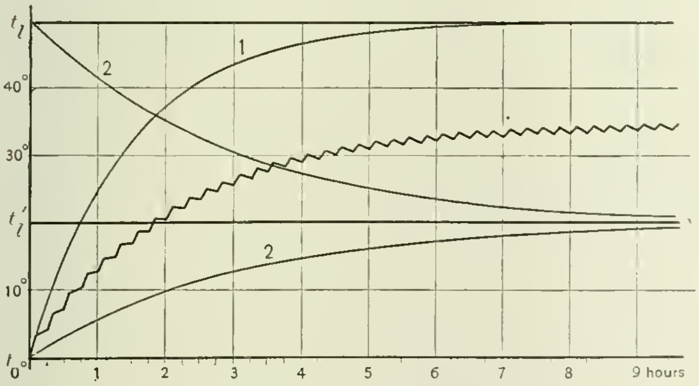


FIG. 3.—COMPOSITE HEATING CURVES.

The temperature of the surrounding air must remain practically constant through these two tests. Find

$$a = \frac{1}{s_a} \text{ com log } \frac{t_l - t_a}{t_l - t_a{}^1} \tag{18}$$

Note.—The a *of this formula equals* $\frac{a}{c}$ *of formula* (15) *multiplied by* 0.4343, *the modulus of the common system of logarithms.*

In like manner, for other conditions of load, we may find

$$b = \frac{1}{s_b} \text{ com log } \frac{t_l{}^1 - t_b}{t_l{}^1 - t_b{}^1} \tag{19}$$

....

$$x = \frac{1}{s_x} \text{ com log } \frac{t_l{}^{(h)} - t_x}{t_l{}^{(h)} - t_x{}^1}$$

where $t_l{}^{(h)}$ represents the limiting temperature for continuous run under that condition of load.

These constants, a, b, . . . x, are properties of the machine.

To apply them, first, to the CASE OF SLOW ALTERNATION between two conditions of load, as with a period of five minutes or more, suppose the machine to run alternately a time s_1 minutes under the first condition and s_2 under the second condition. Starting at an air temperature t_0, required the temperature the machine will reach after any given number of alternations, and also its limiting temperatures after a long run.

$$\text{Find } A \text{ such that com log } A = a \,.\, s_1 \tag{20}$$

$$\text{and } B \text{ such that com log } B = b \,.\, s_2 \tag{21}$$

Then the temperature of the machine at the end of the *n*th occurrence of condition 1 will be, by (8),

$$t_n = t_l - (t_l - t_l{}^1)(B - 1)\left[\frac{1}{A\ B} + \frac{1}{A^2 B^2} + \frac{1}{A^3 B^3} + \dots + \frac{1}{A^n\ B^n}\right] - (t_l - t_0)\frac{1}{A^n\ B^{n-1}} \tag{22}$$

The temperature at the end of the *n*th occurrence of condition 2 will be, by (10),

$$t_n{}^1 = t_l{}^1 + (t_l - t_l{}^1)(A - 1)\left[\frac{1}{A\ B} + \frac{1}{A^2 B^2} + \frac{1}{A^3 B^3} + \dots + \frac{1}{A^n\ B^n}\right] - (t_l{}^1 - t_0)\frac{1}{A^n\ B^n} \tag{23}$$

The limiting temperatures after a long run will be, by (9), at the end of any recurrence of the first condition.

$$t_m = t_l - (t_l - t_l{}^1)\ \frac{B - 1}{A\ B - 1} \tag{24}$$

At the end of any recurrence of the second condition, by (11),

$$t_m{}^1 = t_l{}^1 + (t_l - t_l{}^1)\ \frac{A - 1}{A\ B - 1} \tag{25}$$

CASE OF RAPID ALTERNATIONS.

If the period be less than four or five minutes the composite heating and cooling curve approximates to smoothness.

Suppose the first condition of load to be on for *k* per cent of the time, the second condition for (100 — *k*) per cent, alternating regularly, then $\frac{k}{100}$ corresponds to $\frac{s_1}{s_1 + s_2}$ of the previous case.

The limiting temperature after a long run will be, by (12),

$$t_i = \frac{t_l \dfrac{k}{100 - k} \cdot \dfrac{a}{b} + t_l{}^1}{\dfrac{k}{100 - k} \cdot \dfrac{a}{b} + 1} \tag{26}$$

To find the temperature at any length of time, *s* minutes, after starting find *F* such that

$$\text{com log } F = \frac{s}{100}\,[a \,.\, k + b\,(100 - k)]$$

Then the temperature at the time *s* is, by (13),

$$t_s = t_i - \frac{t_i - t_0}{F} \tag{27}$$

where t_i is found by (26).

These two formulæ, which are approximate, become more nearly correct as the alternations of load become more rapid.

PARTICULAR CASE.—PARTIAL TEST.

In case the value t_i is the only one desired, the value $\frac{a}{b}$ in (26) may sometimes be found more simply than by the method given above. The test then becomes

First.—The temperature of the air being t_0, run the machine under the *second* condition of load until a stationary temperature $t_l{}^1$ reached. Of course, if the second condition is one of rest, $t_l{}^1 = t_0$ and this part of the test need not be taken.

Second.—With the temperature of the machine at $t_l{}^1$, change to the first condition of load and run any convenient length of time.

s_{aa}, as 30 minutes, noting the final temperature of the machine t_a^1.

Third.—Run under the *first* condition of load until a stationary temperature t_l is reached.

Fourth.—With the temperature of the machine at t_l, change to the second condition of load and run *until the temperature has risen or fallen by the amount* $t_a^1 - t_l^1$ *already found.* Note the *time* required, s_{bb}. Then the temperature after a long run will be

$$t_1 = t_l - \frac{t_l - t_l^1}{\frac{k}{100 - k} \cdot \frac{s_{bb}}{s_{aa}} + 1} \qquad (28)$$

This short cut can be taken only when the conditions are such that a continuous watch can be kept on the changing temperature in the fourth part of the test, as when the test is on some stationary part, or when condition 2 is one of rest.

Wireless Telegraphy in the Army.

The extraordinary demands made upon the Signal Corps of the United States Army during the Spanish-American War have given such a lively impetus to this important branch of our military organization that the results will no doubt be permanent in their effect, and of the greatest value to the army. Extensive as were the augmentations and operations of other corps of the army in the war, yet none was increased to such an extent as the Signal Corps, which was enlarged more than twenty-fold—from 60 officers and men to over 1300. And even this increase was scarcely sufficient to meet the incessant demands made by military commanders for communication by telegraph and telephone.

WIRELESS TELEGRAPHY IN THE ARMY.

In order to obtain some idea of the great variety of duties and responsibilities of the Signal Corps, it may be well to classify the work under four heads, viz.: Signal Corps instruction, military telegraph lines, supply depots and electrical installations for the control of artillery fire.

It is connected with the second head, the transmission of intelligence, that the officers of the Corps have particularly distinguished themselves in the design of signaling apparatus, comprising the various forms of telegraphic and telephone outfits, and portable saerchlights. Apparatus for army use, besides being portable must be delicate and certain in their operation and still be sufficiently substantial to withstand the rough usage to which they are frequently subjected.

Articles have appeared from time to time in these columns describing and illustrating the numerous electrical devices in use by our army and navy, but little has been written about the details of the various signaling devices which have been developed by military officers, many of whom are well known to the electrical fraternity. Among these might be mentioned Captain A. B. Dyer, Major Greene, Lieutenant-Colonel James Allen, Captain George O. Squier and Captain Samuel Reber, all of whom worked under the general supervision of the chief signal officer of the army, General A. W. Greeley.

The work to which we wish to make special reference this week is the experiments in wireless telegraphy conducted by Signal Corps officers, and the success achieved by them. The Signal Corps has perfected its own system, and it is of interest to record that this system was the first one ever successfully operated in the United States. Prior to Marconi's extensive work for the *New York Herald* the Signal Corps on Sept. 30, 1899, had operated its own system successfully between Fire Island and Fire Island lightship, a distance of about 10 miles. In April, 1900, it opened two stations in New York Harbor, where messages were passed daily to and fro between Governor's Island and Fort Hamilton. This work was originally undertaken by Lieutenant-Colonel James Allen and Captain George O. Squier, and later passed to the hands of Captain Samuel Reber, signal officer, who, with the assistance of Mr. Carl Kinsley, has made many improvements which reflect credit both upon Captain Reber and Mr. Kinsley. As an outcome there have been established and are now in successful operation two stations in San Francisco Harbor, one at Fort Mason and another at Fort Alcatraz, thus covering parts of the San Francisco Harbor over which it has been impossible to successfully maintain cables, owing to its use as an anchorage ground and the entanglement of anchors with the cables. In addition to these installations six complete outfits have been shipped to the Philippines, where they have been in satisfactory operation between military posts and vessels along the coast.

The accompanying illustration shows the exterior of the station on Governor's Island. The pole which is shown in the picture is 150 ft. above the ground, and is built up from wooden planks, the pieces being staggered and bolted together. The pole is securely guyed at three places. The pole at Fort Wadsworth, 7 miles away, is only 90 ft. in height. The transmitting and receiving wireless telegraphy apparatus developed by the Signal Corps was described is our issue of April 20, in the report of the Institute Conversazione, at which the apparatus formed one of the most interesting of the many exhibits.

Developments in Lead Interests.

Attention has been called in these columns recently to developments in lead mining and reduction and their possible relation to storage battery interests. It is now announced that the capital stock of the Union Lead & Oil Company, which was recently incorporated in New Jersey at $15,000,000, is to be increased to $50,000,000, and that the capitalists who are behind this company are arranging a combination of all the Missouri lead properties. The Whitney-Ryan syndicate is understood to be the moving spirit in these operations, which have already penetrated into the fields now occupied by both the Lead Trust and the Smelting Trust. The original purchase of the Whitney-Ryan group of capitalists in investing in lead mines was to obtain a supply of lead for the Electric Storage Battery Company at Philadelphia. But it has been a developing affair, and the mineral lands purchased by the syndicate form a comparatively small area in the heart of the old lead district, following the reports of their experts, and the ore locations fixed by their engineers have been made to include nearly 7000 acres.

The white lead now manufactured by the Lead Trust has been extracted chiefly from silver and copper ores. The Missouri ores are found in limestone and are not accompanied by other minerals, and the statement is made that the consolidation of the Missouri properties will be promptly followed by the erection of four great concentrating plants on the Big River, which are to be connected by railroad with St. Louis. The intervening distance is only about 60 miles.

New processes of extracting the lead from the ores and converting the product into white lead are also announced. The new extracting process is accomplished by electricity. It is developed by the Electric Storage Battery Company. The Big River is relied upon to supply water for furnishing electricity and dams for the control of the water are now being located.

It is said that 500,000,000 tons of metallic lead have been laid bare by the engineers who have been sent to the Missouri lead fields within the last year. More than 20 per cent of the pig lead produced in the United States is understood to come from the Missouri fields.

Death of Mr. John C. Henry.

THE LATE J. C. HENRY.

We regret to note the death in Denver, Colo., of Mr. J. C. Henry, the well-known electric railway inventor and pioneer. For some years past, Mr. Henry, owing to the delicate condition of his lungs, has been compelled to live in Colorado, and when he was last in New York City some months ago he took rather gloomy views as to the chances for his longevity. The sad news is not, therefore, a surprise to his many friends in this section of the country.

Mr. Henry began his electrical career, like so many other well-known men, in the field of telegraphy, but was of an observing and inventive turn of mind, and very early became interested in the subject of traction. About seventeen years ago, when he was in Kansas City, the late Judge W. J. Henry desired to connect Kansas City with Independence, about 10 miles away, and undertook to equip the road electrically, employing plans and devices which young Henry had been bringing to his notice. There is no doubt that Mr. Henry at that time applied ideas which were afterwards destined to become well-known in the art and standard. His plan was to suspend the conductor by span wires supported at each side of the road, leaving the under side of the wire free so that a traveling contact could be maintained with it. His first contact of this character was a little four-wheel carriage which gripped and ran along the under side of the wire, and which was connected with the motor car by means of a flexible cable. Mr. Henry used to claim that the word "trolley," as applied to overhead roads, originated on his Westport section. It was first called a "troller," but this was changed to "trolley" by the employees or public. The car used by Mr. Henry was open, with seats back to back, facing opposite, and it was equipped with a Van Depoele generator used as a motor and developing about 5 horsepower. It was mounted in an iron frame, with variable speed-changing gear, and was supported at one end on the car axles, engaging with the gearing thereon. The motor was series wound and regulated by resistance. The track rails weighed only 12 lbs. to the yard.

In 1885 Mr. Henry repeated his experiments with heavier machinery on some steam railway tracks at Kansas City owned by the Fort Scott & Gulf Railway Company. A little later he equipped the East Fifth Street Railway in Kansas City with four motor cars, each of which had a single 25-hp motor attached to one axle, projecting up through the car, with its working parts in view of the motorman. The motor was connected to the axle by a planetary gear, and the car was operated by two vertical levers, one to apply the regular friction wheel brakes and the other to connect or disconnect the motor from the car. The motor, whose armature ran constantly, and was 18 inches in diameter, built up of laminated iron with Pacinotti projections, was a slow-speed machine. The fields were wound with a multiplicity of small parallel wires bunched together permanently at one end, the free ends terminating in switch contacts so that the resistance of the fields might be varied and the motors regulated without resistance. The potential of the system was fixed at 500 volts, this being deemed safe for all concerned.

After these demonstrations, Mr. Henry, whose work was beginning to attract considerable attention, undertook to build several roads in Southern California, for which all the machinery was built at Kansas City. Although the apparatus was crude, it served its purpose for several years, and the roads, now with later equipments, have become part of the standard trolley systems in their respective localities.

Mr. Henry has stated that on his early motors he employed carbon brushes, but abandoned their use in favor of a comb brush, which worked very well on the rough commutators of those days. The commutators were insulated with fibre, which would not remain solid, so that the carbon brushes chipped and splintered easily.

After this Western work, during which his health broke down, Mr. Henry came on to New York City to take a share in the important electric railway litigations then going forward; and as the result of the money paid him for some of his earlier inventions he was able to establish himself very comfortably at Westfield, N. J. There he turned his attention again to the development of various ingenious inventions and plans for the improvement of trolley systems, but in 1894 his health again failed and he was obliged to remove to Denver. There, with unabated energy, he had been giving his attention to the equipment of standard steam railway systems with electricity, and the perfection of a regenerating controller for use both on trolley cars and electric automobiles. This device has been tried with very satisfactory results, both in Pittsburg and in New York City.

A list of Mr. Henry's inventions, which we happen to have before us, shows 63 patents issued to him from 1886 to 1900. He also had three patents pending, and seven more patents were being prepared for filing at the time of his death by his friend and legal representative, Mr. T. A. Noble. The inventive work of Mr. Henry began as far back as his connection with the Union Pacific Railway Company as one of its electricians, dating from 1869 and lasting 10 years. While there he brought out many valuable improvements, one of which was the Henry velocimeter, afterwards modified by his assistant, Mr. Boyer, into the celebrated speed recorder of that name. Outside of traction, Mr. Henry did little inventing, that subject engrossing his thoughts.

Mr. Henry was only 53 years old, and was born at Woodstock, Ont. His son, who has been brought up in the telegraphic field, inherits a good deal of his father's talent, and has been quite a frequent contributor to the Western press with stories and articles relative to telegraphic and railroad work.

Another Large Independent Exchange for Detroit.

The People's Telephone Company, of the city of Detroit, Mich., has let contracts for the construction of its exchange and contemplates the erection and equipment of the largest single multiple switchboard and central office equipment ever installed in the United States. This contract was awarded to the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The initial switchboard equipment calls for a switchboard to have a capacity for 14,400 subscribers' lines of the multiple lamp line signal central energy type, equipped for the immediate operation of 6000 subscribers' lines, with complete power, battery and ringing equipment in duplicate, with a capacity sufficient for the complete operation of the full ultimate capacity of the switchboard, and 6000 telephones. The bid is said to have been the highest made. The Stromberg-Carlson system is already in use in Rochester, N. Y.; St. Paul and Minneapolis, Minn.; Boston, Mass.; Youngstown and Akron, Ohio; Camden, N. J.; Duluth, Minn.; Waco and San Antonio, Texas; Lexington, Ky.; Wheeling, W. Va., and a great many other smaller cities in the United States. "We placed our order just in time," says Manager Ware, "to get in ahead of Philadelphia and other Eastern and Southern cities, where new telephone companies are figuring with the Stromberg-Carlson people. In fact, we hurried our order to be sure of having our work done first."

The installation date specified in the contract is Feb. 1, 1902. The People's Telephone Company, after a careful search for adequate headquarters, decided that it could only obtain what it wished by buying a site and erecting an exchange building, and accordingly has puchased a lot 80 by 90 ft., located on the southwest corner of Park and Elizabeth Streets. This company's engineers have figured out that this site is within 200 ft. of the telephone center of the city. The building will be six stories in height, modern in construction, and especially designed for use as a telephone exchange. This building is favorably situated, so that it will receive light from the north and east sides, and afford excellent opportunities of bringing the very large and complex conduit system into the building without conflict with the existing conduit systems of other companies. The engineering problem for the installation of such a large system has been very creditably worked out by their consulting engineer, Mr. Max Reber, of Cleveland, Ohio, who has had varied experience in the construction and operation of some of the largest exchanges in the United States.

The underground material will be supplied by the Standard Underground Cable Company, of Pittsburg. The work of underground construction will be commenced at once. The contracts for other materials have not yet been awarded.

A Public Accountant on Municipal Ownership.

At the recent annual meeting of the Illinois Association of Public Accountants, Mr. John Alex. Cooper read an interesting paper entitled "Municipal Ownership from a Public Accountant's Point of View." An abstract follows:

One of the most frequently advanced claims to the benefits to be derived from consolidation of industries or public service utilities, and the most potent argument in its favor, is that of economy. The promoter makes it his mainstay. He has the results neatly figured out and elaborated, until the layman is overborne by their weight, and it is in the preponderance and one-sidedness of such arguments that their effectiveness principally lies. No one can gainsay the points advanced. Nothing can be produced as precedents, and he were a bold investor that would essay a contention to efface the fulsome idealities of a promoter. Much has been attempted in this merging process in the past two years, and it would be an interesting study for the statistician to discover what percentage the gilded facts in retrospect bear to the golden prospects that were so plausibly presented at the start.

It is much the same state of facts that prevails in any argumentation upon the ever-recurring question of municipal ownership of such features of city life as pertain to the public service—light, heat, power, water, traction, telephone, etc. When citizens of any civic community of more or less influence become imbued with the idea that they can do much to benefit their city by agitating for municipal ownership, or any other form of political acquisitiveness, they are not only sure of a certain effective following, due largely to the infectious nature of the hobby, but also owing to the peculiarly isolated conditions surrounding the properties under consideration, they have the double advantage that arises from their own selection of illustrative examples, and from the natural reserve of individual or corporate vested interests upon the question of the net results of their operations.

In our principal cities organizations are being formed for the advancement of this proposition, and such leagues in their co-operative assistance to one another will, perforce, acquire a formidable strength. It therefore behooves the adverse side to not only concentrate their efforts towards combatting the propositions as they may appear, by discovering and arranging their facts and figures as to the physical points, to sustain the counter arguments in general, but also and more directly to the point, as touching the specific properties that the civic authorities may have engaged attention upon, place their affairs upon an uniform recording and accounting plan, that would enable those interested to know at all times their exact standing financially and statistically, and be prepared to exhibit under such uniform conditions the net economic results by direction of influences more favorable than any that could accrue from the variety of schemes of the advocates of municipal ownership. Not only would each property be prepared to meet the discussion fairly and frankly upon its own ground, instead of going far afield, but would also be enabled to at any time compare results with cities of like size, situation and circumstance, to the benefit of the industry.

Municipal ownership, as a theory or as a pet project for political aspiration, will be a perennial plant attracting the zealous study of its advocates more and more as years advance, and as this country acquires prosperity at the rapid rate that has been its fortune in the past few years. What are its opponents doing to meet it? What study is being given to the comparative advantages of private ownership over bureaucracy? Nothing is being done, comparatively nothing. There is no counter league, no cohesion, or association for consideration of the question in all its breadth, and owing to this and the lack of system and want of method in practice, as well as the heterogeneous ways of determining operative results, these industries are most seriously handicapped in every practical way.

Not merely that, there is not the limit of the mischief; for it must be realized by all, both for and against the proposition, that this condition is the most powerful assistant to the purposes of these leagues that could be wished for by them. In this way—assuming that 50 per centum of such public utilities are non-dividend paying (and this is merely for illustration), the owners having no alternative and no data with which to determine the prospects and deficiencies in comparison with like plants, are only too ready in their dissatisfaction to welcome and vote in favor of the "manna from heaven" offered them by the civic authorities in the return of their invested funds.

Is it not, therefore, the part of prudence to be able to localize your argument, so to express it? Instead of amassing statistics, basing arguments and citing instances of other cities, more or less remote and inaccessible, and therefore of feeble argumentative weight, marshal the points and contentions from the returns and statistics of the plant in question, supporting the data by the books themselves, which would be thrown open for the inspection of the advocates and tax-paying community.

It will avail little not to recognize the obvious right of the community to periodical inspection and returns from the books of corporations who are favored with public franchises. We have just seen an instance of this in the United States Supreme Court decision in the case of the Rogers Park Water Works. Acounting and statistical data are more or less effective in proportion to the consideration and method of presentation. If the records conveniently and without laborious effort at the time place the essential material in form required for a series of years, say, four to eight, and the average returns for such period be the logical argumentative points, forcefully and briefly stated, it will rarely be found that the conservative and influential business element of any city will not at once perceive the hazardous nature of the risk proposed of placing such an investment at the service of political transient management, instead of allowing to the owners the modest profit that is their due.

No industry that has been developed within this century has effaced its initial capital by depreciation, or, to express it the other way, by the march of improvements, so rapidly as that of electric public service. Are tax-payers ready to go down into their pockets again and again every time some radical improvement is forced to their notice? the question of merit or expediency being biased by ward exigencies; or, on the other hand, tolerate and be content with the ultra-conservatism that is to-day the greatest drawback that those British cities have to contend with. Would those cities be using horse cars to-day were the franchises owned by commercial investors? Or would Kansas City be at the enormous expense of converting their cable system into electric trolleys were the plants municipally controlled?

Follow this fad, this theoretical folly, to its logical optimistic extreme, and who shall say where the line is to be drawn? And what do we find as the inevitable result? Socialistic apathy and all its attendant evils; the feeding of the wolves at the expense of the industrious bees; the possible absorption of private enterprise in a number of channels, for it only needs the application of the same principles that these advocates advance to see how paving brick, sewer pipe, cement, bridge works, telephone, hotels, hacks, express and transfer service may come to be embraced in the same general category of public utilities. Where should it stop? Who can say?

It makes no difference whether the city authorities acquire the plants by direct purchase or build others with the people's funds. The effect is the same. Where is the gain for a city to acquire all public utilities and thereby reduce its self-supporting constituency, either by political employment or through the burdens of increased taxation?

By way of diversion, the answer can be found in an actual incident. A newly installed park board required an audit of the park accounts, which revealed that although the bond sinking fund had been provided for and regularly paid into the treasury for years by the County Treasurer, there were neither funds nor securities then on hand to show for it. Upon the question being raised at the board meeting the subject was referred to posterity! About the same time electioneering marching clubs being in vogue, every park employee, nolens volens, upon a certain evening swelled the ranks to the loss from the park assets of two spools of copper cable, a squirrel hutch and its lively contents.

The most effective remedy with which to overcome this too constant element in disturbance of corporate profits is in a modern, uniform, concise and economical system of accounting and office statistics, that will not only serve with the utmost promptness every reasonable requirement of the management ordinarily, and without being a burden upon the revenues, but will also be of such a broad, general form or plan as to be amendable to sub-division and reclassification for the especial edification of the staff and servants as occasion may demand, and also display their results sufficiently to meet any of the usual governmental reports.

Upon this question of governmental reports a word or two: By acceptance of a municipal franchise a corporation is obligated to certain statutory requirements, and the time is approaching when annual statements will be demanded by the authorities of most of the

States, somewhat as in Massachusetts to-day; hence a complacent port towards this change would be wise for two strong reasons—first, the files of reports, if arranged under proper preliminary guidance, would be most effective in neutralizing the apparently fair and fulsome examples presented by the advocates of civic management; and, secondly, from such State control the enterprise stands in a good position to demand that municipal competition be estopped.

New York Electrical Society.

Dr. W. E. Geyer, of the Stevens Institute of Technology, has kindly consented to deliver before the New York Electrical Society on May 16, at the College of the City of New York, a special lecture on "Inductance," which will prove of more than usual interest to the members. It will be entirely non-mathematical. The nature of inductance will be explained and illustrated by many striking experiments, the desired effects being made evident to the eye by using incandescent lamps as ammeters and voltmeters. The following are some of the points that will be illustrated: Choking effect, lag, inductance affected by form of circuit, circuit changing its form to make the inductance a maximum, energy stored in circuit, inductance balanced by capacity in series and in parallel. A special circuit will be run into the college to enable the doctor to make his experiments complete, and ladies will be made welcome upon this occasion as upon all others where illustrative demonstrations take place.

National Electric Light Association.

Mr. C. O. Baker, Jr., Master of Transportation, informs us that it has been thought best not to run a special train from New York to Niagara Falls for the convention of the National Electric Light Association, owing to the difficulty of concentrating the delegates, as many wish to be present at the opening exercises of the Pan-American Exposition, while others cannot leave their business until Monday. Arrangements have, therefore, been made with the New York Central & Hudson River Railroad to attach extra cars to their regular trains leaving Grand Central Station at 8.30 a. m. (Empire State Express), and at 8 p. m. (Pan-American Express), either Sunday or Monday. Certificates, entitling delegates to return at one-third regular fare, should be secured when purchasing tickets. Parlor car seats or berths can be secured by applying to Mr. C. Roach, general Eastern passenger agent, 1216 Broadway, New York. Railroad fare is $9.25 going and $3.10 returning. Berth in sleeper or chair in parlor car, $2.

In addition to the programme published in these pages last week we may add another paper by Mr. August Treadwell, Jr., on "Storage Batteries in Central Stations," and an additional topic, "Steam Heating from Central Stations." There are many indications of a lively interest and a large attendance at the convention.

Pan-American Exposition.

Professor G. F. Sever, superintendent of electrical exhibits at the Pan-American Exposition, informs us that Director-General Buchanan has designated Aug. 22 as Electrical Day at the Pan-American Exposition. This fits the time at which the American Institute of Electrical Engineers will be visiting the Exposition for its meeting, accompanied by a number of foreign electrical engineers, who are coming over this year, and it is believed that the occasion can be made one of unusual interest. It is also proposed to work up some special effects for that day which will have at once a technical and a spectacular value.

The official opening of the show postponed by the fierce snowstorms of the latter part of April will now take place on May 20, so that the Exposition will be open just in time for the Niagara convention of the National Electric Light Association; but it is said that 200,000 incandescent lights are already in operation. There was an intention to keep the show open to the public after May 1, but the cold was so intense in the unheated buildings, this was not feasible, and the interval has been availed of to clean up things generally around the grounds and buildings. Last year the Paris Exposition was opened under somewhat similar conditions too early, and it has been desired not to repeat that mistake.

The tests of the effects on the Electric Tower, electric fountains, etc., are reported to be very satisfactory, and the results promise to constitute one of the greatest attractions at the Exposition.

More Niagara Power.

It is officially announced by the Niagara Falls Power Company that it will at once proceed with the development of the power of the Horseshoe Falls under the charter of the Canadian Power Company, which it controls. The contract has been let to A. C. Douglass. The present plan of the company is to develop 35,000 horse-power. One-third of this will be used to operate an industrial establishment outside Victoria Park on the Canadian side. Another third is to be transmitted to Toronto, and the remaining third is to be held in reserve for the use of the Niagara Falls Power Company on the American side of the river. The two power houses of the company in Niagara Falls, N. Y., and the new power house on the Canadian side will be connected.

The plan for development calls for the construction of an inlet canal from Cedar Island to the power house site, where the wheel pit will be sunk, a tunnel carrying the water to the lower river below the Horseshoe Falls. This pit and tunnel will have a capacity of 100,000 horse-power. The Niagara Falls Power Company will finance the undertaking.

A Novelty in Theatre Lighting.

At the northern section of Blackwell's Island, N. Y., the Manhattan State Hospital, of Ward's Island, has an annex for the insane where recently it was decided to have an amateur minstrel entertainment and vaudeville, given by the employees of the hospital for the benefit of the inmates. There are no electric lights at Blackwell's Island, and as they were deemed essential to the success of the entertainment it was found necessary to wire the theatre with 70 16-cp incandescent lamps, which were connected to a main line of flexible wires leading to the dynamo of the steamboat "Wanderer" at the dock 400 ft. distant.

The lights on the boat were turned out to avoid an overload when the circuit was completed through the improvised main line stretched across the dock and lawn to the theatre. The affair was given Wednesday evening, May 1, and it proved to be a success in every particular. This interesting special piece of work was carried out by Mr. Edward Durant, chief electrical engineer of the hospital.

Development of Power at Rochester, N. Y.

The city of Rochester, N. Y., has long been noted for its electrical utilization of water-power, and we now understand from Mr. G. A. Redman that the last mill on Brown's race, known as the Whitney mill, has been transferred to the Rochester Gas & Electric Company. It is understood that the consideration was in the neighborhood of $18,000. The transfer involves also the transfer of three full water rights on the Genesee Falls on Brown's race to the Gas & Electric Company. The present machinery will be removed by the recent owners, as it was not included in the sale of the building and water rights. As soon as the milling machinery has been removed, the building will be fitted up as an electric power and light station. It will be equipped with generators, and its quota of current will be added to that of the six or seven other electric stations already owned and operated by the Rochester Gas & Electric Company in the different races in that city.

The Gas & Electric Company owns several other mill properties on Brown's race, as well as each of the other races, and it is not impossible that some of these also may be transformed into electric stations. The company is the owner of all of the water rights at the lower falls of the Genesee, and also of twenty-seven thirty-seconds of all of the rights on the middle falls of the Genesee. Plans have been perfected for the devlopment of the east side of the lower falls on a basis of 10,000 horse-power. This leaves the west side of the lower falls and by far the greater portion of the middle falls to be developed as called for by the exigencies of future requirements. In this connection it may be noted that the Gas & Electric Company will install a 1400-hp generator, directly connected to a 1400-hp turbine, and an 800-hp generator, directly connected to an 800-hp turbine, in the new brick station which has been constructed at the upper falls.

CURRENT NEWS AND NOTES.

NATIONAL MUNICIPAL LEAGUE.—The next meeting of the National Municipal League will be held in Rochester, N. Y., May 8, 9, 10.

LONG-DISTANCE TELEPHONE IN GERMANY.—Consul Warner, of Leipzig, notes that the long-distance telephone line connecting the cities of central Germany with Frankfort, Kalk, Mühlheim, Cassel and Wiesbaden, in the western part of the country, has been opened for use of the general public. The charge for using this line is 1 mark (23.8 cents) for every three minutes to any one of the above-mentioned places.

PARIS EXPOSITION HONORS.—The following decorations among others have been awarded by M. Georges Leygues, Minister of Public Instruction: Officers of Public Instruction, George Frederic Kunz, special agent to the American Commission; Louis De Goll Rowland, the agent of the telegraph company; Stephen D. Field, a delegate of the Washington Statue Commission; Robert Winthrop Blackwell, Lindon Wallace Bates and R. C. Batcheller, engineering. Officer of the Academy, James S. Anthony, electricity.

STREET RAILWAY IN GUATEMALA.—*El Gualtemalteco*, official organ of the Republic of Guatemala, publishes the contract entered into by the Government and Senor Don Ramiro Fernandez, in representation of the Urban Railway Company, authorizing the establishment of a tramway between the capital of the nation and the city of Guarda Viejo. The concession carries with it the right to import the necessary cars for the exploitation of the tramway free of municipal duties. The company is obligated to complete the line within five months from the approval of the contract by the Government.

THE ELECTRIC EEL'S VICTIM.—At the Zoological Gardens, says *Chambers' Journal*, a large electric eel was swimming in its tank with more activity than usual, when a big cockroach fell into the water, and in its efforts to get out made a disturbance of the surface, which attracted the attention of the eel. The eel turned round, swam past it, discharged its battery at about 8 inches off, and the cockroach instantly stopped, stone dead. It did not even move its antennæ after. The eel then proceeded to swallow its victim, and the narrator goes on to point out the curious circumstance that the fish, which weighed about 12 lbs., should find it worth while to fire its heavy artillery at a creature an inch and a half long, when it could easily have swallowed it *sans façon*.

SIGNAL CORPS CHANGES.—The following changes in the Signal Corps are ordered from Washington: Major George P. Scriven will proceed to Washington and report to the chief signal officer for duty as disbursing officer in his office, to relieve Captain Eugene O. Fechet, who will proceed to Manila for assignment to duty. Captain Otto A. Nesmith will proceed to Havana for duty as signal officer of that department, to relieve Colonel Henry H. C. Dunwoody, who will repair to Washington and report to the chief signal officer for temporary duty in his office and then for duty as signal officer of the Department of the East, to relieve Captain Samuel Reber, who will repair to Washington and report for further orders.

LONG-DISTANCE TRANSMISSION.—On April 27 the Bay Counties Power Company commenced operating the longest electric power transmission system in the world. The distance of transmission is 140 miles; the lines extending from the water-power electric generating station on the North Fork of the Yuba River, to Oakland, Calif. The load carried was that of the Telegraph & San Pablo Avenues electric railroad lines, of the Oakland Transit Company. At 3 p. m. the 40,000-volt current was switched on in the presence of the officials of the two companies and invited guests. Later a banquet was served at the Bay Counties sub-station in Oakland. Within a few days the street railway company's power stations will be shut down, and the long-distance current depended upon for all of its lines. The 190-mile transmission from the Yuba power station to the Standard Electric Company's San Jose sub-station is about ready to be put in operation.

REFLECTOR INCANDESCENTS.—A remarkable form of an incandescent lamp is the subject of a patent granted April 30 to Jules Edgard de Marcay, of Paris, France. The lamp, instead of consisting of a single globe or bulb, consists of a number of elementary bulbs, each provided with its own filament and grouped about a reflecting body. Each individual lamp is adapted to be placed in or removed from a socket in practically the same manner as are ordinary incandescent lamps. Briefly, instead of arranging in a single bulb one or several filaments, a number of filaments are distributed among independent and interchangeable elements. The patent illustrates a number of forms of lamps. To take one of these as an illustration, a number of lamp elements surround a conical reflector bulb enclosing the elements, being also slightly conical, as shown. There are 16 of these elements which completely cover the surface of the conical reflector.

ELECTROLYTIC REFINING OF ALUMINUM.—There are now in existence or under construction in this country, plants for the electrolytic refining of copper, nickel, silver and gold. In addition there exist operative electrolytic processes for the purification of tin, zinc, antimony, lead and bismuth. The principle of operation is the same in all cases. The impure metal is connected as anode in an electrolyte capable of effecting its solution. Upon the passage of an electric current of a character suited to the particular circumstances, the metal to be obtained, together with all more electropositive metals which may be present as impurities, dissolves in the bath, while less electropositive metals will, within measurable limits, remain undissolved. With properly chosen current density the metal to be refined, being the least electropositive of those in solution, can be deposited in a state of substantial purity. A patent recently issued to William Hoopes and assigned to the Pittsburg Reduction Company deals with this process as applied to aluminum. Crude molten aluminum constituting the anode is contained within a carbon basin, suspended in fused double fluoride of sodium and aluminum (cryolite) to which alumina may be added if desired. With a current density of 20-30 amperes per square inch of anode surface, iron and copper remain unattached, silicon is unattached or volatilized as fluoride, any alkali or alkali earth metals present dissolve and remain in solution in the bath, and aluminum dissolves and redeposits upon the cathode—in this case the carbon lining of the refining tank. The efficacy of such a procedure can scarcely be questioned, but a process involving resolution and deposition of the metal could hardly compete, commercially, with a simple and direct process for the elimination of the impurities from the beauxite which constitutes the raw material for the manufacture of aluminum.

ELECTRIC RAILWAY CONTROLLERS.—Two patents were issued April 30 on electric railway controllers, one of F. W. Garrett and the other to E. W. Stull. The first mentioned is designed to provide a method of series parallel control for two motors, in which the change from field series to field parallel is effected without the use of external resistance, and by a series of steps designed to provide a more even distribution of speed acceleration and also to obviate any tendency of the motors to buck under certain conditions. the motors are changed from series to parallel relation by first connecting their field coils in parallel and their armatures in series with each other, and with the parallel fields, then shifting the connections of one of the motors to place its armature in shunt to the other motor and its field in series therewith, and finally connecting the two motors as a whole in parallel. One of the steps consists in connecting the fields of both motors and the armature of one motor in series, and placing the armature of the other motor in parallel with the first motor. The succeeding step consists in disconnecting the first motor from the circuit and reconnecting it in parallel to the other motor. The Stull patent relates to a method of control which consists in starting a plurality of motors (four or more) connected all in series and then changing them over to a relation in which they are all in parallel, passing through certain intermediate steps in which the motors are partly in series and partly in parallel. The control is mainly effected by utilizing the resistance and counter e. m. f. of the motors, thus thereby disposing to a great extent, if not altogether, with the use of ordinary external resistance. The controlling elements have also contacts so arranged as to make minor circuit changes preparatory to the essential or running positions, whereby too abrupt changes are avoided and the motor circuits are not entirely broken at any time.

TELEPHONES IN LIBERIA.—Minister Smith reports from Monrovia, Feb. 26, 1901, that Mr. T. J. R. Faulkner, a civil engineer from the United States, has placed that city in telephonic communication with White Plains, a settlement 25 miles up the St. Paul's River. This is the longest line in the country.

ANGLO-GERMAN COURTESIES.—The English Institution of Electrical Engineers is to visit Berlin on June 23 to 26, as the guest of Siemens & Halske and the Allgemeine Elektricitäts Gesellschaft. Many of the members will then proceed to Dresden to attend the annual assembly of the Verband Deutscher Elektrotechniker, which takes place this year in that city.

THE NEW FRENCH "HELLO!"—"Hello! hello!" has been the signal both of the telephoner and the telephone girl in every country where the invention has been adopted. France is going to break with this uniform custom. According to new instructions just issued, girls in the central telephone exchange must use the formula "*Je vous écoute.*" Those who are familiar with colloquial French know that the emphatic "*je vous écoute*" corresponds somewhat to "you bet." The merriment provoked by this latest innovation of M. Mougeot, the under secretary of the Postal Telegraph Department, will easily be understood.

ELECTROLYTIC RECTIFIER FOR ALTERNATING CURRENTS.—The asymmetric cells or current rectifiers of the type discovered by Buff, developed by Ducretet, applied to the rectification of alternating currents by Hutin and Leblanc, and of late associated with the names of Pollak and Graetz, have now been further modified by Pollak, who finds that their efficiency is greatly increased by substituting for the usual electrolytes, a solution of an organic acid or its salts. These cells comprise one electrode of aluminum, and one of lead, copper, carbon or other indifferent conductor, and permit an electric current of moderate voltage to pass in one direction only—the electrical analogue of the check valve. When the aluminum functions as cathode, the current passes freely, but in the reverse direction it is nearly or completely checked until a certain definite voltage—largely dependent upon the electrolyte—is reached, when the cell breaks down. The inventor states that by a proper preparation of the plates they may be made to withstand 500 or more volts. He adheres to the earliest and perhaps least satisfactory explanation of their operation—that an actual insulating layer is formed when the current passes to the aluminum electrode as anode, and is destroyed when the current is reversed.

LETTERS TO THE EDITORS.

Copper-Cadmium Batteries.

To the Editors of Electrical World and Engineer:

Sirs.—In view of the interest displayed by the electrical public in the new Edison copper-cadmium-alkaline storage battery, it may not be out of place to call attention to the fact that, assuming the battery to be successful in general, and quite free from any serious tendency to rapidly depreciate, yet even so, Mr. Edison's claims are not extraordinary, because his promise is to double the output of the "Manchester chloride," or to give the output of the "Manchester chloride" battery with half the weight. This, I say, is no great invention, because the battery above cited has an output value equal to 3 amperes per pound at best. There are several batteries now to be had that do double this work, as, for illustration, batteries like the "Gould" special, of the Plante genus. While there are batteries of the Faure genus, such as "Taylor," "Sperry" and others that produce nearly three times that output; or, in reality, nearly 50 per cent more than Mr. Edison promises. This being so, Mr. Edison promises nothing unless it is to do better in the way of depreciation, and promises of this nature, especially before they are substantiated by at least a year of service, are rather to be discounted. There are formidable difficulties to be surmounted in the battery of the school to which Mr. Edison's battery belongs, and while it is to be hoped that the Edison battery will improve with age, rather than depreciate, yet even so the public will, in the judgment of the writer, be perfectly safe, even warranted, in giving the lead-sulphuric acid types of batteries some further consideration before banking on the new possibility. If for no other reason, then because "we know the devil we have."

Thos. J. Fay.

[The copper-cadimum battery is but one step in Mr. Edison's work, and is the only portion so far made public.—Eds. E. W. & E.]

Professional Training in Commerce.

To the Editors of Electrical World and Engineer:

Sirs.—Dr. H. S. Pritchett, president of the Massachusetts Institute of Technology, recently read a suggestive paper before the New England Cotton Manufacturers' Association, in which he advocates the givng of a professional training to men who desire to become eminent in commerce. As Dr. Pritchett rightly points out, "The changed conditions of to-day indicate that a man ought to be educated in some broad view of the relation of men to each other, if he is to assume administrative duties in affairs of large magnitude." Further on he says, "The time is near when those who are to direct great organizations, who are to control and develop manufactures, who are to trade between nations—in a word, the captains of commerce—must look upon their calling as a profession, not as a business; and for this profession there is a training to be had which will not only save time for the individual, but which will develop a broader, a more efficient and a higher type of man; a training which will bring not only a keener vision, but a wider outlook and a better perspective."

How far is it possible, from our present outlook, to realize the ideals set forth by Dr. Pritchett?

If we take the electrical industry, for example, we find that 20 years ago men were rushing into it from all sides, most of them without any special technical training. To-day the junior ranks of this same industry are being replenished chiefly with graduates of the various technical colleges throughout the country. Yet the change has not been from narrowness to breadth, but rather the contrary. The all-round man of 20 years ago had at least the breadth which came from a varied experience in the actual world, while the technical college graduate of to-day "specializes" in college as a preparation to being still more highly specialized as a small cog in some big manufacturing machine. And for all we can see, the intensification of specialization may go on until every man in the great industrial army of the United States, whether college-bred or not, will be wearing a set of intellectual blinkers which will effectually limit his vision to the narrow path in which he has been trained. But this end is unthinkable, if we desire at the same time to preserve industrial efficiency. We all know how apt the specialist in bodily diseases is to find all his patients suffering from the malady which he has made it his lifework to cure, and those who have gained wisdom never go near a specialist except on the advice of the family physician who picks out the right man to whom to go. In like manner, if the electrical industry encourages specialization to the point where it is the rule and not the exception, the time will assuredly come when "unspecialized" men with brains and experience will be sought for outside the ranks of the electrical industry to run it on a paying basis.

Take this country all through and you will find no class of men equal in energy, resourcefulness, business ability and promptness of decision to the presidents of its railroads, and yet were ever a set of men drawn from more various sources, with such diverse experiences, and so little technical education? As the railroad industry is much larger than any other in this country, its need for the assistance of the technical colleges ought to be correspondingly great. The fact remains, however, that our railroad presidents, with few exceptions, have begun life either as rodmen, firemen, brakemen, freight clerks or telegraphers. If presidents of electrical concerns, whether manufacturing or operating, were to be derived from similar sources they would begin life as motor men, lamp cleaners, office boys or mechanics' helpers.

I do not cite these examples because I disagree with Dr. Pritchett in his main idea, namely, that the captains of commerce should arise from men who have secured a professional training toward that end. On the contrary, I am thoroughly in sympathy with his aim, though I believe that the course of study in the technical colleges will have to be revolutionized if he and other educators are to achieve it. I devoutly believe that the technical college is the place in which principles should be instilled into a young man's mind, so that he would find in the factory, in the draughting room, in the sales room, a continual exemplification of these principles in after life. It may be that the history of mechanical invention is taught in technical colleges, though I never was fortunate enough to meet a student who had studied this branch of knowledge. It may be that more practical parts of political economy, such as the rise and fall of prices, the marvelous trade shiftings of successive generations, the changes brought about in the world's history by new discoveries, are part of a technical college student's course. How many students know enough about the physical sciences to be able to read and to enjoy Herbert Spencer's "First Principles," which gives us such a magnificent general view of their inter-relations? In short, the function of the technical college ought to be a training of the mind, a stimulating of the scientific imagination and a deepening of historic insight, so that men might be able to predict the future from their knowledge of the past, and might be able calmly to grapple with the present with a sure knowledge of its underlying principles.

New York, N. Y. A. L. Nostrand.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Starting Resistances for Direct-Current Motors.—Bunet.—A long mathematical article on the calculation of the single steps of rheostats used in starting direct-current motors. He first solves the problem of how to choose the single resistances of the rheostat if the process of starting shall be as follows: The lever of the rheostat is set on the first notch, the current shall be I, which is the maximum current allowed; the motor then begins to start and a counter e. m. f. is developed, so that the current decreases to i; by moving the lever of the rheostat to the second notch, the current increases rapidly again to I, and then decreases again to i; the same shall be the case with all the other notches so that the current varies between the limits I and i. He shows that this is a very satisfactory method of starting, and the more satisfactory the smaller the difference between I and i. Let $A, B, C \ldots N$ be the n resistances determined by the positions of the sliding contact lever of the rheostat upon the n notches, comprising the resistance of the rheostat and the motor, so that N is the resistance of the motor alone. He shows that the above method of starting is obtained, if the ratio $I \div i$ is equal to the ratio $A \div B$, and the ratio $B \div C$, etc. He then gives a simple formula for determining the number of notches in this case, if I, i and the e. m. f. of the circuit and the internal resistance of the motor, are given. He then gives a numerical example: A motor has an internal resistance of 0.05 ohm and is operated in a circuit of 100 volts; the maximum current I is fixed at 200 amperes; if the lower limit i of the current is assumed at 180 amperes, 23 notches are required; for $i = 150$ amperes 9 notches, for $i = 100$ amperes 4 notches. In the second case, with 9 notches, the resistances of the rheostat are 0.45, 0.325, 0.231, 0.161, 0.108, 0.069, 0.039, 0.017 ohm. He then shows how to calculate the time which is required for the contact with each notch. He considers the case of a car, in which a torque is required independent of the speed, and shows that the time from the contact on first notch to the contact of the second notch must be to the time from the contact on second notch to the contact of third notch, as I to i; the time for the contact on each notch decreases in a geometrical proportion. This result can be utilized in the construction of the rheostat by making the contact notches smaller and smaller, according to this geometrical proportion, and by giving the rule to the motorman to turn the lever with constant speed. He finally deals with the case that the power varies, and considers the case of starting a motor at any load, for instance, on a car where the resistance to traction to be overcome varies greatly. He proposes to handle the lever of the rheostat so that he speed of the car is always the same for the same notch of the controller. He develops the formulas of this case.—*L'Ind. Elec.*, March 10.

Slotted Direct-Current Armature Windings.—Rothert.—An illustrated article on the development of direct-current dynamo design in recent years in Europe. Some years ago the American direct-current machines were electrically much better than those built in Europe, especially regarding the dimensions of the armature. In recent years European designers have begun to follow the example of the Americans. He deals with "newer windings for slotted direct-current armatures." Only series windings are considered. The article deals mainly with designs based upon the use of two or three commutator segments per slot. In Europe it had until recently been nearly general practice to use as many commutator segments as armature slots.—*Elek. Zeit.*, April 11. A similar article by the same author in *L'Eclairage Elec.*, March 30.

Converters.—Eborall.—The conclusion of his paper on polyphase sub-station machinery, noticed before in the Digest. It is also commented upon in an editorial. An account is also given of the discussion which followed. Field did not agree with Eborall that the proper place for damping copper pieces is only between the pole-tips and that they are useless elsewhere. Many makers surround the pole with a massive ring, which is thickened up at the pole tips, the poles being often chamfered off at the tips, and the copper rings are arranged to enclose the tips, so that part of the polar surface is made of copper. Normally, the whole pole flux passes through the ring, and in order for it to be blown out into the intervening space between the pole tips it would have to cut across the ring. S. P. Thompson agreed with Field that there is some advantage in putting a thick copper coil around the pole, but he did not stop there, because this did not secure the whole advantage. There might be a reaction due to a lagging or leading current which tends to distort the magnetism to one side of the pole producing an unequal distribution which would be sufficient to admit of hunting. He considered the real remedy to be an amortisseur on the plan adopted by Leblanc with a number of closed copper circuits so that there are circuits through the pole faces as well as around them and between them. The large 3000-kw machines exhibited by the Gen'l Elec. Co., of Berlin, at the Paris Exposition had the pole pieces pierced with five holes of different sizes from front to back and copper rods inserted in each hole. The ends were all short-circuited together, making practically a squirrel cage embedded in each pole.—Lond. *Elec.*, April 19.

Friction and Hysteresis Losses in Three-Phase Induction Motors.—Dettmar.—A communication in which he criticizes the paper of Hissink, abstracted in the Digest, April 13. He claims that Hissink's explanation of the difference between measurements and calculations of the hysteresis and eddy current losses cannot be correct. Hissink had suggested that the difference might be due to the increased friction losses. The present author had found that the friction of the bearings is practically independent of the load. He says that the difference between measurements and calculations is due to two reasons. First, the iron losses are generally calculated by a wrong method; second, there is a non-uniform distribution of the lines of force where they leave the teeth. (See his paper, abstracted in the Digest, Dec. 15, 1900.)—*Elek. Zeit.*, April 4.

Modified Induction Motor.—Osnos.—A communication referring to the article of Grob (Digest, March 30). He remarks that the Grob motor ought to be considered as a special case of a synchronous motor. It is not fair to compare it with an induction motor, as the Grob motor is not self-starting. He gives a comparison of the Grob motor with a synchronous one. This shows that the former compares less favorably than might seem at first sight.—*Elek. Zeit.*, April 4.

Standardization of Electric Apparatus.—Parshall.—An article in which he attempts to outline in a general way the conditions of output which should be defined to insure a given result as to efficiency and maintenance. The thermal limit of output may be defined as the maximum temperature consistent with the durability of the insulation of the electric circuits and the maintenance of the commutator or collector rings in the best working condition. The magnetic limit of output is determined in commutating machines by sparking, and in alternators, synchronous motors, induction motors and transformers by regulation and maximum output. The inherent regulation is defined as the ratio of no-load to full-load voltage without change of excitation. He further discusses regulation by compounding, definition of efficiency and insulation. He refers to the "very elaborate report as to a plan of standardization prepared and adopted by the American Institute of Electrican Engineers." He says that a similar code is also being considered by a number of leading experts in Germany, but that the standardization proposed is not in general agreement with the American standards, in that it is suggested that less stringent regulations as to heating and sparking should be permissible in practice—that is, a greater increase of temperature should be permitted, and a certain shifting of the brushes should be allowed in commutating machines to avoid sparking for a change of load. "What is really wanted is an international code of standardization so that the standards of one country shall not be below those of another."—*Traction and Transmission* (London); *West. Elec.*, April 27.

REFERENCES.

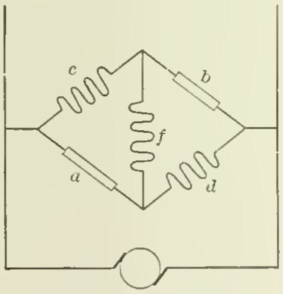
Sparkless Disconnection of Shunt Motors.—Musswitz.—A communication in which he criticizes some special points in the article of Krause, noticed in the Digest, April 13.—*Elek. Zeit.*, April 4.

Rotary Transformers.—Colles.—A continuation of his long paper. He discusses stationary apparatus for the transformation of polyphase currents, and then takes up the rotary transformer. He discusses the two-coil transformer and the single coil rotary transformer, and then gives the theory of the latter apparatus.—*Jour. Frank. Inst.*, April.

Large Generators.—Rothert.—A reply to the recent communication of Pichelmayer. He thinks that the Arnold winding will soon be introduced into American practice. He also makes some remarks on the question of how much overload generators should be expected to stand.—*Elek. Zeit.*, April 11.

Lights and Lighting.

Nernst Lamp Pre-Heater.—An illustrated description of devices of Raab for automatically lighting a Nernst lamp. The principle is based upon the arrangement of the Wheatstone bridge and may be seen from the adjoining figure. *f* is the heating body and *a* and *b* are the incandescent bodies; *c* and *d* are two resistances of proper value. When the lamp is switched on, the incandescent bodies do not conduct the current, and the current flows through *c f d;* the heating body *f* then heats the incandescent bodies *a* and *b*, and the latter become conductors, the current then goes partly through *c b* and partly through *a d*, until finally no current at all or a very small current flows through the heating body *f*, according to the principle of the Wheatstone bridge. Several modifications of this device are also described and illustrated.—*Zeit. f. Beleucht.*, April 10.



NERNST LAMP PREHEATER.

Bremer Arc Light.—A note on this lamp which was described in a paper of Wedding, abstracted in the Digest, July 28, 1900. In the meanwhile, the lamp is said to have been perfected and to have been examined by other experts. Some notes are given from a recent lecture of Bremer. The lamp has been tested by Janet in Paris, who found, in accordance with Wedding, that the Bremer arc lamp consumes 0.17 to 0.1 watt per candle, i. e., one-third to one-fifth of the consumption of other arc lamps. The consumption of the carbons is said to be not greater than that of ordinary arc lamps. For the latter Heim found on the average 0.42 cb. cm. for the positive side and 0.17 cb. cm. for the negative side per ampere-hour. Wedding found for the Bremer lamp 0.25 cb. cm. on the positive side and 0.12 cb. cm. on the negative side.—*Elek. Zeit.*, April 4.

Electric Light of the Future.—E. H.—An article on the sources of electric light of the future. He gives a review of the subjects of the Bremer arc lamp and the Rasch electrolytic arc lamp, also of the Nernst lamp and the Welsbach osmium lamp, all of which were noticed before in the Digest. Regarding "luminescence" as a source of light, he says that a solution of the problem cannot be thought to be impossible because the experiments so far made have been unsuccessful. A brief review is given of Tesla's high-frequency experiments.—*L'Ind. Elec.*, March 25.

Power

Electric Power in a Glass Plant.—Froelich.—A well-illustrated article on the electric installation at the works of the Edward Ford Plate Glass Company, of Toledo, which is the first plate glass plant to operate its grinding and polishing machinery by electric power. Each of the 24 grinders and 20 polishers is connected with a three-phase induction motor. The grinders each require a 100-hp and the polishers a 150-hp motor. All the motors run at two speeds. At slow speeds the poles of the stator are all joined in series and at full speed the poles are joined in parallel reducing the number of poles just one-half.—*Rose Tech.*, April.

Polyphase Equipment of Factories.—Wyld.—An abstract of a paper read before the Birmingham section of the Brit. Inst. of Elec. Eng. After an elementary discussion of the properties of induction motors, he gives a detailed list of polyphase factory plants, which is summarized as follows: The United States has five plants, aggregating 7130 horse-power, Germany 15 plants of 7685 horse-power, Switzerland 9 plants of 5850 horse-power, Italy 22 plants of 12,035 horse-power, Russia 16 plants of 12,700 horse-power, England 16 plants of 9450 horse-power, etc. The total for the different countries is 105 plants, aggregating 68,000 horse-power.—*Lightning*, April 18.

REFERENCE.

Montgomery.—Abell.—An illustrated description of the water-power plant of Montgomery, Ala. There are three turbine-driven, 875-kw, three-phase alternators. The transmission line is 30 miles long.—*West. Elec.*, April 27.

Traction.

Electric Traction in France.—Soulier.—The ninth annual table of statistics, giving data for the electric railways and tramways in service or in course of construction in France on Jan. 1, 1901. There are six full-page tables, giving a large amount of information. The total length of lines has increased from 753 km. in 1900 to 1486 km. in 1901; the total capacity from 28,300 kilowatts to 64,400 kilowatts; the total number of motor cars from 1295 to 2425; the number of lines using the trolley system, from 56 to 76; the number of lines using the conduit system from 3 to 6; the number of third-rail lines from 1 to 4; the number of lines with the pure accumulator system from 6 to 8; the number of lines with the combined accumulator and trolley system from 4 to 6; the number of lines with the combined trolley and conduit system from 2 to 2; the number of lines with the combined trolley and surface contact system from 0 to 7.—*L'Ind. Elec.*, March 25.

Accumulator Traction in Italy.—Lanino.—A long abstract of a paper read before the Italian Electrotechnical Society, on the railway between Bologna and San Felice, a distance of about 26½ miles, where accumulator cars are used. The line serves to connect numerous small agricultural centers, the passenger traffic and the goods traffic are extremely limited. Some details are given regarding the construction of the cars and the Pescetto storage batteries used. Each car contains 288 cells, each weighing 73.6 lbs. The battery in each car has a capacity of 300 ampere-hours, equal at a main pressure of 600 volts, to 180 kilowatt-hours, with an average discharge of 200 amperes. This capacity was intended to furnish sufficient energy for a complete journey out and back in all conditions of weather. It actually enables the car to run a distance of 62 miles under ordinary conditions. No results are given regarding the financial side of the undertaking.—Lond. *Elec. Rev.*, April 19.

Electricity on Main Lines.—Kranold.—A brief communication denying the correctness of a former notice which stated that the cost of operation on the Wannsee Railroad, near Berlin, is less by about 10 per cent, since the introduction of the electric service, than it was with steam. He says that exact figures cannot yet be given, but from the present statistics it appears that the cost of operation with electricity is higher than with steam. "Already the cost of current alone is considerably higher than the cost of fuel for the same transportation with the locomotive service."—*Elek. Zeit.*, April 11.

Convention of Street Railway Association.—An account of the convention held at Strasburg, Feb. 13, of the Associations of the Rhineland, Westphalia and neighboring districts. The subjects of fenders, vestibules, transportation of freight, municipalization of street railways, sandboxes, rails and commutation tickets were discussed. The Hanover Company reported the use of 30 freight locomotives and gross receipts from freight of over $125,000. An electric locomotive can draw four cars, each loaded with four tons, and requires only two couplers. The locomotives require about 50 watt-hours per ton km., and the cost per kilowatt-hour is about 4.7 pfennig, which is a little over one cent. The gross receipts are about 54 pfennig per car km. It was decided to compile some statistics showing the bad effects of the municipalization of street railways. The purchasing of coal in bulk by a number of the companies was discussed. The next meeting will be held at Aix-la-Chapelle.—*St. R'y Jour.*, April 6, Int. Ed., April.

Multiple Unit Systems.—Soulier.—An article on the electric railway from Faget-Saint-Gervais to Chamonix. Water-power will be utilized. Trains consisting of a number of electrically-driven motor cars will be run. For the control of the whole train a system of "servo-motors," operated by compressed air, will be used, by which a motorman in the front car operates the controllers of the different motor cars. This system is described and illustrated.—*L'Ind. Elec.*, March 10.

REFERENCES.

Three-Phase Traction.—Galmozzi.—A long mathematical article in which he develops some simple formulas for the voltage drop and the phase differences in the currents in each phase of a three-phase traction line. They are in general different in the two overhead conductors from those in the rails, i. e., the three phases are not equally loaded. He then gives the analogous formulas for a two-phase system with the rails as common return.—*L'Eclairage Elec.*, March 30.

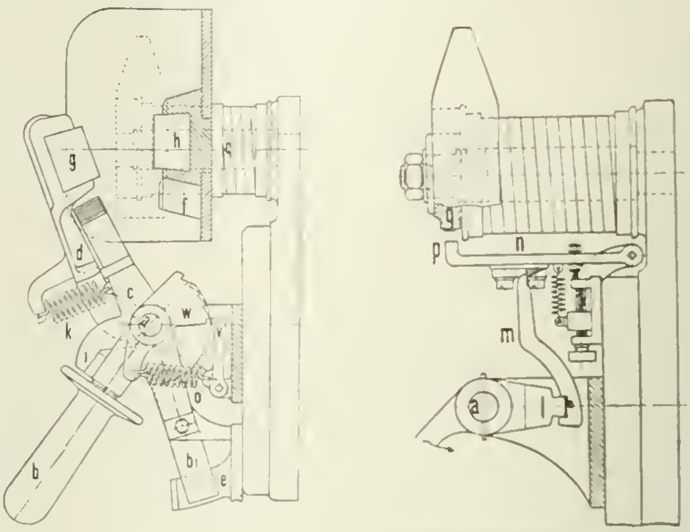
Jungfrau Locomotive.—A description in detail of the Jungfrau three-phase locomotive No. 4. Its features, which distinguish it mainly from the older locomotives of the same road, is the direct-current excitation of the induction motor, for use on descending grades.—*Elek. Neu. Anz.*, April 1.

Isle of Thanet.—An illustrated description of the new British tramway line of the Isle of Thanet. The length of track is 11 miles. The power house contains two direct-current, 500-volt traction sets and two 2500-volt 50-period three-phase generators. The three-phase currents are transmitted to synchronous converter substations.—Lond. *Elec.*, April 19.

Conduit Systems.—Some illustrations, with brief description, of conduit constructions in Paris and Nice.—Lond. *Elec. Rev.*, April 19.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Automatic Circuit Breaker.—Natalis.—An illustrated description of a new circuit breaker of Schuckert & Co. He says that most of the circuit breakers on the market have the following disadvantage: When the apparatus has broken the circuit it may be that the overload is still in existence when one is resetting the circuit breaker. If in resetting one holds the circuit breaker closed by the hand even for a moment only, the overload may do damage to the apparatus. To prevent this danger it has been suggested to use a special hand switch besides the automatic switch. When the circuit breaker has broken the circuit, one has first to open the hand switch, then to close the automatic circuit breaker, and finally to again close the hand switch. In this way there can be no accident, but there is danger that an unskilled attendant might forget to open the hand switch first. In the circuit breaker which he describes these disadvantages are overcome. The circuit breaker is illustrated in the adjoining figures. Around a common axle *a* are movable both the hand switch *b b* and the automatic circuit breaker *c d*, which is released electromagnetically. The switch *b* is provided with copper contacts for making connection with both *c* and *e*; *e* is the one terminal by which the current is fed into the apparatus. The automatic circuit breaker consists of a main switch *c* provided at its end with copper contacts for making contact with the surfaces *f*, and of the arm *d*, provided with a carbon contact *g* which is pressed against the carbon contact *h*, electrically connected with *f*. Only the switch *b* is provided with a handle *b*; when it is opened the arms *c* and *d* are raised by means of *i*, and the contacts between *g* and *h* and between *c* and *f* are closed. The switch *c* is held in this position by the device *l m n*, seen in the second figure and described below, so that the hand switch *b* can now be lowered again, which closes the circuit. The whole manipulation therefore consists of raising the handle *b*, which opens the circuit at *b*, and closes the upper automatic circuit breaker, and of lowering again the handle *b*, which closes the circuit at *b*. As seen in the second figure, the handle *c* and the handle *l* which is firmly connected with *c*, are held in their position against the action of the spring *o* by means of the armature *p* of the electromagnet *q*. But in order to avoid that the whole pressure of the strong spring *o* acts upon the knife edge *n*, the lever *m* is provided, which grasps around the lever *l* so that only a small part of the pressure of the spring *o* acts upon the knife edge *n*. In this way it is possible that a relatively small e. m. f. releases a considerably larger force. The two arms of the electromagnet *q*, one of which attracts the armature *p*, are surrounded by a few windings of the main circuit. The circuit is broken only by the switch *c d*, provided with an apparatus for magnetically blowing out the sparks. In order to open the circuit breaker by hand, the armature *d* is provided with an insulated handle. It is impossible to open the switch *b* while the automatic circuit breaker is closed. This is done by the arresting device *v w*, seen in the first figure. Sparks should occur only at the contacts *g h*, which consist of carbon of the very best conductivity.—*Elek. Zeit.*, April 11.



FIGS. 1 AND 2.—AUTOMATIC CIRCUIT BREAKER.

Safety Device.—Goerges.—A brief illustrated paper read before the Electrotechnical Society, of Berlin, on a new safety device of Siemens & Halske. He calls attention to the importance of devices for preventing the dangers due to the passing of high voltage into low-voltage circuits. When in a step-down transformer supplying a number of lamps, any point of the low-tension winding makes contact with a point of a high tension winding, there is danger To prevent this danger, he connects one point, for instance, the middle point, of the low-tension winding of the transformer with the earth through an air-gap. The apparatus used for this purpose is described and illustrated.—*Elek. Zeit.*, April 4.

British Alternating-Current Central Stations.—The large annual table giving a list of the high-pressure alternating-current plants in Great Britain. There are 72 provincial plants and 12 plants in London. No summary is given. The largest plant has an actual capacity of 4320 kilowatts, the smallest one of 42 kilowatts. Ten plants use both alternating and direct current; 26 plants use a frequency of 100 or above; 33 a frequency of 60 or above, 21 a frequency below 60; 4 plants are for different frequencies.—Lond. *Elec. Rev.*, April 19.

REFERENCES.

Central Station Equipment.—Junkersfeld.—An abstract of a lecture delivered before the Engineering College of the University of Illinois. He discusses the transmission of 25-cycle, three-phase currents and conversion into direct current in sub-stations. He also speaks of the use of double-current generators in Chicago. One of the more recent developments in the distribution of alternating current has been the four-wire, three-phase system in one of the outlying districts of Chicago. He says that the steam turbine at present gives promise of revolutionizing power-station design. He also expects promising developments from the Nernst lamp.—*West. Elec.*, April 27.

Compound Dynamos in Central Stations.—Wille.—The first part of an illustrated article in which he gives illustrated descriptions of successful installations, in which compound-wound direct-current dynamos are used as generators for light and power service.—*Elek. Anz.*, April 11.

WIRES, WIRING AND CONDUITS.

Anchors for Electric Wiring Poles.—CARPENTER.—An illustrated account of tests made of the holding capacity of a certain type of anchor for electric wiring poles, namely, the Stombaugh Guy Anchor, which consists of one full helix or screw thread of cast iron, attached either to a long iron bar or a guy wire. The holding power in clay is greater than that in sand. He gives an empirical formula for the holding power in sandy ground. The resistance, offered by the anchor, in pounds, is 100 times the diameter of the helix of the anchor in inches, multiplied with the square of the depth of the helix, in feet, from the surface. The resistance in clay would probably be 20 per cent more.—*Sibley Jour.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

Electromagnetic Coils and Plungers.—RANKIN KENNEDY.—An article illustrated by diagrams. He treats the coil and plunger as an electromotor and discusses several types. He recommends making the coil wide and thin, and to use soft iron tubes inside and outside, connected by a circular yoke, the outer tube forming a mantel over the coil. This is a scientific construction of the horseshoe type of plunger. It is illustrated in Fig. 1. "We are now coming nearer to a series-wound motor. The wires in the air-gap at *g* are armature conductors, those above the air-gap the field winding." By making the tubes thin enough above their polar faces, they can be saturated magnetically so that the pull will be proportional to the current. If the coil is divided into two coils, one an armature and the other a field coil, it is possible to pull the plunger up or down by reversing the current in either half. A further development leads to the construction of a coil and plunger of the shunt motor type, a main coil forming the armature and a fine wire shunt coil forming the field winding, together with an outer and inner tube with polar faces. There is a constant field, and the plunger may be driven up or down, according to the direction of the currents in the coils. Another modification of the coil and plunger, which is described to give a long range of equal pull or push of small force, consists of a long solenoid with a still longer plunger. The plunger carries a magnetizing coil wound in two sections, producing a pole in the middle. The sectional area of the plunger and the power of the magnetizing coil must be so designed that the plunger is magnetically saturated by its own coil. A current in the long solenoid outside will pull with a long, equal range, either up or down, according to the direction of the current in the coil. In Lord Kelvin's recording instruments this coil and plunger is used. A very powerful coil and plunger for a machine for striking a heavy blow is shown in Fig. 2. The coil is iron clad, and has two ring-shaped inner poles, *N*, *S*, and a plunger to loosely fit the bore. This plunger has cut into it a series of grooves in which the armature winding is wound, to produce a pole in the middle and one at the end. The length of the core is equal to the length of the ironclad coil plus the length of the stroke.—Lond. *Elec. Rev.*, April 19.

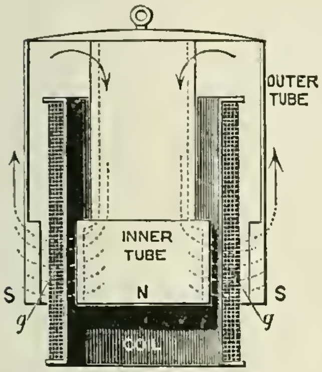


FIG. 1.—COIL AND PLUNGER.

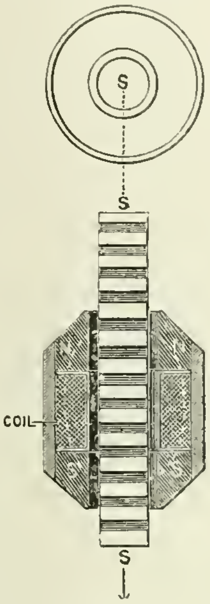


FIG. 2.—COIL AND PLUNGER.

REFERENCES.

Electric Arc.—BERMBACH.—The first parts of a paper in which he gives a summary of our knowledge of the physical phenomena in the electric arc.—*Elek. Anz.*, April 14, 18.

Theories of the Coherer.—TURPAIN.—A critical review of the theories of the coherer, suggested by Branly, Lodge, Righi and Ferrie. He shows that all these theories are not general enough. Each one relates only to a special group of radio-conductors and not to the others.—*L'Eclairage Elec.*, April 13.

Disruptive Discharges.—JOHNSON.—A long, mathematical article, in which he discusses the conditions, under which disruptive discharges can occur.—*L'Eclairage Elec.*, March 16.

Earth Currents.—FOERSTER.—A paper read before the Electrotechnical Society, of Berlin, in which he gives an account of a very long series of measurements of earth currents, extending over about 10 years, made on two German telegraph lines.—*Elek. Zeit.*, April 11.

ELECTRO-CHEMISTRY AND BATTERIES.

REFERENCES.

Reducing Action of Calcium Carbide.—KUEGELGEU. The first part of an article in which he discusses the use of calcium carbide as a means of reduction. In this part he gives an account of his experiments in which he used calcium carbide for the reduction of lead oxide at 800 to 900 degs., or 1000 to 1100 degs. C., for the reduction of lead chloride and of mixtures of lead chloride and lead oxide.—*Zeit. f. Elektrochemie*, April 11.

Electro-Chemistry in 1900.—KRUEGER.—A continuation of his review. This part deals with pyroelectro-chemistry, and the progress in the alkaline industries and in other anorganic chemistry.—*Elektrochem. Zeit.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Meter for Double Tariff.—An illustrated description of a meter for double tariff of Schuckert & Co., to be used by stations which charge different rates for the electric current at different hours of the day. The meter consists essentially of a clock and a motor meter, mounted on a common base. The clock is an ordinary pendulum clock with electric winding. It operates a needle, making in 24 hours one full revolution around the dial, which is divided in 2 by 12 hours. The night hours from 6 p. m. to 6 a. m. are marked by a black line. There are also on the dial two movable small needles, which mark the beginning and the end of the higher tariff. The meter is an ordinary motor meter, with two dials, one for the high and the other for the low tariff, and a relay below the dials; according as the one or the other coil is excited, this relay couples the meter to one or the other counting dial. Either relay coil is excited by the clock. When the time needle of the clock dial reaches the little needle marking the beginning of the high tariff, the night relay coil is excited. When the time needle reaches the other little needle marking the end of the high tariff, the left relay coil is excited. By setting these two needles the time of the high tariff may be determined at will. With this arrangement, therefore, there are two counters, both counting direct kilowatt-hours; but the kilowatt-hours counted by the one counter are charged for at a different rate than those counted by the other counter. The advantages of such a double tariff meter over a meter with only one dial, and in which the constants of the meter are varied at different times, are evident.—*Zeit. f. Beleucht.*, March 30.

REFERENCES.

Measuring Instruments.—HAERDEN.—A series giving illustrated descriptions of electric measuring instruments of precision. These parts deal with standard resistances, bridges of precision, instruments for measuring insulation resistance and galvanometers.—*Elek. Anz.*, April 7, 11, 14.

Magnetic Measurements.—MONTPELLIER and ALIAMET.—A continuation of their illustrated serial. In this part they describe the permeameter of Hartmann and Braun.—*L'Elec.*, April 13.

Photometry.—SHARP.—An article on the photometer equipment at Cornell University.—*Sibley Jour.*, April.

Localizing Faults.—CHARPENTIER.—An article, illustrated by diagrams, in which he describes a general method of localizing faults in a distributing network.—*L'Eclairage Elec.*, March 9.

Cable Tests.—A description of the methods used in the British Navy, for testing electric cables.—Lond. *Elec. Rev.*, April 19.

Direct-Reading Wattmeters.—ARMAGNAT.—A brief article in which he develops the formula for the error, due to mutual induction, in a direct-reading wattmeter. This error is negative and small and independent of the reactance of the circuit. It is so small that it may be neglected in practice.—*L'Eclairage Elec.*, March 23.

Motor Meters.—An article in which the principles of motor meters are explained in a general way.—*Rose Tech.*, April.

Phase Meter.—Johonnott.—An illustrated article on Rayleigh's alternating-current phase meter. The results of some tests are given in diagrams and tables.—*Rose Tech.*, April.

Telegraphy, Telephony and Signals.

REFERENCES.

Wireless Telegraphy.—Lamotte.—A very long, illustrated summary of the present status of wireless telegraphy. He starts from the experiments of Popoff and Marconi, and discusses in detail the construction and the action of both the transmitting and receiving apparatus. The article is concluded by some remarks on Slaby's system of tuning and on receivers of tubes with rarefied gases.—*L'Eclairage Elec.*, March 23.

Printing Telegraph.—Hitchcock.—An article on the applications and requirements of a printing telegraph. What is wanted is a simple practical mechanical page-printer, to work like a typewriter and which can be operated with the least possible power at a speed of more than 100 words a minute. He thinks that not much can be accomplished by new inventions in the direction of improving the purely telegraphic part.—*El'ty*, April 14.

Miscellaneous.

REFERENCES.

Carbon.—Harden.—A long illustrated article in which he gives a summary of the methods of manufacturing carbon for electrical engineering, and also of the methods of testing the carbon made for different purposes.—*Elek. Zeit.*, April 11.

Lightning Rods.—A reprint of the report of the special committee of the Electrotechnical Society, of Berlin, on the rules recommended by the committee, for constructing lightning rods. The question is also discussed in an editorial.—*Elek. Zeit.*, April 11.

Paris Exposition.—Haussegger.—Continuations of his illustrated article on the exhibits of Ganz & Co. This part deals with a three-phase mine locomotive.—*L'Ind. Elec.*, Feb. 25. This part deals with lightning arresters and the retrospective exhibition of Ganz & Co.—*L'Ind. Elec.*, March 10.

Reyval.—An illustrated description of a 215-kilovolt ampere three-phase generator, exhibited by Krizik, of Prag.—*L'Eclairage Elec.*, March 23.

Reyval.—An illustrated description of a 10-pole, 350-kw direct-current dynamo, running at 110 revolutions and giving 1500 amperes at 230 volts, exhibited by the Societe Elektrotechnische Industrie de Slikkerveer (Holland).—*L'Eclairage Elec.*, March 30.

Reyval.—An illustrated description of two 300-kw synchronous converters of the French Thomson-Houston Co.—*L'Eclairage Elec.*, April 6.

Reyval.—A long and well illustrated description of direct-current machines exhibited by Schneider & Co.—*L'Eclairage Elec.*, April 13.

Franklin.—Northrup.—The first part of an illustrated historical article on Benjamin Franklin's contributions to electrical science.—*Elec. Rev.*, March 30.

New Books.

Impianti di Illuminazione Elettrica. Quinta edizione, rifatta. Di Emilio Piazzoli (Hoepli Manual). Milan: Ulrico Hoepli. 605 pages, 263 illustrations. Price, 6.50 lire.

This little book—one of the great series of Hoepli manuals—is printed on thin paper and in fine print, being of a convenient size for a pocketbook or handbook. It appears to be very popular in Europe, and is a sort of compendium of useful knowledge for European electric lighting engineers. It treats the subject very fully, both theoretically and practically, and is well equipped with illustrations and tables. The question of cost of construction and operation is also treated at some length.

Saw-Filing and Management of Saws. By Robert Grimshaw, M. E. New Edition, revised and enlarged. New York: Norman W. Henley & Co. 93 pages, 81 illustrations. Price $1.00.

This little volume contains a large amount of practical information about saws and their management, including filing, setting, gumming, straightening, &c., and written by one who understands his subject. The author's diction, however, is open to improvement. In fact the language of the book, which is nowhere lucid, is in some places quite obscure; and although a reader who is himself familiar with saws, can see that the author's own information is extensive, the general reader may experience some difficulty in deciphering the syntactical enigmas that occur in some parts of the book. There are numerous apparently contradictory statements in the book, which we think would be reconciled if the language were clearer.

L'Annee Electrique. Electrotheraphique et Radiographique. Par. Dr. Foreau de Courmelles. Paris: Ch. Beranger. 334 pages. Price, 3.50 francs.

This is a review of the electrical progress for the year 1900. Besides entering more particularly into the work done in electrotherapy and radiography, the general progress of the science and art has been set forth in readable form. We take it that the book is intended more for the general than for the technical reader, and as such ought to prove interesting to many who desire to keep abreast of the times in electrical work.

The Inspector and Trouble Man. By A. E. Dobbs. Reprinted from *The Telephone Magazine*. Chicago: Electrical Engineering Publishing Company. 106 pages, 67 illustrations. Price, $1.00.

Notwithstanding the perfection of modern telephonic apparatus, "troubles" will crop up and require not only intelligent forethought for their prevention, but even greater perspicacity to hunt up and remove them. Mr. Dobbs, whose experience is probably second to none in this particular branch, has here given the result of his years of training in the form of a colloquial dialogue. This method of presentation appeals to many practical men to whom the majority of books appear dry and uninteresting.

Besides treating of troubles *per se*, the author inculcates in simple terms a number of fundamental principles which every telephone inspector, lineman and exchange operator ought to know. There is scarcely any point within the whole range of telephonic operation, which is not considered in this small volume, and it can be recommended to all having practical charge of such apparatus, whether it be in the exchange or on the outside line.

The book is well illustrated, but it is a great pity that there is no table of contents or index. We trust this fault may be remedied in future editions.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 9, 10 and 11, 1901.

Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

Association of Railway Telegraph Superintendents. Next meeting, Buffalo, N. Y., June 19, 20 and 21, 1901.

Canadian Electrical Association. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

Independent Telephone Association of the United States. Next meeting, Buffalo, N. Y., June 11, 12 and 13, 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

National Electric Light Association. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

New York State Street Railway Association. Next meeting, Rochester, N. Y., September, 1901.

Northwestern Electrical Association. Next meeting, Sheboygan, Wis., last week in June, 1901.

Ohio Electric Light Association. Next meeting, Put-in-Bay, Ohio.

Old Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

Pennsylvania State Street Railway Association. Next meeting, York, Pa., Sept. 4, 1901.

Some Exhibits at the Pan-American Exposition.

In addition to the partial list of exhibits at the Pan-American Exposition published in our issue of last week, the following have come to hand:

McClure's Magazine.—A portion of *McClure's Magazine* is printed at the Pan-American Exposition on a press which is equipped with the latest electrical and mechanical devices. The press is automatically fed with an automatic throw-off switch, two-sheet detector and other little devices which make it complete from start to finish. This exhibit is located in Section "S," of Electricity Building.

THE KEYSTONE ELECTRIC COMPANY, Erie Pa., makes an extensive exhibit, including two generators which supply the current for the projector display of the electric fountain in the electric tower basin. These generators are located in the court of the Machinery and Transportation Building. The direct-current machine has an output of 110 kilowatts at 125 volts, running at a speed of 260 r. p. m. and driven by a tandem compound engine built by the Ball Engine Company, Erie, Pa. The other generator is belted to a simple engine built by the Skinner Engine Company, also of Erie. It has a capacity of 120 kilowatts at 125 volts, and runs at 515 r. p. m. This generator has three bearings, each of which is provided with a wedge adjustment so designed that any bearing can be removed and replaced without the necessity of a realignment of the machine.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has an exhibit in Section "F," of Electricity Building. This exhibit contains a number of old and curious rheostats, also modern rheostats, and gives a good idea of the progress and improvement which has been made in the manufacture of these devices.

THE STANLEY ELECTRIC MANUFACTURING COMPANY'S exhibit will occupy the eastern end of Section "N" in the Electrical Building, the main entrance being on Square J. A novel feature of the exhibit will be the installation of an 80-kw S. K. C. frequency changer in operation. This machine will take two-phase current at 2250 volts, 50 cycles, on one side and deliver it on the other side at 1800-volt, three-phase, 25 p. p. s. A full description of this machine is to be found in the ELECTRICAL WORLD AND ENGINEER of April 6, 1901. The Stanley Electric Manufacturing Company will have at the Exposition grounds also in operation, located in the Exposition power house, a standard two-phase 360-kw S. K. C. inductor type generator delivering current to the Exposition Company for use on the grounds at 2400 volts, 66 cycles. Its switchboard, transformer and instrument exhibit will be very complete.

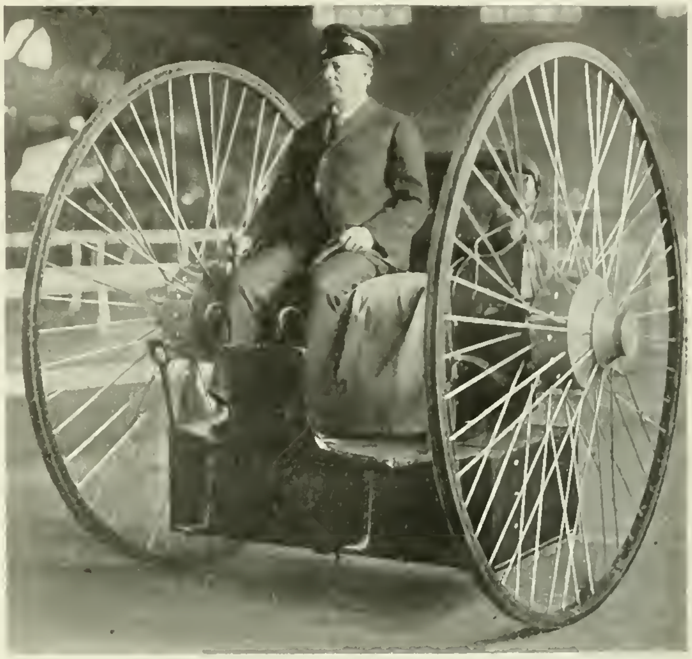
THE STANLEY INSTRUMENT COMPANY, of Great Barrington, Mass., will have an exhibit of wattmeters in Section "N," of the Electricity Building. A number of its instruments will be exhibited and opportunities will be provided for examining the performance of the instruments and the details of their construction. Among other things will be shown the vertical staff carrying the meter-driving disk suspended magnetically in the manner employed in all Stanley wattmeters, in which no mechanical bearing or support is used for the vertical disk-carrying shaft. Meters will be shown in operation as well as in parts, so that a clear idea may be obtained of the instruments in operation, etc.

A Two-Wheeled Electric Automobile.

We illustrate herewith a curious type of electric automobile, which reminds one, by its huge wheels, of the old "ordinary" bicycles upon which some of us tried to break our necks in the early days of wheeling. It also recalls the type of electric car in which the motor was placed in the hub, as in those of Mr. William Baxter, Jr., a plan for which many merits are still claimed. In this "automobile cart," as its designer, Mr. Holson, calls it, the motor is placed crosswise of the axle, with a pinion at each end of the motor shaft, these pinions driving upon opposite sides of a two-faced bevel annular gear fastened to the hub of the wheel. The field frame of the motor rests in ball bearings in the hub frame, and the wires from the battery run through the hollow axle to the motor, being entirely concealed, while the motor itself, as will be noted, is "iron clad," being completely enclosed in a malleable iron case. The motors are of 1 horse-power, capable of developing up to 4 horse-power, and are multipolar series wound. The hub casing has a diameter of 13 inches. The motors take from 15 to 23 amperes on level stretches and under normal conditions.

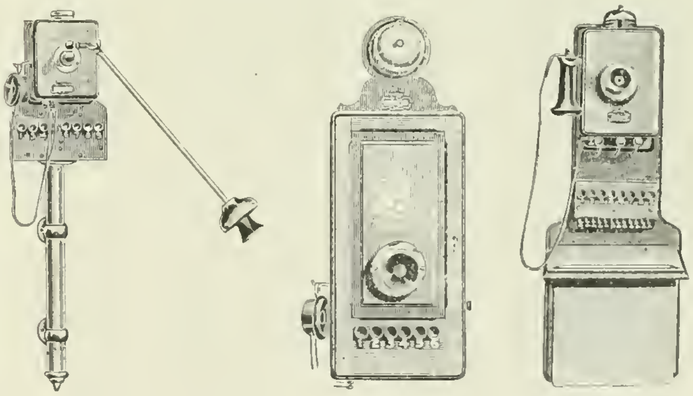
As will be noted, the battery is slung very low, giving a very stable equilibrium, and serving practically as a floor for the vehicle. It weighs 1200 lbs. in the automobile shown, and consists of 40 Helios-Upton cells, having a capacity of 30 amperes at a three-hour discharge rate. Mr. Holson claims to have driven his machine 45 miles on one charge, and to have attained a speed of 16 miles an hour. The vehicle weighs about 2500 lbs. when carrying two passengers.

The controller used permits of four speeds. The machine is steered by a pair of mechanical brakes of the friction type, one acting on each hub, and both being operated by a leathern strap held in the hand of the driver, and functioning just as the reins do in guiding a horse. When both brakes are operated together the vehicle is brought to a standstill. The wheels have wire spokes and iron rims, and are 6 ft. 3 inches in diameter. They will take a 2-inch solid rubber tire in the groove, but Mr. Holson has been using two tires made of rope. When the vehicle stops an iron rod like a shaft is let down under the front platform, so that passengers can get in or dismount without its budging an inch.


AUTOMOBILE CART.

Automatic Intercommunicating Telephone.

The intercommunicating telephone system of the Pacific Electric Company, La Crosse, Wis., is intended for use in factories, stores, houses, or wherever such a system could be advantageously employed. When the operator is through conversing and hangs up the receiver, the line is automatically opened, so that it is impossible for it to become "dead" through the forgetfulness of the operator in leaving his plug or switch in contact. The switchboard of the system is constructed on the same principle, and is made in sizes from 10 to 200 numbers. By the use of this board the operator disconnects himself when he hangs up the receiver. Instead of a lever or plug to connect these telephones, the company uses a push button switch with a magneto device, which makes a reliable contact and permits of no failure of the automatic action of the telephone.


FIGS. 1, 2 AND 3.—INTERCOMMUNICATING TELEPHONES.

The accompanying illustrations represent some of the instruments of this system, Fig. 1 being an office desk telephone, Fig. 2 a house instrument and Fig. 3 a factory set. The instrument can be used with battery call system or magneto call system. The system can be connected with the central office lines.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 6 per cent nominally, and time money at 4 per cent for all dates. Mercantile paper was quiet. There was practically no demand for it in the city, but some went out of town. The rates are 4 per cent for 60 to 90 days' indorsed bills receivable, 4@4½ for choice, four to six months' single names, and 5@6 for others. The New York stock market has been, for two or three weeks past, breaking records, and last week was no exception, the transactions for the week averaging 3,000,000 shares per day. On Friday afternoon there was a reaction, which was attributed to various circumstances, but which was really brought about by the temporary exhaustion of buying power, and the desire to secure profits. The Stock Exchange at the beginning of the week was moved to the Produce Exchange, where business will be transacted until the completion of the new stock exchange building. One of the most striking features of the market during the week was the way in which one stock after another was taken hold of and advanced, one of the principal exhibitions of this kind being Union Pacific common. In the industrial list, United States Steel stocks were the leaders; in fact, they were among the most prominent shares on the market. There was free buying of a general character, both for investment and speculative account. Traction stocks participated in the early strength of the market, and favorable rumors concerning the earnings and prosperity of Brooklyn Rapid Transit had a due effect on speculation in that security. On Friday, however, came rumors of labor troubles on the system, which, although lacking confirmation, depressed the price of that stock, but only 1½ per cent. General Electric continues to maintain the firmness which has characterized this stock for several weeks past. It closed with a net gain of 2¾ points, the sales aggregating 13,000 shares. Western Union again showed strength, and the activity of this stock was a prominent feature among the electrical securities. The sales for the week amounted to 151,580 shares, the stock closing at 97, a net gain of 3½ points, the highest point reached having been 1 point within par. The tractions were weak at the close, Metropolitan having lost 3⅛ points net, and Brooklyn Rapid Transit 1¾. American District Telegraph shared in the activity among the electrics, making a net gain of 5 points, the sales aggregating 3400 shares. Trading in outside securities was rather small in volume, with price changes generally in the way of declines. Following are the closing quotations at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Apr. 27	May 4		Apr. 27	May 4
General Electric	225	227¾	Electric Vehicle	—	10
Brooklyn Rapid Transit	85¼	83½	Electric Vehicle, pfd	—	18
Metropolitan Street Ry.	172⅞	169¾	General Carriage	—	2¾
American Tel. & Cable		98	Illinois Elec. Veh. Tran.	—	¾
Western Union Tel	93½	97	Hudson River Tel	—	120
American Dist. Tel	35	40	N. E. Elec. Veh. Tran.	—	2¾
Commercial Cable	108½	185	N. Y. Elec. Veh. Tran.	—	4¾
Electric Boat	—	18	Tel. & Tel. Co. of Am.	—	5
Electric Boat, pfd	—	45	N. Y. & N. J. Tel	—	162
Electric Lead Reduc'n	4⅝	4½			

BOSTON.

	Apr. 27	May 4		Apr. 27	May 4
New England Telephone	—	—	Erie Telephone	61	59
Mexican Telephone	3	2⅛	General Electric, pfd	—	—
Westinghouse Electric		—	Am. Tel. & Tel	176	176½
Westinghouse Elec., pfd.	75½	—	Boston Electric Light	—	240

PHILADELPHIA.

	Apr. 27	May 4		Apr. 27	May 4
Electric Storage Battery	69	67	Philadelphia Electric	6½	6¼
Elec. Storage Bat., pfd.	74	74	Pa. Electric Vehicle	1⅜	1¼
Elec. Co. of America	9⅜	8½	Pa. Elec. Veh. pfd	1⅜	1
General Electric Auto	—	—	Am. Railways	44½	43½

CHICAGO.

	Apr. 27	May 4		Apr. 27	May 4
Chicago Edison	—	171	Chicago Telep. Co	—	250
Chicago City Ry	—	250	Union Traction	—	15
National Carbon	15¾	15¾	Union Traction, pfd	—	56½
National Carbon, pfd	85	85	Northwest Elev. Com	38	40

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*Asked.

CONDITION OF ERIE TELEPHONE.—The report of Stone & Webster on the Erie Telephone properties summarizes as follows: Overhead construction is in accordance with good standards and well maintained. A large part of the construction has been done in past two or three years and lines as a whole are comparatively new. The underground system is in use in business sections in all of the larger cities. About 40 per cent of the total subscribers are served through underground cable, which contains 48 per cent of the total exchange wire mileage. Average amount of wire mileage underground in Bell system is 52 per cent. The Cleveland Company has 69 per cent underground; pole lines are all copper wire; 90 per cent of subscribers are using long-distance transmitters. This is unusually high. The Northwestern Company has 67 per cent of subscribers' wires underground. The Southwestern Company has 32 per cent of subscribers' wires underground. Michigan Company 43 per cent. The average age of the entire system is 2 to 3 years. The Wisconsin Company has 41 per cent of its subscribers' wires underground. Considering the Erie Company has only six cities of the 52 in the United States with population of 75,000 or more, the proportion of underground wire is very satisfactory. The Erie companies own and occupy 51 buildings and 14 parcels of land; the buildings are generally commodious and creditable. Practically all of the important towns in the territory served, are connected by toll lines, which are generally in good condition, being of standard construction. The cost to reproduce property exclusive of cost of franchises and rights of way, is placed at $26,300,000.

NEW ENGLAND ELECTRIC VEHICLE.—At a special meeting of the New England Electric Vehicle Transportation Company it was decided by a unanimous vote of 171,000 shares to cancel the contract with the Electric Vehicle Company, of New Jersey, and to dissolve the existing company. At the annual meeting the number of directors were reduced to three. The present board consists of F. R. Hart, President C. L. Edgar, both of Boston, and James E. Hayes, of Jersey City. This board will have full powers to act in winding up the affairs of the company, as authorized at the special meeting noted above. It is probable that the affairs will be in such condition within one month that a definite report can be made to the stockholders as to the probable pro rata distribution which will be made. The accident claims against the company form the most uncertain part of its liabilities. Whether the company will continue in active business for the time being has not yet been determined.

NEW ENGLAND TELEPHONE & TELEGRAPH.—The annual report of the New England Telephone & Telegraph Company for the year ended Dec. 31 compares as follows:

	1900.	1899.	Changes.	
Gross	$4,518,396	$3,946,354	Inc	$572,042
Expenses	3,621,644	3,162,802	Inc	458,842
Net	$896,752	$783,552	Inc	$113,200
Dividends	838,635	750,216	Inc	88,419
Surplus	$58,117	$33,336	Inc	$24,781

THE UNITED GAS IMPROVEMENT COMPANY held its annual meeting last week. The report of President Dolan showed net receipts for the fiscal year ended Dec. 31, 1900, $3,380,771, which are 15 per cent on $22,500,000 stock. The profits of $4,048,923 in 1900, included premiums on certain securities realized on in the period of high security values and also certain outside operations while in the result for the year just closed they figure to a lesser degree. The net earnings compare $3,380,771 in 1900, $4,048,923 in 1899 and $1,864,129 in 1898. The directors were re-elected. Mr. Thomas Dolan was re-elected president.

TELEGRAPH & TELEPHONE.—The directors of the American Telephone & Telegraph Company state that there is no truth in the rumor that a consolidation of the Western Union, American Telephone & Telegraph Company and other companies is under consideration. If such a plan is being contemplated, the directors of the American Telephone Company have not been consulted regarding the matter. These rumors are repeated about once a month in Wall Street.

COLORADO SPRINGS ELECTRIC COMPANY BONDS.—Statistics regarding the operations of the Colorado Springs Electric Company, organized in April, 1900, to acquire the El Paso Electric Company and operate traction lines in Colorado Springs and Colorado City, Colo., are given in a circular issued by Spencer Trask & Co., offering 5 per cent 20-year gold bonds of the company. The authorized issue of these bonds is $1,000,000, of which $900,000 are outstanding.

AMERICAN STEEL & WIRE.—The following Steel & Wire directors have resigned: John W. Gates, John A. Drake, Isaac L. Ellwood, Randall Morgan, P. A. B. Widener, Thomas Dolan, Stewart H. Chisholm, Thomas F. Ryan, Philip W. Moen, James Hopkins, H. Clay Pierce. Mr. Gates also resigned as chairman. The following directors remain on the board: William Edenborn, Alfred Clifford, W. P. Palmer, Dr. L. D. Ward.

DIVIDENDS.—The directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1 per cent, payable June 1.

ROCHESTER, N. Y., TROLLEYS.—Notices have been issued of a special meeting of the stockholders of the Rochester Railway Company, to be held May 24, to consider an issue of preferred stock to the amount of $2,500,000, and for the further issue of bonds not to exceed $2,500,000, to be secured by a mortgage on the property. The company is preparing to improve its service.

THE LYNN & BOSTON STREET RAILWAY is authorized by the Massachusetts Railroad Commission to issue $2,700,000 new stock for purchase of Lowell, Lawrence & Haverhill, and $100,000 new stock for purchase of the North Woburn Street Railway, the exchange to be on a share for share basis.

AMERICAN TELEPHONE & TELEGRAPH BONDS.—Kidder, Peabody & Co. have closed subscriptions to the $2,500,000 American Telephone & Telegraph Company's collateral trust 4 per cent bonds, which have been largely oversubscribed.

Commercial Intelligence.

THE WEEK IN TRADE.—With the advent of spring weather has come a better feeling throughout trade in general. The sanguine feeling as to conditions and speculation found reflection in the enormous activity in stock speculation which attracted much money from the usual commercial channels, and expanded clearings to enormous totals. Business in general throughout the country may be described as satisfactory. The iron and steel trades continue to furnish excellent reports, although there is somewhat of a lull in the cruder forms. In the iron trade the advance of $2 per ton in rails, which went into effect on May 1, has resulted in considerable orders from railroads, 125,000 tons having been secured in Chicago alone. In finished products, consumers are still urging quick delivery, in some cases offering premiums for the same, particularly agricultural implement men. The export trade has almost stopped, temporarily, particularly in the cruder forms. The other metals are quite steady. Copper remains unchanged at the same prices that have been maintained for several months past. Lake Superior ingot is quoted at 17 cents and electrolytic at 16⅝ cents. In the machinery market the principal builders in almost every line of machines state that their shops are well filled with work, and that they are naming deliveries, which, in some instances, extend several months into the future. To a certain extent this condition of affairs is reflected along the line of the smaller manufacturers. The failures for the week, as reported by *Bradstreet's*, numbered 163, as compared with 214 the week previous and 153 the same week last year. Railway earnings continue very satisfactory, both as to gross and net receipts.

THE ALLIS-CHALMERS CONSOLIDATION was duly noted in detail in these columns last week, as effected. Vermilye & Co., the bankers, of New York, have charge of the syndicating of the property. The Board of Directors consists of Edward D. Adams, of New York; Charles Allis, of Milwaukee; Mark T. Cox, of Orange, N. J.; James H. Eckels, of Chicago; Elbert H. Gary, of New York; William A. Read, of New York, James Stillman, of New York; Edwin Reynolds, of Milwaukee; Cornelius Vanderbilt, of New York; William M. Allis, of Milwaukee; Frank G. Bigelow, of Milwaukee; W. J. Chalmers, of Chicago; William L. Elkins, Jr., of Philadelphia, and Henry W. Hoyt and Max Pam, of Chicago. It is the intention of the company to double the capacity of the Allis plant at Milwaukee by expending $2,500,000 in the erection of an addition. In the last two years the plants have earned an amount exceeding the 7 per cent required for dividend on $16,250,000 of preferred stock. There is to be $20,000,000 of common. The assets of the new company, without any consideration for the advantages accruing from the proposed consolidation, are as follows:

Cash, capital	$10,000,000
Existing plants	9,935,000
Total	$19,935,000

The valuation of the plants is made by Julian Kennedy, an expert engineer of Pittsburg. His report takes into account the real estate, buildings, machinery, tools, patterns, drawings and patents, together with cost of organizing and getting into full operation, but does not estimate the good will, and is as follows:

Allis Company	$5,120,000
Frazer & Chalmers	3,205,000
Gates Iron Works	410,000
Dickson Manufacturing Company	1,200,000

THE MONTREAL COMBINATION.—The prospectus of the Montreal Light & Power Company, just issued, shows the capital of the company to be $17,000,000. The Montreal Gas Company had put into it a capital of less than $3,000,000. It now comes into the amalgamated concern at $7,500,000. The Royal Electric Company had put into it a capital of less than $1,500,000. It now comes into the new company at $3,750,000. The Chambly Company is capitalized at $3,000,000. It is absorbed by the new concern and rounds out the seventeen-million combination. The control of Gas & Electric was secured by buying it in the open market, and the price paid represented double the original value of these stocks. Therefore, it is difficult to estimate just what the control of these companies cost the new concern. The Royal Electric Company, with shares of $100 par, has been paying dividends of 8 per cent, so its shares were worth $198 last summer and $242 latterly. The shareholders of the Gas & Electric stock, under the new apportionment, get $250 worth of new Light & Heat stock for $100 worth of the old Gas & Electric stock. The shareholders of the Chambly Company offer a majority of their stock in exchange for an equal amount of stock of the Montreal Light, Heat & Power Company. The directorate of the new concern is as follows: President, H. S. Holt; first vice-president, James Ross; second vice-president, Rodolphe Forget; secretary-treasurer, H. H. Henshaw. Directors: H. Montagu Allan, Hon. L. J. Forget, Rodolphe Forget, Lieutenant-Colonel F. C. Henshaw, H. S. Holt, Hon. Robert Mackay, C. E. Porteous, Hon. H. B. Rainville, James Ross.

THE NEW ENGLAND ELECTRIC MANUFACTURING COMPANY was organized under the laws of Massachusetts May 2, 1901, with an authorized capital of $30,000, all paid in in cash, with George O. Proctor, president; Guy H. Proctor, vice-president and manager, and Charles A. Haskell, treasurer. This company succeeds to the business of the Anchor Electric Company, with which Mr. Guy H. Proctor has been connected for five years, and will also manufacture its specialties at its factory at Somerville. Mr. Geo. O. Proctor, the president, is a prominent grain merchant of Boston. Mr. Haskell, the treasurer, has been connected with the leather trade heretofore, and was secretary of the American Hide & Leather Company, the "Upper Leather Combination." The new company start out under the most favorable auspices. Its business experience and financial standing are of the best, and it will doubtless receive its full share of patronage.

THE PACIFIC COMPANY, of Portland, Ore., has the contract for putting in a power plant at White River Falls, Ore., for the Wasco Warehouse Milling Company. The plant will contain two 500-kw A. T. B. General Electric generators, and current will be transmitted 30 miles at 22,000 volts. The Wasco Warehouse Milling Company is located at The Dalles, Ore., and owns several immense warehouses, through which pass annually millions of pounds of wool and thousands of bushels of wheat. It is constructing a large flour mill which will be operated by electric power. It also owns the electric plant at The Dalles, and will close it when the new plant is in operation. The Pacific Bridge Company is closely allied to the City & Suburban Railway, of Portland, Ore.

MANHATTAN ELEVATED CONTRACT.—The Manhattan Railway Company has closed a contract with the General Electric Company for the entire electric equipment necessary for its trains. It involves the G. E. multiple unit train control, and the motors for 800 motor cars and 400 trailer cars. Each of the motor cars has two motors, making 1600 motors in all. Six-car trains will be run. The amount involved is over $3,000,000. The Westinghouse Company secured the contracts for the power station and generating machinery involving $2,000,000. By this division of the contracts the Manhattan Railway Company is getting more expeditious service.

LARGE ELECTROLYTIC PLANT.—One of the notable recent electric contracts is the one awarded to the Stanley Electric Manufacturing Company, of Pittsfield, Mass., by the Castner Electrolytic Alkali Company, of Niagara Falls, N. Y., for eight S. K. C. motor generators, each set having a direct-current output of 500 kilowatts. These machines will take the current from the Niagara Falls Power Company at 2200 volts, 25 cycles, converting same into direct current of 245 volts for electrolytic work. The contract includes a complete switchboard equipment for handling the 8500 kilowatts.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has recently added considerably to its equipment by the purchase of new machinery, including three Gleason bevel-gear planers, which plane the teeth accurately to cone lines, and an additional automatic spur-gear cutter, and Mr. T. G. Meachem states that it is now in the market to make metal gears to order in addition to its well-known New Process noiseless pinions.

MACHADO & ROLLER, of New York City, general sales agents for the Whitney Electrical Instrument Company, have entered into an arrangement with Robert W. Blackwell & Co., Limited, whereby that well-known engineering and contracting house undertakes the sole agency for the Whitney specialties in Great Britain, France and Belgium.

THE UNITED ELECTRIC RAILWAY COMPANY, of Baltimore, has awarded a contract to the Manhattan Electrical Supply Company, of 32 Cortlandt Street, for the supply of over $50,000 worth of insulated wire of sizes varying from Nos. 00 to 14. The wire weighs about 120,000 lbs.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended April 25: Antwerp—96 packages electrical material, $7,965. Aberdeen—3 packages electrical material, $300; 13 cases electric machinery, $2,021. Argentine Republic—2 packages electrical material, $66. Brazil—208 packages electrical material, $13,316; 8 packages electric machinery, $825. British East Indies—15 cases electrical material, $500; 6 packages electric machinery, $945. British Guiana—1 package electric material, $13. Berlin—1 case electric material, $199. Brussels—2 packages electrical material, $184. British Possessions in Africa—95 packages electrical material, $7,059. British West Indies—11 packages electrical material, $136. British Australia—292 packages electrical material, $21,603; 52 cases electrical machinery, $2,053. Central America—22 cases electrical material, $663; 92 packages electrical material, $3,632. Copenhagen—10 cases electrical machinery, $462. Cuba—3 cases electrical machinery, $311; 40 cases electrical material, $1,068; 10 packages electrical material, $555. Dutch West Indies—2 packages electrical material, $32. Florence—27 packages electrical material, $5,065. Gijon—2 cases electrical material, $81. Glasgow—67 packages electrical machinery, $9,541; 11 cases electrical material, $130. Genoa—1 package electrical material, $145. Gibraltar—13 packages electrical material, $750. Hayti—1 case electrical material, $40. Havre—38 packages electrical material, $2,630. London—104 packages electrical machinery, $8,910; 161 packages electrical material, $7,464; 1 case motor vehicles, $148. Liverpool—173 packages electrical machinery, $70,833; 151 packages electrical material, $30,972. Lisbon—2 cases electrical material, $14; 1 case telephone material, $66; 3 coils cable, $2,890. Mexico—26 cases electrical machinery, $4,171; 39 cases electrical material, $1988; 9 reels cable, $3,803. Manchester—1 package electrical material, $30; 229 cases electrical machinery, $27,645; 19 packages motor parts, $2,200. Marseilles—3 cases electrical machinery, $104; 24 cases electrical material, $800. Milan—6 cases electrical material, $3,000. New Zealand—56 packages electrical material, $3,197; 9 packages electrical machinery, $1,225. New Castle—6 cases electrical material, $500. Peru—2 cases electrical material, $30; 265 casese electrical machinery, $19,075. Preston—2 cases electrical material, $100. Southampton—1 case motor vehicles, $25; 10 packages electrical material, $319; 6 packages electrical machinery, $743. Tasmania—39 packages electrical material, $1,120. United States of Colombia—33 cases electrical material, $415. Vienna—4 packages electrical material, $343. Venezuela—52 packages electrical material, $790.

APPARATUS FOR WASHINGTON.—Though the appropriation for the installation of an electric lighting plant for the Interior Department does not become available for several months, it is noted by the Washington *Times* that the plans for the system are being developed. Congress appropriated $74,000 for the work, and that is considered to be hardly sufficient to make all the improvements which are needed in the lighting and the heating of the buildings used by the Interior Department. When the exact needs of the Department, in the line of lighting, heating and ventilation are ascertained, experts from the Treasury will be set to work upon the specifications. The scheme now includes an electric lighting plant, which will be placed somewhere in the building of the Interior Department, probably in a small house, which now stands in the court. This plant will supply current for the Interior Department, the Patent Office, the Pension Office, the old General Post Office building, and perhaps several others. The capacity of the plant will probably be about 6000 incandescent lamps, with boilers of 625 horse-power, and 500-hp engines. A new heating plant will be installed to furnish hot water for warming the Interior Department building, and steam for the Patent Office.

A REAL ISOLATED PLANT is what is proposed for the Boreel Building on Broadway, New York. The famous dingy restaurant in its rear has been bought by the Central Realty, Bond & Trust Company, which owns the Boreel Building, on the adjoining Broadway block, between Cedar and Thames Streets, soon to be replaced by a modern structure. New methods have made the basements of these skyscrapers available for so many uses that the proprietors of the new Boreel Building will not use any of the space in its basement for engines, boilers and dynamos, but will build instead a separate isolated plant on the nearby corner now occupied by "Old Tom's." It is thought that the rents of the additional space in the basement secured in this way will show the purchase of the neighboring property to be a sound business plan.

J. HOLT GATES & CO., 15 Monadnock Block, Chicago, are installing two 60-kw, 60-cycle, 1100-volt Warren alternators at 300 revolutions, direct connected to two Skinner engines, for the city of Cedarburg, Wis. The switchboard will be a fine piece of work and 10 ft. long. The dynamos will be run in parallel, and 50 arc lamps of the series-alternating system will be run in connection with the incandescent lighting. The Warren Company is making a specialty of small direct-connected alternating units for city lighting plants. The double voltage plant the Warren Company furnished to Urbana, Ill., has been a great success, and has excited much interest among electricians generally.

WORK IN CANADA.—Commercial Agent Boardman, writes from Rimouski, April 6, 1901: A company has been formed to put waterworks and an electric light plant in Rimouski. The town has voted to guarantee the interest on $50,000 of the bonds for 25 years. The company has purchased good water power and taken over the old aqueduct. Parties wishing to furnish supplies should write to Dr. G. T. Demers, secretary. Mr. A. Portugais, an enterprising plumber of this town, wishes catalogues and price lists of plumbers' and electric supplies. He does the work for the whole county and thinks he can purchase a part of his goods, if not all, cheaper in the United States.

MR. EDWARD BERGTHEIL and H. Wilson-Young, of the British electrical engineering and contracting firm of Bergtheil & Young, Camomile Street, London, E. C., are now in this country for the purpose of placing some important contracts for electrical equipment and supplies. These gentlemen have just returned from Cincinnati, where they are understood to have placed some substantial contracts with the Bullock Electric & Manufacturing Company, whose British interests they take care of. Messrs. Bergtheil and Wilson-Young are at present stopping at the Waldorf-Astoria. They will be in this country for another 10 days.

ELECTRIC PLANTS IN DUTCH EAST INDIA.—Under date of March 29, 1901, Consul Hill, of Amsterdam, informs the Department that Messrs. H. R. der Mosch and H. Jul Joostenz, of Batavia, Java, have been granted a 30-year concession for the erection of electric light and power plants in the cities of Padang and Djokjakarta. Padang, says the consul, is the largest city of the west coast of Sumatra and has a population of about 35,000. Djokjakarta contains 85,000 people and may be reached by rail from Samarang.

CONTRACT FOR RAILWAY EXTENSION.—Mr. J. Willis Fox, contractor and engineer, 32 Broadway, New York, has secured the contract for the five-mile extension of the Perth Amboy line of the Raritan Traction Company, to Metuchen and Maurer. This also includes the contract for 30,000 square yards of macadam. All material has been purchased, except the macadam stone and cinder ballast, which later will be put 6 inches under the ties.

BRITISH TONNAGE DECREASE.—The report of the British Boiler-Makers' and Shipbuilders' Society shows a decrease of 100,000 tons in the vessels launched during the past year, as compared with 1899. "America," says the report, "has shown a decreased tonnage, and is seeking other means to secure supremacy in the shipbuilding world. The American yards are better equipped with electrical and labor-saving appliances than any in Europe."

THE LIDGERWOOD MANUFACTURING COMPANY, of New York City, which concern is adding to its already commodious offices, has secured a contract from the General Electric Company for five electric hoists to be shipped to British India, where the machines will be utilized for erecting purposes at the power transmission plant at Cauvery Falls, Mysore, for which, it will be recalled, the General Electric Company obtained the contract.

POWER IN WASHINGTON STATE.—The Washington Water Power Company, of Spokane, Wash., which is operating the electric street railway and lighting systems, is arranging to turn the mill wheels of three other counties, Lincoln, Douglass and Adams; also to light the towns of Paha, Cheney, Sprague, Rittsville, Medical Lake, Reardon, Davenport and Farrington. The present capacity, 6000 horse-power, will be increased one-half.

THE CINCINNATI PLANER COMPANY, of Cincinnati, Ohio, reports an improvement in foreign business, having recently booked orders from England, Holland, Italy, Australia, South America and Mexico. It also reports home trade as very good, especially on the larger sizes, having six 60-inch planers now in process of construction.

BIG TOOL ORDER.—The British Westinghouse Electric Company has placed with the Niles-Bement-Pond Company an order for the factory to be constructed by the Westinghouse Company in England. The contract aggregates $420,000, it is said, and is undoubtedly one of the largest for machine tools placed.

ARGENTINE ELECTRICAL IMPORTS.—The imports of electrical machinery, appliances and other supplies, including cable wire and fittings for gas and kerosene lamps, by the Argentine Republic in 1900 were valued at $1,039,531. This was a decrease of $256,918 when compared with like importations in 1899.

THE W. H. ROE COMPANY, of 97 Franklin Street, New York City, is about to construct large hosiery and knit goods works at West Huntsville, Ala., in which electricity will play an important part. C. R. Makepeace, of Providence, R. I., is acting as consulting engineer for the projected plant.

General News.

THE TELEPHONE.

ANSONIA, CONN.—The sale of the Ansonia Telephone Company to the Southern New England Telephone Company was completed in New Haven recently. The price paid for the stock was 150, payment being made in bonds of the Southern New England Telephone Company, which are now worth 123. Rates on the newly acquired circuits will be raised July 1 to the regular rates of the Southern New England Company.

BRADFORD, ILL.—The Milo & Bradford Telephone Company has been incorporated. Capital stock, $5,000. Incorporators: John McClane, Leroy H. Reed and Harmon S. Pettigrew.

CHICAGO, ILL.—The Monarch Telephone Manufacturing Company has been incorporated here. Capital stock, $10,000. Incorporators: John E. Norling, Ernest E. Yaxley and Ward B. Sawyer.

CHICAGO, ILL.—The International Telephone Manufacturing Company has been incorporated here. Capital stock, $100,000. Incorporators: William E. McCormick, J. F. Dunlap and George H. Dunlap.

DES MOINES, IOWA.—The Trans-Mississippi Telephone & Telegraph Company, with offices at Des Moines, and a capital of $100,000, has been incorporated. J. W. Hill, of Des Moines, is president.

WINTERSET, IA.—The Hawkeye Telephone Company will build a new line from Winterset to Des Moines by way of Patterson and Bevington, and possibly Indianola. The company has also secured a franchise at Greenfield and it is likely that a line will be built connecting that town with Winterset in the near future.

TAYLORSVILLE, KY.—The Taylorsville & Bethlehem Telephone Company and the Normandy & Williamsville Telephone Company, both of Spencer County, have filed articles of incorporation.

LOUISVILLE, KY.—The Home Telephone Company, recently incorporated with a capital of $500,000, is said to have received 1,600 subscribers who have signed three-year contracts, and promises to begin business when 3,000 have been secured. John Armstrong, a local capitalist, is president, and E. W. Coleman, secretary and manager.

NEWROADS, LA.—The town council of Newroads has granted a franchise to the Cumberland Telephone Company.

BOSTON, MASS.—The report of Stone & Webster places the structural value of the Erie Telephone system, exclusive of cost of franchises and rights of way, at $25,570,000.

BOSTON, MASS.—The Erie telephone system made a net gain of 1961 subscribers in April: net gain since January, 4981. Total connected April 30, 146,580; waiting connection, 3666.

BOSTON, MASS.—It is understood that the syndicate of local banking houses which purchased the $50,000,000 of American Telephone & Telegraph 4 per cent. bonds, issued early in March, has sold them around par, with 100½ bid and none offered. Negotiations for the purchase of a like amount of bonds, to be issued early in May, are in progress.

SPRINGFIELD, MASS.—A rate of $18 a year on ten-party lines has been granted by the New England Telephone & Telegraph Company to subscribers to the residence service in small towns in Western Massachusetts. Sixty party business telephones, which have been restricted to 500 calls a year, now have unlimited service at the old price, $25. The cities do not share in the reductions.

BOSTON, MASS.—The American Telephone instrument statement for the month ended April 20 shows:

	1901.	1900.	1899.	1898.
Gross output	72,396	53,190	61,481	29,254
Returned	33,177	20,077	13,079	13,139
Net output	39,219	33,113	48,402	16,125
Since Dec. 20:				
Gross output	288,505	236,193	224,325	109,921
Returned	122,604	83,121	54,804	51,697
Net output	165,901	153,072	169,521	58,224
Total outstanding	2,118,717	1,733,577	1,294,767	977,345

DETROIT, MICH.—The Bell Telephone Company will extend its Windsor line to St. Joachim, in Rochester township.

GRAND RAPIDS, MICH.—The directors of the Citizens' Telephone Company have authorized the building of several important lines for the farmers, to be connected with exchanges in Hastings, Lowell, Cedar Springs and Rockford. There will be about 60 miles of these lines. They also ordered the building of considerable extensions of the State toll lines in counties north of Grand Rapids.

DETROIT, MICH.—Arrangements have been completed for the construction of the Detroit system of the People's Telephone Company. They include the erection of an exchange building. The company has planned an extensive underground system. Work on it will begin at once, the material being furnished by the Standard Underground Cable Company, of Pittsburg. The switchboard and telephones will be made by the Stromberg-Carlson Manufacturing Company, of Chicago, and the installation date specified in the contract, which was let recently, is February 1, 1902. The switchboard which will be first installed will have a capacity for 6,000 separate lines and arrangements have been made to care for double this number as the business of the company increases. It will cost $125,000, and with the 6,000 telephones ordered the contract amounted in all to $203,000. The contracts for poles, wire, and other materials have not yet been awarded.

ST. PAUL, MINN.—The Twin City Telephone Company has planned to make a general extension of its system to the residence districts of the city during the present season.

DULUTH, MINN.—The Zenith Telephone Company of Duluth will increase its funds by an issue of $100,000 in bonds, which will be used for extensions.

ELBOW LAKE, MINN.—The Elbow Lake Telephone Company has been incorporated. Capital stock, $10,000. Incorporators: Henry Sampson, Edward J. Scofield, Testen E. Dybdall, L. V. Barnes, William E. Lundeene, all of Elbow Lake.

HAY SPRINGS, NEB.—The Hay Springs Telephone Company has been organized to construct and operate a telephone to Moomon, a distance of twenty miles south of this place, then to connect with the Pine Creek Company's line, extending into the heart of the Sand Hills cattle country. W. B. McQuinn was elected president. The secretary was instructed to procure estimates for material and for construction of the line.

NEW LISBON, N. J.—The Union Telephone Company has been incorporated. Capital, $3,000. Incorporators: Wm. H. Reeves, Alfred J. Davis, M. Warner Hargrove.

SALAMANCA, N. Y.—Irving Hall is building a telephone line from East Randolph to Steamburg and Tunessassa. He will connect with the Independent Telephone line at Salamanca, and get connections with Red House and Little Valley.

ALBANY, N. Y.—The Albany Home Telephone Company, capital $750,000, has been incorporated. Directors: Samuel B. Rawson, F. H. Sudro, T. M. Brush, F. W. Martin, I. H. Griswold, A. E. Lord, of Elyria, Ohio; G. C. Lee, Jr.. Howard Hendrickson, W. H. Keller of Albany.

LONDON, OHIO.—The Madison-Clark Telephone Company, has been incorporated. Capital stock, $75,000.

CINCINNATI, OHIO.—The Spencerville Telephone Company, Spencerville, Ohio, has been incorporated. The capital stock is $20,000.

COLUMBUS, OHIO.—The Port Clinton Telephone Company has been incorporated, with a capital of $40,000 by James H. Brailey, Jr., Ed. L. Barber, Fred J. Bollmeyer, H. A. Barber and J. C. King.

COLUMBUS, OHIO.—At the call of President Yates of the State Association, just half of Ohio's County Auditors met in this city a few days ago to discuss questions of increasing valuations, among which came up the matter of telephone boxes. It was agreed to fix a minimum valuation of $10 a box.

CINCINNATI, OHIO.—President John A. Church, of the Business Men's Club of Cincinnati, has appointed a committee of five, whose duty it will be to take up complaints of various business men from cities and towns outside Cincinnati who allege that they can not secure equitable treatment at the hands of the Cincinnati Telephone Company.

JACKSON, OHIO.—Ira A. Sternberger, of this city, says that a representative of the new telephone line to be built between Jackson, Wellston and Colton, toward Waverly, Ohio., is in the East purchasing equipment. Connection will be made at Beavetown, Ohio, with the United States Independent Telephone lines, which will give entrance into Portsmouth, Toledo, Cleveland, Columbus and all the principal cities of the State except Cincinnati.

OTTAWA, ONT.—The Committee on Banking and Commerce of the Dominion Senate has reported the bill increasing the capital stock of the Bell Telephone Company from $5,000,000 to $10,000,000. The company has thus won out against all opposition. The proposal to restrict the rates the company may charge to such rates as were in existence in 1892, when the company got its original increase of capital stock, and the proposal also of making the company liable for any over-charges since that time, were rejected. The company, however, accepted part of the amendment compelling it to furnish telephones upon application from persons living adjacent to the telephone system. The company was ordered to produce a list of its shareholders before the bill was further proceeded with.

PORTLAND, OREGON.—It is reported that the Columbia Telephone Company, of Portland, which has maintained for several years a large independent system, will be bought out by Ohio capitalists. It is said that the same persons—from Warren and Youngstown, Ohio—who have installed independent telephone systems in Seattle, Wash., and Birmingham, Ala., will organize a $500,000 company to purchase and operate the Portland system.

MARSHFIELD, S. D.—The telephone line between Neillsville and Chili will at once be extended to Marshfield.

PIERRE, S. D.—Articles of incorporation have been filed for the Universal Wireless Telegraph Company, with a capital of $20,000,000. The incorporators are James N. Huston, Thomas E. Bishop and L. C. Smith.

ABERDEEN, S. D.—Manager Zeitlon, of the Dakota Central Telephone Company, has returned from the East, where he arranged for the purchase of large quantities of wire, poles and other supplies for the extension of the system. Copper wire for a new metallic circuit between Aberdeen and the twin cities will soon arrive and the line will be completed as soon as possible. It is possible a branch line from this circuit may be run into Watertown. New exchanges will be put in at Britton, Wilmot and Bryant.

COOKEVILLE, TENN.—The stockholders of the Overton Telephone Company have completed the reorganization of the company. The capital stock was increased from $5,000 to $25,000.

NASHVILLE, TENN.—A charter has been issued to the People's Telephone Company, of Stewart County. The capital stock is $3,000. The incorporators are W. T. Thomas, R. G. McFall, W. B. Scott, C. C. Lewis, W. O. Edwards, George Stacker and R. E. Thomas.

DALLAS, TEXAS.—The Trans-Texas Telephone Company, with headquarters in Brenham, will extend its line north from Caldwell to Milano.

FULDA, TEX.—The Bellah Telephone Company, of Fulda, Baylor County, capital stock $2100, has been incorporated by Sam Bellah, Sidney Webb and W. F. Kaufman.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will build a toll line from Merrill to Rhinelander via Tomahawk.

ELECTRIC LIGHT AND POWER.

VANCOUVER, B. C.—The city council of Vancouver, B. C., has granted an eighteen years' franchise to the Stave Lake Power Company to supply light and power within the city.

SAN FRANCISCO, CALIF.—Electric power generated on the Yuba River 140 miles distant, was for the first time used in the operation of street cars in Oakland on April 28. This is said to be the longest transmission line in the world. The current is transmitted at 40,000 volts.

SAN FRANCISCO, CALIF.—The hoisting at the leading mines on the Comstock Lode, Virginia City, Nev., will soon be done by electricity. The electric hoist at the Yellow Jacket shaft is completed and ready for operation. The electric hoisting machinery for the C. & C. and the Union shafts has been finished at the Risdon Iron Works, San Francisco, and will soon be installed. The next electric plant to be started up will be the one at the Belcher shaft.

DAHLONEGA, GA.—A. J. Warner and W. A. Carlisle, of Marietta, Ohio, and J. F. Moore have incorporated the North Georgia Electric Company, with a capital stock of $50,000.

ATLANTA, GA.—Mayor Mims has approved an ordinance granting a franchise to the Atlanta Railway & Power Company to operate an electric lighting plant in this city, thus almost assuring competition in electric lighting.

MURPHYSBORO, ILL.—An electric-haulage plant is being placed in position at the Harrison coal mine by the Big Muddy Coal & Iron Company. The change is an innovation in mining methods in this section, and the result will be watched with interest.

CAMBRIDGE CITY, IND.—A new municipal electric light plant has been installed in this city. The original cost was $14,000.

HARTFORD, KY.—The Hartford & Beaver Dam Electric Light, Railway & Power Company, of Hartford, Ky., with a capital stock of $50,000, has filed articles of incorporation.

COVINGTON, KY.—The formal transfer whereby various independent organizations are merged into the Union Light, Heat & Power Company, of Covington, has just been effected. The new company owns and controls all the plants in every Kentucky city opposite Cincinnati for several miles in either direction.

CITY OF MEXICO, MEX.—The new electric light plant of Victoria, State of Tamaulipas, Mexico, has been successfully inaugurated.

CITY OF MEXICO, MEX.—Among the important municipal improvements now under way in the city of Merida, the capital of Yucatan, Mexico, is the installation of electric light and gas systems.

MINNEAPOLIS, MINN.—The Barnett & Record Company has recently contracted to build a fireproof grain elevator with a capacity of 1,650,000 bushels for the St. Anthony Elevator Company, of Minneapolis. The elevator receiving machinery, scales, etc., will be operated by electric motors. A new power house will probably be built to furnish the current.

ST. PAUL, MINN.—Articles of incorporation for the St. Louis River Power & Improvement Company have been filed with the Secretary of State. The capital stock is fixed at $100,000. The principal place for conducting business is Cloquet, where a series of river improvements will be made by which the company will be enabled to supply electric, lighting and power. The incorporators are R. M. and F. E. Weyerhauser and Frank B. Poole, of Cloquet; William Irvine, of Chippewa Falls, Wis., and F. C. Denckman, of Rock Island, Ill.

CLINTON, MO.—The Clinton Light & Water Company, with a capital stock of $180,000, has been incorporated by James M. Avery, Paul Tyler, J. T. March and others as incorporators.

HELENA, MONT.—The Missouri River Power Company, which owns a dam and power plant at Canyon Ferry, and which is now constructing a pole line to Butte, will build another dam across the Missouri River at Stubbs' Ferry, five miles below the plant now in operation. The new dam and plant will cost about $1,000,000, and will develop 10,000 horse-power, which, with part of the power now generated at Canyon Ferry, will be sent to Butte.

ALBANY, N. Y.—Lake Placid Electric Light Company has been incorporated. Capital, $10,000. Directors: Melville Dewey, Annie Dewey, Asa O. Gallup, of New York City.

ALBANY, N. Y.—The Carthage Electric Light & Power Company, of Carthage, has been incorporated. Capital, $75,000. Directors: J. E. Strickland and P. J. Corcoran, Carthage; T. B. Basselin, Croghan.

CORNING, N. Y.—The Corning Gas Company has sold its illuminating gas plant and the Corning Likht & Power Company, the city electric lighting plant, to a syndicate of Eastern capitalists headed by Alden M. Young of New York city.

BUTLER, OHIO.—The village authorities have decided to build a municipal lighting plant and are inspecting plants in surrounding cities with a view to securing figures.

KENTON, OHIO.—Samuel R. Bullock, of New York, has purchased the plant of the Kenton Gas & Electric Company. The plant will be enlarged to furnish power for the new road.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Light Company has just put into service two boilers of 1500-hp each and a new engine, together with generators of a capacity of 30,000 lights. This equipment is additional to that already in service.

COLUMBUS, OHIO.—The city council passed April 29 the ordinance providing for the issuance of $110,000 bonds for the erection of a new municipal light plant. The bonds are to bear 4 per cent. interest and to run thirty years with privilege of redemption in ten years.

OTTAWA, ONT.—The Metropolitan Power Company, at Britannia, near Ottawa, has had a large force of men at work all winter, and the gigantic power canal is well on toward completion. Before this canal can be cut through to the river, however, an immense coffer dam will have to be constructed to hold the river water back while the work of rock cutting is pushed ahead; work on the big power house will be commenced at once. It is expected that water will be let into the canal in September next. At present the rock is being removed at the rate of about 250 carloads per day. Timber is being placed in position for the construction of the permanent coffer dam, and concrete will be manufactured for the piers and power houses.

GREENSBURG, PA.—C. S. Knight, of Fort Wayne, Ind., is here making plans for the erection of a mammoth electrical plant to cost $500,000. It is the intention of the company to light all of the towns within a radius of forty miles with electric lights.

MONTREAL, QUE.—The new Montreal Light & Power Company is adding to the generator capacity at Chambly power house. The additions are to be Westinghouse apparatus, and the voltage now will be stepped up to 20,000. This doubling up of voltage will, of course, give the company greater carrying capacity on its lines, and it is evident that it intends selling electricity on an extended scale. It also shows that its present plant is well loaded up.

HARRISBURG, VA.—The town council has taken steps toward establishing an electric light and power plant at a cost of $20,000.

RICHMOND, VA.—The new electrical committee of Richmond has appointed a sub-committee to frame an ordinance for the regulation of electric wires.

KILBOURN, WIS.—There is talk of building a dam on the Wisconsin River at this place and utilizing the estimated 7,000-hp for developing electrical energy, to be transmitted to the various factories and to Madison, Baraboo and surrounding towns.

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THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The San Francisco supervisors have expressed their intention of forcing the street car companies to pay an annual license tax of $50 on each car. The license is at present $15 per annum.

CANADIAN ELECTRIC RAILWAYS.—From returns received from the thirty-five electric railways of Canada, the Dominion Statistician makes up the following statement: At the end of December, 1900, the number of miles of electric railway in Canada increased 681 miles, or 49 miles over the number in the year previous. These railways carried 118,129,862 passengers in 1900, an increase of 14,097,203. This is equal to carrying the total population of the country 21 times. The car mileage run was 30,924,355 miles, an increase of 1,277,508 miles over last year. The mileage run and the passengers carried show that for each mile run the electrics carried 3.8 passengers, against 3.5 in 1899. The amount of paid-up capital invested in electrics on December 31, 1900, was $20,633,000, and the bonded debt was $12,619,422. The number of cars in active service in 1900 was 1,642, an increase of 98 over the previous year. The employes numbered 4,493, showing an increase of 164 over 1899. The total receipts for the year were $5,422,540, and the expenses were $3,268,001. Since 1897, the number of passengers carried by the electric railways increased from 83,811,000 to 118,130,000, an increase of about 41 per cent.

NEW HAVEN, CONN.—President Hall, of the New York, New Haven & Hartford Railroad Company, denies that his company has made plans for introducing electric power on the Waterbury, Meriden & Cromwell steam road.

ATTICA, IND.—The Commissioners of Fountain county have granted a franchise to the Crawfordsville Traction Company.

EVANSVILLE, IND.—The Evansville Electric Railway Company has increased its capital stock from $50,000 to $600,000.

SHELBYVILLE, IND.—At a meeting held by the local electric company recently the estimate for the construction and equipment of the electric railroad between this city and Indianapolis was ratified. Contracts for the construction will be let as soon as preliminaries can be arranged. This action insures the building of this important line. Ed. K. Adams is president of the company.

BALTIMORE, MD.—It is understood in financial circles here that plans are well advanced for the formation of a large security holding company which will make a specialty of controlling, operating and constructing railroads in various cities. Messrs. Middendorf, Oliver & Company, of Baltimore, are among the financiers associated with the company, which has a total authorized capital of $5,000,000. It is understood from an authoritative source that the enterprise will be broad in character and that offices will be opened in Baltimore, New York and other leading cities.

TRENTON, N. J.—The Paulsboro Traction Company has been incorporated. Capital, $1,000,000. The incorporators are Benjamin C. Paul, George C. Laws and George S. Talman.

TRENTON, N. J.—Al Johnson, of New York, the projector of the scheme to connect New York and Philadelphia by trolley, has obtained control of the Trenton, Lawrenceville & Princeton Railroad Company and the Princeton extension. The new company was organized by the election of the following directors: Al Johnson, New York, president; C. M. Bates, New York, secretary and treasurer; Wilbur F. Sadler, Jr., Trenton; F. S. Drake, Philadelphia; W. C. Callahan, Trenton.

NEW YORK, N. Y.—The Brooklyn Car Company, of Brooklyn, has been incorporated. Capital, $3,000. Directors: G. T. Andrews, Brooklyn; F. H. Quinby and H. M. Jackson, New York City.

YOUNGSTOWN, OHIO.—The Ohio River & Youngstown Railway Company has been incorporated by Walter S. Snyder, Albert Fassig, John Patterson, George E. Long and Will E. Nye. Temporary capital stock, $10,000.

ALLIANCE, OHIO.—The Coraopolis & Monaca Electric Railway Company has been incorporated by Henry Cooper, Bellevue; J. C. Whitla, H. T. Dempsey, Beaver Falls; Hermann W. Klein, Allegheny, and C. I. McDonald, Pittsburg.

CLEVELAND, OHIO.—The Cleveland & Chagrin Falls Railway Company has placed a contract for the erection and equipment of a storage battery power station to assist in the operation of the Garrettsville and Warren extensions of the line.

CINCINNATI, OHIO.—The Cincinnati, Dayton & Maysville Traction Company has been incorporated with $10,000 capital stock, which will be increased in the near future to $1,000,000. E. D. Smith, of Blanchester, has been elected president.

COLUMBUS, OHIO.—Officers for the Columbus, Delaware & Northern Railway Company have been elected as follows: James Loren, Columbus, president; J. W. Webb, Springfield, vice-president and treasurer; H. A. Fisher, Columbus, general manager; Lee Fisher, Columbus, chief engineer.

CLEVELAND, OHIO.—The stockholders of the Cleveland, Painesville & Eastern Railway Company have ratified the decision of the directors to extend the line from Painesville to Ashtabula with a branch line to Fairport and voted to increase the capital stock from $1,500,000 to $2,000,000.

YOUNGSTOWN, OHIO. The Sharon & State Line Electric Railway Company has been incorporated under the laws of Pennsylvania by the Penhale-Devitt syndicate. Capital stock, $10,000. The company will operate the Pennsylvania section of the Youngstown & Sharon Electric Railway.

CLEVELAND, OHIO.—An Eastern syndicate is reported to have taken an option on the car manufacturing business of G. C. Kuhlman, of Cleveland. Mr. Kuhlman also has a proposition before the Chamber of Commerce of Elyria, Ohio, for the erection of a plant in that city, in case the Eastern deal is not closed. Mr. Kuhlman proposes to organize a company with $250,000 capital stock.

CANTON, OHIO.—The promoters of the Canton-Akron Electric Railway have organized by electing the following officers: W. H. Hoover, president; Aaron Wagoner, vice-president; Charles A. Kolp, secretary; P. L. Saltonstall, treasurer, and John C. Welty, general counsel. Directors: Wm. H. Hoover, New Berlin; P. L. Saltonstall and C. Eldridge, Boston, Mass.; L. E. Meyers, Chicago; Charles A. Kolp, A. C. Brant and John C. Welty, Canton, and George Crouse and Aaron Wagoner, Akron. A contract for the construction of the road has been placed with L. E. Myers & Company, Chicago.

YOUNGSTOWN, OHIO.—The Penhale-Devitt syndicate, which controls a number of important lighting and railway properties in this vicinity, has secured an agreement with Richard Quay, chief owner of the New Castle Traction Company, the Beaver Falls road, and the connecting links between New Castle and Pittsburg for the consolidation of the two interests. Under the terms of the new consolidation, only one line is to be built between Sharon and New Castle, and the Sharon & New Castle Electric Railway Company has been organized with the following officers: Directors, R. R. Quay, George F. Penhale, M. A. Devitt, H. W. Whipple, M. A. Norris, Alexander McDowell and William Wallace. W. H. Whipple was elected president and M. A. Norris, secretary. By this consolidation it is stated the syndicate controls completed and projected roads making through lines from Youngstown to Pittsburg, and from Pittsburg to Erie.

PITTSBURG, PA.—A charter has been granted to the Coraopolis & Monaca Electric Railway Company for the construction of a line between the points named. The incorporators are: Henry Cooper, Bellevue; J. C. Whitla, Beaver Falls; H. T. Dempsey, Beaver Falls; Herman W. Klein, Allegheny, and C. I. McDonald, of Pittsburg.

CHATTANOOGA, TENN.—Clarence P. King and J. H. Jeffries, Philadelphia capitalists, are here to close a deal for the purchase of the incline up Lookout Mountain, which will be operated in connection with a rapid transit system in which they are interested. They are also negotiating for the purchase of the Chattanooga Electric Railway. If they succeed they will control the entire electric railway system of the city and a line to Chickamauga Park 150 miles in length. The deal would involve $1,000,000.

DAVILLA, TEX.—Mr. E. C. Sonntag, general manager of the Davilla Telephone & Improvement Company, is interested in a plan for the building of an electric railway from Bartlett to this place, a distance of ten miles. Mr. Sonntag believes that the investment will be a paying one and would like to correspond with capitalists in regard to the project.

SHEBOYGAN, WIS.—It is announced that an electric railway will be built from this city to Manitowoc.

MILWAUKEE, WIS.—The Wisconsin Traction, Heat & Power Company has taken important steps to complete the system of electric railways in the Fox River Valley. The acquiring of the property of the Appleton Electric Light & Power Company and the Fox River Valley Electric Railway Company has been commenced and consolidation of the two properties is contemplated. The company has secured a 99-year lease from the Green Bay & Mississippi Canal Company, of the water power and the site of the old Atlas pulp mill at Appleton, and will use the water power to supply electrical energy to Appleton and vicinity.

THE AUTOMOBILE.

SAN FRANCISCO, CALIF.—The San Francisco Fire Commissioners recently decided to order an automobile for the use of Chief Sullivan, and he will soon be able to dispense with horseflesh in going to fires.

ST. LOUIS, MO.—Notice of an increase in its capital stock from $30,000 to $50,000 has been filed by the Scott Automobile Company, all of the increase being paid up. The firm claims assets of $50,000, with no liabilities.

A FAST RUN.—The Automobile Club of America had a fast run on April 27 from College Point, Long Island, to Oyster Bay and back. On the return trip Mr. H. Ward Leonard made twenty-three miles in 55 minutes from Jericho.

THE CHICAGO AUTOMOBILE CLUB held a club run to Wheeling and return Sunday, April 28. Sixteen members made the round. It was the most successful run yet made by the club and showed that the weak points on many of the vehicles which caused annoying delays on previous runs had been overcome.

ELECTION.—At the annual meeting of the General Carriage Company, held in Camden, N. J., last week the retiring board of directors was re-elected, with the exception of T. L. Bragaw, Jr., who was succeeded by John J. Treacy. The directors will meet for organization in a few days, and it is expected that only slight changes will be made in the officers.

LEGAL.

GETTING OFF CARS.- The duty of passengers to look out for themselves in alighting from street cars is stated by the Massachusetts Supreme Court in an action for damages brought by Mrs. Oddy and her husband against a street car company. She intended to leave the car at Lansing Street, Roxbury, but just before that street was reached a fire engine and a hose carriage came along, and the car stopped, according to the rules of the company. Mrs. Oddy, thinking the car had stopped for her, left the car and was knocked down, and injured by the hose carriage. She and her husband sued for damages. A verdict for the company was affirmed by the Supreme Court on the ground that the company had not been negligent. The duties of the conductor were defined by the judge as follows: "It was right for the motorman to stop the car where he did upon the approach of the fire apparatus. The conductor, while bound to give the passenger an opportunity to leave at the stopping-place which had been indicated to him as the point where she wished her journey to end, was not obliged to inform her that that place had not been reached, unless he knew that she was attempting to leave under a misapprehension, and it was his duty to attend to the very things to which he was attending, namely, ascertaining when the obstruction to the progress of the car should cease by the passing of the approaching fire apparatus." The duties of passengers were stated by the court as follows: "Street car companies carrying passengers in ordinary public streets or highways are not negligent in not providing means for warning passengers about to leave a car of the danger of colliding with or being run over by other vehicles in the street. The risk of being hurt by such vehicles is the risk of the passenger, and not of the carrier. It is not a danger against which the carrier is bound to protect the passenger or to give him warning."

PERSONAL.

MR. HORATIO A. FOSTER, the electrical engineer, has removed his offices in Philadelphia to 650 Bullitt Building.

MR. F. P. FISH has been elected a director of the New England Telephone Company, to fill the vacancy caused by the death of Mr. J. E. Hudson.

MR. CHAS. J. GOLDMARK, consulting electrical and mechanical engineer, has removed his offices to the first floor, 66 and 68 New Street, New York.

MR. FRANK J. SPRAGUE left for Europe last week, several important technical matters awaiting his attention in England and on the Continent.

MR. HARRY ROLFE, of the International Correspondence Schools, Scranton, Pa., has accepted an important position in the mechanical engineering department of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

MR. PHILIP DEXTER, of Boston, vice-president of the Erie Telephone Company, with special charge of its finances, has been visiting the field and studying up the situation in Michigan, where a large sum of money is to be spent.

MR. W. F. WHITE, general manager of the Cincinnati Edison Electric Company, has been made a director of the Fall Festival Association of that city, and will take an active interest in the preparations for the Festival Association parades next September.

MESSRS. EDWARD BERGTHEIL AND H. WILSON YOUNG, electrical engineers and contractors, of London, England, are being entertained in Cincinnati by the Bullock Electric Manufacturing Company. They are placing large orders for electrical supplies and equipment.

MR. C. M. JARVIS.—Owing to the determination of the United States Steel Company to concentrate all operating departments of the constituent plants at Pittsburg, Mr. Charles M. Jarvis, vice-president in charge of the operating department of the American Bridge Company has resigned, as he does not care to change his residence from New England.

MR. GEO. H. DANIELS, general passenger agent of the New York Central Railroad, has sent us an unused two-cent postage stamp. Under ordinary circumstances this would be a queer present, but it happens that the stamp is one of the Pan-American Exposition series, and bears on it a beautiful representation of the Empire State Express. Mr. Daniels informs us that probably 300,000,000 of these will be issued.

MR. G. U. G. HOLMAN, a well known electrical engineer, and late of the switchboard engineering department of the General Electric Company, has received the appointment of general manager of the Canadian Electric Light Company of Quebec and Levis, P. Q. The plant is at Chaudiere Falls, seven miles above Quebec, and the other side of the St. Lawrence. Mr. Holman will have his headquarters at Quebec May 15.

MR. A. C. BOSTWICK, the well known automobilist, tried hard to get arrested in Central Park, New York, last week for violation of the rules which compel a chauffeur to slow down to three and a half miles every time he meets a skittish horse. But it would appear that the rules are too absurd to be enforced. Mr. Bostwick was supported by Messrs. Shattuck, Chamberlin and other members of the Automobile Club of America.

MR. LOUIS GLASS, the General Manager of the Pacific States Telephone & Telegraph Company, San Francisco, will have the entire control of the company's business on the Coast, during the absence of President John I. Sabin, who will hereafter spend much of his time in Chicago as president of the Chicago Telephone Company. During the fifteen years of his connection with the telephone company, Mr. Glass has won the regard of all by his uniform courtesy towards both the public and employees. So, it is to be expected that under this arrangement very cordial relations will prevail between the people of the Pacific Coast and the management of the great Pacific system.

MR. ANDREW CARNEGIE, the whilom telegraph messenger boy, elicits the following from the New York *Tribune:* "On the cloudcapped towers of Skibo Castle Andrew Carnegie may be watching from afar the sky kissing flights of the quotations for the securities of the billion dollar steel combination which brought to him one of the largest fortunes of this generation. But for Mr. Carnegie's genius and grasp of affairs no such wonderful development of American steel industries would have been achieved in this era. He may well contemplate with pleasure the complete fruition of his highest hopes. He was the greatest of American makers of steel, and American steel is now at the top in both hemispheres.

YERKES MEN IN ENGLAND.—A special cable dispatch from London of May 4 says: "A strange fatality appears to surround the Yerkes Hampstead & Charing Cross underground line. One after another the lieutenants in charge of the undertaking have resigned for no apparent reason. First Mr. Louderback, who had been Mr. Yerkes' right hand man for years, discovered that the London climate was unsuitable. Then Mr. Davis, who engineered the deal originally, suddenly severed his connection and returned to New York. Yesterday Mr. Howard Abel, who was specially brought from Chicago to superintend the work, resigned too, but declined to make public his reason. He will await the arrival of Mr. Yerkes next month before returning to America. This leaves only Mr. Chapman, the engineer, to look after affairs."

MR. WALTER M. McFARLAND, acting vice-president of the Westinghouse Electric & Manufacturing Company, is the subject of an appreciative article in the May number of *Cassier's*, from the pen of Rear Admiral Geo. W. Melville, U. S. Navy. Lieut. McFarland was for a number of years private secretary and confidential assistant of the engineer-in-chief of the navy, who refers to his resignation from the service in the following terms: "While I cannot but congratulate my good friend, George Westinghouse—whose name is a synonym for engineering genius and business enterprise—on Mr. McFarland's entrance into his official corps, I cannot but regret the loss to the fleet of one of its brightest men, and to myself of a most talented and loyal assistant." The article gives an account of Lieut. McFarland's naval professional career, and concludes as follows: "McFarland, as a worker, is of essentially a healthy type—buoyant, vigorous, and inspiring. He has, in marked degree, a faculty which is essential to men of affairs—the power to preserve continuity of thought on any subject, under frequent interruption and deflection. While quick in decision and action, his judgment is exceptionally well-balanced and unerring. In closing this brief record, I can say only that I have written it with keen pleasure, in my pride in, and warm regard for, one of the ablest and most winning men with whom it has been my fortune to be associated."

OBITUARY.

FRANK STEVENS, chief operator of the Western Union Telegraph Company in Boston, died at his home in Chelsea on April 28. He was born near Concord, N. H., in 1843.

MR. FRANZ RUMMEL, the celebrated Anglo-German pianist and son-in-law of Prof. S. F. B. Morse, has just died in Germany. While touring in this country he met and married the beautiful daughter of Morse, Leila, with whom social gossip once associated the name of Governor Samuel J. Tilden. As an interpreter of Beethoven and Schumann, Prof. Rummel had no superior. He was well known in America, and greatly liked. He leaves a widow and three sons.

EDUCATIONAL.

SYRACUSE UNIVERSITY.—A catalogue of the Syracuse University for 1901 has been received. This university gives a course in electrical and mechanical engineering in charge of Prof. Graham.

THE UNIVERSITY OF TENNESSEE, Knoxville, Tenn., is establishing a system of traveling libraries, and desires to form some technical libraries which may be placed in leading shops throughout the State, remaining six months at each place. Contributions in books are solicited.

UNIVERSITY OF MINNESOTA.—The State Legislature of Minnesota has passed a bill appropriating $60,000 for new buildings and equipment for the Engineering College of the University of Minnesota. The present shop building will be enlarged and a second wing constructed to house the electrical laboratory and lighting and power plant.

PURDUE UNIVERSITY.—We have received a copy of the annual catalogue from Purdue University with the announcements for 1901-1902. Among the special lecturers on technical subjects are the following-named well known gentlemen: A. V. Abbott, of Chicago; B. J. Arnold, Chicago; C. W. Rice, New York City; E. P. Roberts, Cleveland, Ohio; Chas. F. Scott, Pittsburg; A. J. Wurts, Pittsburg; Samuel Insull, Chicago; A. E. Kennelly, Philadelphia, and S. G. McMeen, Chicago. The University has also issued a separate catalogue containing selected views of Purdue University. The issue of views of this sort is a good idea, as it gives a great deal more understandable information regarding the University than usually can be derived from cold type.

Trade Notes.

THE NEW YORK OFFICE of the Onondaga Dynamo Company, of Syracuse, N. Y., was removed on May 1 to the St. Paul Building, 220 Broadway.

OIL FILTERS FOR ENGLAND.—The British Government has just sent its third order to the Burt Manufacturing Company, of Akron, Ohio, for Cross oil filters.

MR. GEORGE BENDER, dealer in second-hand electrical machinery, has removed from 153 to 137 Centre Street, New York, where he has larger quarters.

GOOD TIMES are here, or the A. B. arc lamp is becoming widely known, so says the Electric Appliance Company, Chicago, which is shipping them out by tens and hundreds.

POWER PRESSES.—"Bliss" straight-sided power presses are illustrated and briefly described in a 24-page pamphlet just issued by the E. W. Bliss Company, Brooklyn Borough, New York.

THE AMERICAN BRIDGE COMPANY will furnish to the Illinois Central Railroad Company all of the bridge work required on this railway during 1901. About 3,000 tons of steel will be used.

FARR BULLETIN.—The Farr Telephone & Construction Supply Company, of Chicago, in its April bulletin, gives many illustrations of its line of telephone apparatus, switchboards, etc. The bulletin comes in the form of a large sheet.

THE AMERICAN TOOL WORKS COMPANY, of Cincinnati, Ohio, has a contract for $18,000 worth of tools, including planers, for the Brooklyn Navy Yard. This company has received many orders of late from the Government.

FALCON KNIFE SWITCHES.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has just issued Card No. 112 illustrating its lugs for Falcon knife switches. A price list of the devices is also given.

THE CHICAGO ARMATURE COMPANY announces the removal of its office and works to its new plant at Blue Island, Ill. The company has thus enlarged and improved its facilities so that it can handle its rapidly increasing business expeditiously.

VICKERS, SONS & MAXIM, the largest manufacturers in the world of war material, who have immense works in England and supply all the foreign governments, have recently equipped their plant with Cross oil filters, manufactured by the Burt Manufacturing Company, of Akron, Ohio.

ELECTRIC WELDING.—Two catalogues, Nos. 3 and 4, issued by the Standard Welding Company, Cleveland, Ohio, give illustrations of metal pieces and forms which are electrically welded by this company's process. One of the catalogues relates to the welding of seamless steel tube bicycle parts, and the other to automobile parts.

MACHINE TOOLS FOR ENGLAND.—It is reported that the Niles Bement-Pond Company has secured the big Westinghouse Electric Company's contract for machines to be shipped to England. The Niles Tool Company's plant at Hamilton will furnish the major portion of the material for the British Westinghouse plant.

"A FEW INSTALLATIONS" made by the Ball Engine Company, Erie, Pa., is the title of a handsomely illustrated pamphlet recently brought out by that company. The catalogue is devoted entirely to illustrations showing installations of Ball engines in electrical plants in different parts of the country, there being no descriptive matter.

THE PERU ELECTRIC MANUFACTURING COMPANY has just issued a series of six little booklets on various articles which it manufactures. The latest is one on a porcelain handle and porcelain cross bar baby knife switch that is approved by the National Board of Underwriters. They are sent upon application free of expense.

FUSE ROSETTES are the subject of a 16-page pamphlet of the Peru Electric Manufacturing Company, Peru, Ind. These rosettes are made in several designs and are adaptable to all classes of work. They are manufactured of Peru porcelain, which is tough, strong and of high insulating qualities. The various styles of "Pemco" fuse rosettes are illustrated.

SEARCHLIGHTS, PROJECTORS, ETC.—Mr. Chas. J. Bogue, 213 Centre Street, New York, in a new catalogue of his products calls special attention to the many valuable improvements introduced in his electrical projectors and searchlights. The catalogue contains many illustrations of the different styles of projectors and searchlights manufactured by Mr. Bogue, and the principal features of each are pointed out in the descriptive matter.

THE KNEELAND REFLECTOR COMPANY, Boston, Mass., manufacturer of the Kneeland reflector shades, has removed from the factory on Friend Street to larger and much more convenient quarters at 104 Merrimac Street. This improvement in its facilities will not only increase the quantity of its output, but the increased storage room thus afforded will enable it to carry in stock at all times a full line of its shades in quantity, for immediate shipment

PNEUMATIC TOOLS.—The Standard Pneumatic Tool Company has appointed as its Western manager Mr. James H. Manning, formerly master mechanic of the Union Pacific Railroad Company at Cheyenne. Mr. Manning's headquarters are in San Francisco. A very complete line of the company's "Little Giant" tools and appliances will be carried in stock in order to supply the rapidly increasing demand for these machines from the Pacific Coast.

DE DION-BOUTON MOTORETTE COMPANY, Brooklyn Borough, New York, has issued a 30-page price list of its motors and accessories. The machines and devices are clearly illustrated and their principal features described. The company informs us that its accessory business is increasing very rapidly, and that this department has been placed under the management of Mr. C. G. Wridgway. Mr. Wridgway conducted a similar business in Paris very successfully before he came to this country.

THE STAR DYNAMO WORKS, Jefferson City, Mo., are manufacturing a line of small and medium sized electric motors and incandescent lighting machines. In addition to these the company makes a specialty of furnishing complete incandescent lighting plants, with directions for erecting, so that anyone with slight mechanical ability can install and operate such a plant satisfactorily. The company has complete lists covering the different standard outfits furnished by it which it will be pleased to mail to any one interested.

DYNAMOS AND MOTORS.—In a recently issued bulletin of the C & C Electric Company, New York, are described types "F P" and "F P E" dynamos and motors manufactured by this company. These machines are supplied in the open, the semi-enclosed or entirely enclosed types and their design is such that they may be placed horizontally, vertically or in any other position, and they may be belted, direct-connected or geared to their work. The bulletin contains perspective and diagrammatic views of these machines.

LARGE ENGINE.—One of the large engines being built by the Westinghouse Machine Company for the New York Gas & Electric Light, Heat & Power Company, was exhibited to local engineers at the company's shops at East Pittsburg a few days ago. This engine is of 6,000-hp and is one of eight of like size ordered by the New York Company. The height from the floor line to the top of the cylinders is 37¼ feet, and the diameter of the fly-wheel is 23 feet. This is said to be the largest stationary engine ever built in America. It weighs about 1,500,000 lbs.

ERICSSON TELEPHONES.—The Ericsson Telephone Company, 296 Broadway, New York, has received a letter from the Chief Signal Officer, War Department, Washington, D. C., in relation to the uses of Ericsson telephones in that service. The letter states that in the early part of 1900 the Signal Office shipped a lot of telephones of six different makes to Manila for test purposes, and that the record of the Ericsson telephone has been favorable. The Department on Feb. 26 placed an order with the Ericsson Company for 200 bridging telephones to go to Manila.

THE UNIVERSALIST CLUB of New York City recently gave a banquet at the Hotel St. Denis. Among the addresses was one by a principal of the International Correspondence Schools, Scranton, Pa. The extensive interest felt by intelligent men generally, by students of economics and by educators in this remarkable educational institution was evidenced by the close attention of members of the club to an address lasting an hour. The speaker described the text books used by the schools, the method of teaching by mail, and answered numerous questions regarding the schools.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports business unusually good for the early spring season. Among recent orders are one 200-kw generator for the Laclede Gas Light Company, St. Louis, the third order within two months for the same size machines; a power and light plant for the Heer Shoe Company, Portsmouth, Ohio, including one 80-kw generator, and motors of various sizes; a plant to the Filston Dairy Company, Baltimore, consisting of a 37-kw generator and five motors, and five direct-connected motors to Benedict Bros., Baltimore.

THE GREEN ENGINEERING COMPANY, Western Union Building, Chicago, manufacturer of the Green traveling link grate, has issued a catalogue which is of considerable value to steam users, aside from its descriptive features. It has a long series of coal tables, giving the analysis, heat units and annual output of Pennsylvania coal by counties, Ohio coal by counties and seams, Illinois coal by counties, Indiana coal by counties, Eastern Kentucky coal by counties, and Western Kentucky coal by counties. It is a commendable piece of enterprise, and the catalogue will be prized by steam users as a reference book.

RUBEROID FLOORING.—One of the unique features of the equipment of the new offices of the Standard Paint Company, 100 William Street, New York, manufacturer of the well known P. & B. products, is the use of the P. & B. ruberoid flooring. The floors of the big offices are throughout covered neatly with this material. Ruberoid makes a pleasant walking surface, being elastic and not so resisting as wood or oilcloth, and deadening the ordinarily harsh sound of footsteps. It is said to be absolutely water, acid, alkali and vermin proof, and is easily kept clean, absolutely odorless and pleasant to handle. Handsome designs can be painted upon it. Its durability and economy make it a very desirable flooring for mills, factories, breweries, engine rooms, etc., while its neat appearance makes it desirable as a flooring for stores, offices, etc.

ELECTRICAL AND MECHANICAL EXPERT WANTED.—An examination of applicants will be held at the Navy Yard, Washington, D. C., May 17, for an electrical and mechanical expert in the Bureau of Yards and Docks, Navy Department. The pay will be fixed at $7.04 or $6.00 per diem, as the result of the examination may warrant. The examination will be open only to those who can give evidence of having received a degree in an electrical or mechanical course from an institution of learning in good standing, and who have since then had at least three years' experience in the design, manufacture or supervision during or after installation, of electrical machinery, etc. Applications should be delivered to the Commandant, Navy Yard, Washington, D. C., on or before May 16. Each applicant must give his name, age, residence, citizenship, present occupation and previous employment or work done.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has opened a Cleveland branch office and store in the Electric Building, from which point the company's rapidly developing business in Ohio and adjacent States will be taken care of. The office will be in charge of Mr. A. E. Barker, and Mr. H. B. Hanford, and probably others of the company's traveling force, will have their headquarters at the new office. The company intends to carry a full line of samples of all switchboards, telephones and other apparatus at the new branch. Among other important exchanges in Ohio, the Kellogg Company is equipping Ashland, Alliance and Canton, aggregating 5300 members. The boards used are the full signal light central energy boards, the same as have recently been installed in the Cuyahoga Telephone Company's sub-exchange at East Cleveland which was described in ELECTRICAL WORLD AND ENGINEER March 9.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., calls attention to its Bulletin No. 117, just from the press, descriptive of the S. K. C. indicating wattmeter and S. K. C. phase indicator. These instruments depend upon the dynamometer principle and are of the spherical coil type. No allowance has to be made in the reading of the wattmeter, as it is not affected by a leading or a lagging load of any power factor. It indicates power directly, or in other words tells what the engine is doing. The S. K. C. phase indicator facilitates the counteracting of leading or lagging load disturbances on a line by indicating the proper variation of the excitation of the synchronous motors connected thereto. At a glance it tells the condition of phase relation of current and e. m. f. Where motors and lights are supplied by the same machines this instrument is of great value. By its indications the regulation of the whole system may be materially increased.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that its spring business has opened up in a most gratifying manner, and every department of its business is rushed with orders. It states that it is meeting with unparalleled success in the introduction of its new J. M. standard junction boxes, and that wherever put in, these boxes have met with the greatest success, and that all contractors say that this is one of the most economical and best arranged boxes they have ever used. It is so built that it has a slate lined wiring pocket back of the tablet, and the entering wires can be brought in from any direction through the sides or back without difficulty. The tablet board can be easily removed without disturbing the box, and is not placed in position until all the building operations are completed. The boxes are made in two general types, one for surface work and one for concealed work. The company has got out a special bulletin covering these boxes, which it mails on application.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 30, 1901.
[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

672,913. ELECTROLYTIC CURRENT RECTIFIER AND CONDENSER; C. Pollak, Frankfort-on-the-Main, Germany. App. filed March 7, 1899. (See Current News and Notes.)

672,936. CONTROL OF ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed Aug. 28, 1900. (See Current News and Notes.)

672,939. ANCHOR FOR ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed June 16, 1898. The rod of rare earth is provided with a lug between its extremities to which a supporting wire is attached.

672,942. SYSTEM OF AUTOMATIC TELEPHONE EXCHANGE; A. E. Keith, J. Erickson and C. J. Erickson, Chicago, Ill. App. filed June 23, 1897. A simplification of the interconnecting circuits.

672,950. ELECTRIC MOTOR; F. A. Merrick and J. D. Ferror, Johnstown, Pa. App. filed Aug. 16, 1900. The shaft can be removed from the machine without disturbing either the armature or the commutator.

672,951. ELECTRIC RAILWAY MOTOR; F. A. Merrick, Johnstown, Pa. App. filed Aug. 21, 1900. Details for facilitating the connection and separation of the sections of the field magnet.

672,952. ELECTRIC RAILWAY MOTOR; F. A. Merrick, Johnstown, Pa. App. filed Aug. 21, 1900. A modification of the preceding.

672,959. ELECTRICAL CONNECTOR; H. E. Norris, Northeast, Pa. App. filed July 20, 1900. A bond having a protuberance at each end of less diameter than the terminal portions of the bond.

672,967. TELEPHONE EXCHANGE MECHANISM; H. P. Snow, Erie, Pa. App. filed Sept. 28, 1899. Series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group.

672,989. TRANSFORMER; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 12, 1901. An induction coil comprising a central coil, a series of coils arranged equi-distant apart and surrounding the central coil and means for making a magnet circuit around said coil.

672,992. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed July 25, 1900. (See Current News and Notes.)

673,020. ELECTRIC PENDULUM CLOCK; F. Haenichen and O. A. Haenichen, Paterson, N. J. App. filed Jan. 10, 1900. The invention consists of an electric pendulum clock in which the impulse is imparted to the pendulum by the armature of an actuating electromagnet in connection with a weighted impulse rod and a current reverser, by which alternately currents of opposite polarity are thrown through the coils of the electromagnet for neutralizing the residual magnetism in the cores of the same.

673,039. TELEPHONE SYSTEM AND APPARATUS THEREFOR; A. T. M. Thomson, East Duluth, England. App. filed Oct. 9, 1899. In this system the subscriber communicates with the central operator by means of signals which are printed, thus avoiding communication through telephonic instruments and preventing central from hearing the conversation carried on between connected subscribers.

673,072. TELEPHONE METER; D. M. Bliss, Lowell, Mass. App. filed Oct. 1, 1900. A telephone meter located at the telephone instrument and provided with operating mechanism; a controlling circuit for said operating mechanism, and a circuit controller for said circuit operating in response to the operation of the signaling devices, said circuit controller being selectively influenced by incoming and outgoing signals respectively and adapted to remain in either position until again acted upon.

673,085. SAFETY SYNCHRONIZER FOR COUPLING INTO PARALLEL ALTERNATING CURRENT MACHINES; J. Pearson, St. Paul, Minn. App. filed Feb. 19, 1901. The combination with a rotary converter having direct-current leads and alternating current leads, of an automatic or self-closing switch in the alternating current leads, an automatic circuit breaker in the direct-current leads, and means independent of said switch and circuit-breaker for simultaneously tripping the same.

673,106. ELECTRIC ARC LAMP; S. H. Anderson, Pasadena, Cal. App. filed May 23, 1900. Details.

673,108. RHEOSTAT; A. W. Berresford, Westfield, N. J. App. filed June 12, 1900. A rheostat mounted on a circular base of insulating material provided with a row of teeth to act as detents for the arm and having suitable grooves to receive the material in which the resistance wires are embedded.

673,139. PORTABLE ELECTRIC FAN; E. R. Post and F. Wright, Newburg, N. Y. App. filed May 26, 1900. Details of a fan motor.

673,169. ELECTRIC ELEVATOR; N. O. Lindstrom, New York, N. Y. App. filed Feb. 4, 1901. Switch in the car by which it is possible to change the speed of the actuating machine, whether it be running as a motor or as a dynamo, and without the use of a rheostat.

673,172. MAGNETIC SEPARATOR; R. McKnight, New York, N. Y. App. filed March 15, 1900. A belt made up of magnetic material which is magnetized by running in proximity to a series of magnets arranged adjacent to a portion of its length, receives the crushed ore and carries the magnetic particles to one location and allows the non-magnetic particles to fall away at another location.

673,176. CLAMP FOR TROLLEY WIRES; J. W. Perry, Philadelphia, Pa. App. filed March 28, 1901. The end of a cross-over arm is provided with a laterally swinging clamp to grip and hold the wire in place.

673,186. MEANS FOR RETRACTING TROLLEYS; T. J. White, St. Louis, Mo. App. filed Dec. 26, 1900. Details of a spring ratchet device.

673,191. DEVICE FOR ATTACHING OR DETACHING ELECTRIC LAMPS; D. H. Arthur, Philadelphia, Pa. App. filed Dec. 27, 1897. Gripping jaws on the end of a rod are manipulated to attach or detach a lamp located in a remote position.

673,211. TELEPHONE APPLIANCE; M. London, McKeesport, Pa. App. filed Oct. 31, 1900. A bracket for holding the receiver.

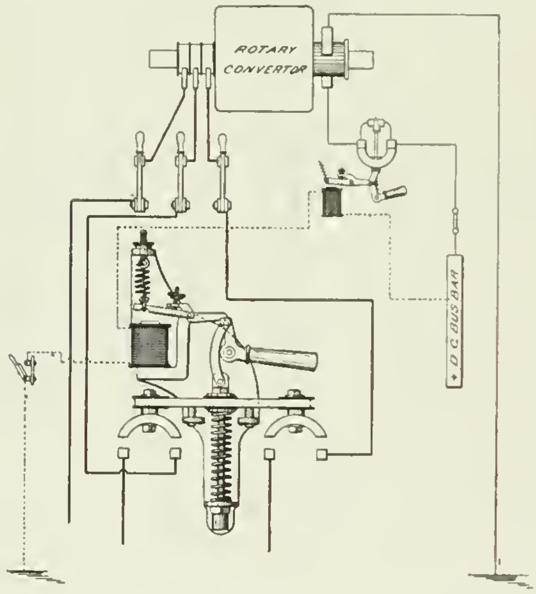
673,219. DOUBLE RELAY CROSSING SIGNAL; B. N. Parrish, Jackson, Mich. App. filed June 30, 1900. Details.

673,222. STORAGE BATTERY; A. Reuterdahl, Providence, R. I. App. filed Aug. 9, 1900. An envelope containing the plate and the active material is inserted in a groove in the walls of the cell, thereby causing the envelope to press the active material against the plate.

673,238. ELECTRIC SIGNAL; H. M. Buck and J. H. Love, Baltimore, Md. App. filed June 11, 1900. Details.

673,249. BASE FOR BATTERY CELLS; G. T. Eyanson and A. J. Shinn, Philadelphia, Pa. App. filed Dec. 4, 1900. A base piece for battery cells, having long channels through which liquid may be made to flow to the interior of the cell, the said channels being small in calibre so that the liquid therein will be of high resistance.

673,266. BOOSTER REGULATING SYSTEM FOR STORAGE BATTERY CIRCUITS; A. S. Hubbard, Belleville, N. J. App. filed March 2, 1901. The booster has its armature connected in circuit with the battery and its field magnet energized by circuit connections responsive to variations of battery potential to cut down the battery current on excessive variation in either direction.



673,085.—Safety Synchronizer for Coupling into Parallel Alternating Current Machines.

673,274. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, New York, N. Y. App. filed March 27, 1899. In a circuit controller, the combination of two movable switch members for controlling the same circuit, and two electro-responsive devices for controlling said switch members, each switch member and its electro-responsive device operating automatically and independently of the other to affect the same circuit, one when excessive current flows and the other upon failure or abnormal decrease of current.

673,277. INCANDESCENT ELECTRIC LAMP; J. E. DeMarcay, Paris, France. App. filed Nov. 8, 1898. (See Current News and Notes.)

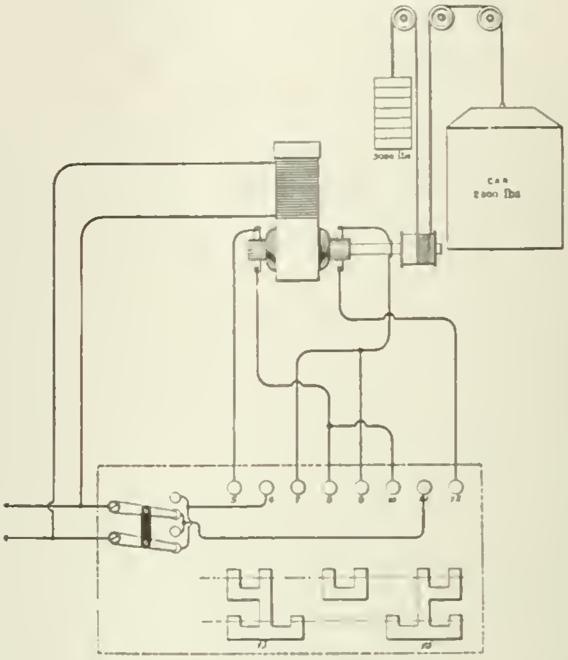
673,286. ELECTROMECHANICAL EMERGENCY BRAKE FOR TRAM CARS; E. V. Planta, Lucerne, Switzerland. App. filed Jan. 10, 1901. Skid shoes are allowed to drop from the rails in front of the wheel whenever the motors are thrown onto a closed short circuit.

673,287. STORAGE BATTERY; A. Reuterdahl, Providence, R. I. App. filed Oct. 10, 1900. Details.

673,289. SUPPORTING FRAME FOR RELAY MAGNETS; U. S. Rogers, New York, N. Y. App. filed Feb. 28, 1901. Details of construction.

673,315. PRINTING TELEGRAPH; G. A. Cardwell, New York, N. Y. App. filed Nov. 18, 1899. An electrical apparatus for printing or other purposes, comprising a number of working circuits or branches each, including a working magnet and having at least three breaks or gaps, controllable magnets each responding to a characteristic kind of impulse, sets of switches operated by the controllable magnets and each set closing breaks in different working circuits, but not all the breaks in any one working circuit and the operation of particular sets of switches in a certain order of three at the least, closing all the breaks of a particular working circuit.

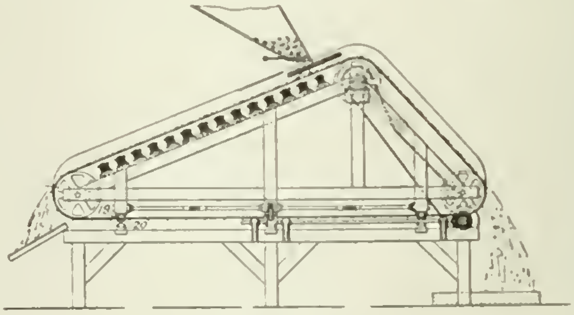
673,344. TELEPHONE SWITCH AND CUT-OUT; P. J. Wendell, Opheim, Ill. App. filed April 18, 1900. The object of this invention is a switch and cut-out whereby a telephone in the circuit may be completely cut out and the circuit be shunted past the telephone without interrupting the work of the other telephones in the circuit, or the telephone may be cut out from either direction while kept in circuit with all the instruments in the line in the opposite direction, and this without destroying the operativeness of the portion of the circuit from which it is cut out.



673,169.—Electric Elevator.

673,348. ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed March 13, 1901. To attain certain objects the invention comprises a connection which includes the proper resistance and one or more cells of battery, and which is connected with the brush of the booster in such a way that it co-operates with the series field of the generator.

673,350. TELEPHONE TRANSMITTER; C. E. Tocom, New York, N. Y. App. filed Feb. 4, 1901. Three diaphragms are used, granulated carbon being confined between the middle one and each of the others by soft textile material.



673,172.—Magnetic Separator.

673,364. PROCESS OF THE PURIFICATION OF ALUMINUM; W. Hoopes, New Kensington, Pa. App. filed Sept. 1, 1900. (See Current News and Notes.)

673,368. TROLLEY STAND; F. Pfent, Conners Creek, Mich. App. filed June 27, 1900. Details relating to the spring mount.

673,372. VOLTAGE REGULATOR; P. S. Tirrill, Groveton, N. H. App. filed June 27, 1900. A claim describes the invention as follows: In a voltage regulator, the combination with a solenoid-coil connected in multiple arc to the supply wires, and a core and sustaining-spring; of a double contact lever connected to the same, a torsion spring forming a fulcrum-mount for the lever, an upper and lower contact, a double solenoid core, one portion of which is connected to one of said contacts and the other portion to the other contact, and each being thereby thrown alternately into the circuit of the supply wires and an automatic rheostat connected to and worked by the core of the double solenoid, said rheostat being in the circuit of the dynamo field magnet

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THE EDISON SYSTEM IN BOSTON.

Nearly ten years ago an admirable article appeared in our pages by Mr. A. C. Shaw, describing in great detail the growth of the Edison system in Boston. This week we are able to return to the subject and now present an even more extensive article by Mr. E. S. Mansfield on the development and status of the system, which is one of the most important and most conspicuously successful in the country. It is needless to remind our readers that a great deal has happened in the interval between the two articles, and that remarkable changes have swept over the central station industry in the decade—the use of motors, the employment of storage batteries, the rise of the alternating system, the perfection of the enclosed arc, the general consolidation of local plants. Throughout all these mutations the Edison system in Boston has remained under one vigilant governing intelligence, and may fairly be said that President Edgar has made his influence felt in every branch of the work under his care. Even as we write, the vast arc lighting system in that city is also about passing under his management, presenting further opportunities for economical and profitable direction of the two great properties.

Our readers will readily note for themselves many salient features of interest in the article herewith presented, and will thank Mr. Mansfield for his lucid description and painstaking care in dealing with each part of the system. We venture to point out one or two things that might possibly be overlooked. The station has claims to be regarded as a novelty; in fact, we know of nothing like it. It represents what we might call the "compartment" or "cellular" type. Although three generating plants receive attention in the article, the load is almost wholly taken from the Atlantic Avenue station where the company obtains the best economy. Mr. Edgar has never believed it safe to depend on one station exclusively. Hence, carrying out an ingenious and thoroughly sound idea which he has nursed ever since the original equipment there went in, he has arranged the old and the new station as separate units. They can be operated singly or together; and either is adequate should anything whatever go wrong with the other. "Reserve" has, indeed, been the Edgar keynote, for it was the Boston Edison example which did so much to popularize the storage battery in central station work. As will be noted, the company has gone on increasing its battery equipment right down to the present time, finding in it an element which simplifies the distribution question very materially.

In these days when the alternating system bulks up so notably and, indeed, it may be said, dominates the future, the example of the success of the Edison direct current system in Boston as set forth in the article is worthy of more than usual consideration. It would be interesting to determine exactly, if it were possible, just how much the curious concentric physical shape of Boston has had to do with the result; as well as the character of the buildings and business. They certainly have been well adapted to the Edison system and have been availed of in masterly fashion. It is true that three-phase generation has been resorted to, but as in long, narrow New York, the distribution is practically all direct current, and this permits the important reserve value of the storage battery to come into full play. In other words, the Boston Edison system is evidence of sound eclecticism in the selection of the latest and best methods, and the results are indicated in the increasing angle of the curve showing the growth of load.

THE CONVENTION AT NIAGARA.

We have given our readers so many articles from first to last on the development and utilization of Niagara power, both at the Falls and at Buffalo, that we feel there is no reason to inflict on them again an oft-told tale. Few electrical plants, if any, are so well-known as those at the Falls, where it has now resolved itself merely into a question of expansion along the lines already made familiar. The visit of the National Electric Light Association to Niagara this year is impelled rather by a desire to see the Pan-American Exposition than to traverse again ground that has become so hackneyed in an engineering sense. Still, the beauties of the Falls are ever fresh, especially at this season of the year, and the officers of the Association are to be congratulated on not trying to establish headquarters in Buffalo itself, where the Exposition rush is already making itself felt in higher rates for hotel accommodation. The Exposition is handily accessible from the Falls, and is mightily well worth seeing. We are glad to know that it has served as an inducement to bring out a large attendance at the convention, whose meetings we could wish better attended. The widening range of central station work brings its managers face to face with many new problems of a varied nature, and to their solution, intercourse and exchange of views among those concerned is necessary. We do not recall a single meeting of the Association in all the long years of its existence where a central station manager could not derive great benefit from being in attendance, even if not participating in the discussions. There is still just as much opportunity as ever for the president and other officers to distinguish themselves by service to the industry.

Returning for a moment to Niagara itself, it may be pointed out that while the utilization of the great water power still goes on the long-distance transmission is all the time kept in check by the local demand for current. Mr. H. W. Buck, the electrical engineer of the Niagara Falls Power Company, has lately put the local utilization for that plant at 16,900 horse-power, intermediate utilization 11,500 horse-power, long-distance transmission 18,850 horse-power, which includes 5000 horse-power for the temporary uses of the Pan-American Exposition. There is, of course, the development down the gorge, but all that current again seems to find a ready local market. As a matter of fact, if we want real long-distance work, it is to the extreme West that we must look, although in the eyes of the public Niagara remains, curiously enough, the great exemplification of that kind of engineering.

ELECTRO-CHEMISTRY.

In our correspondence columns appear two interesting letters brought forth by an editorial in our issue of April 27. The purpose of that editorial comment has been successful, in so far as it has elicited this expression of views and debate. We quite agree with Mr. Burgess in so far as regards the requirements of electro-chemical industry and the capabilities of electro-chemists. The object of electro-chemical industry is, of course, to produce chemicals by electric processes at a small a cost and as great an effectiveness as possible. An electro-chemist, in the performance of his industrial work, cannot afford to make researches upon dissociation constants at indefinitely great dilution. He must be essentially an engineer and a man of business. In all this we are entirely on Mr. Burgess' side.

But we must differ with Mr. Burgess, if he takes the position that a trained electro-chemist does not need to be thoroughly grounded in the science of electro-chemistry, or to be familiar with the most recent developments of the German electro-chemical school. We take it that the very best theoretical knowledge, and the most complete laboratory equipment, is only just good enough for the preparatory training of men who are to turn that scientific knowledge to practical account. The process of thorough grounding in the science of any business with the view to a practical equipment for that business should stop only at the point where further expenditure of time and educational effort would tend to narrow rather than broaden the intellectual grasp of the subject. Similarly, when athletes are trained, it is possible to overdo the muscular training by carrying the developing process injudiciously too far. For this proposition of thorough scientific education we stand. The day has gone forever when ignorance of the science of any industry can be either a recommendation or an excuse. We want the highest possible development of theoretical knowledge, as taught in our technical colleges and universities, in the belief that the more we know about the laws of Nature, the better opportunity there will be to utilize them for the benefit of the race and for ourselves.

As far as concerns the aluminum and calcium carbide industries they would not have been capable of development to their present condition, if the sciences of electro-chemistry and electro-thermistry had not been developed to their present condition with the aid of the theoretical man. In other words, the practical results of the electrical industries, at the present time, are partly due to the business men who had sufficient confidence in the practical outcome of the process to invest capital in them, partly to the practical men who used sound judgment and practical experience in the work, and partly to the theoretical men who established laws, principles and sign-posts for the guidance of the practical workers, warning them where they should expect to fail, and indicating where they should expect to succeed. If the experimental researches of such men as have set the stepping-stones of electro-chemistry from Faraday to Nernst had not played their part, the practical men would to-day have been hindered, and would have had to do that work themselves, or given up the quest. We are entirely in sympathy with the views of Mr. Johnson, who lays stress both on the necessity for better theoretical and technical training of the electro-chemists at the outset of their labors, and also upon the practical nature of the electro-chemist's labors.

BLAZE CURRENTS AND LIFE.

In the Proceedings of the Royal Society for March appears a remarkable paper by Dr. A. D. Waller, who states the proposition that in the case of the particular class of vegetable seeds with which he has experimented, namely, beans, the seed is alive if it responds in a particular way to an electric stimulus, and that, on the contrary, it is dead if it fails so to respond. The method of distinguishing consists in placing the bean between a pair of suitable moist electrodes, and sending an electric discharge or impulse through the same, such as the discharge of a one-microfarad condenser, which has been charged by a couple of Leclanche cells. After the electric impulse, the bean electrodes are connected to a sensitive galvanometer. Suitable compensation is introduced to annul any unbalanced e. m. f. which may exist in the circuit prior to the application of the electric stimulus. Two such stimuli are usually given, one in the positive and the other in the negative direction. If the bean is alive, it will give a relatively powerful discharge (about 75 millivolts e. m. f.) usually in the same direction as that of the stimulus, while if the bean is dead, it will give only a relatively feeble polarization e. m. f. (about one millivolt) in the opposite direction to that of the stimulus. The process of disinguishing seems usually to have killed the bean, but in some cases the bean has been successfully planted after the test. The "blaze" e. m. f. set up is by no means a transitory feature, but after rising suddenly to, say, 75 millivolts, it falls in logarithmic fashion to about 10 millivolts in the course of half an hour. From a theoretical standpoint the subject is highly interesting, since it opens up a wide avenue for the study of the relations between life—that wonderful enigma—on the one hand, and electric actions, so completely capable of measurement and control, on the other hand.

WIRELESS TELEPHONY.

In the London *Electrician* for May 3 an article appears on this subject by Professor E. Wilson and C. J. Evans. Experiments are described, which were made for the purpose of extending the range of induction telephony between suitably separated and opposed induction coils, one of which carried the speech current, and the other of which had a reproduced speech current induced in it. The interest of the experiment lies, however, in the use of a direct-current arc as a telephone relay. Two methods are described, one in which an electromagnet energized by speech currents acts upon a direct-current arc, in such a manner as to slightly deflect it in a vibratory manner, after the fashion of the electric blow-pipe. The direct current thus supplied to the arc undergoes vibratory variation by reason of this influence, and the theory is that the range of variation is considerably magnified by the process. In the other experiment, the lower of the two arc carbons is mounted upon a transmitter, so that its distance from the upper carbon is slightly varied in a vibratory manner, and the influence of this variation upon the direct-current strength is to cause a like but amplified vibratory variation of its strength.

THE COMPUTATION OF TRANSMISSION SYSTEMS.

We are publishing this week a study of certain problems in power transmission that will, we think, be welcome to engineers who are wrestling with them in daily practice. Mr. Baum's method of attack is one which leads to very convenient graphical results, exceedingly easy to apply when once they are put in shape. And the computation which leads up to them is by no means intricate, although it involves necessarily a considerable number of constants, not all of them easy to predetermine. Aside from the convenience of the diagrams, it is a good thing to have emphatically brought to notice the all-important matter of regulation. The truth to tell, regulation is in many instances the one controlling factor in the design of the line, and even of the whole plant, for upon regulation depends the quality of the service, and hence the commercial prosperity of the plant. It profits little to design the line according to the canons of the art for maximum economy of transmission if for one reason or another the regulation is so poor that it becomes difficult to sell the output. And as a matter of fact, poor regulation is for one reason or another the besetting sin of many power transmission systems. It takes no little finesse to design a system so that the voltage on the distributing system shall be nearly uniform and constant, or to run the system to this end after it is installed.

Mr. Baum's diagrams are in a form which displays in a very striking fashion the effects of varying load, and particularly of varying power factor. Take, for example, Fig. 1, a common and comparatively simple case, and note the effect of passing, say, from half load at power factor unity to six-tenths load with a 5 per cent lag. The effect of the regulation is something startling, and it is by no means reassuring to note the trivial effect of change of load compared with that of the shift in power factor. In these days of alternating arc lights such changes are likely to be of daily occurrence, and only the utmost tact and skill can prevent them from producing most evil effects on the voltage of the distributing system. Or suppose some customer starts a big induction motor, which may, in starting, have a power factor not far from 70 per cent, corresponding to a considerable change in the power factor of the system even though the actual amount of energy involved be comparatively small. Down goes the voltage and then the users of incandescent lights begin to raise a justifiable protest. Such diagrams bring out the evil results of shifting power factor in a very striking manner, and point most forcibly to the need of available remedies. At present these are, in general, conspicuously absent. In more than a few plants it has been found necessary to cut apart the transmission and distributing systems by means of motor generators in order to secure immunity from such changes in regulation. It seems a drastic remedy, but it is effective and therefore is endured. Of course, slow changes in load and power factor can readily be controlled by manual regulation at the substation at the price of eternal watchfulness, but sudden changes are likely to catch even the most vigilant operator napping and then there is trouble. Add to such difficulties the effects of unbalancing the load, and it is easy to see that the regulation problem is one of most serious magnitude. As distances of transmission grow longer its solution becomes progressively more and more difficult.

As regards the generating station itself some relief may be had from modern methods of compounding. But while these may be of material assistance, up to the present time there does not appear to be any method in use which will really compound successfully against both change of load and change of power factor unless the latter is within quite narrow limits. And even if these limits should be successfully extended there still remains the unbalancing problem which in some plants is at times very troublesome. Regulation seems to us to involve two quite distinct processes, each of them involving engineering and inventive skill of no mean order. First, the primary voltage at the receiving end of the line must be held as nearly uniform as the conditions of load permit; and, second, the residual variations, including the effects of unbalanced load, must be taken care of at the sub-station. With respect to the former, several methods have been proposed of compounding the generators so as to take care of the general conditions of drop. However well designed the generators may be they will not, without assistance, take care of the drop in the line, and while the compounding devices may be far from perfect they can at least keep the variations of voltage at the receiving end within reasonable limits—within, at least the capacity of the regulative appliances there installed. As for sub-station regulation, careful hand regulation is not to be held in contempt, and on some systems it proves entirely adequate.

But there is certainly a loud call for automatic regulators capable not only of holding the general voltage steady, but of correcting unbalancing, whether the primary voltage is steady or not. In theory, such automatic regulation should be fairly easy of accomplishment, for it merely means the automatic operation of sub-station regulators such as are even now available. But in practice we have yet to hear of such apparatus being successfully used, although from time to time attempts at its construction have been made. To produce the required results the regulation should be by rather fine degrees, and the regulators on the two or three phases of the distributing system should have range enough to cover easily the maximum variation of voltage as between phase and phase. We have knowledge of several experiments on such apparatus being in progress, but of actual commercial results there are as yet none on record. Of the demand for such automatic regulation there is no question, and it is safe to say that the first successful apparatus on the market will meet a reception very gratifying to the inventor. But he has not yet appeared to claim his reward and we desire kindly but vigorously here to stir him into a sense of his responsibilities. It is time for him to move on and to move quickly. There is need of results, for power transmission must not fail of good service.

The Convention of the National Electric Light Association.

Mr. C. O. Baker, Jr., master of transportation of the National Electric Light Association, writes us: "It was stated in the transportation notice sent out last week that extra cars would be attached to the 8.30 a. m. train of the New York Central & Hudson River Railroad on Sunday and Monday. This is an error, as the 8.30 a. m. train does not run on Sunday, neither will extra cars be attached to this train on Monday (Empire State Express); but necessary extra cars will be attached to all other trains."

Following is the programme of the meeting:

TUESDAY, MAY 21.

Morning Session, 10 O'Clock.—Address by President Cahoon. Paper, by C. R. Van Trump, Wilmington, Del., on "A Station Load Diagram."

Afternoon Session, 2 O'Clock.—Paper, by Francis W. Willcox, Harrison, N. J., on "The Practical Side of the Incandescent Lamp." Report of the Committee on Standard Candle-Power of Incandescent Lamps," Dr. Louis Bell, chairman. Report of the Committee on Amendments to Freight Classification of Electrical Apparatus, James I. Ayer, chairman.

WEDNESDAY, MAY 22.

Morning Session, 10 O'Clock.—Paper, by H. W. Hillman, Schenectady, N. Y., on "Arc Lighting at the Beginning of the Twentieth Century." Report of the Committee on Photometric Value of Arc Lamps, Henry L. Doherty, chairman.

Afternoon Session, 2.30 O'Clock.—Paper, by Louis R. Wallis, Woburn, Mass., on "The Foresee (4-C) System of Charging." Report of the Committee on Uniform Accounting, G. E. Tripp, chairman. Report of the Committee on Analysis of Flue Gases, Henry L. Doherty, chairman. Executive Session—Report of the Committee on Legislative Policy, Samuel Insull, chairman.

THURSDAY, MAY 23.

Morning Session, 10 O'Clock.—Paper, by Augustus Treadwell, Jr., New York, N. Y., on "Storage Batteries in Central Station Work." Report of the Committee on Rules for Electrical Construction and Operation, Captain William Brophy, chairman. Topic, "Steam Heating from Central Stations."

Afternoon Session, 2.30 O'Clock.—Paper, by Calvin W. Rice, New York, N. Y., on "Distribution of Current at High Potential in New York City." Report of the Committee on Amendments to By-Laws, Samuel Insull, chairman. Executive Session. Reports of the secretary and Treasurer and Executive Committee. Election of officers for ensuing year.

Following are the officers of the Association and the members of the Executive Committee:

Officers—President, James Blake Cahoon, New York, N. Y.; first vice-president, Louis A. Ferguson, Chicago, Ill.; second vice-president, W. Worth Bean, St. Joseph, Mich.; secretary and treasurer, George F. Porter; master of transportation, C. O. Baker, Jr. Executive Committee: Henry L. Doherty, Denver, Colo.; Charles B. Hunt, London, Ont.; Ernest H. Davis, Williamsport, Pa.; H. M. Atkinson, Atlanta, Ga.; Samuel Insull, Chicago, Ill.; Samuel Scovil, Cleveland, Ohio; Charles E. Scott, Bristol, Pa.; William M. Brock, Paterson, N. J.; E. F. Peck, Brooklyn, N. Y.

Summer Meeting of the American Institute of Electrical Engineers.

The Institute has announced the following programme subject to revision, and has sent copies to members of the various electrical engineer societies in Europe. It is proposed to begin by a meeting of the members of the American Institute of Electrical Engineers and their European guests for formal welcome and reception on Wednesday, Aug. 14, 1901, at the house of one of the engineering societies in New York City as found most convenient and as arranged later. A collation will be served after the meeting, and there will be a steamboat excursion in the afternoon.

On the two following days technical visits will be made to important works and installations in New York city and vicinity. A banquet will take place on one of these evenings, and arrangements may be made later for a reception or some entertainment in the evening. No special assignment is made for Saturday, in order to enable visitors to make their own arrangements for sight-seeing and recreation.

The council committee has under consideration for Sunday, Aug. 18, a daylight trip up the Hudson to some convenient point, thence by rail to Albany, where the party will stop over night, leaving early on Monday, Aug. 19, for a visit to the works of the General Electric Company at Schenectady. From Schenectady the party will go by special train to Buffalo. On Tuesday morning, Aug. 20, the general meeting will open at Buffalo, in the Temple of Music, with addresses by the Exposition and municipal officials. A preliminary visit will be made to the Exposition in the afternoon. On the three following days there will be sessions for the reading and discussion of papers in the forenoon, and perhaps on some of the afternoons. The director-general of the Exposition has designated Thursday, Aug. 22, as "Electrical Day."

The programme contemplates the allotment of an entire day, if possible, for an excursion to Niagara Falls and the various electrical features to be seen at that place. Visits will also be made to various sub-stations in Buffalo from which Niagara power is distributed. The closing meeting will probably be held on Saturday, Aug. 24. Entertainments and receptions may be provided for some of the late afternoons or evenings.

Visitors desiring to include other large American cities in their tour, will be able to obtain all information desired from the secretary of the Institute, and also from members of the Institute residing in these cities who will be in attendance at the meeting both in New York and Buffalo.

Local committees of the American Institute of Electrical Engineers will be appointed in some of the larger cities to co-operate with the council committee for the purpose of facilitating the arrangements which the visitors may desire to make for visiting various places of interest.

The Consolidation of Lighting Interests in Cincinnati.

After a period of embittered warfare, in which a hot but fruitless campaign has been waged against electricity by some of the parties interested in gas, an important consolidation has been effected in Cincinnati, Ohio, through the intervention of the North American Company, of which Mr. C. W. Wetmore is president, and whose able representative has been Mr. John I. Beggs. The amount of the capital stock apportioned to the different companies on the recommendation of the arbitrators is as follows:

Cincinnati Gas Light & Coke Company	$19,264,000
Cincinnati Edison Electric Company	7,742,000
Jones Brothers Electric Company	896,000
First Cincinnati Edison Electric Illuminating Company	84,000
Brush Electric Light Company	14,000
Total	$28,000,000

This amount is the capitalization of the new corporation, which takes the name of the Cincinnati Gas & Electric Company. The members of the new board of directors are: S. R. Burton, George Bullock, J. T Carew, R. S. Cunningham, W. A. Goodman, A. Hickenlooper, R. A. Holden, A. H. Hinkle, M. E. Ingalls, N. G. Kenan, M. E. Moch, Casper H. Rowe, George R. Sheldon, J. G. Schmidlapp, C. W. Wetmore.

Of the new board of directors, nine are from the gas company interests, five from the Edison Company and one from the Jones Brothers Company. Beyond the fact that General Hickenlooper, president of the old gas company, will be elected president it is not positively known who the other officers of the company will be. It is intimated however, that Mr. Wetmore will be made vice-president of the company, that being the same place that he has held in the organization of the Cincinnati Edison Electric Company. It is the idea of Mr. Wetmore that there can be a much larger business developed in the supply of electric current to manufacturing establishments, and the business in this direction will be actively pushed. As for the gas business, Mr. Wetmore believes that there is a great opportunity for the extension of the use of gas for fuel. These two branches of the business will afford opportunities for largely increasing the business of the combined company, in addition to the natural increase of the consumption of gas and the extension of the commercial electric lighting.

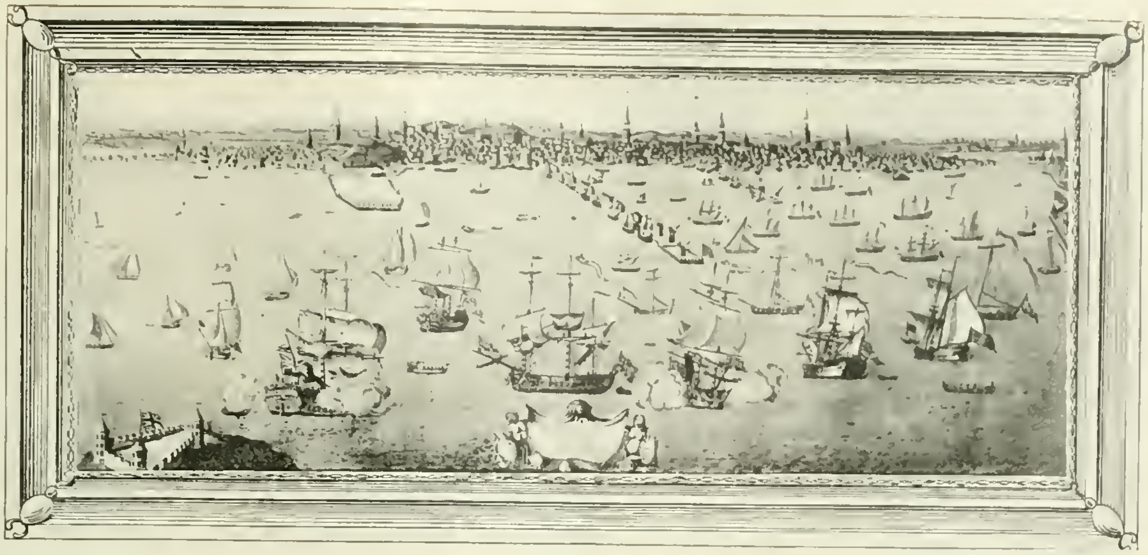


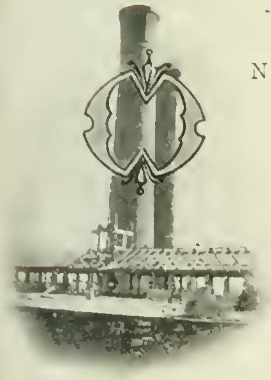
Fig. 1.—*View of Boston in 1773, Taken from Engraving Belonging to the Bostonian Society, Boston, Mass.*

The Edison System in Boston Its Development and Present Status.

BY E. S. MANSFIELD.

INTRODUCTION.

"No, ne'er was mingled such a draught,
In palace, hall or arbor,
As freemen brewed and tyrants quaffed
That night in Boston Harbor."



ON the 16th of December, 1773, the little town of Boston was in a state of unusual excitement. Lying anchored at Griffin's wharf were three ships, lately come from England, laden with tea consigned to certain Boston merchants by the East India Tea Company, upon which had been imposed a tax by the British Government. Tea being one of the most popular articles of import, the mother country had taken this method of forcing upon her liberty-loving daughter the policy of "taxation without representation," which was not only distasteful to the colonists but was opposed with all the vigor of their patriotic hearts.

Nineteen days had elapsed since the arrival of the first of these ships; days filled with anxious waiting combined with feverish activity. Every effort had been made to have the ships returned to England without discharging their cargoes, but without avail. The Governor was determined and the consignees were persistent.

By virtue of the law, if the tea was not discharged within 20 days after the arrival of the ships the custom-house officers would have the right to unload it themselves, and it was the solemn resolve of the committee that the tea never should be landed. A meeting was being held late in the afternoon at the Old South Church, where the patriot leaders were speaking in the strongest terms against the oppression of the crown and trying to effect some means of raising the embargo. During the discussion, the Quaker Rotch, owner of one of the ships, entered the meeting and announced that the Governor had absolutely refused to permit the withdrawal of the ships, whereupon Samuel Adams arose and, with a loud voice, exclaimed: "This meeting can do nothing more to save the country." This was the signal previously agreed upon, and a band of 40 or 50 of the citizens of Boston, who, by the flickering light of their candles, had decked themselves in the guise of Indians, passed by the door of the church, waving hatchets in their hands and giving voice to their warwhoops, and proceeded on their way, marching two by two down Milk Street, through Pearl till they reached Griffin's Wharf, where they posted guards to prevent the intrusion of spies, took possession of the three tea-ships, ripped open 340 chests and in about three hours threw into the Atlantic the whole consignment of tea, valued at about $100,000, and then dispersed in perfect order without molesting any other property.

FIG. 2.—VIEW OF BOSTON ABOUT 1800, FROM AN ENGRAVING OF THE BOSTONIAN SOCIETY, BOSTON, MASS.

If these same disguised citizens of Boston could pass along the same route to-day, before they had proceeded a great distance down Pearl Street, instead of the dwarfed masts of three tea-ships clustered about the quiet wharf, they would see the twin chimneys of the Edison Company's third district station rearing their graceful shafts 200 ft. into the air, surmounting a station of imposing proportions, equipped with apparatus the most modern and most progressive of any in the electric lighting industry. There they would find the boiler room directly over the spot where the tea-ships had been anchored years before. They would also find that the huge stones and timbers which composed the old wharf had been removed and that this whole area, where the waters of the harbor had been wont to ebb and flow with untrammeled liberty, had been driven thickly with piles and filled in with cement. They would also find there a continuous demonstration of the fact that salt water is as efficient for condensing purposes as it is for steeping tea, and it would not be surprising if they also found one of the company's agents on hand offering to replace their tallow candles with the Edison incandescent lamps in the ratio of 16 to 1, supplied from their underground mains.

The station referred to above is one of the most up-to-date plants in the country, and forms one of the six stations which comprise the manufacturing and electric storage equipment of the Edison Electric Illuminating Company of Boston, three of the stations being equipped exclusively with storage batteries and accessories, the other three containing the generating apparatus, to which is added in each case an electric storage battery plant.

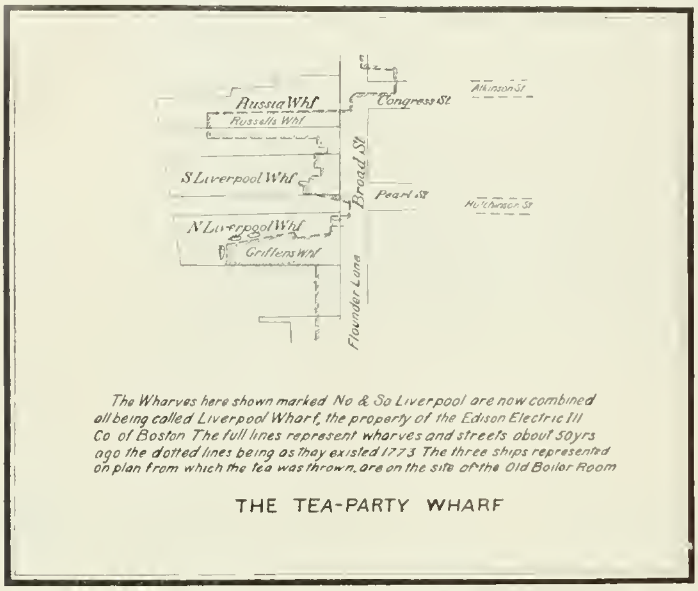

Russia Whf
Russells Whf
Congress St
Atkinson St
S Liverpool Whf
Broad St
Pearl St
Hutchinson St
N Liverpool Whf
Griffens Whf
Flounder Lane
The Wharves here shown marked No & So Liverpool are now combined all being called Liverpool Wharf, the property of the Edison Electric Ill Co of Boston The full lines represent wharves and streets about 50yrs ago the dotted lines being as they existed 1773 The three ships represented on plan from which the tea was thrown, are on the site of the Old Boiler Room
THE TEA-PARTY WHARF

FIG. 3.—THE TEA-PARTY WHARF.

It is our intention in this article to describe, as fully as may be, all the important features of the company, not only from the standpoints of generating and distribution, but also touching many of the local conditions which have influenced the development of the Edison system in Boston.

Space will be devoted to each of the stations in turn, giving more especial attention to the most recent plant on Atlantic Avenue, together with the addition thereto which has just been completed. This combined station is the one which occupies the site of the Tea Party Wharf, as described above.

Attention will also be called to a few of the more interesting details which pertain to the system, and which are instrumental in increasing its commercial efficiency.

HISTORICAL.

FIG. 4.—TEA WHARF ROCKS.

The Edison Electric Illuminating Company of Boston, was organized Dec. 26, 1885, with a capital stock of $100,000, which included the payment of $35,000 to the Edison Electric Light Company, the parent company, for license rights under the Edison patents. This contract limited the operations of the company to an area of about 70 acres in the business center of the city, almost directly surrounding what is now the first district station of the company. The right was given, however, to extend over the entire city of Boston or any part of it on equitable conditions. The plant which formed the nucleus of the new company consisted of one 200-hp Babcox & Wilcox boiler, and one 90-hp Armington & Sims engine, driving two Edison type H dynamos having a capacity of about 400 lights each, installed in the basement of Cashman & Keating's printing office situated in the rear of Haymarket Place, near Head Place. The company, having obtained a franchise from the city, leased a piece of property extending from Head Place to Bumstead Court, containing a two-story brick building, the lower floor of which had previously been used as a stable and the upper one as a tenement. The building was slightly changed over, and the company, having obtained possession of the little plant described above, removed it to the lower story of this building, which occupied a part of the land now covered by the "First" station boiler room. This station (Fig. 13) was started on Feb. 20, 1886, and the first customer to be supplied with electricity for lighting was the Bijou Theater, on the occasion of the production of "Iolanthe" on the evening of Feb. 22. The equipment of the station was soon after increased by the addition of one horizontal tubular boiler, one 125-hp Armington & Sims engine driving two Edison type H dynamos, which came from the New Orleans Exposition, and a similar engine and dynamos which had been sent from the Edison station at Rochester, N. Y. There was also a 30-hp Armington & Sims engine, to which were belted two Edison type S dynamos. This station gave the company a capacity of 2400 16-cp lamps burning at one time. In order to secure a full complement of customers at as early a date of possible, the company adopted the policy of free wiring for prospective customers and, in a very short time, the business had increased to so great an extent that the plant was taxed to its utmost capacity. It was only necessary to do free wiring for about six months, as the new method of illumination became so popular that customers were willing to have their premises wired at their own expense. In a very short time, the initial station proved itself so inadequate for the increasing business of the company, that at a meeting of the stockholders, held on the 10th day of November, 1886, it was voted to increase the capital stock to $250,000, and to enlarge the plant. Work was commenced at once on a new two-story brick building, 70 ft. by 50 ft., adjoining the old station, with an entrance on Head Place, having space for the accommodation of 20 150-hp Armington & Sims engines and 40 Edison bipolar dynamos of the No. 20 type, two dynamos being belted to each engine and run on the Edison three-wire system. There were installed at this time, however, seven engines and fourteen dynamos, the station being first operated in June, 1887.

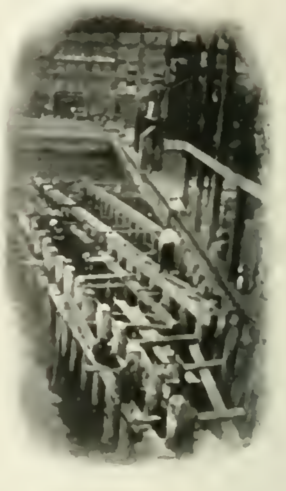


FIG. 5.—NEW LINE OF WHARF.

This station in Boston was probably the first power station in the world, as previous to this time there is no record of more than one or two motors being operated from a single plant, while the Boston station, in the latter part of 1887, was supplying current for 92 motors with an aggregate of 300 horse-power. Later, motors were run on the outside wires of the three-wire system, this company being the first one to adopt this system of power transmission.

FIG. 6.—AT THE WHARF END.

In September, 1887, Mr. C. L. Edgar, who directly previous to this time had been engaged in designing and building small central stations in Pennsylvania, became the station manager of the new company, and from that time up to the present Mr. Edgar has been personally identified with the progress and enlargement of the company, and it may be said that the present prosperous condition in which the twentieth century finds it, is largely due to the wisdom and foresight of the one who now holds the combined office of president and general manager.

Notwithstanding the mammoth proportions of the new plant on Head Place, as seen in the light of the time, such a fully equipped station satisfied, only temporarily, the growing demands of the company, so that from time to time it was necessary to make additions or construct new stations as the case might be, and the business increased so rapidly that there was but a short interim between the successive additions.

In June, 1887, the capital was increased to $500,000, and a new district opened between Tremont and Washington Streets, as far north as Bowker Street.

The financial showing of the Boston plant, even while using old second-hand machinery, was so promising that it not only made it easy to secure this additional capital for the increase of the plant, but it also resulted in securing the capital for the starting of the Chicago Edison Company, the Philadelphia Edison Company and the two uptown stations in New York City of the Edison Illuminating Company.

On Dec. 21, 1887, the second district station, fronting on Hawkins Street and extending through to Bowker Street, was started for the first time. This plant consisted of a two-story brick building, in which were installed two Heine boilers, one of 200-hp and the other of 300-hp capacity, four Armington & Sims 150-hp engines and eight Edison type No. 20 dynamos. This equipment was later increased to 12 engines and 24 dynamos. During the year, the overhead system of distribution was beginning to be abandoned and about 10 miles of three-wire underground tube was laid.

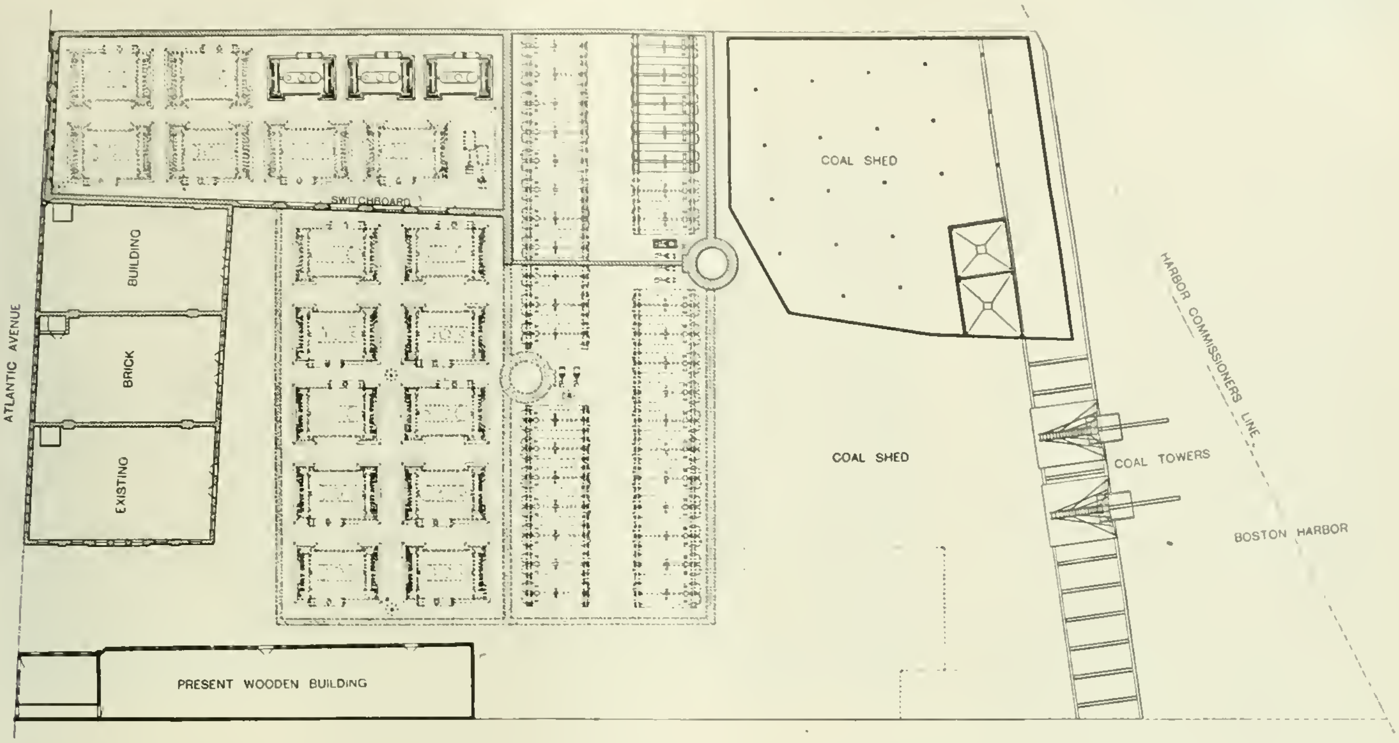


Fig. 7.—General Plan of Third Station Property, Atlantic Avenue—Original Installation and Proposed Extensions, 1891.

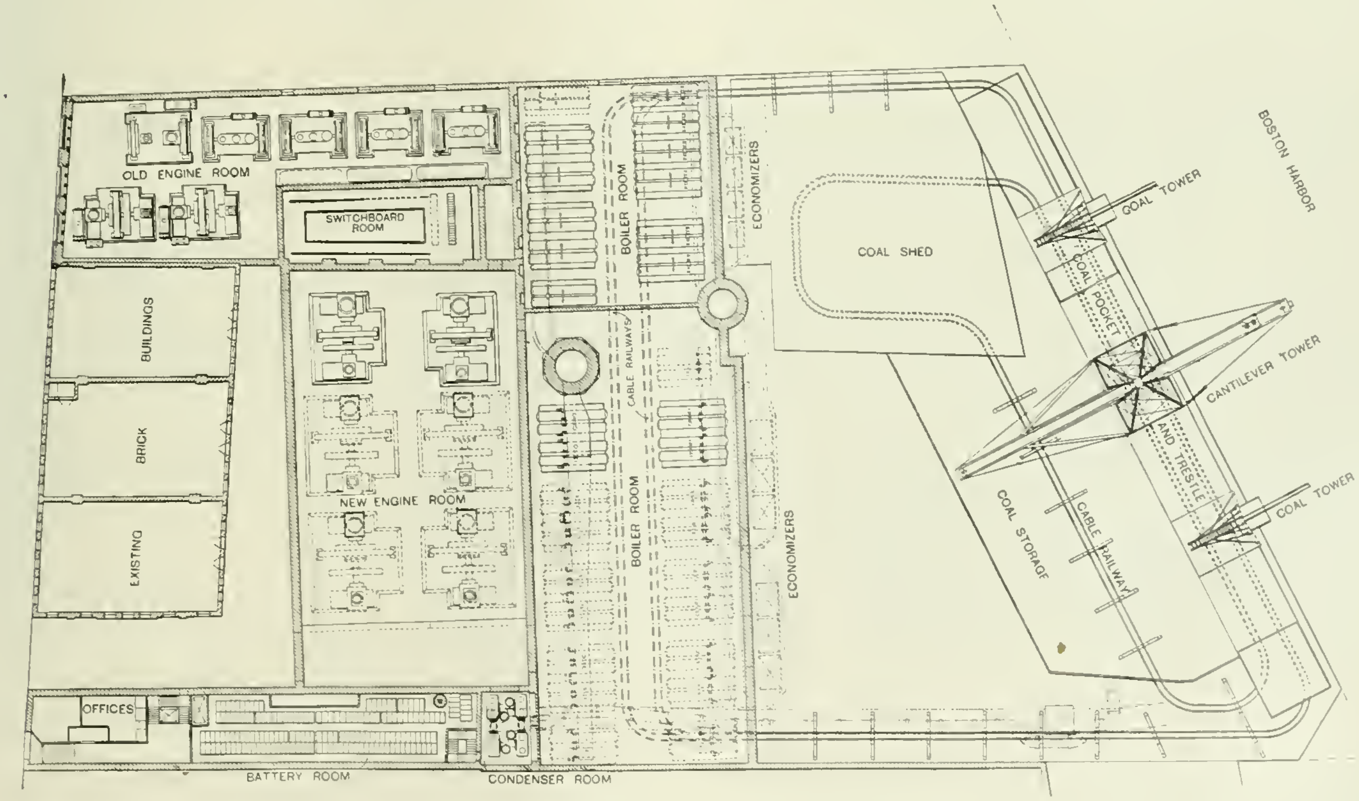


Fig. 8.—General Plan of Third Station Property, Atlantic Avenue—Installation and Proposed Extensions, 1901.

In June, 1888, a fire broke out in the first station dynamo room, destroying all the apparatus there contained. During the progress of the fire, a telegram was sent to Schenectady, requesting the immediate shipment of dynamos, and these, together with such ones as could be borrowed near home, were set up temporarily in the engine room, so that in 20 hours after the fire had been extinguished the current was again turned on.

During the summer of 1890 the first station building on Head Place was enlarged to include five stories, the first two being occupied by the generating plant and the other three being devoted to miscellaneous departments and the general offices of the company. The still increasing demand for current soon rendered the supply from these two stations, even when fully equipped, totally inade-

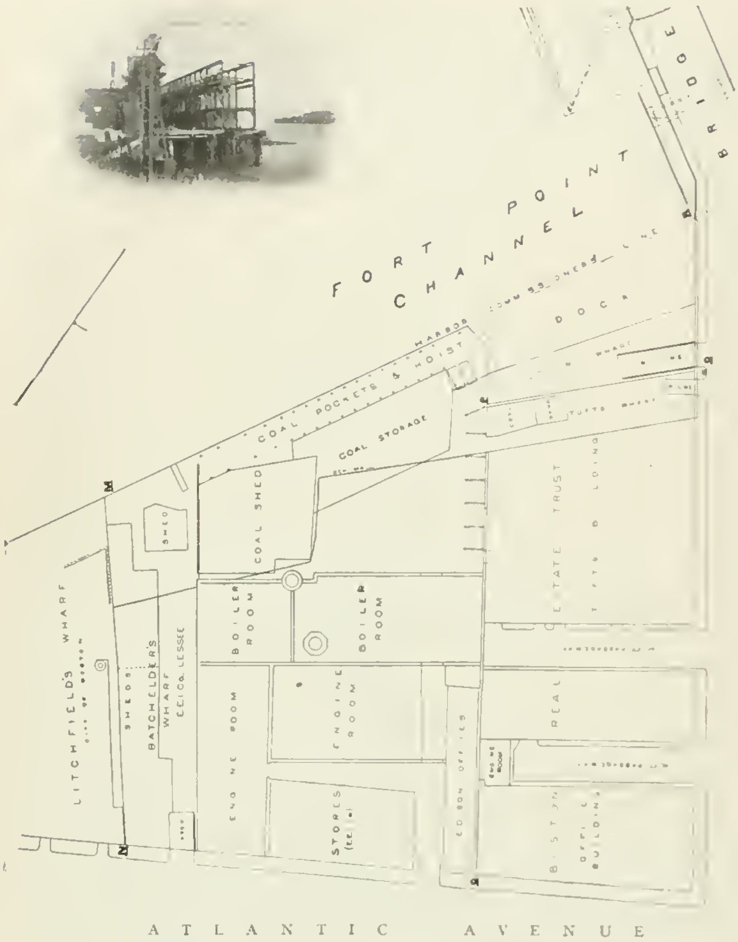


FIG. 9.—SURVEYOR'S PLAN OF ENTIRE ATLANTIC AVENUE PROPERTY.

quate and made necessary the building of a larger station composed of larger units and working on a more economical basis. This condition of affairs was met and its problem solved by the foresight of the company in providng such a station previous to the time when it was actually needed. To this end, Mr. Edgar visited many of the most important stations in Europe during the spring of 1890, investigating thoroughly the subjects of the construction of station buildings, types and sizes of units employed, and the general conditions which go to make up a modern economical electric light station. The outcome of this investigation was the company's third district station, now situated on Atlantic Avenue, at the foot of Pearl Street, occupying what was formerly known as Dolbeare's and Liverpool wharves, and a part of which was the site of the old "Tea Party Wharf," this property having been purchased by the company for this purpose. The ground was broken on Oct. 10, 1891, and a modern fire-proof structure erected, consisting of an engine room separated from the boiler room by a thick brick wall. The equipment consisted of Babcock & Wilcox water-tube boilers and triple expansion, vertical, condensing engines, to which were coupled direct-driven generators. This station was looked upon as a very great departure in the electric lighting industry, as these slow speed vertical engines were the first ever built on this side of the water, and the direct connected units were among the first in the history of the business, while the size of the engine room, with its ideal location upon the water front and its modern facilities for handling and storing coal, created widespread interest among engineers throughout the country.

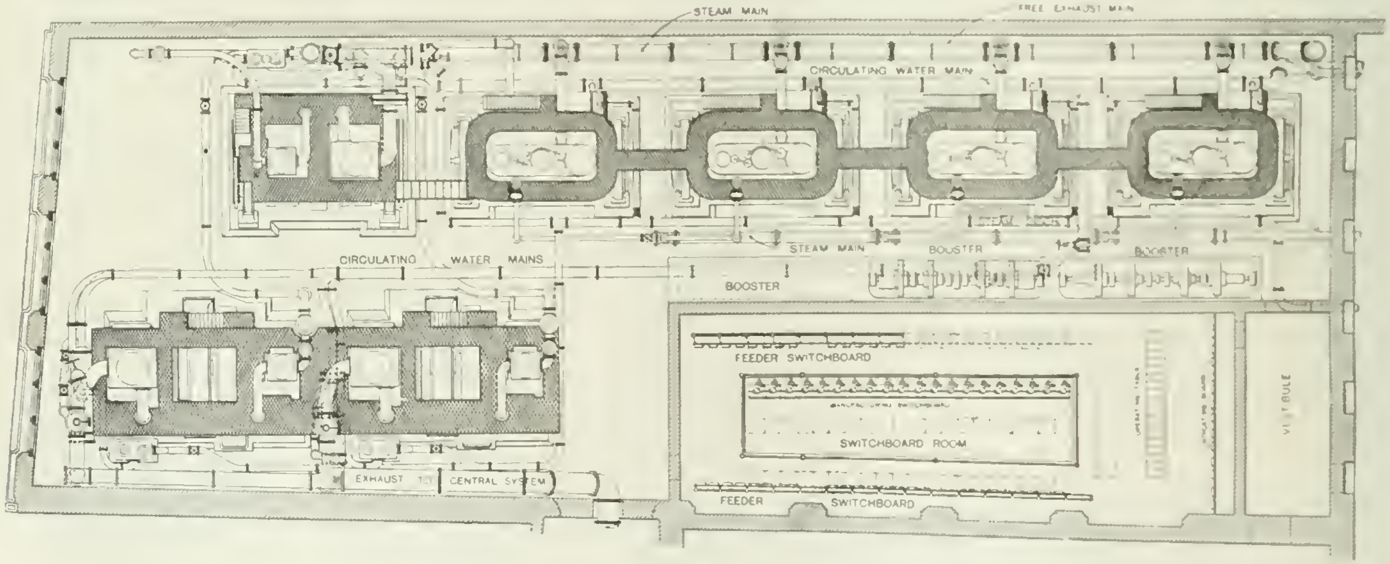


Fig. 10.—Plan of Old Engine Room, Atlantic Avenue.

Mr. Edgar went again to Europe early in 1893 to investigate the subject of storage batteries as auxiliaries to large central stations, such use having been made of them to quite an extent abroad, although practically a new thing in this country. The use of the storage battery in this capacity recommended itself so strongly that one was contracted for, to be installed on trial at the third district station on Atlantic Avenue, and this was put into commission in March, 1894, having been installed in a brick building just outside of the station and directly back of the switchboard. This battery was the first of its kind in the country and was looked upon with many misgivings by eminent engineers in different branches of the industry; but the battery proved itself equal to the test and showed itself to be a very important adjunct to the system. In June, 1895, another German battery was purchased and installed at the Head Place station in a building on Bumstead Court. The use of these batteries proving so satisfactory in connection with the generating plant, at the stations then existing, it was decided to provide battery sub-stations in the outlying districts, in order to increase the capacity of the system and to reduce the feeder losses during maximum distribution.

The fourth district station, consisting of a battery plant, was installed in August, 1896, and was located on Scotia Street, quite near to the center of the Back Bay district.

In September, 1897, a storage battery was installed in the second station on Hawkins Street, a third story being added to the building to accommodate it, and in August, 1898, a storage battery was put into commission in the fifth district station on West Canton Street. In September, 1900, another battery was installed in the sixth district station, situated on Pittsburgh Street, in South Boston, thus covering a district which heretofore had been supplied by means of a submarine cable across the Channel.

In March, 1900, work was started on an addition to the Atlantic Avenue station, following very closely the plans proposed in 1891, and consisting of a steel frame brick structure, comprising an engine and boiler room, connecting and extending at right angles to the station already existing. The wharf was also extended out to the Harbor Commissioners' line and modern coal handling machinery installed. This addition to the latest station has so increased the capacity of the system that a natural growth of the company's business can be handled without additional building for some time to come.

STATION NO. I.

Situated on Head Place, near the corner of Boylston and Tremont Streets, and extending back to Bumstead Court, is the first district station of the company. The main building has a frontage of 70 ft. on Head Place, extending 50 ft. to the rear. It is five stories high, and is of fireproof construction throughout, not only the walls being made of brick but also the ceilings and partitions. The only exposed woodwork in the building is found on the floors used as offices and appears in the form of doors and window casings, and in some cases light wooden partitions. The ceilings throughout the building are made up of brick arches supported between 10-inch wrought iron I-beams, spaced about 5 ft. apart, resting on pairs of 10-inch I-beams bolted together, which are in turn supported by cast-iron columns 11 inches in diameter on first and seconds floors, and 7 inches in diameter on the remaining floors. The walls to a height of 3 ft. are painted a dark red color; the remaining area of the walls and the ceilings are finished in pure white. The fifth floor of the building is tiled throughout in a very artistic manner, different designs being used in the various offices and hall. The other floors are covered with a layer of concrete 3 inches thick, upon which is laid about an inch of asphalt. The engine room floor is made up partially of movable cast iron plates, below which run the exhaust steam pipes, as do also the drips from the engines. The third and fourth floors are painted a deep maroon color. The building is lighted by means of windows on Head Place, also by large skylights. Where daylight cannot be obtained, illumination is provided by Jandus arc lamps, supplied with current from the incandescent mains.

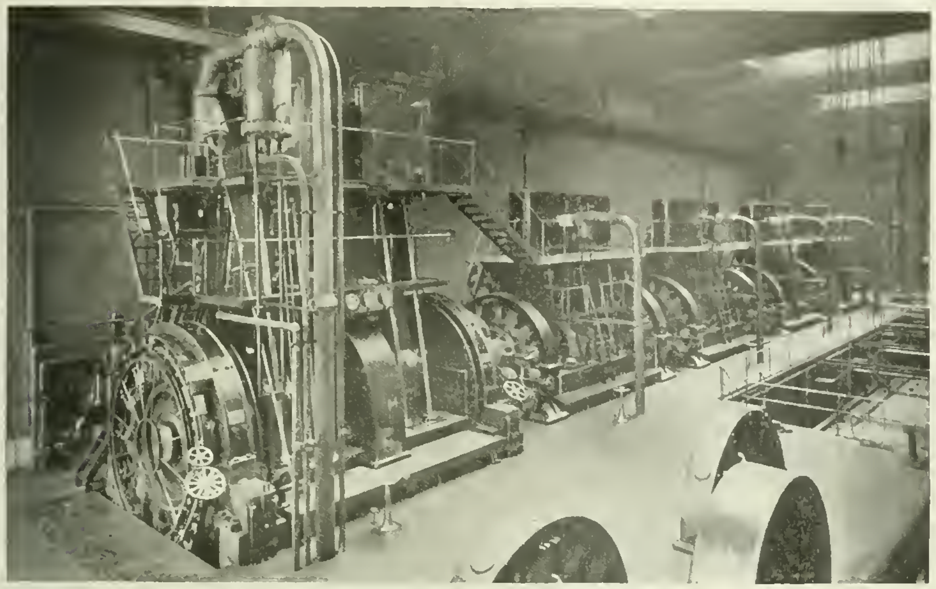


FIG. 11.—OLD GENERATING ROOM.

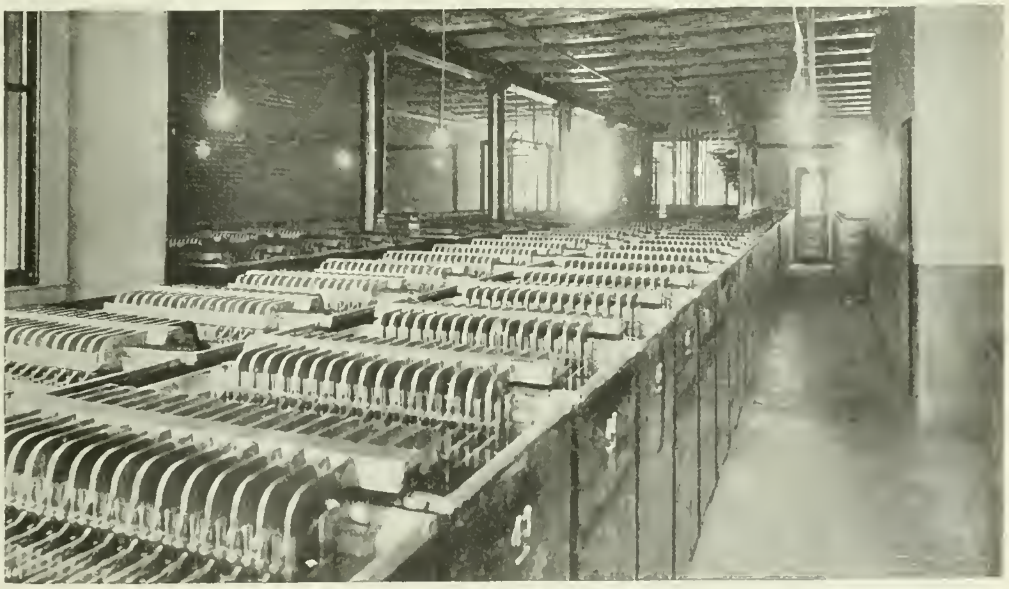


FIG. 12.—OLD STORAGE BATTERY PLANT.

The engine room occupies the first floor, just below the street level and is equipped with 19 Armington & Sims simple non-condensing engines of 150 horse-power, each running at a speed of 260 r. p. m. The cylinder diameter is 15½ inches, and the stroke 15 inches. The engines extend in rows along the width of the engine room, with the main operating valves of one row facing those of the next in order to facilitate economical handling. Also located on the engine room floor is a Knowles pump, directly driven by a 20-hp Edison, 250-volt motor, which operates a hydraulic passenger elevator. The engines transmit power to the dynamos in the next story by means of belts passing through the floor of the dynamo room. The generators, 38 in number, were built by the Edison General Electric Company, are shunt wound and of the bipolar type, with a rated capacity of 60 kilowatts each. To each engine are belted two of these 125-volt generators, running in series and furnishing current to the Edison three-wire system at a pressure on the outside wires of 250 volts maximum, so that each engine may be said to have connected to it and to control one three-wire unit.

Above the dynamos are suspended from the ceiling sets of copper rods, running the length of the room, to which are connected, through central station switchboards, the positive and negative sides of each dynamo, the neutral side of each dynamo being connected through a switch and Bergmann ammeter to the neutral bus-bar. Beneath each ammeter is a controlling rheostat connected in series with the field of the dynamo supplying current through that meter. The sets of copper rods referred to above conduct the current at the different voltages to the bus-bars located in the regulating and distributing room from which it is distributed at the voltage required through the feeder switches to their respective feeders.

In the regulating and distributing room (Figs. 15 and 16) is located a three-wire booster set, rated at 75 kilowatts, having four poles on each end and running at a speed of 750 r. p. m. The motor ends are wound for 250 volts and 300 amperes, while the booster ends have a capacity of 1350 amperes at 55 volts. Here also is situated the feeder switchboard in two parallel sections between which are the bus-bars. The positive and negative sides of the feeders are each connected through an ammeter to a four-way switch, so arranged that the feeder can be supplied with current from a bus of whatever voltage required. By means of a pressure wheel the pressure at the distant end of each feeder can be determined. Located on the east side of the room are the battery switches, operated by electric motors, by means of which one or more cells of the battery can be cut in or out as required. The feeder vault (Fig 18) just below the regulating room consists of the feeder ends, extending into the room. The feeders are connected to the various feeder switches by copper bars so clustered that the positives and negatives are in groups by themselves and separated from each other.

The third floor of the building is occupied by the offices of the purchasing agent, the mechanical engineer and the general agents, while the fourth floor is given up to the accounting department, the offices of the auditor and cashier. The executive offices occupy the whole of the fifth floor, one suite being devoted to the use of the president and general manager, the other to the general superintendent.

The boiler room consists of a four-story brick building, 60 ft. by 35 ft., situated on Bumstead Court, just at the rear of and adjoining the engine room. The boilers at this station are operated at 100 lbs. steam pressure, there being installed on the first floor three Whittier return tubular boilers, each having a shell 16 ft. long and 72 inches in diameter, containing 140 3-inch tubes. The furnaces have each 36 square feet of grate surface. The second floor is used as an ash room, the ashes being discharged through chutes from the boilers above, after which they are teamed away. The third floor is equipped with five Babcock & Wilcox water tube boilers, having a nominal capacity of 285 horse-power each, made up of three 36-inch drums, having 15 sections of 12 tubes each, and a grate surface of 56 square feet. Facilities for producing forced draught on the Babcock & Wilcox boilers are provided by means of a 6-ft. B. F. Sturtevant fan driven by a double simple direct-connected engine running at 430 r. p. m. The boilers are supplied with city water by means of three Davidson simple feed pumps, having a 12-inch stroke, the diameter of the steam cylinder of one being 9 inches, of the other two 10 inches each. These feed-water pumps are fitted so that they can be used in connection with a system of piping and fire hose in case of fire. There are also provided in case of need three No. 9 E. Korting universal injectors. Before reaching the pumps the feed water from the city mains passes through a Goubert heater, which consists of a coil of pipe containing the water surrounded by exhaust steam from the engines. By this means the water is raised to a temperature of about 210 degs. F.

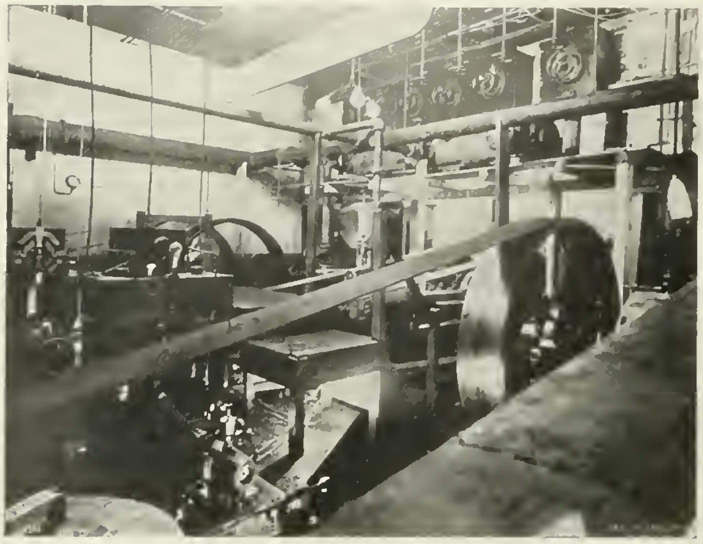


FIG. 13.—FIRST ENGINE AND DYNAMO ROOM OF THE COMPANY LOCATED IN AN OLD STABLE, BUMSTEAD COURT.

The fourth floor of the building consists of a coal bunker, having a capacity of 250 tons. The coal is hauled from the water front to a coal pocket beneath Bumstead Court, where it is deposited through coal holes. Beneath this pocket is a track for the accommodation of coal cars. These are filled from the pocket, raised to the roof by means of an electric elevator, and the coal is deposited into the bunker through scuttles from which place it is delivered, as required, in front of the boilers by means of steel chutes. The flue gases pass through a rectangular shaped chimney 150 ft. high, having sides 25 ft. by 14 ft. at the base and 22 ft. by 12 ft. at the top. The chimney has a brick cap surrounded by a grated iron platform and railing. Owing to its size and height, it is a landmark in this section of the city.

There are two storage batteries in use in connection with the station, which will be described together with the other batteries.

STATION NO. 2.

Almost a duplicate of the first station in matter of consruction and equipment, the second station (Fig. 17) was constructed to supply the demands of the business section of Boston north of that taken care of by the Head Place station. It has a frontage of 38 ft. 3 inches on Hawkins Street, extending through to Bowker Street, a distance of 164 ft., having a frontage of 15 ft. 3 inches on Bowker Street. The main building is three stories high, built entirely of brick and iron, and is very similar to the first station in respect to the interior finish. The ceilings, made up of brick arches faced with corrugated iron, are supported at the walls by 6-inch square iron columns and in the center of the engine room by a row of wrought iron columns 14 inches in diameter, and in the dynamo room by columns having a diameter of 11 inches. In the engine room are installed 12 Armington & Sims, 150-hp simple non-condensing engines, driving, on the floor above, 24 60-kw, 125-volt generators, built by the Edison General Electric Company, and connected in the same manner as the units at the Head Place station. The dynamo room is plastered and both this and the engine room are painted dark red to a height of 5 ft., the rest being finished in white. These rooms are lighted by windows on Hawkins Street and by Jandus arc lamps. The feeder switchboard is located in the western end of the dynamo room, through which the current from the different buses is distributed to the feeders in the vault below by means of flexible cables. On the south side of the room is located a General Electric three-wire booster set, consisting of a motor and booster for both positive and negative sides of the system. These boosters have each six poles, are rated at 75 kilowatts, and run at a speed of 650 r. p. m. The motor end runs on 240 volts, and the booster end is wound to deliver 1364 amperes at 55 volts.

On the third floor of the building is an electric storage battery which will be described later.

The boiler room is a continuation of the engine room, and is situated directly in the rear of it, consisting of one story with a coal bunker just above, the roof of which is on a level with the floor of the battery room. The boilers are operated at 100 lbs. steam pressure and consist of the following: Two Babcock & Wilcox single-deck water-tube boilers of 225 nominal horse-power, with Jarvis setting, which are made up of 13 sections of 9 tubes, each 18 ft. long by 4 inches in diameter; two Heine safety boilers of 260 nominal horse-power each, having Jarvis setting, and consisting of 140 3-inch tubes with two 36-inch drums; one Heine safety boiler of 164 nominal horse-power, having 87 3-inch tubes and one 48-inch drum. The feed-water is supplied from the city mains and flows through a National heater by which it is raised to a temperature of about 210 degs. F. It is then delivered to the boilers by two simple direct-acting Davidson feed-water pumps, having 7-inch steam cylinders.

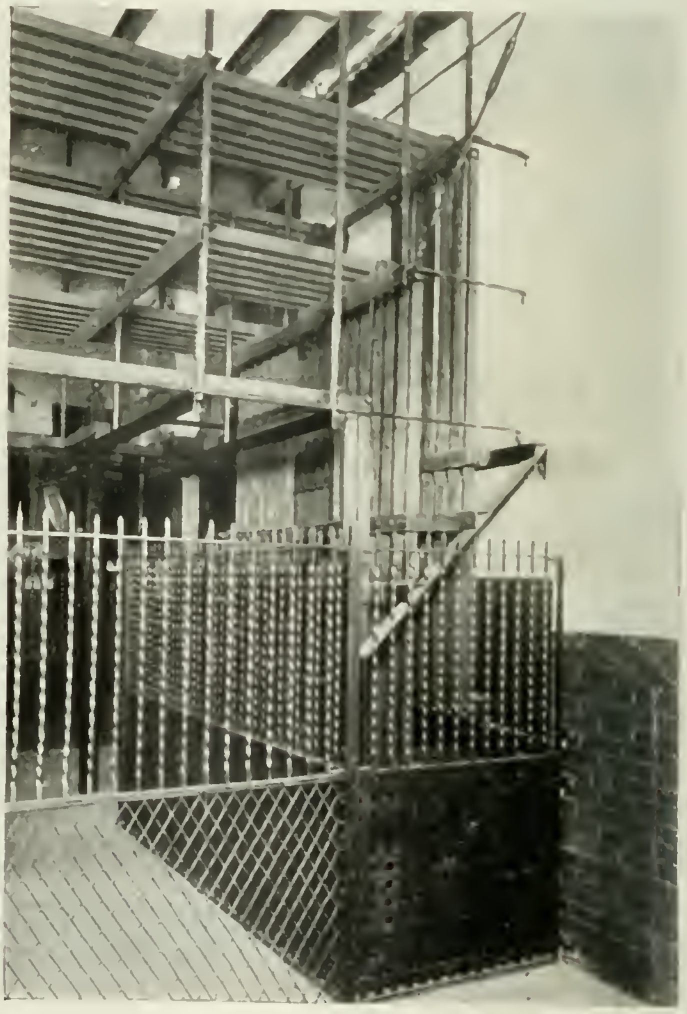


FIG. 14.—EIGHT COPPER BARS CONNECTING SWITCHES AND FEEDERS. FIRST DISTRICT STATION, BUMSTEAD COURT.

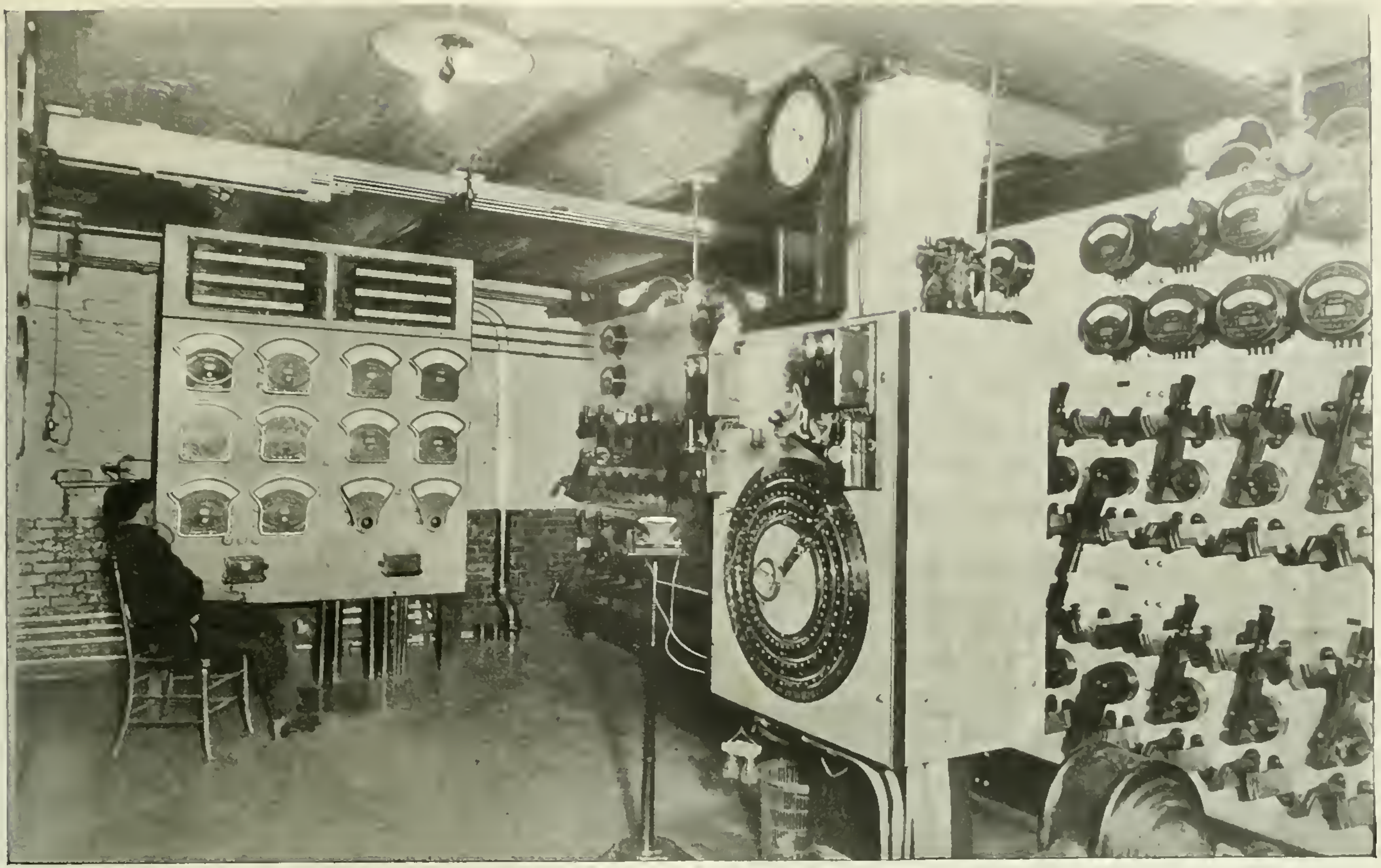


Fig. 15.—Regulating Room, Head Place Station—Feeder Switchboard and Pressure-Wire Wheel.

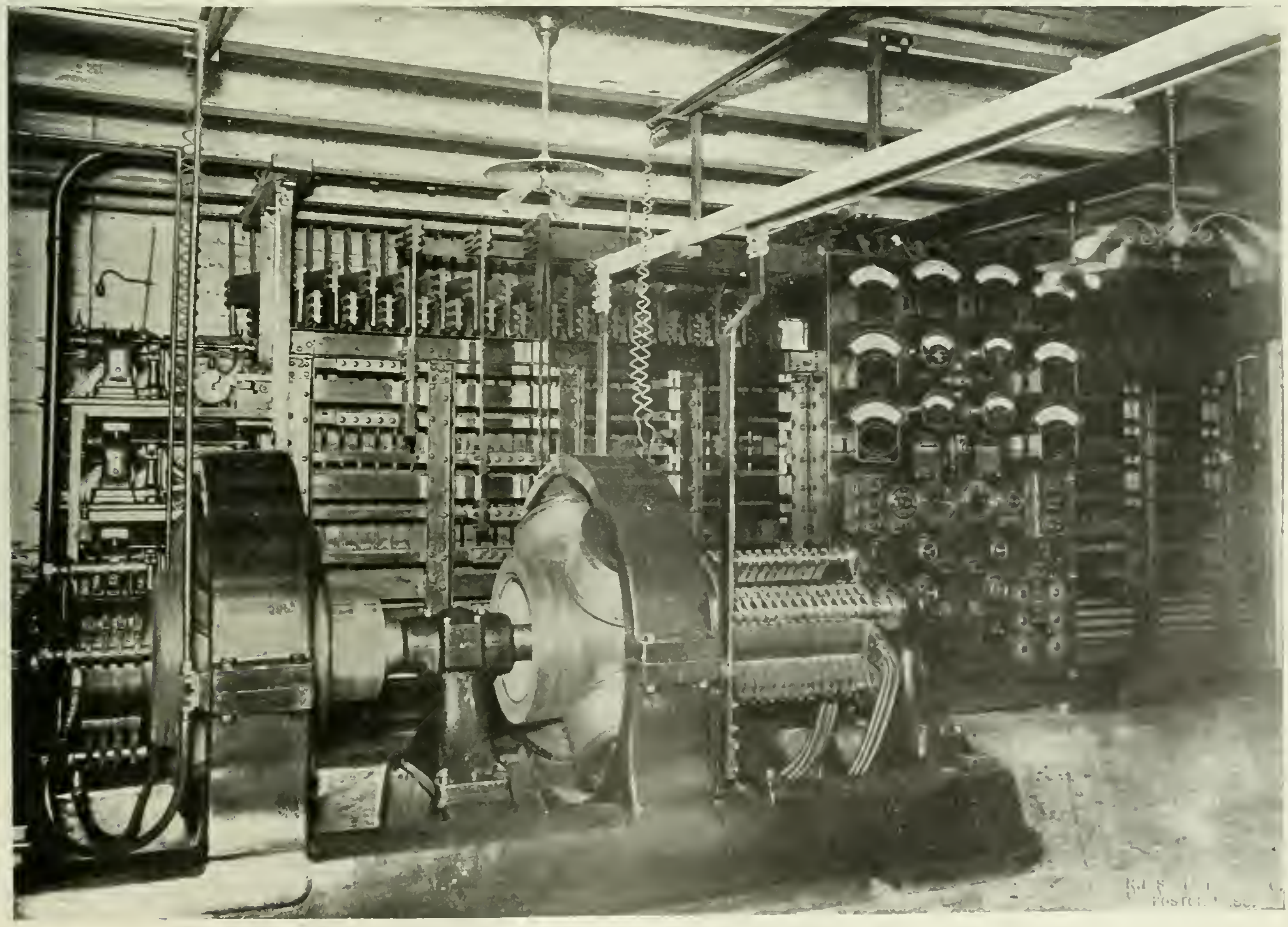


Fig. 16.—Regulating Room, Head Place Station, Showing Booster Set and Battery Regulating Switches.

with a stroke of 10 inches, and a water cylinder 4 inches in diameter. These pumps are also fitted to provide water for use in case of fire. Injectors are installed and always ready for use in case of necessity. Forced draught may be used on all the boilers by means of a Sturtevant blower, having a fan 5 ft. in diameter, driven by a 25-hp, 220-volt Sprague motor.

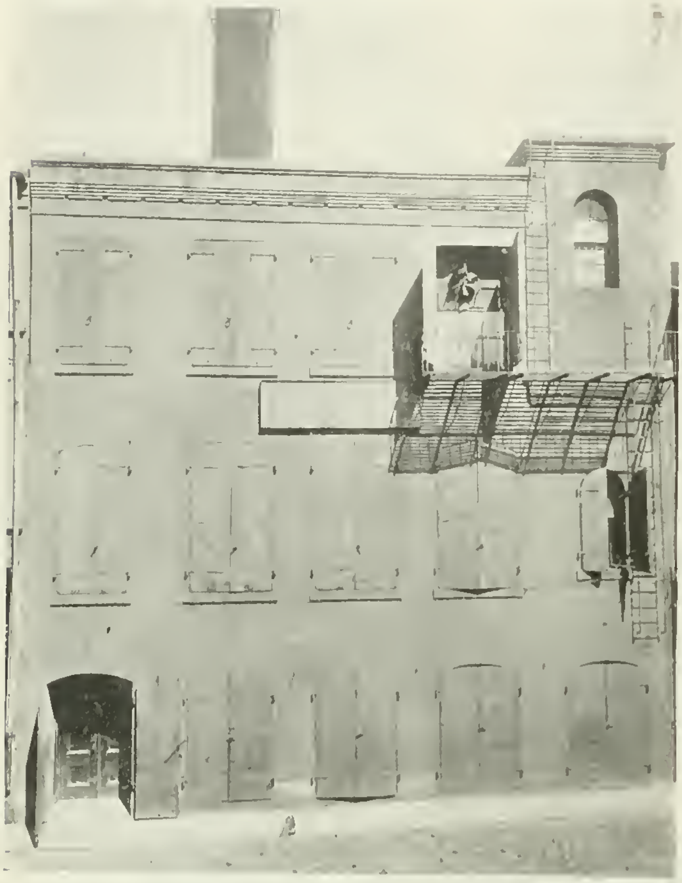


FIG. 17.—FRONT VIEW OF SECOND DISTRICT STATION, HAWKINS STREET

The coal is hauled to the station and discharged into a pocket beneath the sidewalk on Hawkins Street, from which place it is loaded into cars raised to the roof by an electric elevator and deposited through scuttles into the coal bunker of 200 tons capacity, located directly over the boiler room. The coal is delivered, as required, directly in front of the boilers, through steel chutes. The ashes are wheeled out into an ash room between the boiler room and Bowker Street and carted away.

STORAGE BATTERIES.

The electric storage battery, as a means of storing electrical energy and delivering it again, when required, at a per cent of efficiency great enough to make it of commercial value, has made very rapid progress during the last few years. Although having been used to some extent abroad, previous to 1894 the storage battery as an adjunct to large central stations was a thing almost wholly unknown in this country, and was even then just entering the experimental stage.

Having the courage of its convictions, the Boston Edison Company contracted for a battery plant which was first operated at the Atlantic Avenue station in March, 1894, being the largest one of its kind in the country. Soon after, the company installed other batteries, not only in connection with existing generating plants but as exclusive battery installation in districts widely removed from the central stations. For some time it had been necessary to refuse to supply power and light to new customers in outlying districts on account of the distance to the central stations which would be responsible for a heavy feeder loss and a wide variation in pressure. Neither would it be practicable to establish generating plants in these sections, not only on account of the character of the districts covered but also on account of the poor economy of such stations. The storage battery has, to a certain extent, met and solved this problem and has opened up territory otherwise inaccessible to a system using direct current, exclusively, so that this system of storing and distributing electrical energy, although not by any means perfect, still fills a very important place in the economy of a modern central station.

The battery system of the Edison Electric Illuminating Company of Boston comprises eight storage batteries, located at the different stations, two of these being Tudor batteries made by the Accumulatoren-Fabrik Aktiengesellschaft, of Hagen, Westphalia, Germany, the other six being chloride batteries, manufactured by the Electric Storage Battery Company, of Philadelphia, Pa. A single cell of the Tudor battery consists of a tank of hard pine, 14 inches by 17 inches and 35 inches deep, lined with sheet lead 1-16 inch thick, containing 18 positive plates ⅝ inch thick and 19 negative plates ⅜ inch thick, each being 28 inches deep by 15 inches wide. Both the positive and negative plates are made of solid cast lead, with corrugated faces, which hold the active material, consisting in the positive of red lead oxide and of litharge in the negative plates. The plates are separated from one another by two rows of ⅝-inch glass tubes, extending the length of the plates. The plates are suspended by lead lugs on either side, which rest on two ⅜-inch glass plates extending to the bottom of the cell, the battery plates extending 5 inches from the bottom and 2 inches from the top of the cell. The electrolyte consists of distilled water, to which is added, in the ratio of one to four, sulphuric acid having a specific gravity of about 1.830. The cell furnished by the Electric Storage Battery Company, of Philadelphia, is its type II 47, of similar construction, which consists of an ash tank 46⅝ inches by 21½ inches by 42⅞ inches high, outside measurement, lined with 5-lb. lead. Each cell contains 23 positive and 24 negative plates 16½ inches by 33 inches.

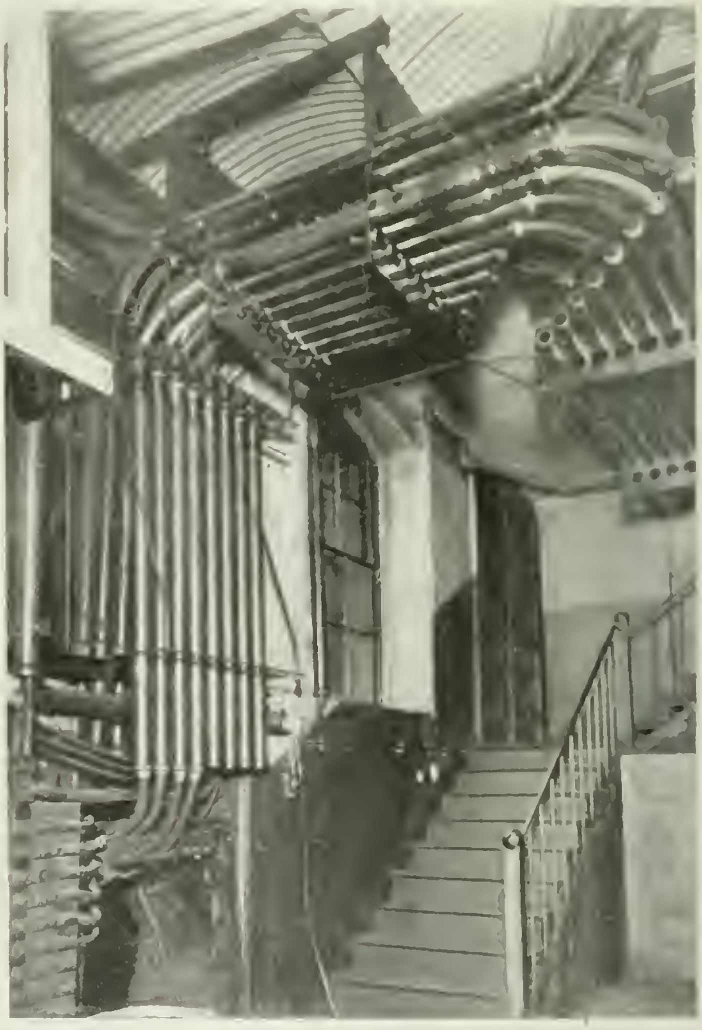


FIG. 18.—CABLES CONNECTING SWITCHBOARD AND FEEDERS, SECOND DISTRICT STATION.

The negative plates of the cell are constructed of chloride of lead buttons with a frame cast around them, while the positive plates consist of cast lead grids with corrugated ribbon buttons pressed into them. The electrolyte is the same as described above. The cells are connected in series by means of heavy lead bars between the cells, to which the lugs of the positive plates of one cell and the lugs of the negative plates of the next cell are firmly welded. They are connected to the regulating switches by drawn copper bars, varying in width from two to three inches and in thickness from ⅜ to ¾ of an inch. There are two batteries located at the Head Place station, one being a Tudor battery installed in a four-story brick building on Bumstead Court just opposite the boiler room, the other one being an Electric Storage Battery Company product, located on the second and third floors of a new building at Nos. 1 and 2 Head Place, just adjoining the station building. The Tudor battery, located in the three upper floors of the building, consists of 144 cells as before described, 72 on each side of the system, 25 of which are end cells, each one being connected to a block in the regulating switch by means of a copper bar running into the regulating room on the first floor. The regulating switch consists of a line of insulated copper blocks, each one connected to an end cell, alongside of which runs a copper bar connected with the battery bus. Each end of a copper brush rests upon one of these strips and is mounted upon a threaded shaft which slides it along these strips, cutting in or out the cells as is desired. There are three of these switches in multiple on each side of the system, which are operated by an electric motor governed by a small switch on the regulating board, so that from 48 to 72 cells may be run in series on each side of the system and may be discharged at three different pressures, as may be required. The rate of discharge on both sides is 9400 amperes at a one-hour rate and 4890 amperes per hour for three hours, the voltage at the end of discharge being 1.7 per cell, which figure is uniform in all the batteries. The maximum charging rate is 3774 amperes. The specific gravity of the electrolyte is 1.888. The other first station battery consists of 75 cells of the chloride battery on each side, 25 of which are end cells, situated on the second and third floors of the new building on Head Place. The maximum charging rate is 2252 amperes, while the rate of discharge is 5600 amperes at 130 volts at a one-hour rate, and 2800 amperes per hour for three hours. The specific gravity of the electrolyte is 1.200 in all the American batteries. At one end of each of the battery rooms is partitioned off a regulating room, containing three regulating switches in multiple, the positive switches being in one room, the negative in the other. These switches are operated by means of an electric motor on each switch, which are controlled by push buttons on the switchboard in the regulating room. By means of a system of bevel gears and rods, an illuminated indicator in the regulating room shows how many cells are in circuit at any given time.

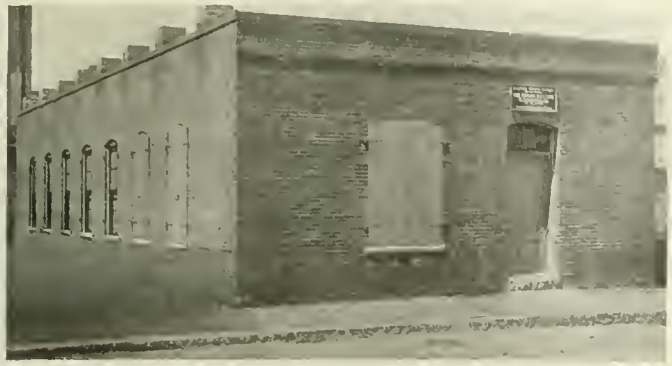


FIG. 19.—SIXTH DISTRICT BATTERY STATION, PITTSBURG STREET.

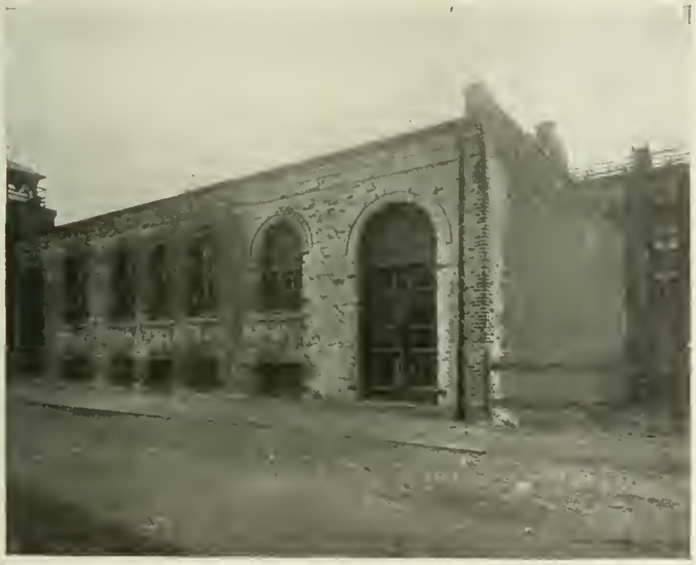


FIG. 20.—FOURTH BATTERY STATION, SCOTIA STREET.

At the second district station on Hawkins Street, the battery room occupies the third floor of the building and contains 140 Electric Storage Battery Company's cells, 70 on each side of the system, the usual number being connected as end cells. The regulating switches, three in number, are located in a room at one end of the batteries and are erected in a vertical position with the threaded rods extending through the floor into the regulating room and terminating in a handwheel, so that the switches can be operated by hand by a man at the feeder switchboard. The maximum charging rate is 1600 amperes and the maximum rate of discharge is 4000 amperes at a one-hour rate and 2000 amperes per hour for three hours.

The storage batteries at the third station, two in number, are located in the basement and first floor of the company's system of distribution building, No. 516 Atlantic Avenue, just adjoining the new station. The two batteries are identical in all respects and each consists of 75 cells of the Electric Storage Battery Company's manufacture on each side of the system. The maximum charging rate is 2252 amperes and the maximum rate of discharge is 5600 amperes per hour for three hours. The regulating switches are installed in a small regulating room on the first floor, partitioned off from the battery room and consist of 12 switches, three in multiple, on each side of each battery. These switches are operated by electric motors through a set of gears and are controlled in the regulating room of the station at a distance of 200 ft. by means of push buttons on the switchboard. The main current to and from the batteries flows along underground cables connected to the battery bus-bars on the third-station switchboard.

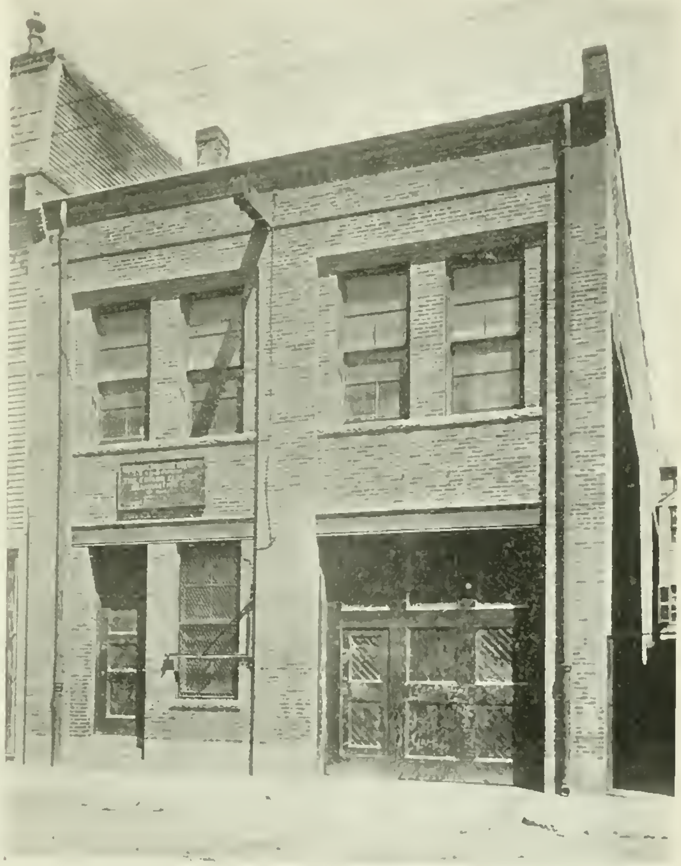


FIG. 21.—FRONT VIEW, FIFTH DISTRICT BATTERY STATION, WEST CANTON STREET.

The fourth station on Scotia Street supplies the district known as the Back Bay, and was not only the first exclusive battery plant erected by the company, but the first one in existence. The building is a one-story brick structure, covering an area of 60 by 65 ft. The roof is 25 ft. above the floor, and the walls are so constructed that the room may be divided into two stories or may be enlarged by extending upwards. The front of the building is separated from the battery room by a plaster partition, forming a regulating room 12 ft. wide and extending the length of the building. The battery consists of 72 cells on each side, and in all other respects is exactly like the two batteries at Atlantic Avenue, described above, having been made by the same company. The copper bars from the end cells pass through the partition to the regulating room, where they are connected to three switches in multiple on both sides of the system, so that the batteries can be discharged at three pressures at the same time. These switches are operated by hand. Between the two regulating switches is a slate-regulating board upon which are mounted Weston portable voltmeters, reading to three volts, so arranged as to read, through circular cell switches, the voltages of the regulating cells on each side of the system. There are also on this board two Weston round pattern galvanometers and two booster field regulators. Opposite the regulating switches is the feeder switchboard which has two buses on each side of the system, and to the apparatus and feeders are connected two double-throw switches, thus permitting of the connection of any of them to either bus. Weston round-pattern ammeters are used to indicate the load carried by each feeder. There is also installed at this station one three-wire booster set, consisting of four 60-kw Edison bipolar dynamos, the booster armatures having been rewound.

The fifth station building is located on West Canton Street, between Tremont and Shawmut Avenue, is wholly of brick, 27 ft. 2 inches by 99 ft. 3 inches inside, and consists of two stories, one floor being below the street level. In this basement are located 144 cells of the Tudor battery, 72 cells on each side of the system, 25 of which are end cells. The maximum charging rate is 1986 amperes, and the rate of discharge is 4925 amperes at one-hour rate and 2570 amperes for three hours. There is also on this floor a booster set consisting of four Edison bipolar dynamos, the armatures having been rewound. There is in addition a feeder switchboard having 4 buses, 3-battery regulating switches in multiple, and meters, instruments, etc., similar to those installed at the Scotia Street station.

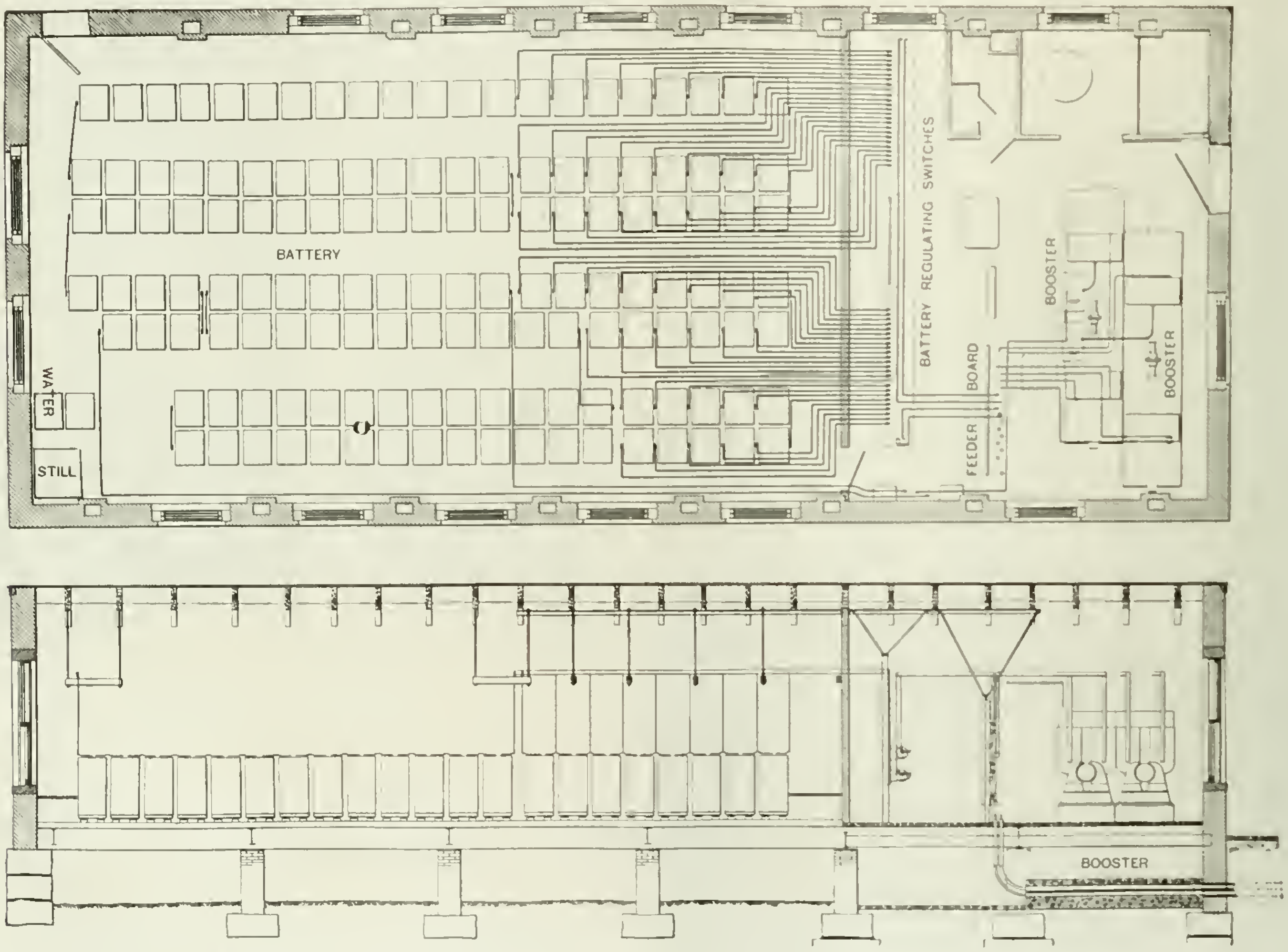


Fig. 22.—Plan and Elevation of Pittsburg Street Storage Battery Station.

The sixth district station is the one most lately installed and is located on Pittsburgh Street, in South Boston, a short distance beyond the Congress Street Bridge. The station consists of a small one-story brick building, 27 ft. by 68 ft. by 12 ft. high, having a wooden roof. There is a partition which forms a regulating room in the front end and leaves the remainder for a battery room. The battery consists of 140 cells of the type manufactured by the Electric Storage Battery Company, of Philadelphia, having 70 cells on a side and 25-end cells. The maximum charging rate is 1280 amperes and the maximum rate of discharge is 3040 amperes at one-hour rate and 1520 amperes per hour for three hours. The regulating room, 20 ft. by 27 ft., contains two regulating switches operated by hand, in multiple on each side of the system, also feeder switches, boosters and measuring instruments similar to those at the other battery stations. All of the batteries on the Edison system taken together form one of the largest installations on record, which is capable of supplying a total of 43,765 amperes for one hour or 65,647 ampere-hours at a three-hour rate.

STATION NO. 3.

In 1891, without any precedent in this country, and with comparatively little in Europe in the way of ideal examples, the Edison Company of Boston laid out plans for a central station to be located on Atlantic Avenue, which would supply the growing demands of the company for a quarter of a century to come.

The plans included not only the ground property upon which buildings were to be erected, but the extending of the wharf into the channel to facilitate the handling and storage of coal; the character and extent of the structures, and the equipmnt of the station after its erection. It is worthy of note that plans as projected in 1891 have been carried out in 1901, almost in their entirety, after the vast experiences of a decade second to none in the history of electrical and mechanical engineering.

On another page are included two plans (Figs. 7 and 8), the first one of which shows in full lines, the property and equipment of the company as it existed in 1891, with the proposed additions shown in dotted lines; and, second, a similar plan showing in full the total installations in 1901, and having in dotted lines the proposed additions for the future. It will be seen at a glance that the only radical divergence between the two is the extension of the wharf to coincide with the Harbor Commissioners' line and the increase in size of the units in the station.

The property on Atlantic Avenue controlled by the Edison Company, as shown on the surveyor's plan, is included in the area lettered M-N-O-P-Q-R, and consists of Liverpool and Dolbeare's wharves, upon which the station stands, and Batchelder's wharf just north of the station building and the new driveway wharf, extending from the Edison property to Congress Street, the last two being leased by the company. The total property covers about 129,500 sq. ft., extends 299 ft. on Atlantic Avenue and 305 ft. back to the Harbor Commissioners' line on the north side and 480 ft. on the south side, giving a water frontage of 559 ft. As a matter of convenience in the description of this property, the old station building with its foundation built in 1891, and the addition thereto made in 1900, will be treated separately, more space being given to the latter construction, while the apparatus and equipment will be described as a whole, regardless of location.

The old station is situated on Atlantic Avenue, having a frontage of 60 ft. and a depth of 230 ft. The engine room, 60 ft. by 160 ft., is separated from the boiler room by a thick brick wall, through which the steam mains pass on their way to the engines. The height of the engine room is 40 ft. above the engine room floor, this being 10 ft. above the base of the engine foundations, while the boiler room roof is 49 ft. above the ash room floor.

The entire building above the foundation is of brick, the walls being plain but substantial; the façade on Atlantic Avenue, however, is of artistic design, being built of Perth Amboy yellow brick, with terra cotta trimmings. Three large arches extend across the front of the building, surmounting massive glass windows which serve to flood the front of the engine room with light. The roof is supported by nine iron girders, 3 ft. 9 inches deep and 60 ft. span, built by the Smith-Carleton Iron Works, of Boston. The roof is covered with tar and gravel, and is broken up by four skylight ventilators, running transverely, which occupy about one-quarter of the roof area.

In the southeasterly corner of the engine room there is partitioned off a switchboard room, 70 ft. by 26 ft., which extends 14 ft. above the engine room roof, and is surmounted by a monitor. The switchboard room will be described later. The boiler room is 62 ft. high in the center and 60 ft. on the sides, above the ash room floor, and has a large monitor through which are two tracks of the cable railway upon which the coal cars run. Winslow & Wetherell, of Boston, were the architects of the old building, and Whidden & Co., of Boston, were the contractors.

As the solid ground beneath this station only extended about 88 ft. from the front wall a large part of the building rests upon an artificial foundation. Under the engine room were driven on 4-ft. centres, spruce piles, not less than 7 inches in diameter at the smaller end, and varying from 25 to 35 ft. in length. The foundation of the walls consists of granite 6 ft. high, under which are piles 2 ft. on centres.

The boiler room is supported by eight piers of solid masonry, each one resting on 30 piles, 35 ft. long, driven to a solid bearing and cut off at one foot below mean low water. At the rear of the boiler room is a heavy masonry sea wall, resting on seven rows of piles on 2-ft. centres.

In the engine room the piles were cut off 7 ft. above mean low water and covered with 6 ft. of solid concrete, made up of one part Portland cement, two parts of sand and four parts of broken stone. Running on rails near the roof of the building are two cranes operated by hand chains, one of 15-ton capacity, having a span of 56 ft., located in the west end of the room, the other of 16-ton capacity and 32-ft. span, running the length of the switchboard room.

NEW CONSTRUCTION.

The new construction work at the Atlantic Avenue Station, begun

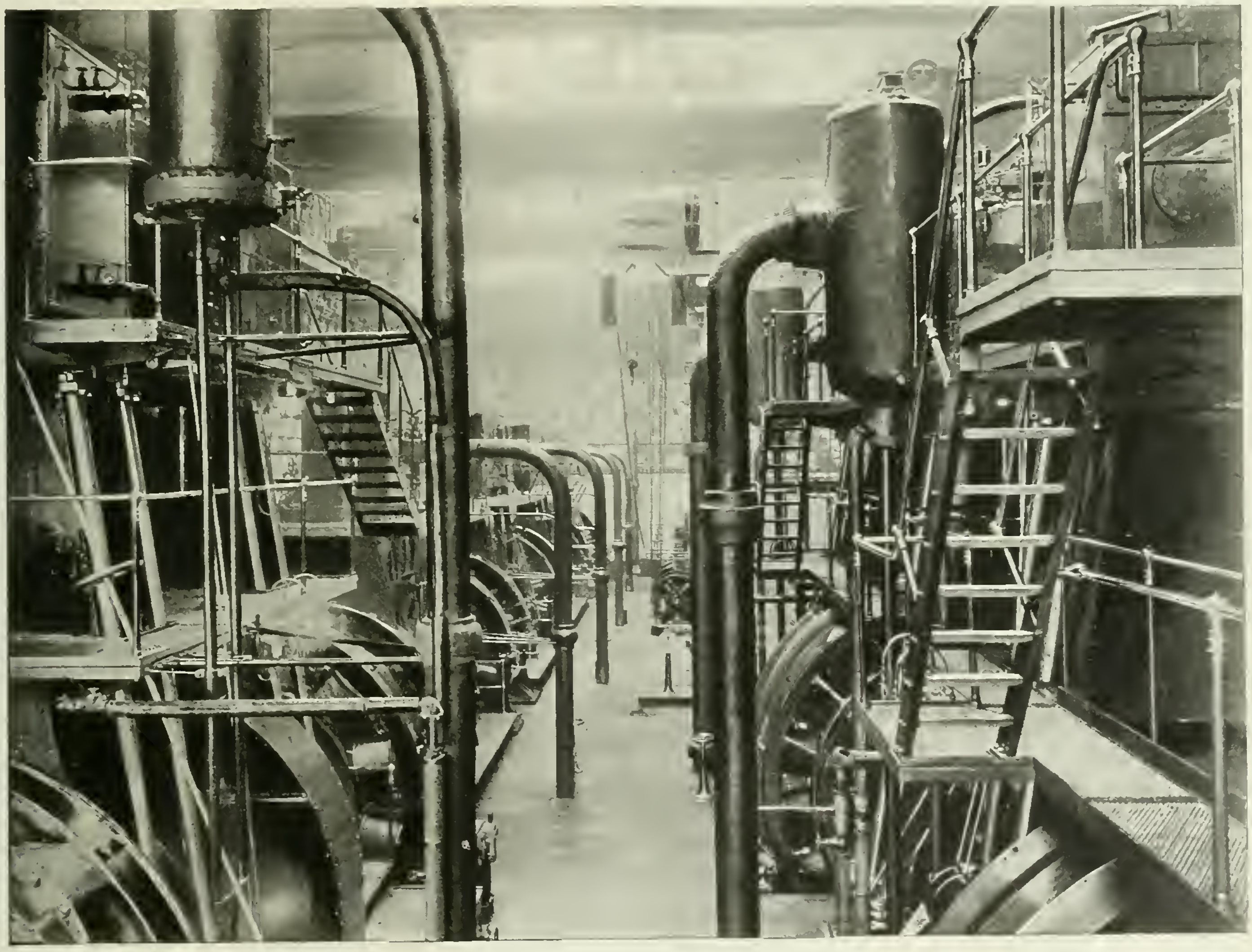


FIG. 23.—VIEW IN THE OLD ENGINE ROOM, ATLANTIC AVENUE, LOOKING EAST.

in March, 1900, consisted of an engine room, extending at right angles from the old engine room to the system building, a distance of 150 ft.; a continuation of the old boiler room, a distance of about 160 ft., to an extension of the westerly wall of the system building; and an extension of the wharf property to the Harbor Commissioners' line.

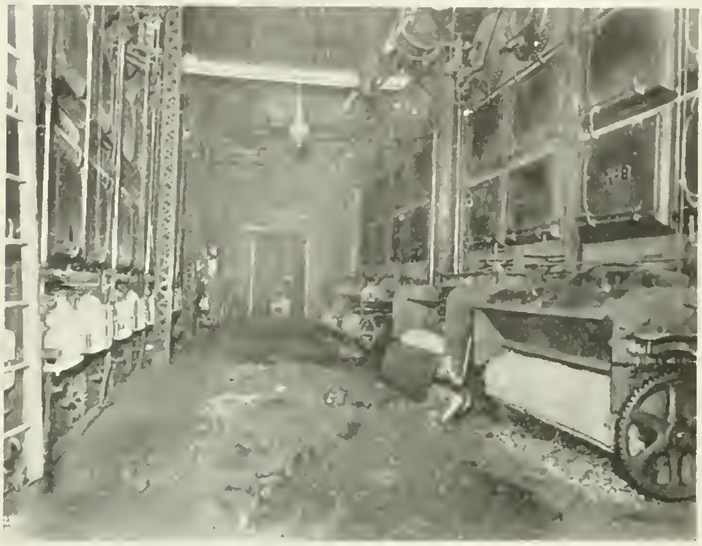


FIG. 24.—VIEW ALONG THE OLD BOILER ROOM, ATLANTIC AVENUE.

FOUNDATION.

The excavation for the foundation of the engine and boiler rooms presented difficulties rarely met in this class of engineering and rendered the work exceedingly slow and tedious. The whole area was first excavated to a depth of 6 ft., the material removed consisting of ashes, oyster shells and other filling. As soon as the required depth was reached, Nova Scotia spruce piles 50 ft. long, with tips 6 inches and butts 14 inches in diameter, were driven 2 ft. on centres each way.

After the section was piled for a short distance towards the water front, obstructions were found which caused the piles to broom repeatedly. In one or two cases where the piles were capped, the tips turned and came up again four or five feet away, and one pile, as afterwards appeared, came in contact with one of the oak timbers forming part of an old wharf and was driven completely through it, leaving a hole the size of the iron tip.

Upon digging down farther to remove obstructions, there was found a part of the old "tea party" wharf, consisting of wooden cribs loaded down with huge stones, the wharf proper having been built up from these. There was also found the old sea-wall which formerly had protected the wharf, and which now presented the greatest obstacle to the work of driving piles. This sea wall, which had to be removed as far as possible, was about 150 ft. long, averaged 10 ft. in width, and extended down from 22 ft. to 28 ft. It contained stones of great size, one being 16 ft. long, 7 ft. wide and 20 inches thick.

While the sea wall was being removed near the old station, the walls of the building had to be held in place by six 2½-inch rods passing through from side to side, being bolted on the outside. The wall towards the excavation was also reinforced by four 12-inch timber shores. When the excavation had reached below low water, the greatest difficulty commenced, for in spite of the fact that the trenches were dammed with sand bags, and one 10-inch and two 8-inch pumps were working continually pumping out the water, the work could only be carried on at low tide. Although this was continued from 15 ft. to 20 ft. below low water, yet towards the end of the wharf the stones were so far below the surface that it was not possible to remove them. Some of the oak timbers, 14 inches square, belonging to the old wharf, were found in perfect condition.

There were driven in all 5280 piles, 1000 of which were shod with iron shoes, and it took three pile drivers five months, working night and day, to do the work. After the piles were all driven, the ground was excavated 3 ft. more and the piles were cut off at grade 7. Under the new chimney 400 piles were driven in a space 35 ft. x 40 ft., these being cut off at grade 2.

On top of the piles, over the entire area, was laid concrete to a dept of 3 ft., except in the northeast corner of the boiler room, where the old sea wall was found. As it was impossible to remove the lower part of this, the hole was filled up with 20 ft. of concrete on top of the sea wall. Six feet below the top and imbedded in this concrete were placed four 15-inch 60-pound I beams 20 ft. long, and twelve 12-inch 40-pound I beams 12 ft. long, across which rested fifteen 12-inch 40-pound I beams 16 ft. long.

There was then added concrete to the depth of 6 ft., making a total depth of 9 ft. over the entire surface except as in places noted. The concrete below the chimney was 14 ft. deep. The composition of this concrete was one part Alpha (Portland) cement, three parts sand and five parts 2-inch broken stone. The engine foundations are built of brick, laid in Alpha Portland cement. Each engine bed is fastened to its foundation by four 3-inch bolts and thirty-six 1½-inch bolts, 2 ft. long, embedded in the foundation.

During the excavating and piling, provision was made for a sluiceway to be used for the purpose of supplying salt water to the condensers. It is 245 ft. long and extends from the condenser room under the boiler room and wharf out into the harbor, the lower part being 8 ft. below low water thus guaranteeing an adequate supply of water at all times. This sluiceway was built of two thicknesses of 6-inch hard pine sheet piling driven tight, treenailed with oak; the outside course being 26 ft. long and the inside 15 ft. long. The

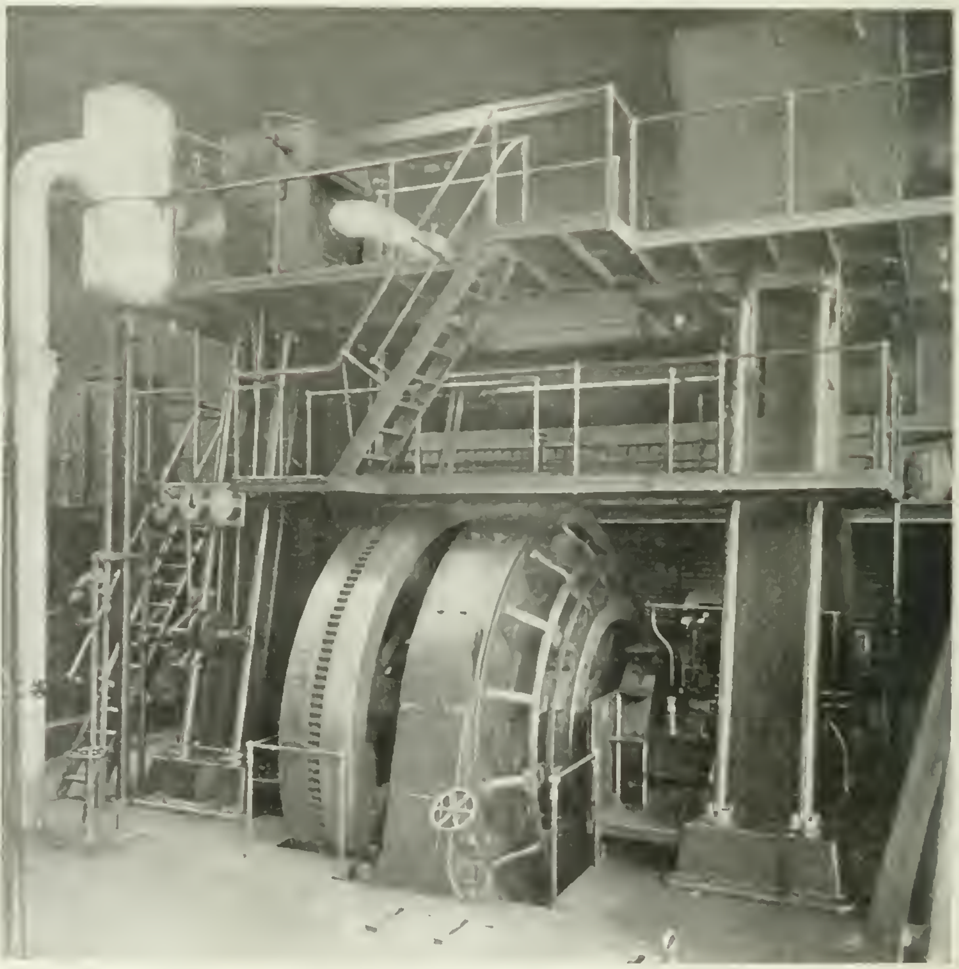


FIG. 25.—1200-HP MCINTOSH & SEYMOUR ENGINE AND 800-KW GENERATOR, OLD STATION, ATLANTIC AVENUE.

sluiceway is 6 ft. in width, the bottom being covered with 16 inches of concrete, the top of which is grade minus 8. The top of the sluiceway is made up of 12 by 12-inch hard pine timbers, upon which rest 6-inch I-beams running under the floor along the width of the boiler room; under the wharf 12-inch timbers take the place of the I-beams. The top of the sluice outside is at grade 6, an inside section being 72 square ft. in area. On the top of this sluiceway is located a 48-inch discharge pipe, embedded in the concrete floor of the boiler room, the pipe having an elbow extending downward at the end, so that it is submerged at low tide.

There was a total of 13,500 cubic yards excavated in this work, and there was 62,000 cubic yards of concrete laid in the boiler and engine rooms. In several places where piles could not be driven under the walls it was necessary to use cantilever girdrs to transfer the load to positions where it was possible to drive piles.

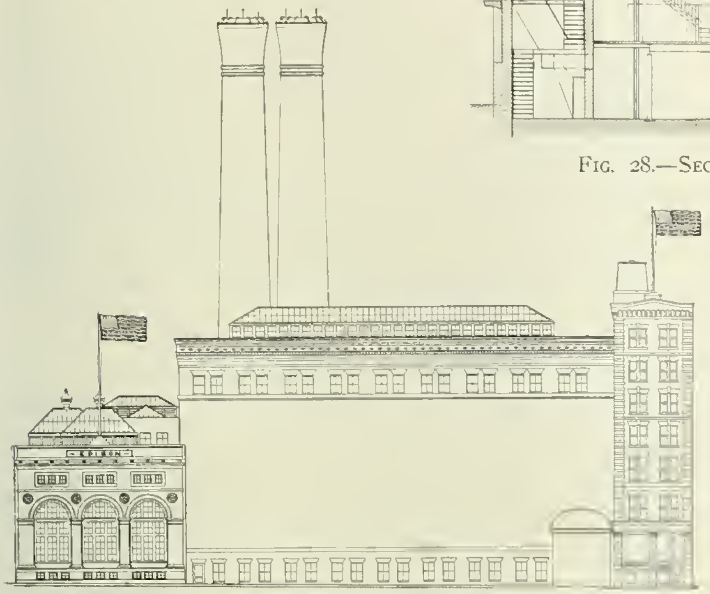


FIG. 26.—FRONT ELEVATION OF STATION AND SYSTEM BUILDINGS, ATLANTIC AVENUE.

At the southwest corner of the engine room, the column was so near to the System building that it was necessary to use a cantilever.

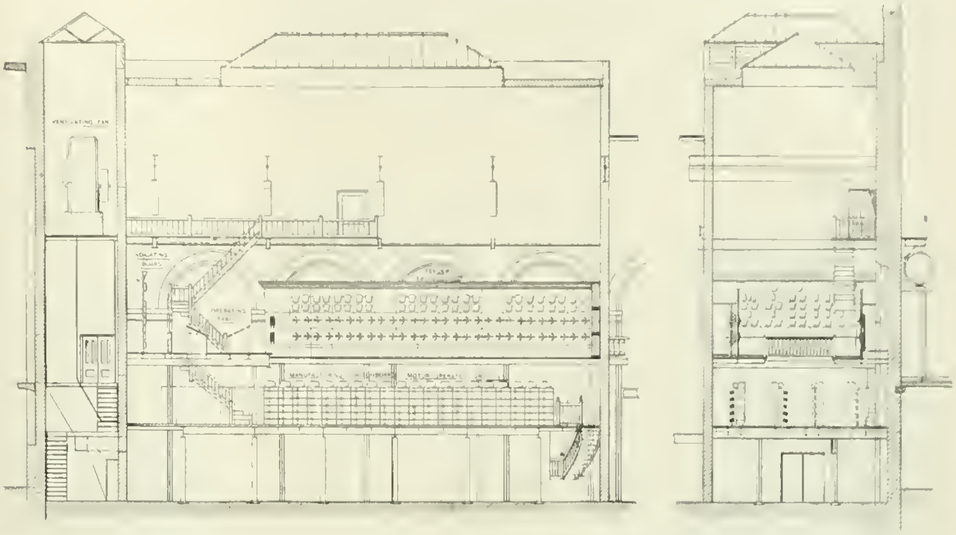


Fig. 28.—Sectional Elevations of Switchboard Room, Atlantic Avenue.

This girder was composed of two plate girders, two feet deep, resting on three 20-inch I beams, which acted as a fulcrum. Under this fulcrum were 18 piles spaced about 2 ft. 6 inches on centres. The tail of the cantilever extended back far enough to catch the load from the next column, the other end extending under the wall of the System building. The piles were cut off at grade 6 and the concrete started at grade 5 and was built up around the girder and beams to grade 14. The top of the girder was set at grade 13 ft. 6 inches.

At the northwest corner of the engine room, the same method was followed, with the exception that in the place of plate girders four 15-inch I beams were used, the tops being set at grade 10 ft. 3 inches. The piles were cut off at grade 7 and concrete started at grade 6 and carried up to grade 11 ft. 10 inches.

At the southwest corner of the boiler room, a girder was required to span the sluiceway, which has an outside width of about 9 feet. This girder was composed of two plate girders 2 ft. deep, tied together by four plates. The girder was set on concrete with the top at grade 12. The portion of the sluiceway which passes through the boiler house is spanned by 6-inch I beams, 2 ft. on centres. The ends of these beams rest directly on piles which are cut off at grade 5 ft. 6 inches.

Where the sluiceway passes under the easterly wall of the boiler house, the wall is supported by three 6-inch I beams, 28 ft. long.

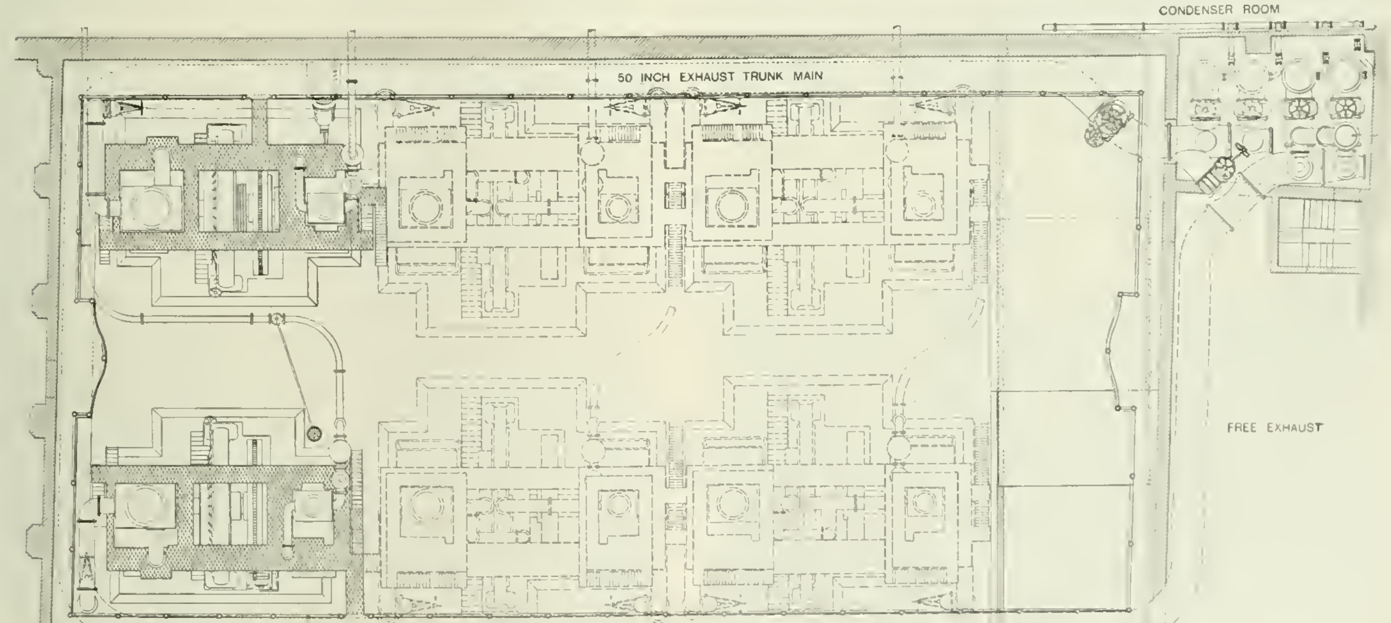


Fig. 27.—Plan of New Engine Room, Atlantic Avenue.

which rest directly on piles. These beams are set at the same level as the beams over the sluiceway.

At the southwest corner of the boiler house, the old wall was found to be in very poor condition, and as there were two columns which had to bet set into it, it was thought necessary to improve the foundations under the same.

This had to be accomplished by means of beams, located as follows: Under one column, seven 20-inch I beams, 28 ft. long were laid transversely under the old wall, projecting under the engine house about 6 ft., where they were supported on three 10-inch I-beams, under which piles had been driven about 2 ft. on centres. The other ends of these 20-inch I-beams were supported on a cluster of piles about 15 ft. from the inside of the old boiler house wall.

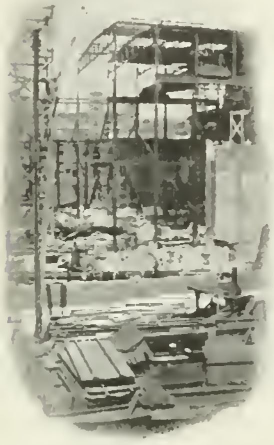


FIG. 29.—THE STEEL FRAMEWORK.

Under the other column, three 20-inch I-beams, 18 ft. long, were laid diagonally from the corner of the engine house. These beams rest on two 10-inch I-beams, 14 ft. long, which were set parallel to the northeast wall of the engine house and also on the three 10-inch I-beams previously mentioned. Under all of these 10-inch I-beams piles were driven about 2 inches on centres. Three 20-inch I-beams 14 ft. long were put in to support the northeast wall of the engine house. These beams rested on the two 10-inch I-beams previously mentioned and extended underneath the engine house floor.

BUILDINGS.

The new buildings cover an area of about 150 by 160 ft., and are of the most modern fireproof construction. Under the walls of the building, resting on the concrete, is a granite foundation 3 ft. 8 inches wide and 20 inches thick, from the Stony Creek Quarry, Connecticut. Under the columns were placed granite levelers 4 ft. square, having a thickness of 20 inches.

The engine house roof is supported by nine trusses, resting on columns in the walls, spaced 16 ft. apart. The frame is entirely of steel, made by the Passaic Rolling Mills, Paterson, N. J. The trusses are of the Warren type, with the sloping top chords, which conform to the flat pitch of the roof. The span of these trusses is about 84 ft. centre to centre bearing. The main roof consists of 10-inch flat terra cotta arches on I-beam and channel iron purlins, which are riveted to the top chords of the trusses. Over these arches there were laid in successive layers 2 inches of concrete, 1 inch of Portland cement and a 5-ply composition roof. A monitor 110 ft. long and 20 ft. in width runs along the centre of the building. This monitor is covered with wire glass supported on I-beams and channel iron purlins, and on the sides by angle iron studs. All the woodwork throughout the building is covered with 16-oz. sheet copper, the copper work being done by S. D. Hicks & Son, of Boston. Along both sides and ends of the monitor, on the inside, a footwalk with hand-railing is provided. The trusses are braced by means of angle iron struts running lengthwise of the building and diagonals in two bays, at the level of the bottom chord. The sides and top of the monitor are braced in the same bays by diagonal rods.

The columns supporting the engine house roof are about 84 ft. high, the foot of each being set at grade 13 ft. 6 inches. At grade 77 ft. 10 inches the crane track girder rests on the columns. Below the crane track the column section is composed of two 12-inch channels (flanges turned in) riveted to a 23¼-inch web plate by means of four 4 by 4-inch angles.

Above the crane track the section is composed of one 12-inch channel, two 4 by 4-inch angles, two 6 by 4-inch angles and one 7½-inch web plate. At the level of the bottom of the crane girders, the columns are held by horizontal struts, each composed of two 4 by 4-inch angles latticed.

The engine room walls are built of Bay State brick, furnished by the Bay State Brick Company. They are 3 ft. thick up to the level of the crane girders, above which they are 16 inches thick for the rest of the height. Norton's Roslindale cement was used in the ratio of 1 to 2.

The crane track girders run along on the side walls of the engine room, and are supported by the columns at grade 77 ft. 10 inches. They are composed of four angles and a web plate, and are 3 ft. 2 inches deep. On the top flange is a 4 by 2½-inch steel bar, with the top planed and the corners turned to form the rail. This is attached to the flange of the girder by means of angle irons at intervals of about 3 ft. The rails are 80 ft. 10 inches, centre to centre.

At the southerly end of the engine room, 23 ft. above a driveway leading into the boiler room, is a sliding floor composed of a fixed portion under which the sliding portion passes. The sliding part is supported on 126 rollers, 3½ inches in diameter, which run upon a 5-inch 85-lb. rail. The rollers are set 12 inches on centre, and are held together by a harness consisting of bars 4 inches by ½ inch. The rails are spaced 20 ft. ¼ inch. centre to centre. These rails are supported by the wall on the northerly side, and upon the southerly side by eight angle iron posts, with brackets, and under the fixed portion by hangers riveted to the floor beams above. The sliding portion is made in two parts, each composed of ⅝-inch plate, riveted to 15-inch I-beams. These I-beams frame into longitudinal beams, to the bottom flange of which is riveted a track bar running on the rollers. The fixed portion is composed of 15-inch I-beams resting on the walls with two ring segmental brick arches.

The 50-inch exhaust pipe passing around the inside of the engine room walls on three sides of the building is supported on the main columns in the wall, and on 6-inch plate and angle columns set about 3½ ft. in from the wall. The small columns are composed of four 3 by 3-inch angles and one 6-inch web plate. Four columns on each side of the engine room run to the basement floor. They are braced at the engine floor level by means of angle iron struts, riveted to the sides of the columns and set into the wall. The pipe rests on two 8-inch channels riveted to the wall columns and cantilevering over the small columns. To allow for the expansion and contraction of the pipe at the points of support there are provided planed bed plates, riveted to the 8-inch channels.

Over this exhaust pipe, at grade 51 ft. 6 inches, is a gallery passing entirely around the engine room. In the centre of the ends of the building, there are balconies which are supported by brackets. The gallery is composed of channel iron stringers and angle iron floor beams, on which rests a flooring of slate 2 inches thick. At the southerly end it is supported by curved brackets which are held to the wall by means of anchor bolts. Elsewhere the gallery is supported by angle iron posts riveted to the channels which support the exhaust pipe.

The walls of the engine room from the engine room floor to the tops of the doors above the gallery are tiled with a special tile made by the Grueby Faience Company. Tiles of a dark green color extend to a height of 2 ft. at the lower and upper border, the remaining area being of a cream color. Above the tiles the plain walls are tinted a light cream color. The walls of the old engine room are finished in a like manner.

The ceiling is plastered, and painted a cream color, as are also all the exposed ironwork in both engine and boiler rooms. The floor is tiled with octagonal red tiles, and small chocolate squares, with a black border 2 ft. wide around the room and also around the engines.

Besides the monitor already referred to, the engine room is lighted by a row of 10 windows 4 by 7 ft. in the basement toward the street, also a row of 8 windows 4 ft. by 7 ft. above the crane track on each of three sides of the building.

FIG. 30.—CHIMNEY BASE.

The boiler house roof is supported on 13 trusses of the Warren type similar to those of the engine house. These trusses vary in span, those over the old portion having a span of about 71 ft., centre to centre of bearings, while those over the new portion have a span of about 76 ft. The easterly ends of all the trusses rest on the wall, also the westerly ends of trusses over the old portion. The next two are supported by a latticed girder riveted to two of the engine room columns, and the remainder are directly supported by the engine room columns. The trusses are braced in five bays in the plane of the bottom chords by angle iron struts and diagonal rods. The roof and sides of the monitor are braced in the same bays by diagonal rods. The roof of the new portion was extended over the old boiler room, being at a grade high enough to allow the new trusses being placed without disturbing the old ones.

The roof is flat and is provided with a monitor 40 feet wide, through which the cable road can run the whole length of the building. Under this monitor and passing through the roof trusses are the coal bunkers. The flat portions of both main roof and monitor are composed of flat terra cotta arches between I-beams and channel iron purlins, the roof being finished as in the case of the engine room. The purlins are riveted to the top chords of the trusses and are tied together at intervals of about 6 ft. by ¾ inch tie rods. In the vertical side of the monitor, attached to angle iron studs, are wire glass windows, 4 by 7 ft., the woodwork being covered over with copper. Along both sides of the monitor, on the inside, there is a footwalk provided with a pipe handrail. This footwalk is composed of iron bars set on edge supported by the top chords of the trusses.

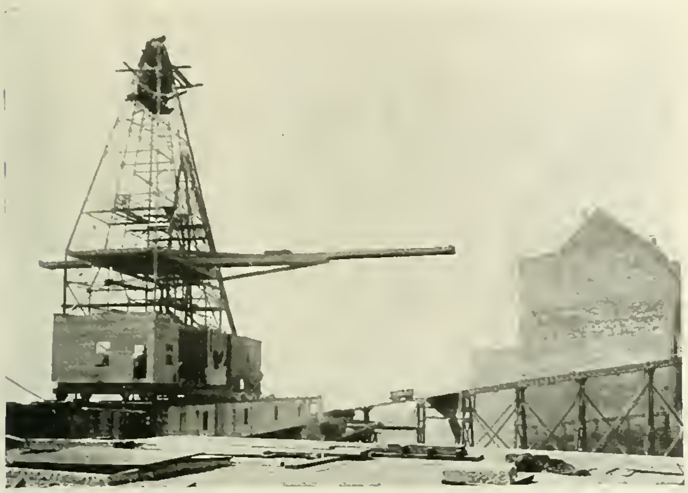


FIG. 31.—VIEW OF CANTILEVER TOWER AND CABLE RAILWAY DURING CONSTRUCTION, ATLANTIC AVENUE.

Extending the length of the building over the outside edges of the coal bunkers there is a partition of corrugated iron fastened to angle iron studs, making a dust-proof coal pocket, which prevents the coal dust from getting into the boiler house. These studs are fastened to one of the roof purlins and the channel irons at the edge of the coal bunkers. Along the centre of each coal bunker, resting on the top chords of the trusses are four 6 by 12-inch hard pine stringers which form the tracks for the coal conveyor. The two coal bunkers are V-shaped, and pass directly through the trusses along the centre of the building. They are composed of ⅜-inch plates riveted to I-beams which are attached to the channel iron, forming the top flanges, and to the angle iron at the bottom forming the bottom flanges.

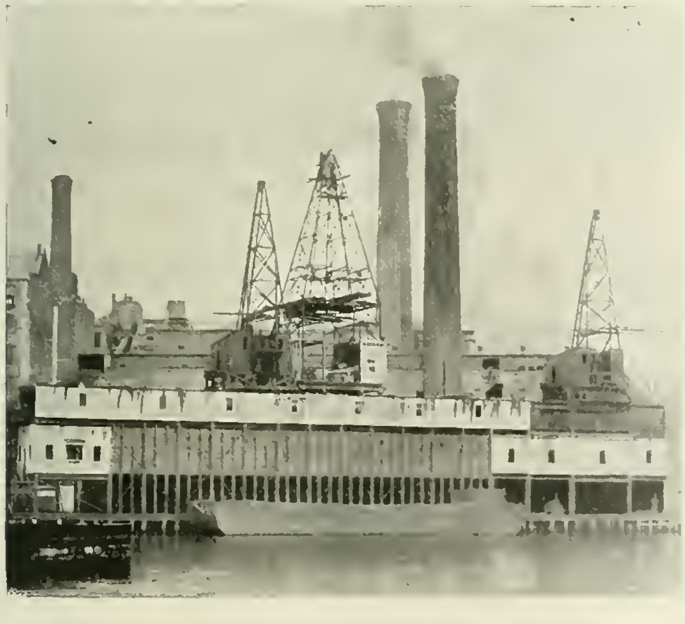


FIG. 32.—VIEW OF ATLANTIC AVENUE STATION, FROM THE WATER FRONT.

The two chimneys passing through the roof required special framing about them.

The walls are built of brick similar to those of the engine room, the thickness being, however, 3 ft. throughout their entire height.

The architects having charge of all this work were Winslow & Bigelow, of Boston, and the contractors were Norcross Brothers.

CHIMNEYS.

The twin chimneys which tower above the boiler house are identical above the roof, the only difference between them being that the base of the new chimney is octagonal in shape, whereas the old one is round. The new chimney is 200 ft. high, is octagonal at the base for the height of 55 ft., the outside diameter being 20 ft. between parallel faces. For the rest of the distance it is circular in shape, having a diameter of 14 ft. 7 inches just below the cap.

At the base the outside shell is 24 inches thick, and the inside shell 16 inches, leaving an air space of 11 inches between the two. The inside shell extends to a height of 135 ft., is 8 inches thick at the top, and is lined with firebrick for 55 ft. of this distance. The outside shell is 12 inches just under the cap. The inside diameter of the flue is 11 ft. 5 inches. The cap is of cast iron, and is made in 16 sections, weighing 250 lbs. each. They are bolted together with ¾-inch bolts, the joints being filled up with red lead and covered over with copper. Four lightning rods serve to complete the structure.

WHARF.

The addition to the wharf consisted in extending the wharf already existing, out to the line of the Harbor Commissioners. The wharf, as it previously existed, had an area of about 18,000 sq. ft., while the addition recently completed, together with Batchelder's wharf, gives a total wharf area of about 42,000 sq. ft.

In the extension there were driven in parallel rows 10 ft. apart and 4 ft. on centres 455 best quality oak piles, 65 ft. long and 14 inches in diameter 5 ft. from butt and 8 inches in diameter at tip. On top of the piles are two 8 by 14-inch hard pine girder caps, bolted to the top of each pile with two 1-inch screw bolts; bolted to these by 1-inch screw bolts are four 10 by 14-inch hard pine rider caps. Running crosswise on the riders are hard pine stringers 6 by 14 inches, laid 18 inches on centres, to which is securely fastened 4-inch spruce plank.

Under the driveway leading to this property from Congress Street there were driven 139 oak piles, 55 ft. long, having a diameter of 13 inches, 5 ft. from butt, and a diameter of 7 inches at the tip, girder capped by 6 by 12-inch hard pine, and having two 8 by 12-inch hard pine rider caps, above which are placed on 2-ft. centres 6 by 12-inch stringers covered by 3-inch spruce planks and 2-inch hard pine planks.

The piling both in the foundations and wharf was done by L. R. Tidd, of Boston. The harbor next to the wharf has been dredged to a depth leaving 25 ft. of water in the channel at low tide.

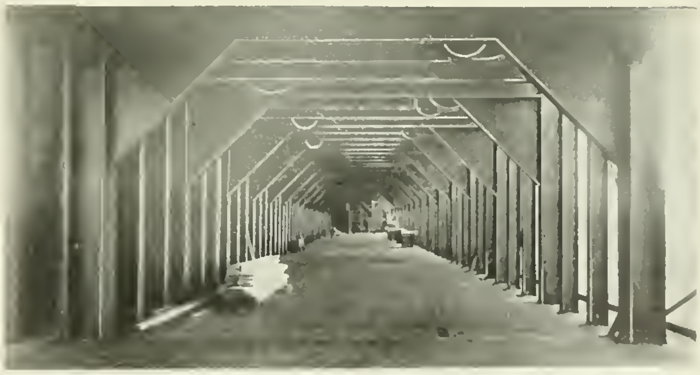


FIG. 33.—STEEL COAL POCKET AT END OF WHARF, ATLANTIC AVENUE.

STEEL COAL POCKET.

At the end of the wharf and running parallel to it is a steel coal pocket 144 ft. long 20 ft. wide and 17 ft. deep, having a capacity of about 1300 tons of coal. Beneath this pocket is a driveway 12 ft. high, used for loading teams with coal.

The total structure, including the coal pocket, is 246 ft. in length, and is supported by two sets of columns, the main ones being spaced 12 ft. on centres, the intermediate ones being placed at 4-ft. intervals between the main columns.

These main columns are built up of web and angle-iron construction, the webs being 15 by ⅜ inches and 42 ft. 7¾ inches long, the angles 5 by 3½ by ⅜ inches; the auxiliary columns consist of 9 by ¼ inches plate, 32 ft. 6 inches long. These latter columns extend up through the coal pocket, serving to support a part of this load, while the former extend the entire height of the structure, supporting the rails of the cable railway and also the coal towers above. Across the top of these columns are girders 24 ft. 11¼ inches in length, made up of 24 by ¼-inch webs and 5 by 3 by ⅜-inch angles, which support the rails. The main columns are braced by angles 2½ by 2½ by ¼ inches, running diagonally in the plane of the columns. The floor and sides of the coal pocket are made of 3-inch hard pine plank. There are 24 coal chutes built in the bottom of the coal pocket at regular intervals on both sides to facilitate the loading of coal teams on the wharf. This coal pocket was built by the New England Structural Company after plans by the Metropolitan Coal Company of Boston.

COAL TOWERS.

On top of the coal pocket, running on rails spaced 21 ft. 3¼ inches on centres are three coal towers, two of which are of ordinary form and construction, extending 70 ft. above the rails, and each being equipped with two Lidgerwood hoisting engines for operating the coal buckets.

The third consists of a steel cantilever tower 91 ft. high, 31 ft. 6½ inches long and 24 ft. wide, mounted on eight double-flanged wheels running on rails the entire length of the pocket, 43 ft. above the wharf. The main floor is constructed of 15-inch 42-lb. I-beams, resting directly on the trucks. The cross beams are 15-inch 33-lb. channels, while the diagonal bracing is effected by 12-inch 20½lb. channels. The uprights at the four corners are made up of two 6 by 4 by 9-16-inch angles, bolted together and extended about 30 ft. above the main floor beams to which they are secured. These uprights are braced diagonally with 3 by 3 by ⅝-inch angles. Thirty ft. above the main floor the columns are continued at an angle forming a square pyramid extending 55 ft. above, at the top of which are four 36-inch sheaves hung on a swivel, over which run the main hoisting ropes. The boom is of steel construction and extends out on each side of the coal tower, the land side being fixed and extending 72 ft. from the centre of the tower. The water side of the boom extends 62 ft. from the centre of the tower, and is so constructed that it can telescope the land side of the boom. The coal bucket can travel the entire length of the two sections of the boom, so that coal may be taken from a barge on the water side, and discharged into the hopper of the coal pocket, or it may be carried farther and emptied into a coal shed on the land side of the tower. In like manner the coal may be taken from the coal shed and discharged into the coal pocket, or loaded on to a barge at the end of the wharf.

The hoisting machinery in the tower is electrically driven. The main hoist consists of two drums of the standard friction type, running at a speed of 900 ft. per minute, hoisting a load of 7750 lbs. The drums and armatures are on the same shaft, each drum being driven independently by a 100-hp, 250-volt multipolar motor running at 150 r. p. m. The trolley hoist located on the opposite side of the tower consists of two drums on the same shaft, one being loose, the other keyed to the shaft, the power being transmitted by means of a positive 4-jaw clutch. Directly connected to each end of the drum shaft is a 40-hp, 250-volt multipolar motor, operating at about 200 r. p. m. This cantilever tower, as well as the two smaller towers, was built by J. H. Procter & Co., of Boston.

Besides the coal pocket already described having a capacity of 1300 tons, there is a coal shed on the old portion of the wharf capable of storing 4200 tons, and a coal yard on the land side of the coal pocket having a capacity of 4500 tons, so that the entire wharf as now constructed is capable of storing 10,000 tons of coal.

CABLE RAILWAY.

The coal is conveyed from the coal wharf to the boiler room by means of a cable railway, which runs along the top of the coal pocket over a trestle having an 8 per cent grade, into the south end of the boiler room, along the length of the boiler room and down to the coal pocket again. There is also a loop which supplies coal to both of the wooden coal sheds. Along the top of the coal pocket and throughout the length of the boiler room there is a double track, there being in all about 2000 ft. of single track. The trestle is made up of hard pine bents, having posts 10 by 10 inches at the lower end and 12 by 12 inches at the higher end, being braced by 4 by 8-inch hard pines fastened by ¾-inch bolts.

The tracks have a gauge of 21½ inches, being made up of 16-lb T-rails, the curves having a radius of 12 ft., with horizontal pulleys for guiding the cable.

The cars, 10 in number, are 8 ft. 6 inches long, 5 ft. 1 inch wide at the top and 3 ft. 8 inches wide at the bottom, and 5 ft. 3 inches deep. They each run on 8 wheels, weigh 1¾ tons, have a capacity of 2½ tons, and have sides which open out to discharge the coal, this being regulated by a trip located in any desired position.

Each car is provided with a stop which works the automatic switch thus putting the car on the desired track in the boiler room. The cars may be loaded with coarse or fine coal by regulating the screens in the tower. Two men can operate this system, one man being required to ungrip the cars the other to load and grip again.

Steel hoisting cable ¾ inch in diameter is used to propel the cars, this cable being driven at a speed of about 200 ft. per minute by a 12-ton cable drive, consisting of a system of gears and pulleys, which is operated by an electric motor. The device for taking up the slack wire consists of a movable pulley, around which the cable passes, traveling on a horizontal track. The cable is kept taut by means of a weight connected to the movable pulley by a cable passing over an auxiliary pulley. This cable railway was built by J. H. Procter & Co., of Boston.

BOILER ROOM.

The floor of the old boiler room is 15 ft. above the ash room floor, and is supported on horizontal box girders 18 inches wide by 31 inches deep, these being tied together by plate girders running transversely, 16 inches wide by 36 inches deep. These are supportd by two rows of box columns 18 inches square.

In the new boiler room the supports are built up on a basis of separate units of two boilers each. Under each side wall are placed three 15-inch I-beams, while under the centre walls there are placed three 20-inch I-beams. The main floor is made up of brick arches, resting on beams. The stoker pit runs across the width of the boiler room from one set of boilers to the other.

The boilers are located in rows extending from north to south of the boiler room, there being seven boilers on the water side of the room and eight on the engine side, the chimneys being situated between the old and new boilers. The boiler room equipment consists of seven double-deck water-tube boilers, built by the Babcock & Wilcox Company, having a nominal capacity of 368 horse-power each. Each boiler consists of two drums 42 inches in diameter and 22½ ft. long, containing 14 sections of 12 tubes each, providing a water-heating surface of 2680 sq. ft. The grate is 8½ ft. wide and 7 ft. long, giving a grate surface of 59½ sq. ft. The ratio of the heating to the grate surface is 62.6. Two of these boilers are fitted with the Hawley down-draft furnace.

There are also installed eight double-deck Babcock & Wilcox water-tube boilers of a nominal capacity of 418 horse-power. These are made up of two 42-inch drums, 23 ft. 3 inches long, having 16 sections of 12 tubes each, the tubes being 4 inches in diameter and 18 ft. long. The water-heating surface is 4181 sq. ft. and the superheating surface is 376 sq. ft.

These boilers are equipped with Babcock & Wilcox chain grate stokers, 90 by 111 inches, providing a grate surface of 69.4 sq. ft. The stokers are driven by 7½-hp, 220-volt motors, having a speed of 300 r. p. m., made by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. The motor is geared to a jack shaft, having a speed of 70 r. p. m., which can be varied 12½ per cent either side of normal by means of a motor starting box.

There is an eccentric on the jack shaft with a rod connecting down to a rocker arm carrying a pawl, which engages a tooth wheel driving a worm, which in turn drives a gear fastened to the main sprocket shaft of the grate. These stokers are guaranteed to run successfully under continuous load at a temperature of not less than 150 degs. F. There is space in the new boiler room for an extension of the boiler plant whenever it becomes necessary to utilize it. The ashes are discharged from the furnaces through chutes to the ash room below the boiler room floor, and then carted away. On the water side of the space beneath the boilers there are two rooms partitioned off, one for the circulating pumps and the other for the feed-water pumps.

There are three M. T. Davidson compound tandem, non-condensing circulating pumps, which supply the surface condensers with water from the harbor, the water ends being lined with composition metal to prevent any action of the salt water on the pipes. Two of the pumps have steam cylinders of 10-inch and 20-inch diameters, water cylinders 20 inches in diameter and 24-inch stroke, with 14-

inch suction and discharge pipes. The other pump has steam cylinders 7 inches and 14 inches in diameter, a 14-inch water cylinder and a stroke of 16 inches, the suction and discharge pipes being 10 inches in diameter. The feed pump room contains two Davidson, simple pumps, each having a steam cylinder 14 inches in diameter and a water cylinder 8¼ inches in diameter, with a stroke 14 inches, making 86 strokes per minute; also two Blake, vertical compound duplex pumps with steam cylinders 10 by 16 inches in diameter and water cylinders 8 inches in diameter, having a 10-inch stroke. There are also installed and ready for use, if necessary, 10 Korting universal injectors.

The feed water for the boilers is taken directly from the city mains, the pipes in the street being so arranged that it would be almost impossible for the supply to fail. The main service pipe is 12 inches in diameter, having a water pressure of 40 lbs. There is also a 12-inch high-pressure main, which can be used in case of emergency. From the city mains the water flows through a Goubert exhaust feed-water heater, after which it passes into a Cochrane open heater, where it is heated by direct contact with the exhaust steam from all the auxiliaries; from this heater it is pumped into the boilers by the feed-water pumps. There is being drilled at the present time, just outside the boiler room, an artesian well, which has already been sunk 500 ft., and if this well should supply the proper quality of water, it will be used as a partial supply for the boilers. On the outside of the boiler room towards the wharf, a space has been reserved for economizers, but at the time of writing they have not yet been installed.

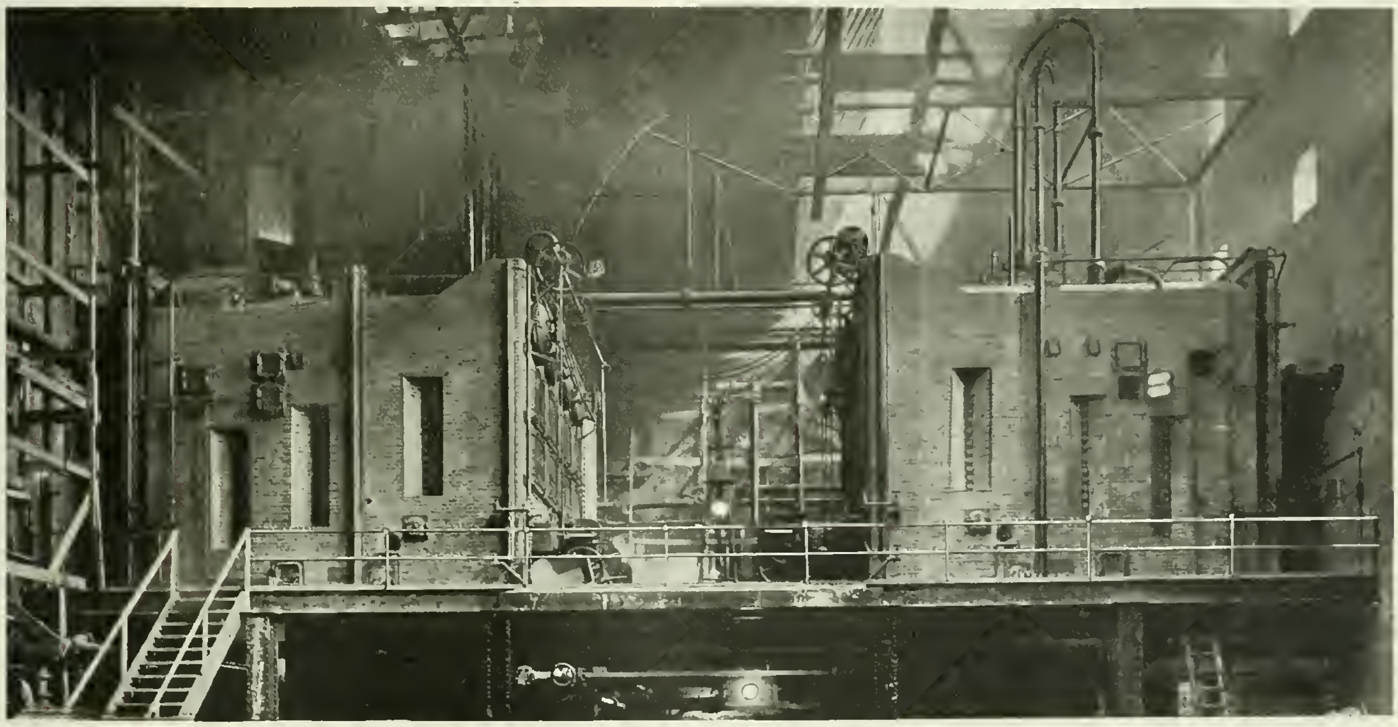


FIG. 34.—NEW BOILER ROOM, ATLANTIC AVENUE.

CONDENSER ROOM.

At the southeast corner of the engine room, at the end of the System building, is the condenser room of the central condensing system. There are installed here two Blake twin vertical air pumps (inverted) of the regular marine type, having steam cylinders 16 inches in diameter and buckets 44 in diameter, with a common stroke of 24 inches. These pumps take the water and condensed steam from the Knowles jet condensers, which are of the cone type, located below, and discharge it into the harbor through the 48-inch discharge pipe located on top of the sluiceway. The salt water from the channel flows through the sluiceway, already described, into the jet condensers, where it is met by the exhaust steam from the engines which has passed through the 50-inch condenser pipe, running around the engine room under the gallery, and also through Goubert feed-water heaters, consisting of a number of brass pipes conducting the feed water, surrounded by a chamber through which the condensed steam passes. The 50-inch exhaust main is furnished with two 30 and 36-inch free-air exhaust pipes, having Sturtevant exhaust heads. When the condenser room is completed it will have double its present capacity.

ENGINES.

The engine equipment at the Atlantic Avenue Station consists of four 660-hp vertical triple expansion engines, each driving two 200-kw generators; one 1200-hp engine driving two 400-kw generators; two 1200-hp engines, each driving one 800-kw generator, and two 2400-hp engines, each driving one 1600-kw generator. The four 660-hp engines were built by the J. Morton Poole Company of Wilmington, Del., after plans by the Edison General Electric Company. They are all of the triple expansion condensing, vertical type, directly connected to the generators, one at each end, the armature acting as flywheels. These engines are run at 120 revolutions per minute, the pressure being 160 pounds. The diameters of the cylinders are 16¼ inches, 23⅞ inches and 38½ inches, respectively, the stroke being 30 inches The piston rods are all 3¼ inches in diameter. The high pressure rods are all packed with "Tripp" metallic "two-four" packing, the intermediate and low pressure rods having soft packing.

The engines stand 18 feet 3 inches above the floor, which is three feet above the top of the brick foundation. The engines are fitted with piston valves, and have centrifugal governors on the crank shafts between the crank disks. The cylinders are steam-jacketed and lagged and are surrounded by a sheet iron casing. Each engine is provided with a Wheeler surface condenser and a Knowles combined circulating and air pump, which are located in the rear of each engine.

Engine No. 5, located at the end of the row of engines just described, is of the vertical cross compound type, designed and built by McIntosh, Seymour & Company, of Auburn, N. Y. It runs at 100 revolutions per minute on 160 pounds steam pressure. It is rated at 1200-ihp and has a total weight of 254,000 pounds. The diameter of the wheel is 12 ft. and its weight is 40,000 pounds. The principal dimensions of the engine are as follows: Diameter of outside main bearings, 14 inches, length 30 inches; diameter of inside main bearings, 14 inches, length 20 inches; diameter of crank, 15 inches, length 8 inches; diameter of crosshead pin, 7 inches, length 9 inches; bearing surface of crossheads, 17x20 inches; diameter of piston rods, 5 inches; diameter of steam pipe, 8 inches; diameter of exhaust pipe 20 inches.

The engine is guaranteed to regulate from no load to full rated load within two per cent. variation of speed. The guaranteed water consumption, including steam condensed in jackets and reheater coils, is 13¼ pounds per indicated horse-power. The high pressure cylinder is jacketed and a reheater consisting of heating coils having 440 square feet of heating surface is connected between the cylinders. These auxiliaries are supplied with steam at boiler pressure. Both cylinders are four-ported, and are provided with valves of the flat gridiron type of standard form. The clearance in the high pressure cylinder is 2 per cent. and in the low pressure 3 per cent.

The main valves are driven by an eccentric, controlling the admission of the steam and the opening and closing of the exhaust. The cut-off of the steam is effected by the cut-off valves which are controlled by a centrifugal governor situated on the main shaft of the engine.

The valve gear is positive, composed of simple levers and links, and the cut-off can take place at any point between zero and the maximum cut-off. Piston rods of both cylinders are furnished with "Tripp" metallic packing, they are also provided with auxiliary glands for the use of soft packing. The throttle valve is a quick opening valve of the double poppet, balance type, operated from the floor level by an operating wheel provided with a crank handle. The main steam pipe to the engine is fitted with an 8-inch direct separator.

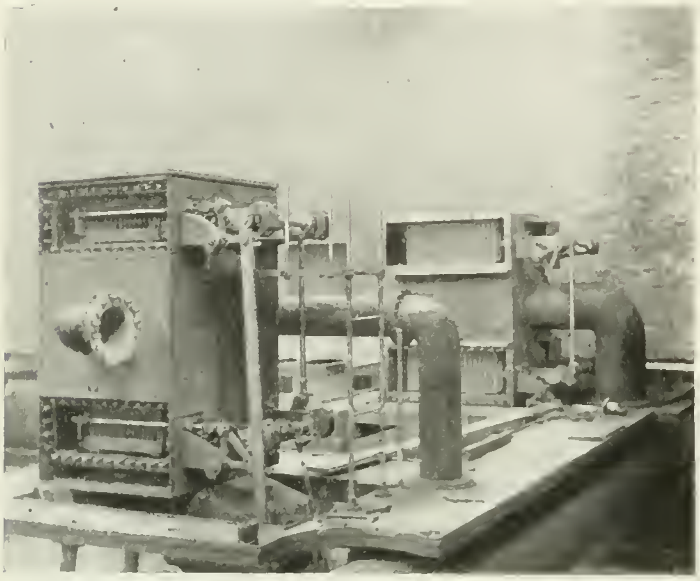


FIG. 35.—VALVES AND STEAM CHESTS, 2400-HP ENGINE.

Directly behind the engine is located a Wheeler surface condenser consisting of 1450 tubes 10 ft. 2 inches long and having an outside diameter of ⅝ inch. There is also provided a vertical twin bucket pump built by the George F. Blake Manufacturing Company, having a steam cylinder 9 inches in diameter and a water cylinder 18 inches in diameter and a stroke of 12 inches.

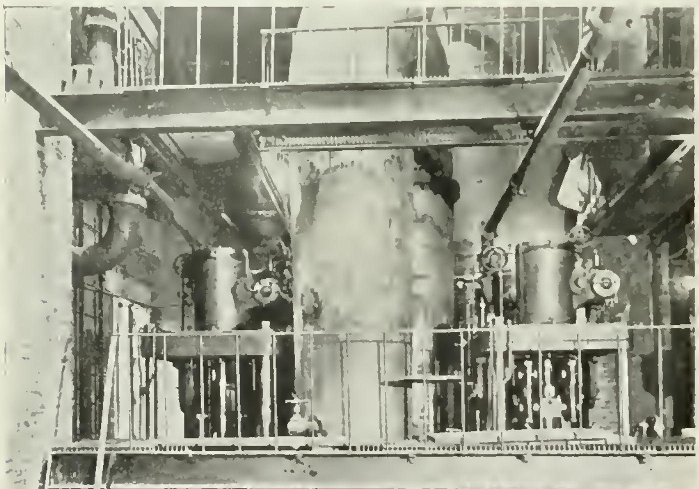


FIG. 36.—VIEW IN CONDENSER ROOM OF THE CENTRAL CONDENSING SYSTEM, ATLANTIC AVENUE.

In the same end of the engine room on the opposite side and facing engine No. 5 are two 1200-hp engines numbered 6 and 7, which are alike in all respects and are arranged to drive one 800-kw dynamo each, situated on the engine frame between the high and low pressure engines. The engines are of the vertical cross-compound, side crank type, were built by McIntosh, Seymour & Co., run at a speed of 100 revolutions per minute, and have each the following dimensions:

Diameter of high-pressure cylinder, 23 inches; low pressure, 48 inches; stroke, 48 inches. Total weight of engine, 275,000 pounds. Weight of wheel, 65,000 pounds; diameter of wheel, 15 feet. Diameter of bearings, 17 inches; length of same, 35 inches; diameter of shaft between bearings, 20 inches; diameter of crank pin, 8 inches, length 8 inches; diameter of crosshead pin, 7 inches, length 8 inches; bearing surface of crosshead 17 x 20 inches; diameter of piston rod 3 inches; diameter of throttle 9 inches, main steam pipe 10 inches, exhaust pipe 20 inches.

The engine is guaranteed to regulate from no load to full rated load within 2 per cent. variation of speed, and not to consume more than 13¼ pounds of dry steam per indicated horse-power per hour when running at full load.

The cylinders and steam chests are lagged with magnesia fibre and sheet steel. Between the two cylinders is located a reheater containing about 440 square feet of heating surface supplied with steam at boiler pressure. The cylinders are four-ported and provided with standard flat gridiron valves. The high-pressure cylinder has a clearance of 2 per cent, the low pressure 3 per cent.

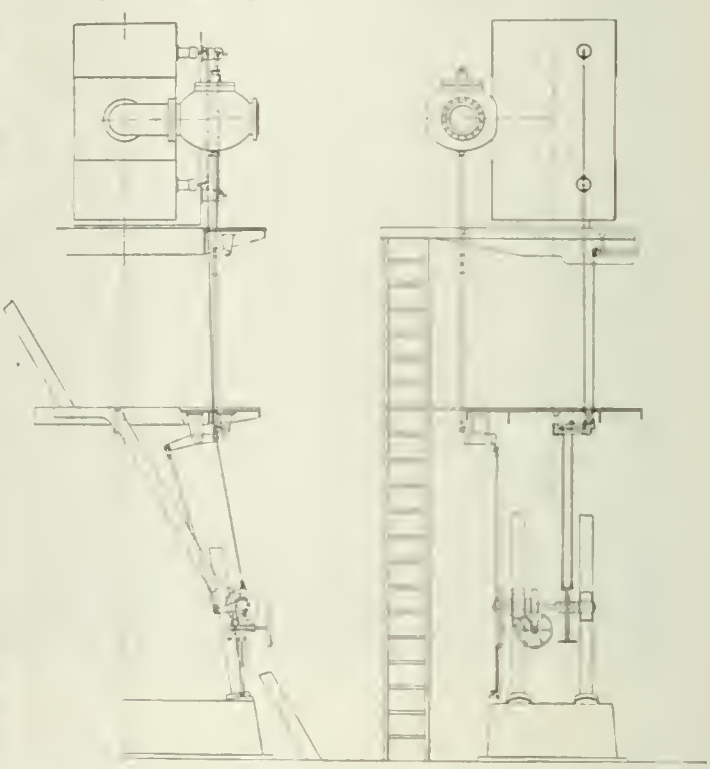


FIG. 37.—THROTTLE AND DRIP CONNECTIONS 2400-HP ENGINES.

The valve gears and governors are of the same type as No. 5 previously described. The bearings are hollow and provided with a circulation of water. They are also each provided with two sight feed oilcups in addition to the oil which is supplied the bearings by means of a brass oil pump driven from the valve gear. The crank pins, crosshead pins, guides and wipers are oiled continuously by means of a supply tank situated upon the upper platform connected by a system of brass piping to an adjustable sight feed outlet to each part to be lubricated.

The engines are equipped with Cochrane receiver separators and have throttle valves of the quick opening piston type.

At the rear of each engine is a Wheeler surface condenser having 1186 tubes 10 ft. 2¼ inches long and ¾ inches in diameter. Also a Blake air pump similar to the one on No. 5 engine. These two engines are piped to connect with the central condensing system if required. All the engines can be run with open-air exhaust if necessary.

The latest units installed by the company consist of two McIntosh & Seymour 2400-hp engines, each driving one 1600-kw generator These units are situated, as shown on the plan, in the end of the new engine room next to the switchboard room and are so placed as to face each other. The engines are of the vertical cross-compound side crank type, run at a speed of 100 r. p. m. on a pressure of 160 lbs., and have the following dimensions in common: Diameter high-pressure cylinder, 29 inches, of low pressure, 60 inches, stroke 56 inches. The total weight of engine 500,000 lbs., weight of wheel 130,000 lbs., diameter 18 ft. Diameter of bearings, 24 inches, length 48 inches; diameter of shaft between bearings 27 inches; diameter of crank pin 12½ inches, length 10½ inches; diameter of crosshead pin 10½ inches, length 10½ inches; bearing surface of crosshead 21 x 25 inches; diameter piston rod, 6 inches; diameter steam pipe 10 inches, of exhaust pipe 24 inches.

The speed is guaranteed to within a variation of two per cent. from no load to full load, and the engines are guaranteed to operate on a maximum steam consumption of 12¾ lbs. per hp per hour, including steam condensed in jackets and reheaters.

Between the two cylinders is located a reheater having a total heating surface of 800 sq. ft. The clearance in the high-pressure cylinder is 2¾ per cent and 4 per cent in the low-pressure cylinder. The throttle valve is of the quick opening piston type, operated by a set of levers, a sketch of which is shown on another page.

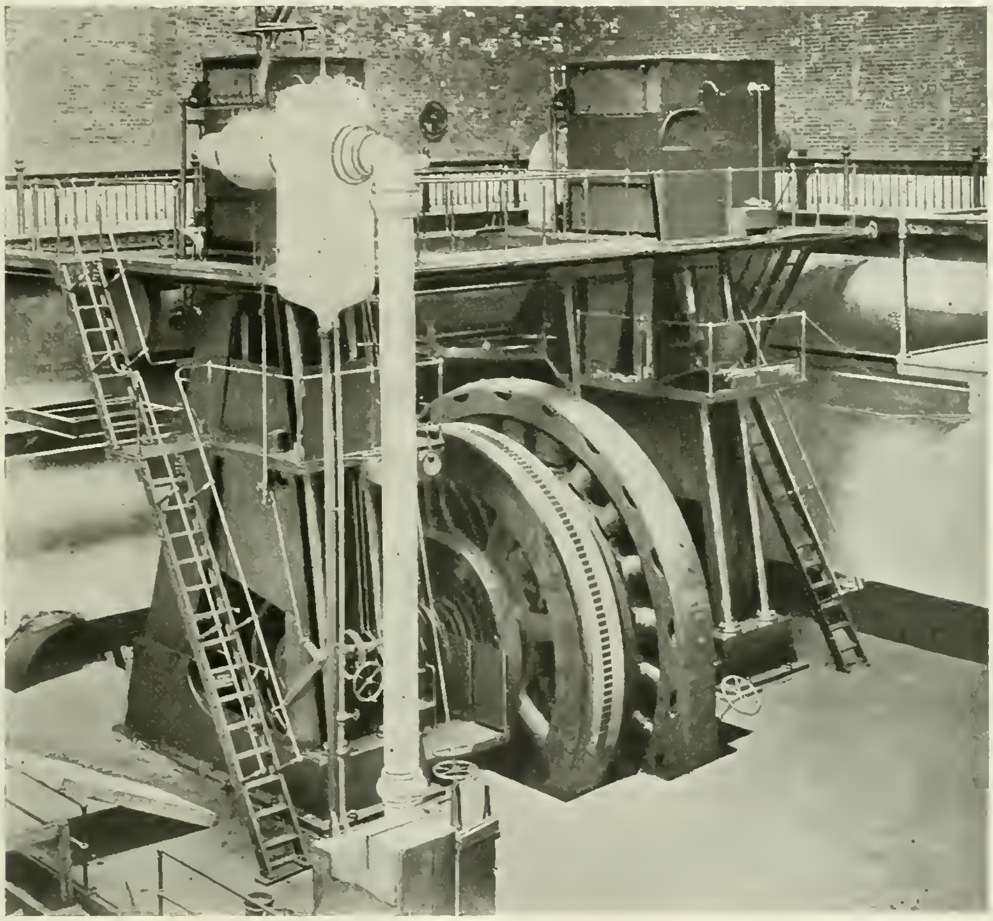


Fig. 38.—2400-hp McIntosh & Seymour Engine and 1600-kw G. E. Generator in New Engine Room, Atlantic Avenue.

The engine is provided with a turning gear operated by a 5-hp, 220-volt, General Electric motor, attached to the rear of the engine bedplate, supplied with a controller and rheostat giving five running speeds, the minimum being 200 and the maximum 960 r. p. m.

The valves, governors and other details of these engines are similar to those of the 1200-hp engines, previously described. The engines are connected with the central condensing system by a 50-inch pipe extending around the room beneath the gallery. The space in the new engine room now unoccupied will be utilized in the future as necessity requires. It is proposed, at the time of writing, to fill this space with 4000-hp engines, of similar type, driving 2500-kw direct-connected generators.

STEAM PIPING.

All of the copper pipe and most of the screw flanges, as originally installed, have been discarded and are now replaced by steel pipes with flanges welded on. All the high-pressure steam pipe is made up of tongue and groove joints with copper gaskets, all the fittings being made of air-furnace gun iron, having a tensile strength of 30,000 lbs. per square inch. The company has its own standard for flanges, bolting, etc., those used being heavier than others found in common practice. The main steam pipe is anchored at certain definite points, so as to control the direction of expansion.

From the steam outlets on the boilers 6-inch vertical loops, carried up high above the boilers in order to give the desired flexibility, connect to the steam mains which vary from 8 to 12 inches in diameter. These mains run crosswise of the boiler room, discharging into short 12-inch headers parallel with and supported on the side wall between the boiler and engine rooms. From these headers, which are connected by means of 8-inch equalizing loops, the pipes lead directly to the engines.

The engines in the old room are divided into two groups, each one on a 12-inch main, the four triple-expansion engines being fed from one main and the three 1200-hp compound engines from the other. In the new engine room each engine has its own pipe connecting to one of the headers. Each engine has, besides its quick-acting throttle, an outside gate valve geared to a floor stand convenient to the engineer standing at the throttle. Each boiler is provided with an automatic stop check to prevent the back flow of steam in case of a drop in pressure or a rupture in the boiler. Each boiler has a stop valve which is geared to a position on the outside of the boiler room wall, where it can be operated in case of an accident in the boiler room.

All the auxiliary apparatus, like feed pumps, circulating and air pumps, are fed independently from the boilers by means of a 6-inch pipe. All the high-pressure drains from the engines and main steam pipes are returned to the boilers by the Holly system.

CRANE.

In the engine room, running the length of the room on tracks already described, is a 50-ton overhead traveling crane, built by the Morgan Engineering Company, of Alliance, Ohio. This crane is one of the largest in existance, having a span of 80 ft. 10 inches, one piece of the crane weighing 40,000 lbs. It is provided with two hoists. The main hoist having a capacity of 50 tons, with a maximum lift of 56 ft. and an auxiliary hoist of 5 tons capacity and a lift of 62 ft. The main hoist has a speed of 11 ft. per minute, full load, the speed increasing with decrease of load. The auxiliary hoist has a speed of 50 ft. per minute. The cross travel varies from 80 ft. to 100 ft. per minute, and the longitudinal travel from 100 ft. to 150 ft. per minute.

The armature of the hoisting motor has an automatic electric brake, operated by solenoids, and applied by gravity so that if the current should fail from any cause, the brake would immediately apply itself and prevent the running down of the load. The main hoist is also supplied with a mechanical brake. The crane is operated by four 220-volt General Electric enclosed multipolar electric motors of different capacities, as follows: Main hoisting motor, 50-hp, auxiliary hoisting motor 25 hp, trolley travel 5 hp and the bridge travel 30 hp.

The motors are all controlled from a cage suspended from the crane, in which are installed four Morgan lever controllers, and reversing switches. This crane can pick up the heaviest piece which comes into the station from a dray in the driveway, lifting it through the sliding door opening and depositing it in its required position without its being removed from the hoisting hook.

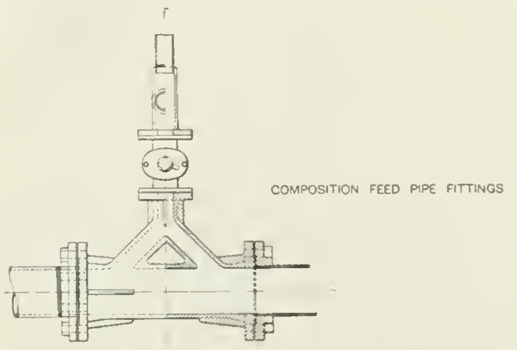


FIG. 39.—COMPOSITION FEED PIPE FITTINGS.

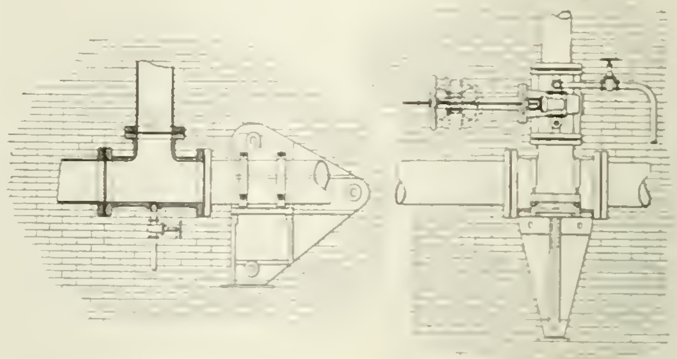


FIG. 41.—HIGH-PRESSURE STEAM PIPE FITTINGS AND ANCHOR.

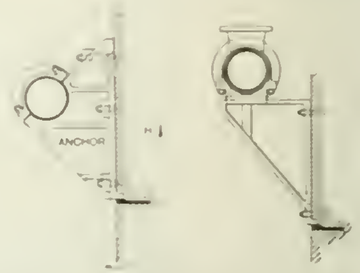


FIG. 42.—HIGH-PRESSURE STEAM PIPE FITTINGS AND ANCHOR.

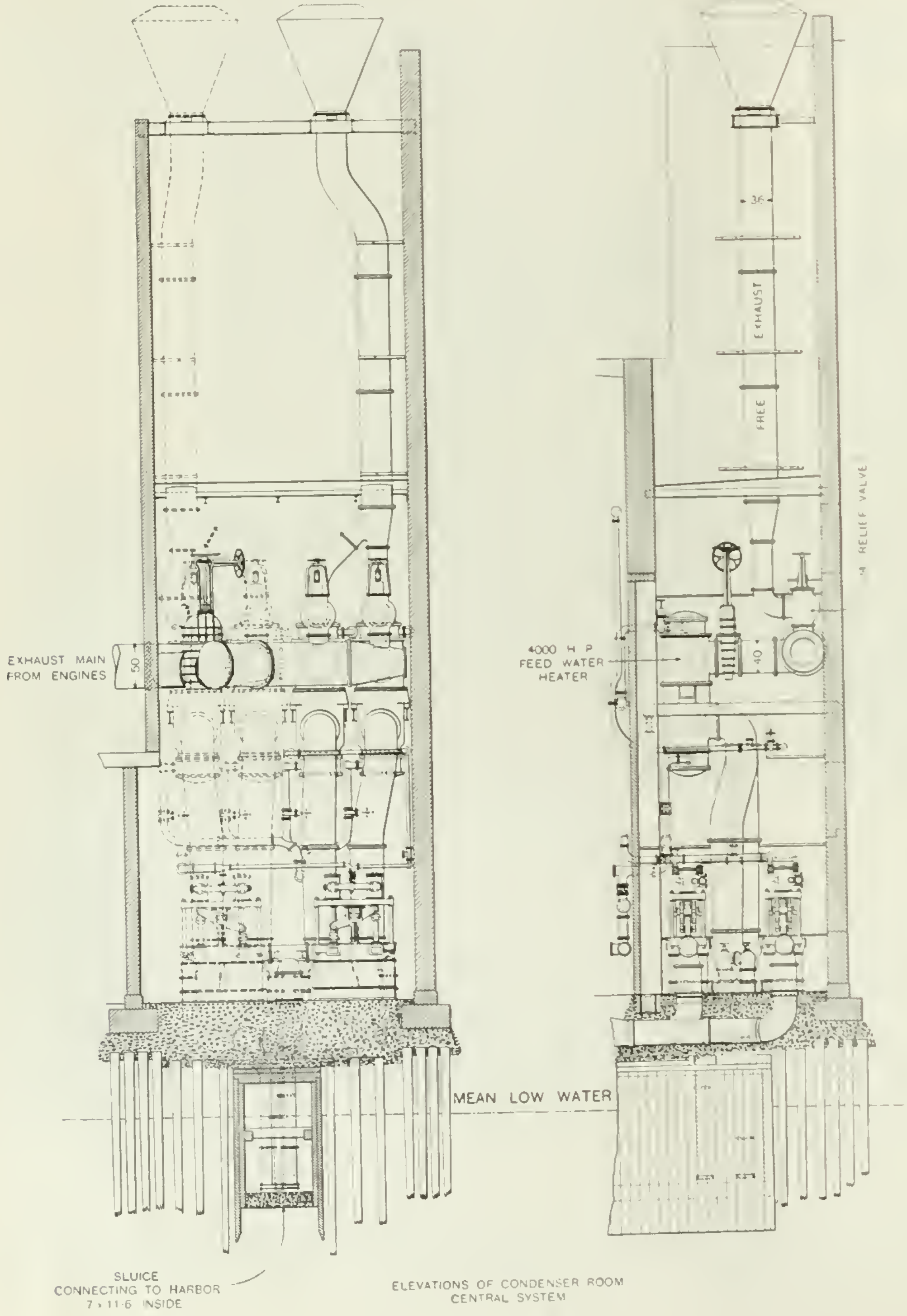

EXHAUST MAIN FROM ENGINES
50
36
EXHAUST
FREE
RELIEF VALVE
4000 H P FEED WATER HEATER
40
MEAN LOW WATER
SLUICE CONNECTING TO HARBOR 7 x 11-6 INSIDE
ELEVATIONS OF CONDENSER ROOM CENTRAL SYSTEM

FIG. 40.—ELEVATIONS OF CONDENSER ROOM, CENTRAL SYSTEM.

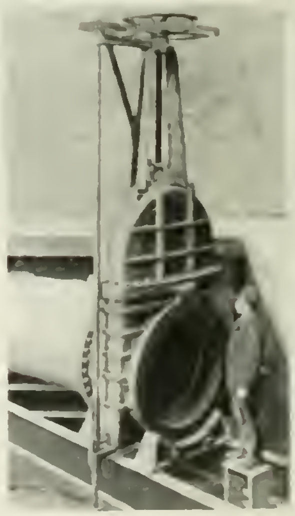


FIG. 43.—CHAPMAN VALVE IN MAIN CONDENSER PIPE, ATLANTIC AVENUE STATION.

GENERATORS.

All of the generators installed at this station are of the direct-connected type, the first four having been designed and built by the Edison General Electric Company, the remainder by the General Electric Company, at Schenectady, N. Y. There are two generators on each of the four 650-hp engines of 200-kw each. They run at a speed of 120 revolutions per minute, develop 1333 amperes at 160 volts, and run on the three-wire system; one dynamo on each engine being connected to the positive and the other to the negative side of the system. The pole pieces, fourteen in number, are all connected in multiple and are bolted to the inside of the circular casting resting on the foundation bed of the engine.

The armature consists of a cast iron pulley, on the outside circumference of which is bolted and keyed a brass rim about 1 inch thick, having spokes which carry the laminated core and the winding.

The winding consists of 980 sections, each being composed of a heavy U-shaped copper bar which, with one section of the commutator, forms one complete turn around the laminated core, the commutator being on the side of the armature. The fourteen sets of brushes are supported on a circular frame, which revolves on a hub supported by three heavy cast iron arms, radiating from the centre and attached at the other ends to the field casting. There are two brushes on each holder composed of copper wire gauze, making contact on the commutator. A lever is provided on the front of the dynamo by which all the brushes can be lifted from the commutator simultaneously. By means of a hand wheel, all the brushes can be adjusted simultaneously, and in addition each brush can be adjusted individually.

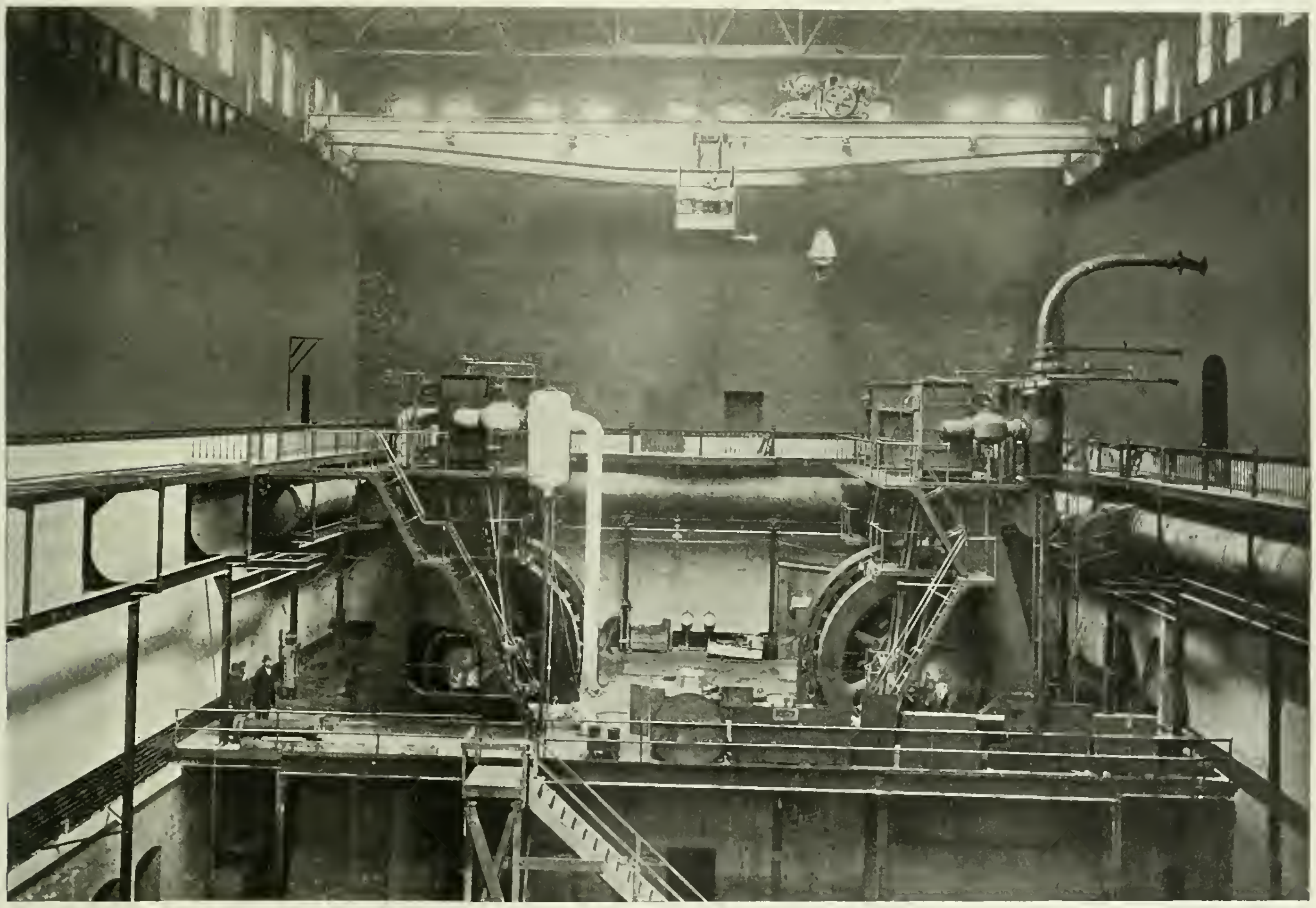


Fig. 44.—View in New Engine Room, Atlantic Avenue.

Each consecutive brush is of opposite polarity and the brushes of similar polarity are connected together by three strands of copper cable. The current is carried to the main switchboard by means of heavy flexible cables. There are, in series with the fields, rheostats which are controlled in the regulating room.

The diameter over the fields is 10 ft.; of the armature is 7 ft.

The 1200-hp engine, numbered 5, is equipped with two 400-kw generators which are very similar to those just described, the only radical difference being that they are double the capacity.

The dynamos have 12 poles connected in multiple and develop 2857 amperes at 140 volts, running at a speed of 100 revolutions per minute.

The two 1200-hp engines numbered 6 and 7 are each equipped with one 800-kw generator, located on the bed of the engine, between the high pressure and low pressure crank.

The dynamo is run at a speed of 100 revolutions per minute and is guaranteed to develop 2666 amperes at 300 volts, or 2963 amperes at 270 volts. These machines furnish current to the outside wires of the three wire system. The frame consists of a circular cast iron yoke with 16 inwardly projecting poles of cast steel. The armature is of the ironclad or slotted core type, and is thoroughly ventilated by means of air ducts ⅜ inch in width. The armature spider is of best grade cast iron to which are keyed the laminations or punchings in such a way that no bolts pass through the core. The armature winding consists of copper bars, laid in slots and insulated from the armature core by means of alternate layers of oiled linen and paper. The outside diameter of the armature is 10 ft. The commutator, consisting of hard drawn copper bars running parallel to the shaft, is supported on an extension of the armature spider in such a way as to entirely avoid any relative movement between the armature winding and the commutator segments.

The conductors are entirely on the surface of the armature, no copper extending along the inside of the armature core, but being connected on the back of the armature by means of soldered joints and in front by a copper rod extending from each conductor to a segment of the commutator. The current is collected by means of eight brass brushholders on each stud containing carbon brushes. An arrangement is provided by means of which the brushes may all be shifted at once to change the lead. These machines are guaranteed to carry a 25 per cent. overload for one hour and an overload of 40 per cent. temporarily without flashing or injurious sparking. The commercial efficiency at full load is 93.5 per cent.; at half load, 90.5 per cent.

In the new engine room the dynamos connected to the 2400-hp engines are each of 1600-kw capacity, one being located on the bed-plate of each engine, between the high and low pressure engines. The generator connected to engine numbered 8 runs at 100 revolutions per minute, is shunt wound, has an output of 5330 amperes at 300 volts or 5900 amperes at 270 volts, and has a circular magnet frame of high permeability cast iron, with 22 inwardly projecting poles having magnets connected in series. It is divided horizontally so that the upper half can be lifted up to provide for inspecting or removing the armature.

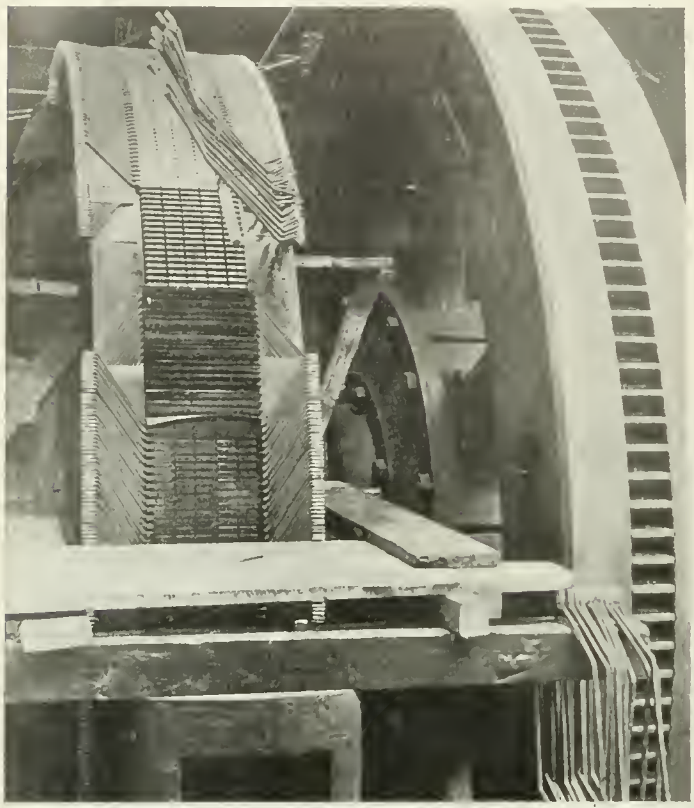


FIG. 45.—1600-KW ARMATURE IN PROCESS OF LAYING CONDUCTORS.

The pole pieces are made of cast steel and are fastened to the magnet yoke by bolts, so that any pole piece and field spool can be removed without disturbing the armature or magnet yoke. The weight of the complete machine is 190,000 lbs., that of the armature being 90,000 lbs. The armature spider is made of cast iron and is so designed that all shrinkage strains are avoided. The armature punchings or laminations are made from the best material, thoroughly annealed and securely keyed to the spider after having been thoroughly japanned to prevent eddy currents.

At certain intervals, space blocks are inserted between the laminations, providing ventilating ducts $\frac{3}{8}$-inch wide for cooling the core and windings. Slots are punched in the periphery of the laminations to receive the armature conductors.

The armature conductors are made up of copper bars of high conductivity, adjacent ones being thoroughly insulated from each other. Conductors are bent on a form into the proper (hexagonal) shape so that they can be laid in the slots without difficulty and are interchangeable. The commutator, composed of hard-drawn copper bars, is supported on an extension of the armature spider and is keyed directly to the shaft, thus preventing any relative movement between the commutator segments and the armature conductors. Each conductor of the armature is connected to a segment of the commutator by a copper bar soldered at both ends. As there is no dead copper running on the under side of the armature, the conductors are connected by means of six copper bars running in parallel lines around the rear of the armature, to one of which every eighth conductor is connected in such a way that conductors of like potential and polarity are joined to the same copper bar.

The brushholders, eleven on each stud carrying carbon brushes, are so constructed that the tension on any brush can be adjusted without lifting the brush from the commutator and without the use of any tools. A threaded rod with a hand wheel is provided by which the lead of the brushes may be regulated by a man standing in front of the engine. The current is conducted from the collecting bars to the switchboard by means of a conductor made up of 1 heavy flexible cables. These generators have a commercial efficiency of 94 per cent at full load and 91 per cent at half load.

The dynamo opposite, on No. 9 engine, is very similar to the one just described, with the following exceptions: It is a double current machine, so wound as to furnish both direct and alternating current the rated capacity being 5330 amperes at 300 volts direct current or 2500 amperes on each of six phases at 184 volts alternating current, or a proportional amount of either if both kinds of current are taken from the machine at the same time. It has 30 poles and runs at 10 revolutions per minute, giving a periodicity of 25 cycles per second Besides the commutator on the direct current side, it has six collector rings on the opposite side of the armature with brushes and cables to conduct the alternating current to the switchboard. It is quite probable that the dynamos on the future engines will be driven driven and of greater capacity.

SWITCHBOARD ROOM.

In the southeast corner of the old engine room, as has been stated before, there is partitioned off a switchboard room, containing a feeder switchboard gallery, a regulating room and a motor operated switchboard. A photograph and drawings of this room are shown on another page. On the north side of the gallery is located a feeder switchboard, made of Knoxville marble, equipped with 5-way switches, connecting the feeders to one of the five different buses on each side of the system, running along the back of the board. The booster switches are also located on this board.

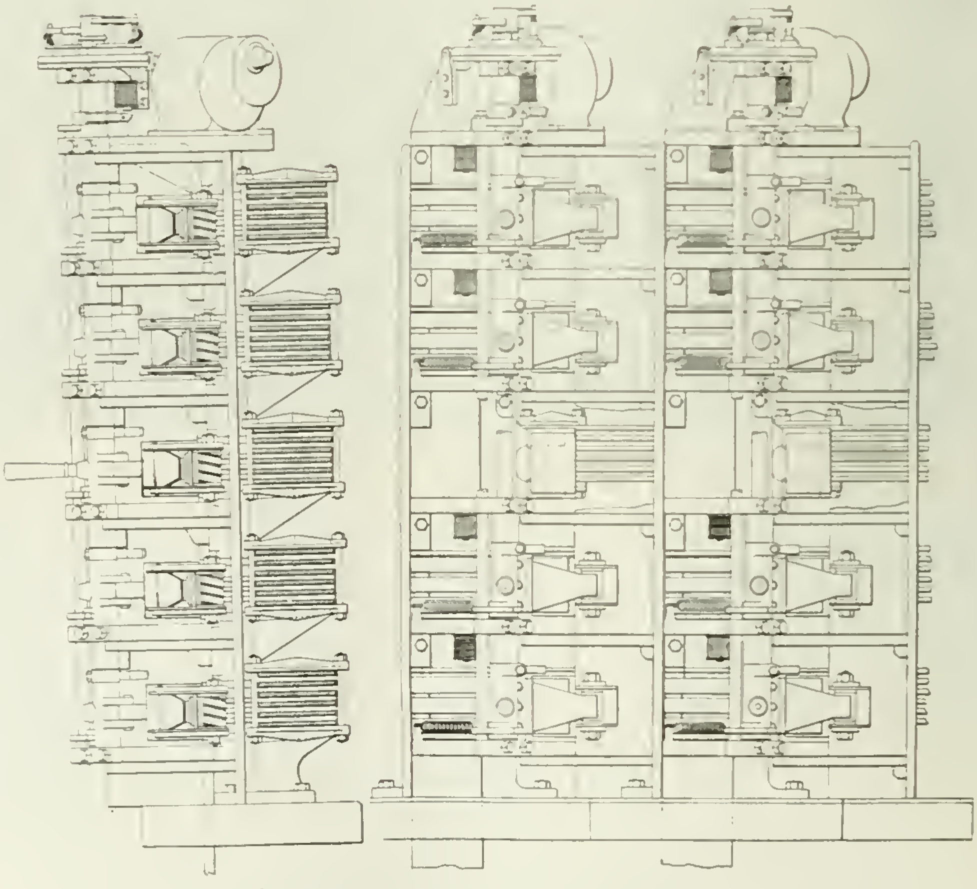


FIG. 46.—ELEVATION OF MOTOR CONTROLLED SWITCHES.

Above the switches are ammeters, of both the Weston and Thomson astatic types, in series with the feeders. Located at the end of this feeder board are four dial posts of the Cory system of engine telegraph, there being one for each engine room. Each set consists of one disk, signifying the engine or booster in question, the other denoting the instructions to be given regarding that unit.

On the opposite side of the room is another feeder switchboard, similarly equipped, containing also the battery switches. At the east end of the switchboard is the regulating platform, containing a board carrying all the main dynamo ammeters. A pressure wheel, having blocks connected to the pressure wires of all of the feeders, is so arranged that by moving the wheel around to a certain pressure block, the voltage on that feeder can be determined.

An ammeter connected in series with the station neutral wire shows how much the system is out of balance and which way. There are also installed here the battery neutral meters, Weston galvanometers for switching in the machines and other miscellaneous instruments.

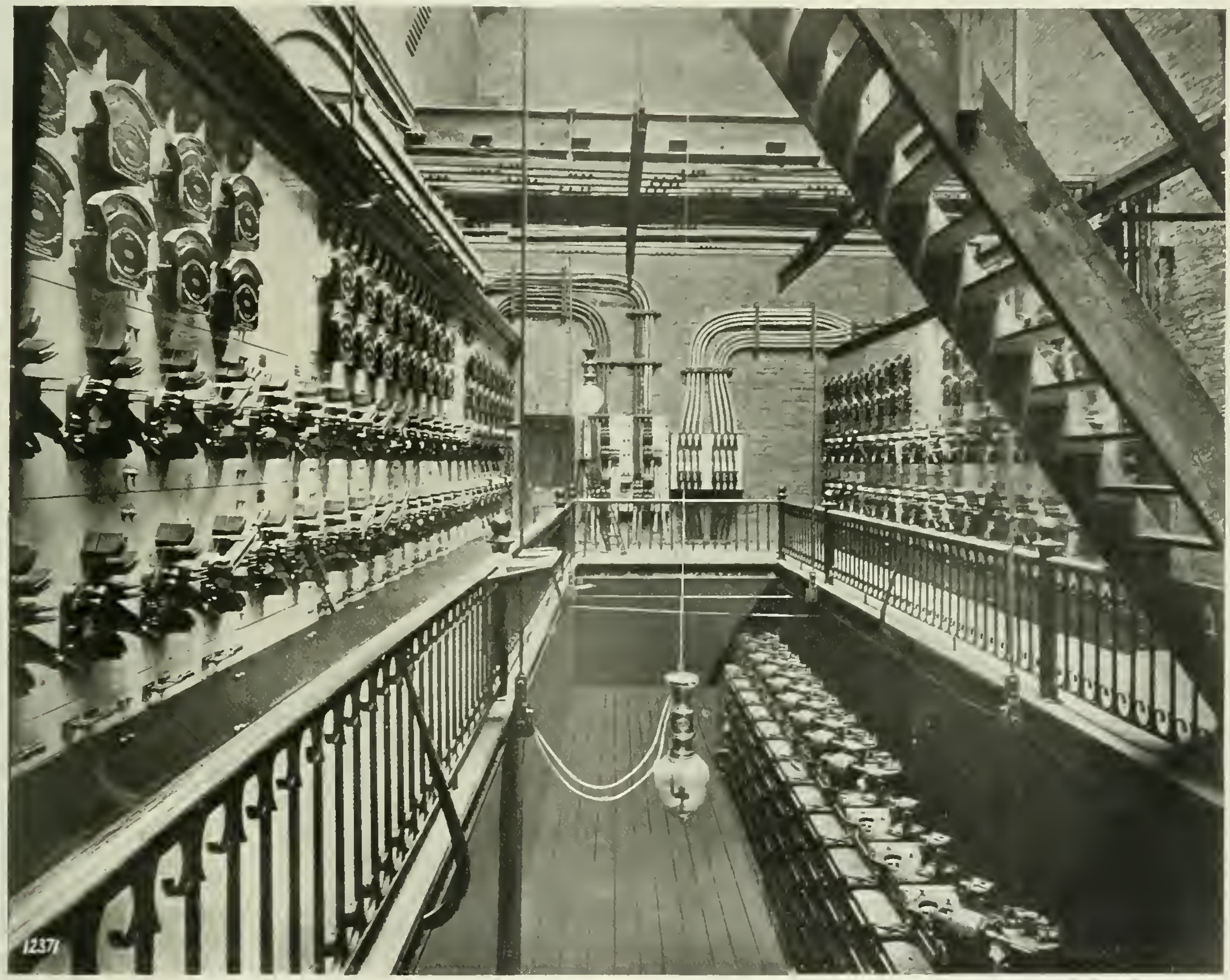


Fig. 47.—Switchboard Room, Atlantic Avenue, Showing Switch boards and Motor-Operated Switches.

Extending across the regulating platform are located the operating tables, upon which are located the control wheels for the dynamo field rheostats, also the apparatus for controlling the motor switches located on the floor below. Each switch is made up as follows: A copper post extends vertically along the length of the switch, through the floor, and is connected to the source of the current. Behind each row of switches are five bus-bars, to which are attached, one for each switch, five blocks of copper having their faces in line with the face of the copper post. There are mounted on a supporting pillar having a slate base, five copper pressure contact switches, which make connection between the copper post and the copper block on one of the bus-bars. The contact switch is made up of strips of copper, bent into the form of a hollow D, the ends making contact. These are each provided with an auxiliary circuit breaker and a magnetic blow-out. The whole switch is operated by a General Electric 2¼-hp, 115-volt motor, so arranged that by pressing a certain button at the operating table, the corresponding switch will be closed or opened as desired.

If one switch is operated while another on the same post is making contact, the latter switch will open automatically before the former one closes, so that no two switches on the same post can make contact with two bus-bars at the same time. There are 40 of these sets of switches, located 20 in a row along the length of the switchboard room, the positive switches thus being separated from the negatives. Each set of switches is enclosed in a neat box-like casing, made of Knoxville pink marble, a magnetic blow-out arrangement is so located as to drive the arc away from the switch towards the marble partition.

A certain number of these switches were designed to carry 7000 amperes for the larger dynamos and some of the tie-lines, while the rest are only required to carry 3500 amperes each. The buses at the rear of these switches carry the current directly to the feeder switchboards. There is a space provided on the other side of the room from these switches for a similar installation whenever it may be required.

These motor controlled switches were designed by the General Electric Company especially for the Boston Edison Company, and are the first of the kind in existence. Although they may be considered somewhat of an experiment, there is no reason to believe that they will not perform in a satisfactory manner the work for which they were designed.

In the engine room, near the wall of the switchboard room, are located two three-wire General Electric booster sets, one being of 75-kw capacity, having six poles and running at a speed of 650 r. p. m. The motor end runs on 240 volts, while the booster end develops 1364 amperes at 55 volts. The other booster set has the same capacity, having four poles and running at 750 r. p. m., the motor

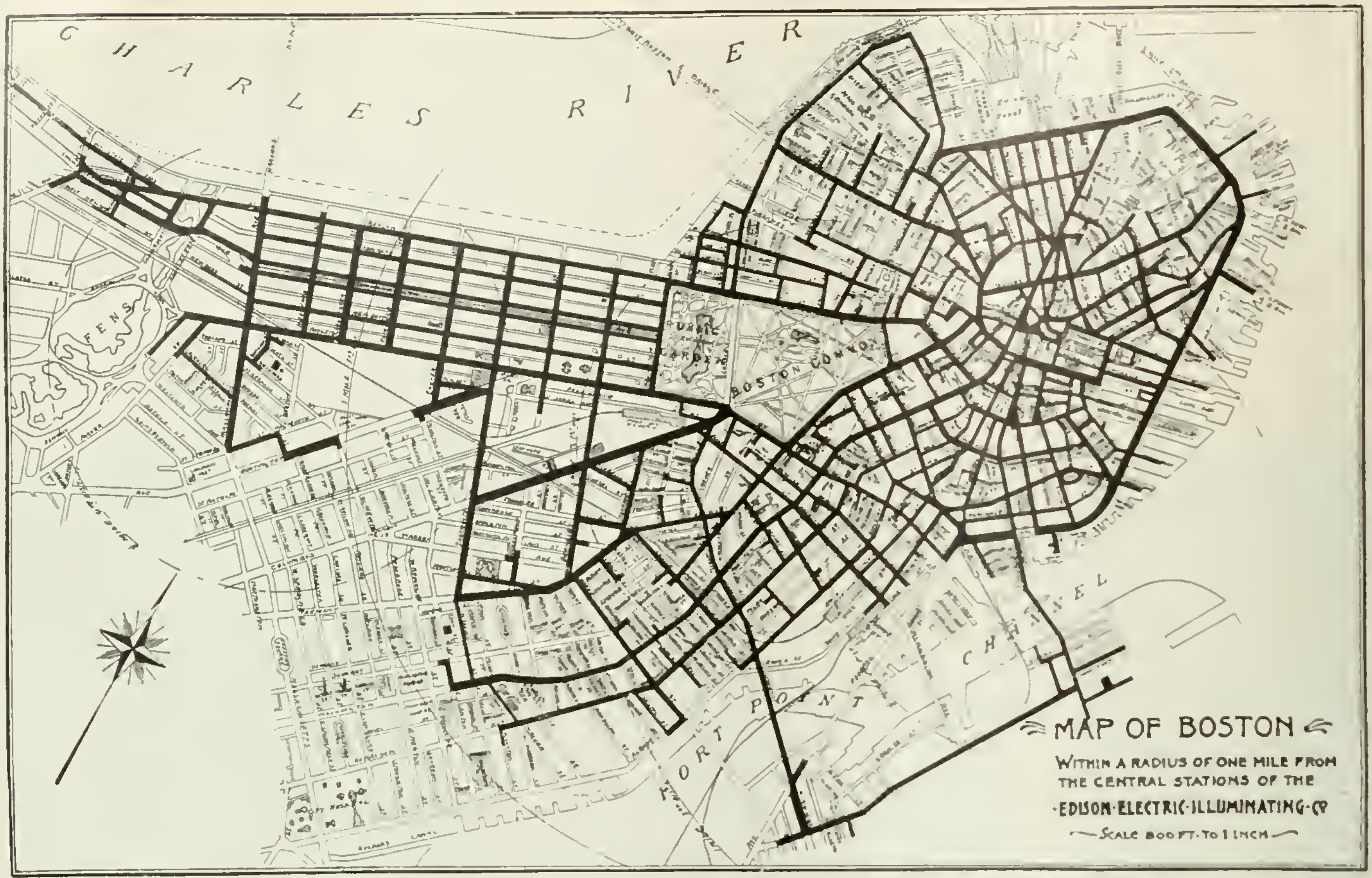


Fig. 48.—Map of Boston—Black Lines Show Streets Covered by the Edison System.

end running on 250 volts and the booster end supplying 1350 amperes at 55 volts.

DISTRIBUTION.

The current, after leaving the generators, is conducted by flexible cables through ammeters and switches to the bus-bars on the back of the feeder switchboard. Through the feeder switches the current is transmitted by the feeders through the feeder boxes to the junction boxes, from which the current passes to the mains. Services connect these mains with the customers' cutouts.

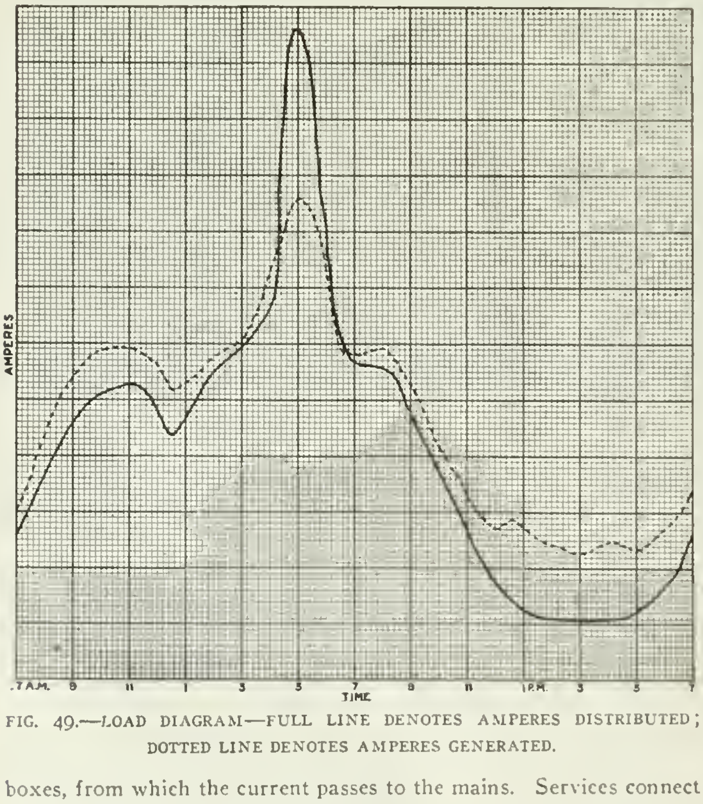


FIG. 49.—LOAD DIAGRAM—FULL LINE DENOTES AMPERES DISTRIBUTED; DOTTED LINE DENOTES AMPERES GENERATED.

About fifty-three miles of street in Boston are covered by the underground system of the company, consisting of mains, feeders, feeder boxes, junction boxes, manholes, etc. There are 301,329 ft. of mains installed in the form of Edison 3-wire tube, the copper conductors varying in size from 200,000 to 350,000 circ. mils. There are installed, in the shape of feeders, 127,000 ft. of Edison three-wire, 1,000,000-cm tube, also 145,000 ft. of 1,000,000-cm cable and 35,000 ft. of 350,000 cm cable laid in conduit. Besides these, there are laid 17,000 ft. of Edison tube used for tie lines and 1000 ft. of 12-conductor and 63,000 ft. of 3-conductor pressure cable. The total length of Edison tube is 445,000 ft., that of the cable being 242,000 ft. A part of the cable in use has paper insulation, while the greater part of it is insulated with rubber.

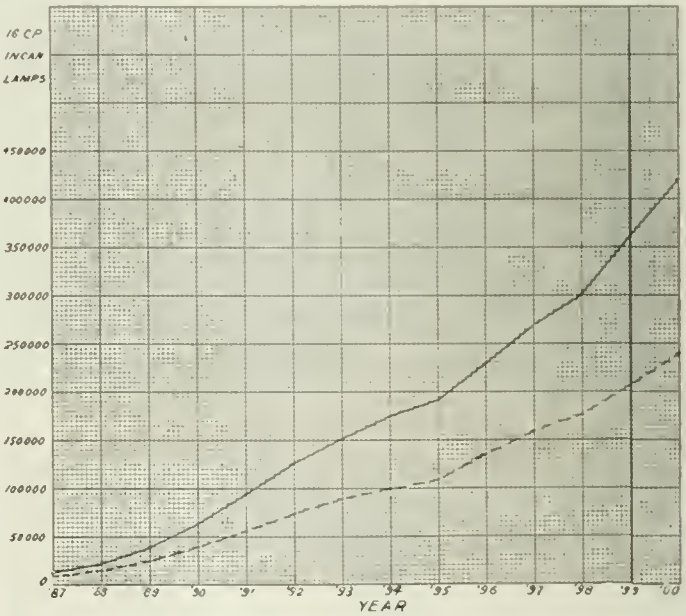


FIG. 50.—DIAGRAM SHOWING INCREASE OF LOAD CONNECTED—FULL LINE SHOWS TOTAL LOAD CONNECTED, IN TERMS OF 16-CP LAMPS; DOTTED LINE SHOWS TOTAL INCANDESCENT LAMPS IN 16-CP EQUIVALENTS.

The cable now in use by the company is of four different makes, as follows: General Electric, Habirshaw, New York Safety and National Conduit & Cable. The cable is all drawn into conduits, varying in size from three to 120 ducts, and is laid in trenches 5 ft. to 14 ft. in depth. Two kinds of duct are in use, the cement lined furnished by the National Conduit & Cable Company, and the vitrified duct of the H. B. Camp Company, there being 80,000 single duct feet and 10,174 trench feet of the former and 371,000 single duct feet and 32,659 trench feet of the latter. There are also installed as a part of the system 18 Edison tube feeder boxes, 393 Edison junction boxes with a total of 185 manholes.

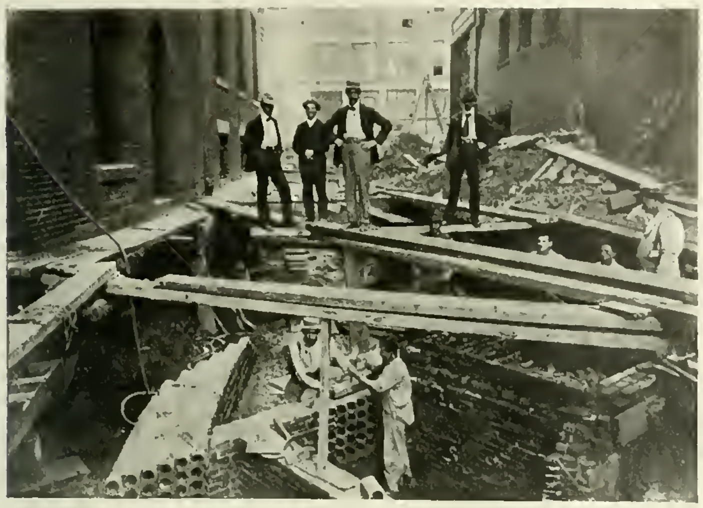


FIG. 51.—CABLE MANHOLES JOINING DUCTS LEADING FROM ATLANTIC AVENUE STATION.

The current is measured on the customers' premises by means of Edison chemical meters, and T.-H. recording meters. The well-known Wright demand meter, which has been described sufficiently heretofore, is also used quite extensively on the system to indicate the maximum amount of current consumed at any one time.

Edison incandescent lamps are used on the system and are furnished and renewed without expense to the customer, there being connected to the company's mains 243,800 16-cp lamps, or their equivalent. There are also connected to the incandescent circuit 2429 arc lamps, most of these being Jandus enclosed arcs of the 150-hour type. The motors on the system vary in size from 1-16-hp to 100-hp, with an aggregate of 10,400 hp.

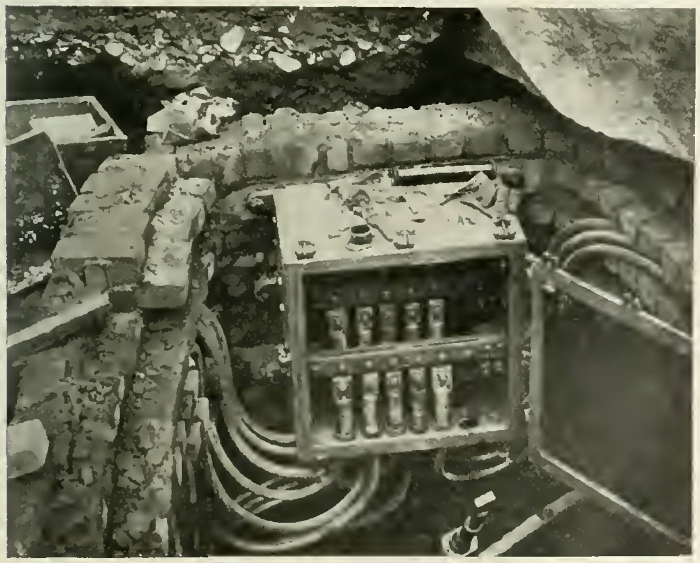


FIG. 52.—A CABLE JUNCTION BOX.

The current is generated principally from the Atlantic Avenue station, the plants at stations numbered 1 and 2 begin operated only during the periods of heavy load in the winter, or when the tie lines would otherwise be overloaded.

The current is distributed to the sub-stations by means of tie lines, there being six sets running to the first station, two to the second, and one to the sixth, while from the first station there are two connecting to the fourth station, and one to the fifth station. The current from the Atlantic Avenue station proceeding over the tie lines is carried in each case to the bus-bars on the feeder switchboard, and is used to supply the demands of the customers and also to charge the storage batteries.

There will be found on another page a representative daily load diagram (Fig. 49) showing in full line the distributed amperes on the whole system, the broken line representing the total generated load. It will be observed that the maximum load occurs at about 5 p. m., at which time the curve of distributed amperes towers above the generated curve, the storage batteries supplying the difference of load. On either side of this peak are positions where the generated curve surmounts the distributed. At such times the batteries are being charged from the system.

About 48 per cent of the current generated at the Atlantic Avenue station is distributed for lighting and power in that district, about 40 per cent is sent over the tie lines to the sub-stations having an auxiliary steam plant, and about 12 per cent goes to the battery sub-stations for supplying customers in those districts and for charging the batteries.

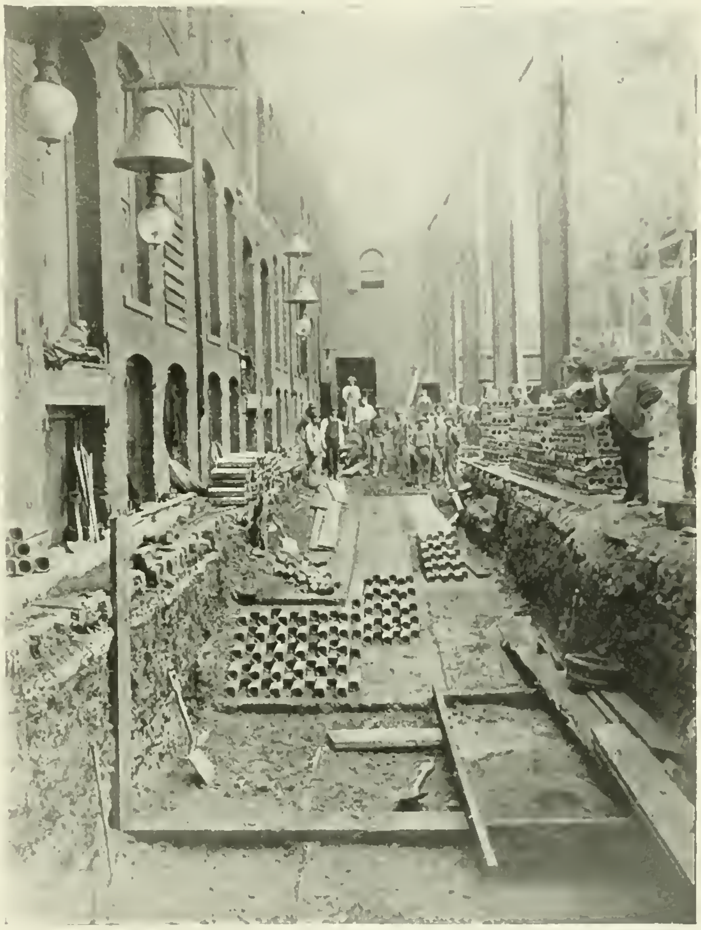


FIG. 53.—CONDUIT IN ALLEY LEADING TO THIRD DISTRICT STATION, ATLANTIC STATION.

Negotiations are under way for the purchase of the Boston Electric Light Company by the Edison Company, and when these plans have been fully consummated and the two systems have been put upon a revised basis of operation, it is probable that that part of the commercial lighting and power of the Boston Company which is included in the Edison districts will be supplied from the Atlantic Avenue station, the reserve power thus relieved at the Boston Company's station being used to operate through motor generators the sub-stations of the Edison Company heretofore supplied from the Atlantic Avenue plant.

OTHER BUILDINGS.

Besides the buildings already referred to, at 1 and 2 Head Place, next to the first station, is a four-story brick building, the first floor and basement of which are used as exhibition rooms where there are examples of many of the different kinds of machines and apparatus operated by electricity which have been loaned by the manufacturers, and are exhibited by the company. The second and third floors of the building contain the storage battery which has already been referred to.

The fourth floor of the building is fitted up as a hall, which is used for meetings and conferences, and by the Edison Employees' Club for lectures and entertainments.

At 516 Atlantic Avenue, next to the new station, is the System of Distribution Building, seven stories high, and made entirely of brick. The offices of the distribution and generating departments are located in this building, as is also the draughting room. Two of the floors are occupied by storage batteries, and the lamp department and stockroom occupy other floors of the building.

On the fifth floor of the building is a testing laboratory fully equipped with the latest and most delicate apparatus. Here are kept the company standards for calibrating instruments to be used in measuring current. Here the insulation of cables may be tested, new or proposed apparatus investigated, and general laboratory work done in connection with the business of the company.

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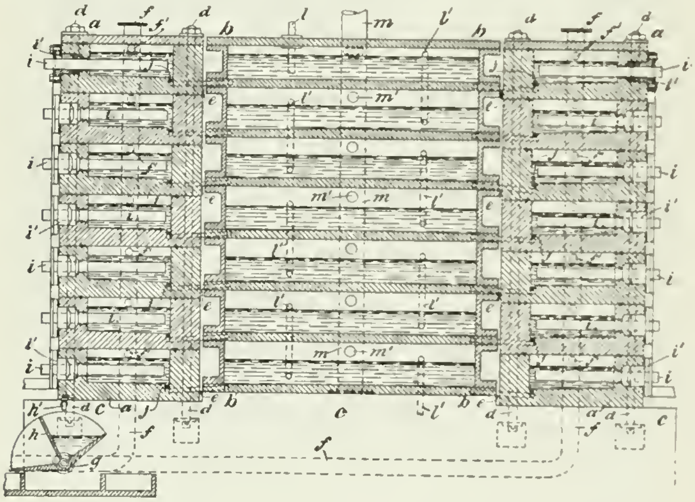
A Novel Electrolytic Cell.

In the electrolytic production of alkali and chlorine in the well-known Castner type of cell, sodium set free by the electrolysis of sodium chloride in solution is absorbed by a cathode of mercury; the resulting amalgam must then be brought into the presence of water to oxdize the sodium to caustic soda, and the regenerated mercury must be returned to the field of the current. The problem of the most effective accomplishment of this result, apparently so simple, is in reality greatly complicated by three factors, namely, the tendency of the separated sodium to react upon the electrolyte, which limits the percentage which may be profitably absorbed in the mercury; the relative slowness with which the amalgam reacts with water to produce caustic; and the tendency of the mercury itself to oxidize if too far denuded of its alkali metal.

One of the most ingenious cells of this form is the subject of a patent recently issued to George and George W. Bell, of Liverpool, England. This cell is destitue of moving parts, and the transfer of the charged mercury is effected by varying the pressure upon its surface, whereby it is alternately forced into the presence of water and permitted to return to its normal position beneath the anodes. The absence of moving elements permits a compactness and closeness of organization which is well illustrated by the accompanying figure, showing a section through a battery of 14 cells. The electrolyzing cells *a*, are arranged in two tiers, flanking the oxidizing compartments, *b*, and connected with them by conduits, *c*, joining their basal portions. Each cell is provided with a horizontal series of carbon rods, *i*, passing through stuffing boxes *i*¹, and constituting the anodes. The cathode is a layer of mercury covering the bottom of each decomposing compartment, electrical connection therewith being made through the amalgamated metal bars *j*. The oxidizing cells wherein the amalgam is partially denuded of its sodium, are, as shown, placed adjacent to and slightly above the electrolyzers, with their bottom plates inclined slightly toward the conduits *c*, on either side. The caustic solution circulates through the intermediate chambers by means of the pipes *l*, *l*¹, and a manifold *m*, *m*¹, is provided for education of the liberated hydrogen. As appears in the figure, a single valve, *g*, intermittently operated by a tumbling box *h*, controls the outflow of chlorine from all of the seven decomposing cells constituting one tier; a similar valve upon the same rock-shaft controls the gas discharge from the other set of cells, the two valves being so arranged that the throw of the shaft which closes one opens the other.



NEW FORM OF ELECTROLYTIC CELL.

Let us suppose the chambers, *a a*, to be filled with a saturated solution of sodium chloride, the intermediate cells *b* with water, the mercury cathode to be in place covering the bottom of the electrolyzers and filling the conduits *c*, and one of the valves *g* closed. Upon the passage of the current sodium is liberated and dissolved by the mercury, while chlorine accumulates above the electrolyte, and as the pressure due to the chlorine rises the mercury is forced through the channels *e* into contact with the water in the central cells. This continues until all of the mercury has passed from the electrolyzers, whereupon electrolytic action practically ceases, owing to the reduction of the cathode area, an essential feature, since continued pressure would break the mercury seal between the chloride and caustic solutions. At this point the tumbler-box, operated by the flow of water from the cock *h*¹, shifts the valves, the mercury returns by gravity to the set of electrolyzers from which it had been discharged, and the operation begins for the opposite series. The electrolyzers are supplied with sodium chloride solution through a system of pipes whose flow is governed by the same rock-shaft which controls the gas pressure, and hence the entire operation of the battery of 14 cells is regulated by the stream of water from the cock *h*¹, a remarkable example of ingenious simplicity.

The inventors describe other means for accomplishing the same results, intermittently operating electromagnetic devices whereby the flow of chlorine may be governed, or the hydrostatic head of electrolyte or of caustic solution varied in such manner as to cause the alternating flux and afflux of the mercury; and electric motor-meters adapted to shift the valves after a definite and predetermined quantity of current has traversed the electrolyte. The cell, however operated, is, of course, subject to the disadvantages inherent in the mercury cathode type, but within its limitations it should prove highly efficient

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A Simple Diagram Showing the Regulation of a Transmission System for any Load and any Power Factor.

By F. G. Baum.

AT the last annual meeting of the American Institute of Electrical Engineers, Dr. F. A. C. Perrine, in conjunction with the writer, gave a method for calculating the regulation of transmission lines.[1] A simple diagram results from the equation developed in the article mentioned, which gives the pressure at terminals of generator for any load and any power factor with but a single calculation. For any transmission line let

E_0 = e. m. f. at terminals of generator,
E = e. m. f. at terminals of receiver,
R_1 = equivalent resistance[2] of step-down transformers,
R_2 = equivalent resistance of step-up transformers,
$L_2 w$ = equivalent inductance of step-up transformers,
$L_1 w$ = equivalent inductance of step-down transformers,
R = resistance of line,
$L w$ = inductance of line.

Also let

$L_t\, w = (L_1 + L_2 + L)\, w$
$R_t = R_1 + R_2 + R$
I_c = capacity current of line.
$I \cos\theta$ = energy component of load current.
$jI \sin\theta$ = wattless component of load current

It was shown in the article referred to that the e. m. f. at terminals of generator is given by the equation:

$$E_0 = E + I\cos\theta\,(R_t + j\,L_t\,w) + j\,I\sin\theta\,(R_t + j\,L_t\,w) + j\,I_c\left[\left(R_2 + \frac{R}{2}\right) + j\left(L_2 + \frac{L}{2}\right)w\right] \quad (1)$$

This equation expresses in complex quantities the fact that each component of the line current may be considered as separately flowing over the entire line, and the capacity current over one-half the line and the step-up transformers. (Since positive rotation is taken as counter-clockwise, the impedance in complex quantities of a coil having resistance and self-induction is properly written $R + j L w$. Quantities multiplied by $+j$ are then laid off above and quantities multiplied by $-j$ below the zero line.)

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[1] The use of aluminum line wire and some constants for transmission lines. By F. A. C. Perrine and F. G. Baum, Trans. A. I. E. E., Vol. XVII. p. 391.

[2] It is customary to convert all pressures to equivalent line pressure. If R is the resistance of the primary of the transformer, and r is the resistance of the secondary, the equivalent resistance is calculated by the formula $R_1 = R + a^2 r$, a being the ratio of transformation. The equivalent inductance Lw is determined from the resistance drop in the transformer and the short circuited regulation.

Let us take, first, a line 15 miles in length. Here the charging current may be neglected, since it will only be about 2/3 ampere at 10,000 volts. This reduces equation (1) to

$$E_0 = E + I \cos\theta \, (R_t + j L_t w) - j I \sin\theta \, (R_t + j L_t w). \qquad (2)$$

Since in transmission usually a three-phase star connection is used such a line will be assumed in this paper (a single or two-phase system may also be worked out in the same way). In making calculations on three-phase systems it simplifies the problem to consider one leg only. If $E\sqrt{3}$ is the voltage between line wires we consider one leg of the system with a voltage E applied to one line wire and the neutral, the latter having no resistance or inductance. This corresponds to a balanced load on a three-phase system.

First case (Fig. 1.):

Length of line	15 miles
Power delivered	3000 kw (1000 per leg)
Voltage delivered (between neutral and outside)	10,000
Frequency	60 cycles
Distance between wires (wires on corners of triangle)	30 inches
Resistance of line	6 ohms
Inductance of line	10 ohms
$R_1 = R_2$	1 ohm
$L_1 w = L_2 w$	5 ohms

From the above we get

$$R_t = 8 \text{ ohms.}$$
$$L_t w = 20 \text{ ohms.}$$

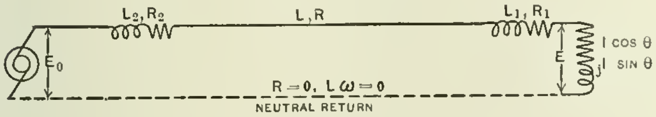


FIG. 1A.

(The constants assumed gives 8 per cent $I^2 R$ loss at full load in the transmission from the terminals of generator to terminals of receiver.)

Current delivered with $\cos\theta = 1$ is 100 amperes. Hence we have for triangle abc, Fig. 1,

$$ab = R_t \, 100 = 800 \text{ volts,}$$
$$bc = (L_t w) \, 100 = 2000 \text{ volts,}$$
$$\therefore ac = 100 \, (R_t + j L_t w) = 2200 \text{ volts.}$$

For any power factor, $\cos\theta$, lengths along ac are equal to $I (R_t + j L_t w) \cos\theta$; i. e., proportioned to load at constant receiver pressure, since $I \cos\theta$ is proportional to load and $(R_t + j L_t w)$ is a constant.

Let Oa represent 10,000 volts delivered to receiver. We are to determine the generator pressure for any condition of load. The triangle abc gives the voltage drop over the line with a non-inductive full-load. Oc will, therefore, give E_0 for non-inductive full-load. Draw cg, making an angle θ equal to, say, 43 degs. 30 min., with ac corresponding to $\cos\theta = .725$. From c draw a line at right angles to ac and produce it until it meets cg in g. Then, since

$$ac = I \cos\theta \, (R_t + j L_t w) \text{ and angle } acg = \theta$$
$$\therefore cg = I \sin\theta \, (R_t + j L_t w)$$

by construction. That is Og represents E_0 for full load for a power factor of 0.725. Since the receiver pressure is to be maintained constant, ac will always represent the same load whatever the power factor. Lengths from a along ac are proportional to load. Divide ac into, say, 10 equal parts, corresponding to 0.1, 0.2, 0.3, etc., of full load. Through points marked 0.1, 0.2, 0.3, etc., draw lines at right angles to ac. From a draw radial lines, making angles with ac corresponding to $\cos\theta = .95$, $\cos\theta = .90$, etc., for leading and laging current. With O as center and 10,000, 10,200, 10,400, etc., as radii, draw arcs of circles as shown. The radial distance between two successive circles represents 2 per cent of delivered voltage.

To illustrate the use of the diagram suppose we wish to find the generator pressure for 0.9 of full load, delivered at 0.8 power factor. Follow the line ac up to c', then go along the line $c'g'$ to the intersection of $c'g'$ with the line corresponding to $\cos\theta = 0.8$. This point is seen to represent a voltage of 12,150, or the generator voltage must be 21.5 per cent above the receiver voltage. In a similar manner the generator pressure may be found for any other load at any power factor for lagging or leading current. If the current leads the desired point is given by the intersection of $c'g$, and line marked $\cos = 0.8$.

In constructing the diagram for any particular transmission line, it is only necessary to determine ab and bc; the remainder of the construction is mechanical.

Second case:

We may apply the same method to the case of a long line, a line 150 miles in length being assumed. For this case we use equation (1), first given.

Power delivered	9000 kw (3000 kw per leg)
Length of line	150 miles
Voltage delivered (between neutral and outside wire)	30,000
Frequency	60 cycles

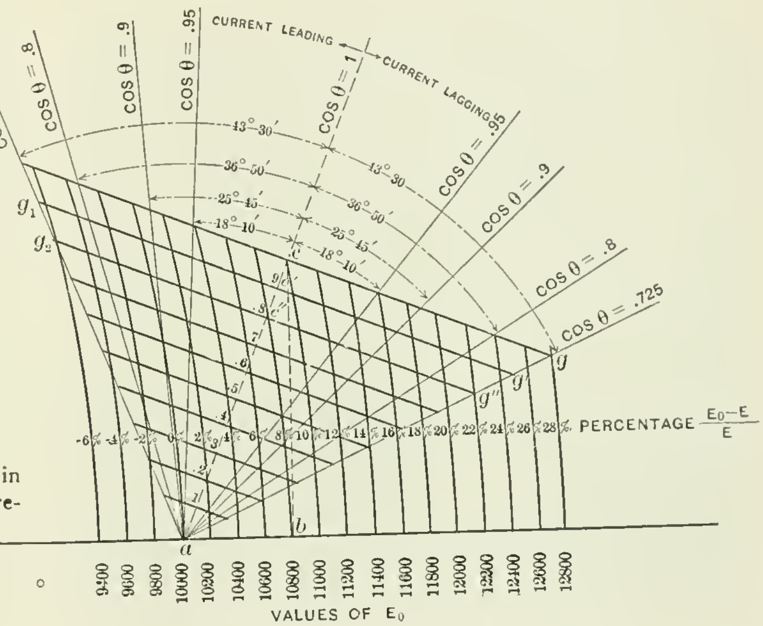


FIG. 1.—DIAGRAM FOR CALCULATING TRANSMISSION LINES

Distance between wires (wires on corners of triangle)	40 inches
Resistance of line	26 ohms
Inductance of line	106 ohms
R_1	2 ohms
R_2	2 ohms
$L_1 w$	15 ohms
$L_2 w$	15 ohms

Capacity current per wire is 40 amperes (the charging current will be about 35 amperes at light load).

From the above we get

$$R_t = 30 \text{ ohms,}$$
$$L_t w = 136 \text{ ohms,}$$
$$R_2 + \frac{R}{2} = 15 \text{ ohms.}$$
$$\left(L_2 + \frac{L}{2}\right) w = 68 \text{ ohms.}$$

(The constants assumed above give an efficiency of transmission of about 88 per cent at full load).

Current delivered per wire is 100 amperes with $\cos\theta = 1$.

Hence we have for the triangle *abc*, Fig. 2:

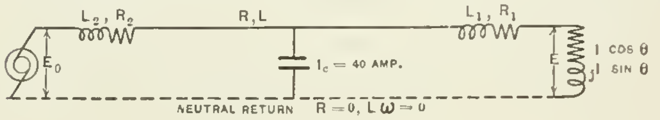
$$ab = (R_t)\ 100 = 3000 \text{ volts,}$$
$$bc = (L_t\ w)\ 100 = 13600 \text{ volts,}$$
$$\therefore ac = 100\ (R_t + j\ L_t\ w) = 13800 \text{ volts.}$$

And for the triangle *kla*

$$kl = \left(R_2 + \frac{R}{2}\right) I_c = 600 \text{ volts,}$$

$$la = \left(L_2 + \frac{L}{2}\right) w\ I_c = 2720 \text{ volts.}$$

Fig. 2 is similar to Fig. 1, except for the triangle *kla*. To find E_0 for 0.8 full-load at a power factor of 0.8, follow *ac* up to the letter *c''*, then along *c''g''* to the intersection with the line corresponding to $\cos\theta = 0.8$. The value of E_0 is seen to be 39,000 volts. That is, the pressure at the terminals of the generator must be increased 30 per cent. . At some point in the system, therefore, this amount of regulation must be allowed.



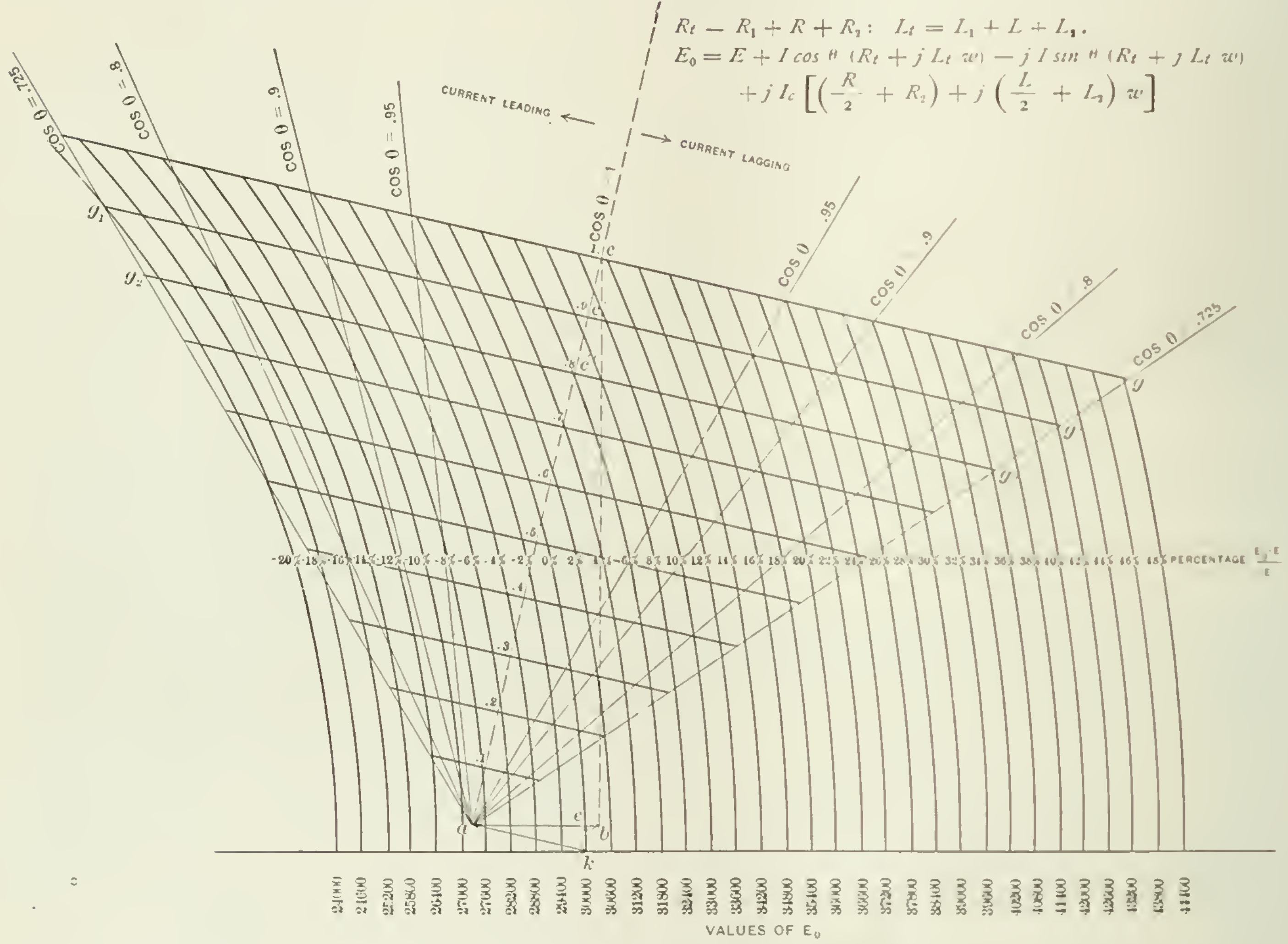


FIG. 2.—DIAGRAM FOR CALCULATING TRANSMISSION LINES.

As shown by the point *a*, the generator pressure for 30,000 volts delivered with no load on receiver will be 27,300. There is, therefore, a rise in pressure at no load between the generator terminals and the receiver equal to 2700 volts, or 9 per cent.

It will be found that the diagram given will very much lessen the labor of making calculations for transmission lines. For each particular case the triangle *abc* must be constructed, the remainder of the diagram is drawn mechanically.

Following are the constants for a 15-mile line:

$R_t = R_1 + R + R_2,\ L_t = L_1 + L + L_2$

$E_0 = E + I \cos\theta\ (R_t + j\ L_t\ w) - j\ I \sin\theta\ (R_t + j\ L_t\ w).$

$Oa = E$

$ab = I\ R_t$

$bc = + j\ I\ L_t\ w$

$cg = I \sin\theta\ (R_t + j\ L_t\ w).$

Constants: $R_2 = R_1 = 1$ ohm, $R = 6$ ohms; $L_2 w = L_1 w = 5$ ohms. $L\ w = 10$ ohms.

K. W. deliv. = 3000; voltage deliv. = 10,000 (Bel. neutral and line wire).

Eff. of transmission at non-inductive load = 92 per cent.

As an example, find *Eo* for 0.8 load at 0.725 power-factor. Follow *ac* to point *c''* (marked .8), then follow *c''g''* to point of intersection of *c''g''* with line marked $\cos\theta = 0.725$. The point is on the circle 12,200. This is the value of *Eo* (22 per cent above *E*). (Lagging current assumed in example, for leading current *Eo* is given by *pt.* g_2).

Following are the constants for a 15c-mile line:

$R_t = R_1 + R + R_2:\quad L_t = L_1 + L + L_2.$

$$E_0 = E + I \cos\theta\ (R_t + j\ L_t\ w) - j\ I \sin\theta\ (R_t + j\ L_t\ w) + j\ I_c \left[\left(\frac{R}{2} + R_2\right) + j\left(\frac{L}{2} + L_2\right) w\right]$$

Constants: $R_2 = R_1 = 20$ ohms; $R = 26$ ohms.

$L_2 w = L_1 w = 15$ ohms; $L w = 106$ ohms.

K. W. delivered = 9000.

Voltage delivered = 30,000 (bet. neutral and outside wire) = *ok*.

$Kl = + j\ I c \left(\frac{R}{2} + R_2\right);\ la = - I c \left(\frac{L\ w}{2} + L_2\ w\right);$

$ac = I \cos\theta\ (R_t + j\ L_t\ w)$ is prop. to load on receiver.

$cg = I \sin\theta\ (R_t + L_t\ w).$

Eff. of transmission at non-ind. full-load = 88 per cent (about).

As an example, to find *Eo* for 0.8 load at 0.8 power-factor. Follow *ac* to point *c''* (marked .8), then follow *c''g''* to point of intersection of *c''g''* with line marked $\cos\theta = 0.8$. The point is on the circle 39,000. This is the value of *Eo* (30 per cent above *E*). (Lagging cur, assumed in example; for leading cur, *Eo* is on $c''\ g_2$ and $\cos\theta = .8$).

Telephone Line Construction on the Pacific Coast.

THE line construction on the Pacific Coast of the Pacific States Telephone Company is modified by the fact that sleet is unknown. Hence pole lines can safely be loaded with a much greater number of wires than would otherwise be safe. Another peculiar practice of this company is that of using porcelain insulators altogether for local city and suburban lines. Pole lines with porcelain insulators present a very neat appearance when constructed as well as is the custom of this company. Figs. 1, 2, 3 and 4 give a good idea of the main features of the work in various cities. The longest cross arms for city and suburban lines carry 20 porcelain insulators on top of the cross arm and one on each end, making 22 in all. The cross arms are of Oregon pine, 10 ft. long. For long-distance work, as shown on the top of the pole (Fig. 1) 10 pins with glass insulators are put on a cross arm 10 ft. long. The local line cross arms in Fig. 1 are not full length. Fig. 2 shows a pole line of about the maximum line carrying capacity used, which has 176 wires on 8 cross arms, besides a cable and some few wires on the lowest arm. No. 14 galvanized iron wire is used on city and suburban lines. On long-distance lines, hard-drawn copper weighing 435 lbs. to the mile, No. 8 B. W. G. (about No. 6 B. & S.) is the standard. Aluminum has been used to some extent on long-distance lines recently. There is one line of this kind from Bakersfield to Los Angeles, and one from Sacramento, Calif., to Reno, Nev. The aluminum con-

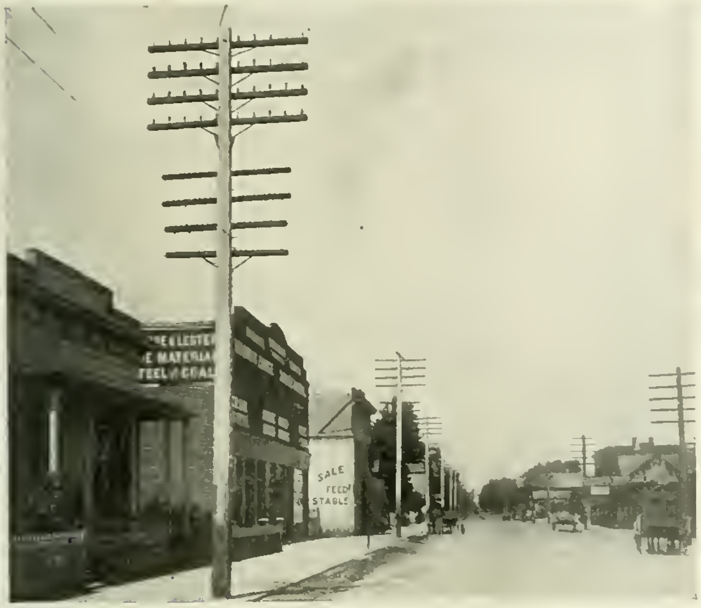


FIG. 1.—POLE LINE WITH LONG-DISTANCE AND LOCAL WIRES, SAN JOSE.

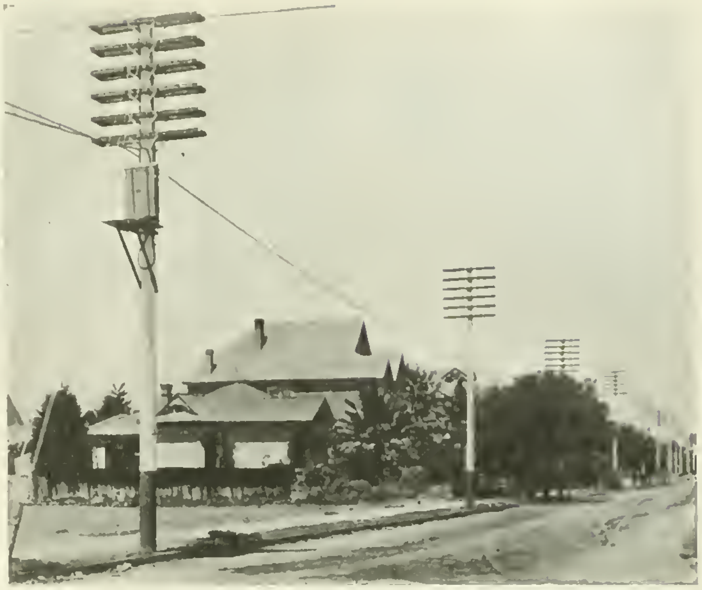


FIG. 3.—POLE LEAD, PICO AND MAIN STREETS, LOS ANGELES.

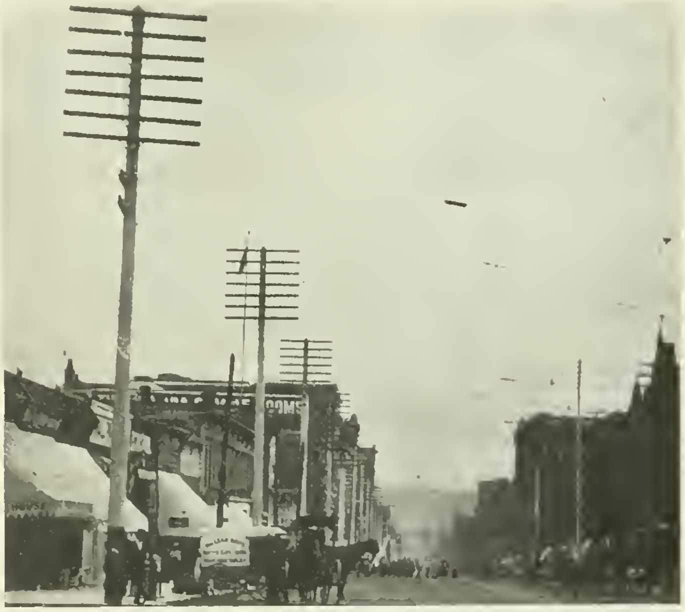


FIG. 4.—POLE LINE, PACIFIC AVENUE, TACOMA.

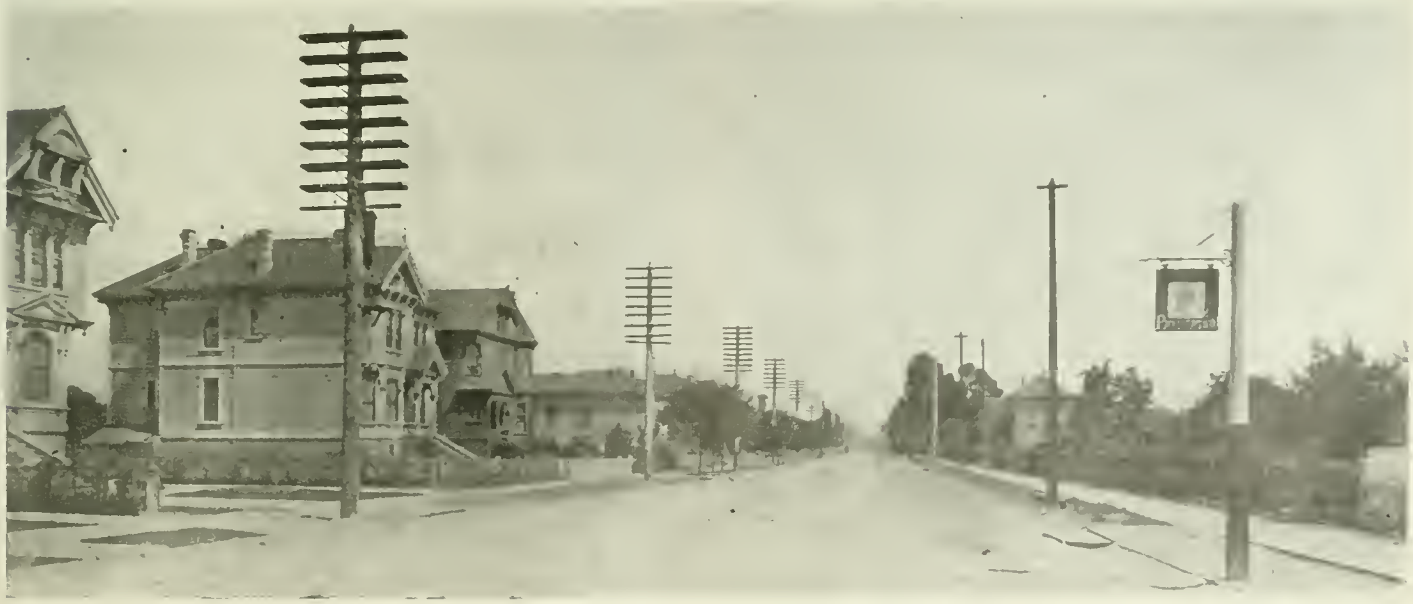


FIG. 2.—POLE LEAD, CENTRAL AVENUE, ALAMEDA.

ductor is in the shape of a 7-strand cable, weighing 210 lbs. per mile. The poles on the aluminum line are placed from 36 to 40 per mile. Underground cables on local lines have 40 pairs of No. 16 wire. Long distance lines are run through underground cables, having 10 pairs of No. 14 wire. Between Oakland and San Francisco, under the bay, are six submarine cables, containing 7 pairs each. No submarine cables are used larger than this. The conductors are composed of 7 strands of No. 20 copper wire on all recent cables. The stranded conductor is found vastly superior to the solid for this class of work, as the solid wires break with handling and disable many wires in a cable. A history of all cables is kept at the office showing their conditions at different tests. The submarine cables running north across the Golden Gate are all double armored. Those to Oakland are single armored. An interesting experiment has been tried at Portland. A 75-pair paper insulated and lead-covered cable was armored and run under the Willamette River as a submarine cable. So far the experiment has been a success. No 4 wire was used in the armor.

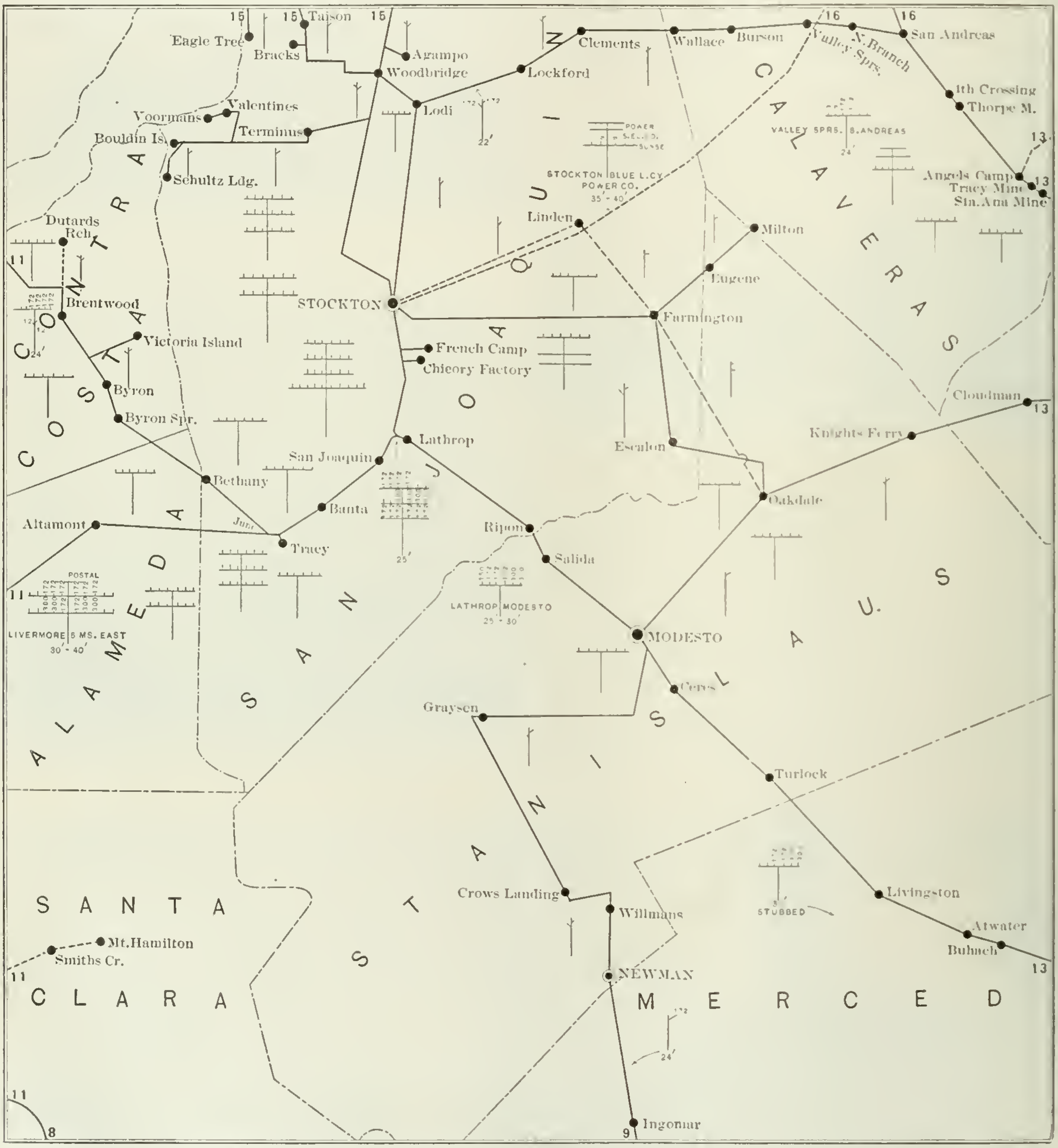


FIG. 5.—METHOD OF SHOWING LINES. (SOME POLES NOT SHOWN FULLY IN THE REPRODUCTION.)

On underground work in San Francisco great success has been obtained with "electrolysis-proof" conduit duct, a production which originated on the Pacific Coast, and is now manufactured in Chicago. It is said that lead-covered cables under similar conditions to those in vitrified clay ducts show practically no electrolysis, while those in some clay ducts are badly pitted. The "electrolysis-proof" conduit is a tough paper tubing treated with a compound. About 1,000,000 ft. of this conduit is now down. The joints between pipes are made by driving the ends of the pipe together, the ends being arranged for a male and female joint with 1-inch countersink. The joint is dipped in the compound used in making the pipe. The joint so made is very tight. In fact, the pipe has been used in some cases for water pipe. It is made in 7-ft. lengths.

The engineer's office keeps track of long distance and toll lines in the company's territory by means of sectional maps. The map of the territory is divided up into sections, and a detail map of each section kept. One of these sections is shown in Fig. 5. The details of the pole lines between towns is indicated by diagrams on the map. A miniature pole is shown, and the number of wires and weight of each wire in pounds per mile can be seen at a glance. The height of the pole is shown by the figures at the base.

Lake Huron. *Lake Michigan.* *Torch Bearers.* *Lake Ontario.* *Spandril.*

Statuary Around the Electric Tower, Pan-American Exposition.

The Pan-American Exposition.

The one striking feature of the Pan-American Exposition which will make it live in the memory of all who are fortunate enough to see it, and which will undoubtedly be recognized as the most emblematical feature of the Exposition, is the Electric Tower, some idea of which may be obtained from the illustration shown herewith. On entering the grounds, the Electric Tower, 400 ft. high, stands out prominently above everything, and although it is not yet completed and much of its beauty is still to be developed, it is already the center of attraction at the Exposition by day and night, and nothing but praise is heard concerning it, more especially when it is illuminated. It is then that the full beauty of the tower is brought out, the even distribution of light giving it the appearance of being transparent.

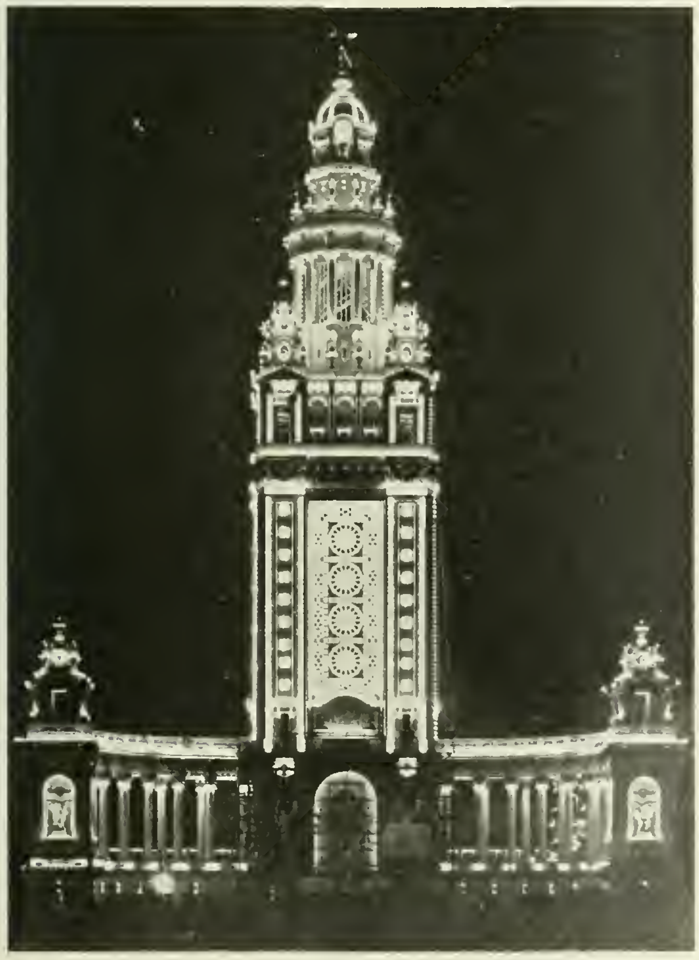


FIG. 1.—ELECTRIC TOWER ILLUMINATED.

Five hundred thousand gallons of water per hour will pour forth in a cascade into the upper basin, which will be filled with lights and will run down into the huge lower basin in which are arranged 100 powerful searchlights, which will focus upon the cascade.

The general scheme of lighting the Exposition is so perfect that no glare of light strikes the observer, although the illumination is so bright that it may be seen for miles around. It is when seen at a distance that the care and skill employed in working out this lighting scheme are fully appreciated, the various cupolas, minarets, etc., being subordinated to the Electric Tower, while the absence of arc lamps from the grounds gives the observer the full benefit of the beautiful details of the various buildings picked out in the soft and even diffused light of the incandescent lamps.

Probably another feature which will impress every visitor to the grounds is the unique way in which the electric tower is lighted. The current is brought in from Niagara and is controlled by a water rheostat, which enables the engineers to illuminate the tower and buildings gradually, so that one first sees a dark, dull, red outline of the Tower starting up in the sky, following with a brighter red and then a golden hue, until finally turning to the brightness of the full candle-power of the lamps used. The effect has been compared to that of a beautiful woman unveiling, and is attracting the attention of every visitor to Buffalo. We illustrate herewith the Electric Tower at night and the Music Hall, both photographed by their own light. Details of the Electric Tower and of the Electric Fountains were given in our issue of May 4.

The names of exhibitors in the Electricity Building correspond to the numbers on the floor plan (page 828): Section "A."—1, Niagara Falls Transformer Plant; 2, General Electric Company.

Section "B."—1, Morris Electric Company; 2, H. B. Camp Company; 3, Bossert Electric Construction Company; 4, National Carbon Company; 5, American Vitrified Conduit Company; 6, Peru Electric Manufacturing Company; 7, McGraw Publishing Company; 8, The O. C. White Company.

Section "C."—1, General Electric Company.

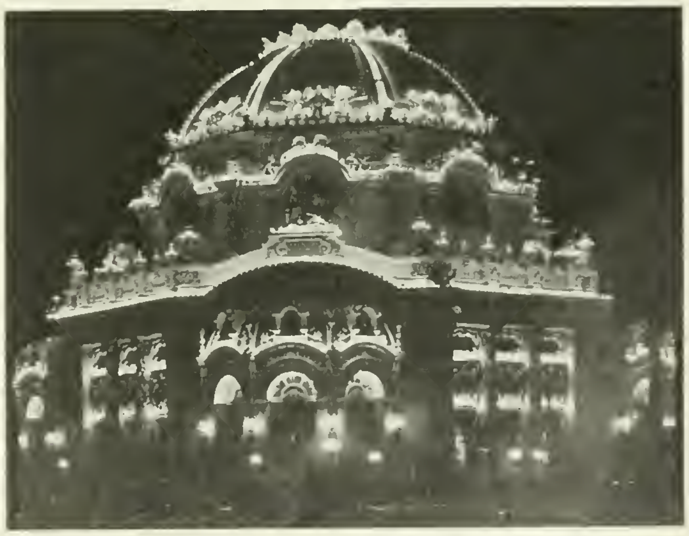


FIG. 2.—TEMPLE OF MUSIC.

Section "D."—1, Edison Manufacturing Company; 2, Bullock Electric Company.

Section "E."—1, Westinghouse Electric & Manufacturing Company.

Section "F."—1, Buckeye and Jandus Electric companies; 2, Western Electrician; 3, M. R. Hutchinson; 4, McRoy Clay Works; 5, Cutler-Hammer Manufacturing Company; 6, Warren Electric Manufacturing Company; 7, Hazard Manufacturing Company, 8, Standard Underground Cable Company.

Section "G."—1, American Electric Telephone Company; 2, Stromberg-Carlson Telephone Company; 3, Wilhelm Telephone Company; 4, National Automatic Telephone Company; 5, Clark Automatic Telephone Company.

Section "H."—1, Historical Exhibits; 2, 500-volt Service Switchboard.

Section "J."—1, General Electric Company.

Section "M."—1, F. C. Perkins and D. & W. Fuse Company; 2, C. B. Rowell; 3, Waite & Bartlett Manufacturing Company; 4, B. & E. Hanfeld; 5, R. V. Wagner & Co.; 6, Incandescent Electric Light Manipulator Company.

Section "N."—1, Gould Storage Battery Company; 2, Onondaga Dynamo Company; 3, Niagara Falls Power Station Models; 4, Stanley Instrument Company; 5, Northern Electric Manufacturing Company; 6, Stanley Electric Manufacturing Company.

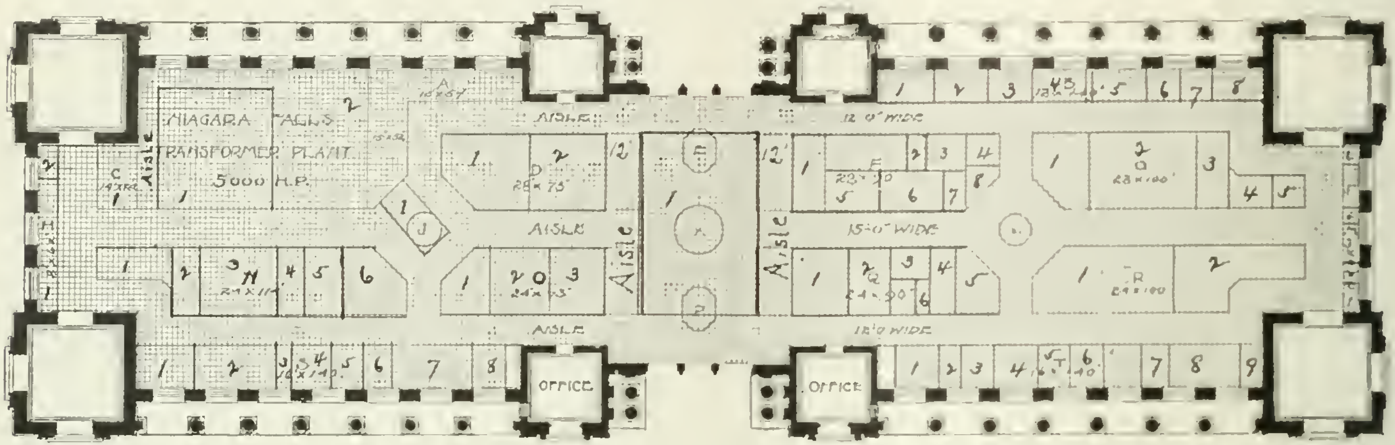


FIG. 3.—FLOOR PLAN ELECTRICITY BUILDING, SHOWING LOCATION OF EXHIBITS

Section "O."—1, Electric Storage Battery Company; 2, Holophane Glass Company; 3, Crocker-Wheeler Company.

Section "Q."—1, Brown Optical Company; 2, Buffalo Concessions Company; 3, Kate Fearn's Silk Loom; 4, Lea Manufacturing Company; 5, Safety Insulated Wire Company; 6, Eureka Tempered Copper Works.

Section "R."—1, Kellogg Switchboard & Supply Company; 2, Western Electric and Bell Telephone companies.

Section "S."—1, Arnold Electric Power Station Company; 2, Collective Exhibits; 3, Buchheit Badge Company; 4, Submerged Electric Motor Company; 5, Mann Brothers; 6, The Robbins & Myers Company; 7, S. S. McClure Company; 8, Buffalo Concessions Company.

Section "T."—1, P. B. Delany; 2, A. W. Hall; 3, S. Lubin; 4, Buffalo Candy Company; 5, Bettini Phonograph Company; 6, E. R. Johnson; 7, National Gramophone Company; 8, American Clock Company; 9, Mason Monogram Company.

The New Lighting Contract at Denver Voided.

A decision of more than usual interest is that just rendered at Denver, Colo., by Judge Palmer, in the suit brought by Perry L. Hubbard against the city of Denver and the LaCombe Electric Lighting Company to restrain the defendants from entering into a 10 years' contract to supply the city with 1000 arc lights for $90 a year a light. The plaintiffs contended that under the charter the city could not enter into a contract for which no appropriation had been passed to cover all the indebtedness implied in the contract. The effect of the decision is to make inoperative the contract between the city and the LaCombe Company until the suit is finally determined in the Court of Appeals. The decision does not involve the validity of the franchise granted the new company, but only the contract between the city and the company. The LaCombe Company is still empowered to operate its commercial plant and furnish light to private consumers.

Judge Palmer said: "The question involved in this case is whether the contract made between the city of Denver and Charles F. La Combe and his assigns for the lighting of the city of Denver with electric arc lights for a period of ten years is a good and binding contract. By this contract, the city of Denver agreed, among other things, to pay said LaCombe $7.50 a month a light for 1000 arc lamps of 2000-cp each, and $70 a year for each arc lamp in excess of 1000. The vital question is whether the city of Denver has the power under its charter to enter into the contract in question. It is a general and undisputed proposition of law that a municipal corporation possesses and can exercise the following powers and none other: First, those granted in express words; second, those necessarily or fairly implied in or incident to the powers expressly granted; third, those essential to the declared objects and purposes of the corporation—not simply convenient but indispensable. Any fair, reasonable doubt concerning the existence of power is resolved by the courts against the corporation and the power is denied. Of every municipal corporation the charter or statute by which it is created is its organic act. Neither the corporation nor its officers can do any act or make any contract or incur any liability not authorized thereby. All acts beyond the scope of the powers granted are void. Much less can any power be exercised or any act done which is forbidden by charter or statute.

"Among the powers granted by the charter to the city of Denver is the power by ordinance to 'Provide for the lighting of streets and public grounds and erecting lamp posts, electric towers and other apparatus.' The exercise of this power is limited in two ways:

"First, by authorizing the creation of a debt for specified purposes, such purposes not including public lighting. The charter having enumerated the purposes for which a municipal debt may be created, there is an implied prohibition that a debt may be created for other purposes.

"Second, by limitation upon the power of the city to contract as expressed in the following provision of the charter: 'The city council shall not order the payment of any money for any purpose whatever in excess of the amount appropriated for the current year, and at the time of said order remaining unexpended in the appropriation of the particular class or department to which such expenditures belong. Neither the city council nor any officer of the city shall have authority to make any contract or do anything binding on the city or imposing on the city any liability to pay money until a definite amount of money shall have been appropriated for the liquidation of all pecuniary liability of the city under such contract; or in consequence thereof; said contract to be *ab initio* null and void as to the city for any other or further liability; provided, first, that nothing herein contained shall prevent the city council from paying any expense the necessity of which is caused by any casualty, accident or unforeseen contingency happening—after the passage of the annual appropriation ordinance; and, second, that the provision of this section shall not apply to or limit the authority conferred by sections 7, 8 and 9 of this article, nor to moneys to be collected by special assessments for local improvements.'

"It appears by virtue of the terms of said contract the city of Denver became bound unto and liable to pay to Mr. LaCombe or his assigns the sum of at least $90,000 for the year immediately following the completion of the LaCombe arc lighting plant, and a like sum for the succeeding nine years, or an aggregate of $900,000, which sum would certainly be increased by the cost of more arc lights, which the growth of the city would command, and which under the contract would cost $70 each.

"The last provision of the city charter is mandatory, and persons dealing with a municipal corporation must at their peril take notice not only of the powers vested in a corporation, but of the mode by which its powers are to be exercised, so far as such mode is mandatory."

Judge Palmer then cites the case of the Smith Canal Company against the city, and quotes the ruling of the court at that time that this clause of the city charter makes the appropriation of a definite sum of money an indispensable prerequisite to a valid obligation to pay money.

"It is admitted in the agreed statement of facts that the city has not at any time appropriated a definite sum of money or any amount of money whatever for the liquidation of pecuniary liability of the city under the contract provided for the ordinance or to meet the liability imposed upon the city by said contract, unless the annual appropriation ordinance operates as such appropriation. This ordinance appropriates $90,000 for public lighting of the streets of the city of Denver by arc electric lights of 2000 standard candle-power, and also for the payment of gas and electric light bills in the different city buildings outside of the fire and police department. It is manifest that the chartered requirement that a definite amount of money shall first be appropriated for the liquidation of all pecuniary liability of the city under a contract or in consequence thereof has not been complied with. The provisions of the appropriation ordinance fall short of meeting this requirement.

"The item of $90,000 appropriated for the year 1901 is for two purposes, first, for street arc lights, and, second, for gas and electric lighting in the downtown buildings. How much of this is appropriated for street arc lights or how much for downtown buildings, or how much to pay for incandescent lights or how much to pay for gas, is not disclosed.

"It therefore appears that a definite amount of money has not been appropriated for the expense of street arc lighting, as contemplated by the LaCombe contract."

Judge Palmer also states that in view of the fact that the Denver Gas & Electric Company offered to furnish lights for $60 apiece a year it was an abuse of the trust committed to the city council to reject that offer and donate the sum of $30,000 a year for 10 years to the LaCombe Company. With regard to the contention of the plaintiffs that the letting of the contract for public lighting is by the charter conferred to the board of public works, Judge Palmer states that while he is not prepared to state that the position is not well taken he does not consider it necessary to pass upon the question, as the clause of the charter which he quoted is sufficient to cover the case in point. He therefore declares the contract between the city and the LaCombe Company null and void.

The defendants gave notice that they would appeal.

Some Features of the Recent Wall Street Corner.

A panic or scare was caused in Wall Street last week by the discovery of a corner in Northern Pacific common stock, for which two powerful interests were bidding so fiercely to secure control that at one moment the price was driven up to $1,000—the stock barely earning 4 per cent. The result was, of course, tremendous excitement, and a great strain on telegraph, telephone, cable and messenger service. An estimate placed the number of messengers employed in the financial district during the day at between 2500 and 3000, and yet this huge force was entirely inadequate to meet the unprecedented demands made upon it. Every one of the big telegraph and cable companies had been under a strain for some time to keep up with the enormous business, but the demand on Blue Thursday eclipsed all records, and the messenger system threatened several times during the day to go to pieces.

The American District Telegraph Company usually employs about 150 boys in its Exchange Court office. During the last two weeks it had to increase this number to more than 300. On Thursday drafts were made upon all the up-town offices and branches until a force of 450 boys had been gleaned for the down-town service. This force, in turn, was overwhelmed with business in short order, and agents were sent out into the streets to hire extra boys. Clerks from the main office, and even linemen and the drivers of repair wagons, were pressed into the service, until during the afternoon a force of 500 messengers, nondescript and otherwise, was being rushed through the financial district by this company alone. Boys were given as many as 25 messages each to deliver. The American District Company collects messages for the Western Union Company. On Thursday the superintendent of the latter company asked for help in delivering its messages. It was said by the American District Company superintendent that this was the first time in 15 years that this has been done. At the Broad Street office of the Western Union it was said that never before had so many messages been received in the office in a single day. It was computed that the number would easily reach 10,000 up to the hour for closing the Stock Exchange.

The Postal Telegraph & Commercial Cable Company's down-town office early in the day received an extra force of 100 messengers from the main office, and was even then compelled to refuse many orders for boys.

The Bankers and Brokers' Messenger Exchange on New Street, which makes a specialty of furnishing messengers for the Stock Exchange, had 500 boys at work Thursday. This, according to Manager Jones, represents an extra force of 400 boys, and the manager was out searching the highways and byways for more boys.

At the offices of the Anglo-American, French, and other foreign cable companies it was stated that business for the day had been unprecedented. Extra messengers had to be employed.

Another interesting feature was that no fewer than 12 brokerage houses engaged electric automobiles from the New York Electric Vehicle Transportation Company to carry messenger boys with orders to and from the Stock Exchange. So crowded have been the wires of late, and the new Exchange is so far from most of the larger offices, that some means had to be devised to get messages to the floor more quickly than a boy could run with them. An automobile can be hired for $10 per day, and many of the houses state that during these busy times one is worth over $100.

Since the removal of the Stock Exchange to its temporary quarters in the Produce Exchange the growth of business has been so great that an extension of the telegraph and telephone facilities has already been required, and the new exchange was closed on Saturday last, largely with the object of permitting these extensions to be made.

Electric Lighting and Insurance.

The annual meeting of the National Board of Fire Underwriters was held last week in the rooms of the Board at No. 32 Nassau Street, New York City.

F. C. Moore, of New York, chairman of the Committee on Light, Heating and Patents, brought the attention of the board to the question of the life of electrical devices. He said that a president of a Western insurance company estimates that 25 per cent of the losses of the past year are due to these devices. He said that he had submitted a number of questions relating to electrical devices, and their dangers, to prominent electrical engineers throughout the country, but as yet has not received answers from all the engineers.

Mr. Moore said that an inspection of the devices at the Pan-American Exposition disclosed the fact that there was considerable defective wiring, and that a number of "mud" tubes had been used instead of porcelain tubes. Mr. Moore said that orders had been given for the necessary repairs.

Cheap Telephone Service in Indiana.

About a year ago a co-operative telephone company was organized at Bowers Station in Montgomery County, Ind., and those interested in it are loud in its praise. The plan of the company is for all who have a permanent use of the telephone to help bear the expense of putting in the switchboard, and the farmers buy the instruments and pay for the wire that gives them switchboard connection. Where two or more people use the same wire the expense is divided between them. In addition to this each subscriber pays $3 for the privilege of joining the company. A monthly fee of 25 cents is also charged. All members of the company have the free use of any connections with the exchange, while non-subscribers pay toll. Those in the company say they are getting good service at little expense. The company is not organized for profit, the 25 cents a month being used to keep up repairs and the expenses of the exchange. Nearly 40 towns are now represented in the company, and over 6000 telephones are connected. The last town to be connected is Kirklin, which is given free connection to the members of the co-operative company. It is the purpose of the company to keep on spreading, and it will in a short time have connection with Indianapolis, and the system operated by the long-distance company.

Electric Automobiles in New York City.

President Henry Sanderson, of the New York Electric Vehicle Transportation Company, in a circular to the stockholders announcing an assessment of $10 per share, says: "Your company has now reached a point where your directors deem it wise, in the protection and furtherance of its interests, to immediately make provisions for the better establishment of its present business and the proper meeting of future requirements. Earnings have steadily increased, the April income being the greatest in the company's history. The demand for vehicle service has been constantly in excess of the vehicle equipment.

"The new main station at Forty-ninth Street and Eighth Avenue, and the various sub-stations, conveniently located at necessary points throughout the city, have shown most satisfactory results. Additional stations must be provided, before next winter, delivery wagon facilities in particular being required. The Buffalo branch of the company is proving a desirable investment and considerable extensions are there in progress, more especially to meet the very profitable demand that is anticipated during the Pan-American Exposition.

"The Fifth Avenue Company, under your ownership, has largely extended its franchises and the value of this property. Improvement in tires and the mechanical construction of the vehicles and the great betterment in station facilities have largely modified the difficulties that heretofore have been a bar to progress and materially lessened the costs of operation. A new type of battery of more than double the mileage on one charge of electricity has been comprehensively experimented with, and, after operations covering 25,000 miles, has developed but few defects. This battery has, almost without exception, given reliable service and in successful operation will enable the company to enter into vigorous prosecution of its business along all lines of development."

Loss on English Postal Telegraphs.

Mr. Henniker Heaton, Conservative, in the House of Commons on May 10 drew attention to the annual loss of £700,000 in the English telegraph service, aggregating £8,300,000 since the Government took over the lines, and asked how the Government proposed to remedy this.

Sir Michael Hicks-Beach, the Chancellor of the Exchequer, admitted the correctness of the figures. The reason of the loss was that the public was more eager for rapid communication than the revenue warranted. Unproductive extensions must be discouraged.

Mr. Henniker Heaton asked also if the Government was prepared to lease the telegraph lines to a private company. The Chancellor of the Exchequer did not reply.

Electricity and the Copper Market.

Consul-General Mason at Berlin has written to the State Department a comprehensive letter on the production and consumption of copper in Germany, in which he says: "The recent decline in the price of copper to $335.78 per ton in the controlling market of England, together with the fact that the total European imports of that metal averaged only 18,091 tons per month during January, February and March, 1901, against 23,600 tons per month from April 1 to Dec. 31, 1900, have been widely discussed as indications of the restricted activity which now prevails in electrical and certain other branches of manufacture throughout Great Britain, France and Germany. That this lull is but temporary and due largely to the paralysis of export trade incident to the wars in South Africa and Asia is generally believed. Meanwhile, the slight decline in the price of copper brings that metal into closer harmony with the current values of steel and iron, and has already acted as a stimulant to consumers, who are counting on the steadily increasing production of North America to maintain the future price of copper at or even below its present value.

Although complete statistics for the year 1900 are not yet at hand, it is closely estimated that out of a world's produce of about 470,866 tons, North America yielded 268,787 tons, England 520 tons, Austria-Hungary 1130 tons, Russia 6000 tons, Chili 25,700 tons, Germany 31,950 tons, and Japan 27,500 tons—the remainder being mainly from Australia, Tasmania and Spain. The actual German consumption of last year was about 106,696 tons, as compared with 19,622 tons in 1880 and about 48,000 tons in 1890.

It is thought probable that the consumption of copper in Germany will not seriously decrease during the present year. How much will be used for electrical purposes is a point upon which opinions differ. A trade circular issued by Messrs. Aron, Hirsch & Sons, a leading copper firm at Halberstadt, shows that during the six years from Jan. 1, 1895, to the end of 1900, the increased consumption of copper in Germany, Great Britain, France and North America averaged 49 per cent, while the increase in the world's production during the same period was only 43 per cent, and it is said by the same authority that the total reserve stock of raw copper, instead of increasing, has diminished by 63,021 tons during the past six years.

The Signal Corps Telegraph in the Philippines.

A special dispatch from Washington to the New York *Evening Post*, says: A problem will confront General Greely, Chief Signal Officer, when he invades the Philippine archipelago in July. His force of officers will be cut in twain at that time, and his struggle will be, after inspecting the situation with his own eyes, to map out the remaining work of the Signal Corps so that 15 officers can perform the duties hitherto distributed among 30. The red lines on the official map of the Philippine Islands show a system of land wires and submarine cables stretching between extremes about a thousand miles apart, but so ramified as to compose a total length of between 4200 and 4300 miles, or enough to make a line from San Francisco to New York and back to Chicago. Over this system there pass an average of 10,000 Government messages a day, these messages averaging at least 100 words, so that, in round numbers, it may be said that 1,000,000 words are transmitted daily by telegraph on Government business. This is almost a necessity of the situation, in view of the absence of any proper postal facilities. It is the only efficient means of communication between the military and other functionaries of the Government. The abundant use of the wire, indeed, has given rise to a witticism by one of the signal officers, speaking of his army brethren at a certain headquarters: "They never send any dispatches; they merely file letters." It is natural that they do, if we reflect that the news of the first operations of our forces in Mindanao did not reach Manila for three weeks, whereas the same points on the same island can communicate with the capital now in 15 minutes.

CURRENT NEWS AND NOTES.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS meets at Milwaukee, Wis., on May 28, with headquarters at the Plankinton House. Among the papers are "Requirements of Electricity in Manufacturing Works," by Professor W. S. Aldrich; "Blue Printing by Electric Light," by H. G. Reist. There will be visits to the Allis, Vilter, Christensen and other Milwaukee shops of interest to the profession.

ELECTRIC FIRE ENGINE.—A Pittsburg correspondent writes us that J. E. Weaver, a machinist of Allegheny City, Pa., has built an electric fire engine. The machine is completed and the Allegheny City fire department will give the new invention a trial at the earliest opportunity. The apparatus differs from the steam fire engine in so far as there is no boiler and engine. Instead, there is an electric motor of 40-hp capacity which will do the work. The inventor obtains his current from the trolley wires. The new engine weighs between 5000 and 6000 lbs.

MR. MORGAN AND THE CABLE STORY.—The report from Paris that Mr. J. P. Morgan had leased one of the Atlantic cables for the day during Friday last week is declared by the managers of the various cable companies to be without foundation in fact. It was pointed out that the agreement entered into at an international convention at Berne several years ago would prevent such an arrangement. Another fact which would stand in the way was that, in order to reach a cable, it would be necessary to have a land line from Paris to the cable terminal. Since all the French lines are controlled by the Government it would, under no circumstances, lease one of its lines to a private individual. The story, therefore, seems to have been completely pulled to pieces in the light of facts.

LIBRARY FOR SCHENECTADY.—It is reported that the General Electric Company has donated $15,000 to the city of Schenectady with which to purchase a site for the proposed $50,000 library to be erected in that city by Mr. Andrew Carnegie.

LONG-DISTANCE HYPNOTIZING.—A test of hypnotizing over telegraph and telephone wires between Denver, Colo., and Pueblo, 120 miles, is reported by the Colorado papers. Apparently the ability to do such a thing has been proved once more, but the utility of it as a new industry was not clearly established.

A LARGE UNDERGROUND ORDER.—The village board of Riverside, a small suburb of Chicago, recently ordered the Chicago Telephone Company to put its seven circuits running to its seven subscribers in the town underground. Naturally, the company couldn't see where the profits or utility came in, and preferred to take out the telephones rather than go to the expense of underground construction.

DISAPPEARANCE OF CABLES IN NEW YORK.—The cable on the Columbus Avenue line of the Metropolitan Street Railway Company was taken out on Saturday night last, and the electric conduit system inaugurated. People along the line gave the last cable car a lively farewell, fireworks being set off at some points, and there was much cheering. The Broadway line is now the only one in the city operated by cable, and this is practically ready to give way to electric power.

ELECTRICAL EXHIBITION, CHICAGO Y. M. C. A.—The Y. M. C. A. Electric Club, of Chicago, gave an exhibition of recent electrical developments for the benefit of the general public at its rooms in the Association Building the evening of May 7. The Y. M. C. A. electrical laboratory class also made a display. This class is doing good work in electrical education evenings for its members, and has become one of the recognized means of night school electrical training in that city.

VIBRATION IN UNDERGROUND.—The committee which has been inquiring into the vibration on the London Tube (underground) railway has made a report which says that the vibration is undoubtedly caused by a large proportion of the weight of the electric locomotives not being borne on the springs. They also say that the rails employed by the company are lacking in rigidity. The company has ordered a new type of locomotive, and will try to employ stiffer rails. The committee expresses the belief that the problem of preventing vibration can be solved.

CABLE EXTENSION IN AFRICA.—United States Consul-General Guenther, at Frankfort, in a report to the Department of State, says: "The Central African telegraph line, connecting Brazzaville with Loango, on the west coast, has been completed, and direct communication with Libreville may be had from any station of the English Atlantic cable." He adds that the cable from Brazzaville to Stanley Pool, which is being laid to connect with the telegraph system of the Congo State, will ultimately be extended to Lake Tanganyika, where it will form a conjunction with the German East African system. Mr. Guenther writes also that work has been begun on a new cable between England and Germany, which will be the seventeenth in existence between the two countries. The line runs from Emden to Barton.

FIRE PROTECTION CONFERENCE.—The fifth annual meeting of the National Fire Protection Association will be held in Chicago on June 11, 12 and 13. The opening sessions will be held in the assembly room of the Chicago Underwriters' Association at the Grand Pacific Hotel. The last day's conference will be held in the demonstration room of the Underwriters' Laboratories, No. 67 East Twenty-first Street. Among the interesting papers to be presented are: Report of Committee on Electric Fire Pumps, C. M. Goddard, chairman; Report of Committee on Thermo-Electric Fire Alarms, F. E. Cabot, chairman; Report of Committee on Uniformity of Requirements, H. A. Fiske, chairman; Report of Committee on Devices and Materials; W. C. Robinson, chairman. Laboratory demonstrations comprise an exhibition of methods employed in testing hand chemical fire extinguishers under the standards adopted, with explanation of results obtained in a number of tests; exhibition of methods employed in testing cotton rubber-lined hose under the standard adopted; exhibitions of the methods employed in testing automatic sprinkler heads: (1) pressure tests for determining leaking point; (2) oven tests and bath tests for determining fusing points; (3) distribution and capacity tests; (4) methods employed in effecting corrosion and results of tests of corroded and coated heads; (5) miscellaneous tests.

ELECTRIC FURNACE PROCESS.—Some years ago Leon Paul Hulin, of Modane, France, proposed a method of electrolytic decomposition, called by him "electroly-filtration," wherein the ions were liberated upon unsubmerged porous electrodes, and the products transferred through them by the hydrostatic head of the electrolyte. A patent for what seems to be the electric furnace analogue of the Hulin process has just been issued to Alfred H. Cowles, of Cleveland, Ohio, who was prominently identified with the early practice of electro-metallurgy in this country, and especially with aluminum bronze manufacture. A crucible of porous carbon, surrounded by a water jacket spaced away on all sides in such manner as to form an intermediate condenser, forms one electrode, while the other takes the shape of a carbon rod, inserted through a cover which hermetically seals the mouth of the crucible. Upon electrolysis in this crucible of a fused electrolyte yielding a gaseous ion, or upon reduction therein by carbon of a compound yielding volatile products, these pass through the porous carbon walls under pressure of the reaction gases, are condensed on the inner walls of the water-jacket and tapped off. The process is described with reference to the reduction by carbon of sodium aluminate, the products being sodium, which passes through the walls, and aluminum carbide, which remains in the crucible; or if copper or its compounds be present, aluminum bronze is formed. The operation necessitates the use of extremely high temperatures to avoid clogging the pores of the carbon by condensed sodium, and for this reason must compare unfavorably as regards current efficiency with those processes in which the alkali metal is obtained directly in the liquid condition.

MOTOR REGULATION.—Two belated patents on motor regulation were issued April 13, one to Dr. S. S. Wheeler on an application filed Sept. 24, 1894, and the other to James Burke on an application filed March 22, 1895. Both of the patents relate to the control of motors operating on constant-potential circuits. Two methods are described for carrying out the principle involved in the Wheeler patent, in one of which a dynamotor is used and a motor-generator in the other. In either case one of the regulating armatures is in series with the armature of the motor to be regulated, and the brushes of the other regulating armature are connected to the brushes of the working motor. In the case of the dynamotor this later circuit contains a regulating rheostat, while in the case of a motor generator the two regulating fields are controlled by rheostats. In the case of the dynamotor the speed of the regulating armature is controlled by varying the load on the generator side, which is done by means of a rheostat in the circuit connecting this side with the working motor brushes. When the speed of the regulating armature is low the counter e. m. f. of its motor side is correspondingly low, and therefore the working motor has impressed upon it almost the entire e. m. f. of the working circuit. If by means of the rheostat the load on the generator side of the dynamotor is reduced, the speed of the armature is correspondingly increased, thereby throwing a larger counter e. m. f. into the circuit of the working motor, and thus reducing its impressed e. m. f. It will be noted that the current generated in the dynamotor is fed to the armature of the working motor, thereby assisting it in its work. When a motor-generator is used there is no rheostat in the circuit between the regulating generator and the working motor, the regulation being effected by means of a field rheostat common to both the regulating motor and generator fields, which latter are in parallel. The Burke patent describes an arrangement in which there are two regulating machines connected in series to the working circuit, the working motor being connected across the terminals of one of these machines, both of the fields of which can be regulated. By proper regulation of the fields the working motor may be supplied with an e. m. f. much below that of the working circuit, or with an e. m. f. much above that of the working circuit, or with e. m. f.'s anywhere between these limits. The regulation consists in varying the relative strength of the two fields and in reversing the direction of one of the fields.

A POWER EXCHANGE is being established at Rochester, N. Y., with the object of inducing manufacturers to settle there and use the electric power now being developed on a large scale from the Genesee Falls. It is practically a board of trade, and is already negotiating for various industries that can move there and use the power to advantage.

THE LATE J C. HENRY.—Note was made in these pages last week of the death at Denver of the well-known electric railway inventor, J. C. Henry. Denver papers to hand give accounts of the funeral and show him to have been held in high esteem locally. It is understood that not long before his death Mr. Henry made an exclusive contract with the Stanley Electric Manufacturing Company for the use of his patents so far as they related to vehicles moving on a fixed track, and including his "regenerative controller" devices.

LONG-TRANSMISSION LINE.—An official test of the Standard Electric Company's lines, switching stations and step-down transformers in San Jose, Calif., was made on May 4, in the presence of Prince Poniatowski and other officials. Current was transmitted at 42,000 volts, the distance of transmission being 100 miles. Again California has opened the longest commercial electric power transmission line in the world. The current is supplied from the generating plant of the Bay Counties Power Company, on the North Yuba River. The Standard Company will not be able to start up its own generating plant for some months.

LETTERS TO THE EDITORS.

Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs.—In the suggestive editorial, "Electro-Chemistry," in your issue of April 27, you do not seem to fully realize the good work that is done in this country by the younger teachers of physical chemistry. For example, I had the benefit of a very efficient course in electro-chemistry under Dr. Robb, using Leblanc's "Electro-Chemistry," at Trinity College, Hartford, and another course in electro-analysis, under Dr. Riggs, before I studied in Germany. Then both Professor Richards, of Harvard, and Professor Whitney, of the Massachusetts Institute of Technology, are at the heads of special laboratories, where a number of investigations in this subject are carried on, not to mention a number of other followers of Nernst and Ostwald in America.

But your point that in the majority of American institutions electro-chemistry is inadequately taught and has inadequate laboratory facilities, as compared to the German teaching of the subject, is quite true, in my opinion. There is a great need for young electro-chemical engineers who understand the theory of electro-chemistry, and have the practical knowledge of American methods and American conditions of high-priced labor, and the consequent necessity for simple processes and automatic apparatus.

With the abundance of American capital looking for investment at the present time and our cheap water-power, splendid opportunities are offered for the development of electro-chemistry and especially electro-metallurgy, far beyond the present state, just as has been done in electrical engineering with brilliant success in the past 10 years. It must be remembered that there is much less self-induction in the "brain circuits" of American capitalists than in foreign capitalists, and that American engineers have usually a clear distinction between beautiful "laboratory" processes and those that allow a fair margin of profit after 15 per cent has been charged to interest and depreciation. All things considered, the outlook for progress in these two lines is attractive even if the expectations of the past few years have not been realized as yet.

With regard to the present "dissociation theory" of electro-chemistry, it certainly bears the stamp, "Made in Germany," and the commercial success of the applications and the recent innovations in Germany are the best tests of its soundness. A theory should be to the engineer what the lathe is to the machinist, a tool to accomplish work. As long as one theory enables one to prophecy and explain phenomena better than any other, it should be kept in commission. But when another theory comes up that does the work better, then the old theory should be thrown in the scrap-heap and allowed to rust. The charge that the "dissociation theory" of electrolysis is transcendental, is common to many theories. It can be said that it is hardly so metaphysical or so autocratic in character as the old Dalton atomic theory which assumed the existence of 60 or 70 infinitesimal indivisible particles, each with its own specific properties; yet the tremendous advances that chemistry has made are due to this theory. So the questions whether atoms, "electrons" and ions have a real existence, as we imagine them, what is the difference between positive and negative charges, how can zinc have an electrolytic solution tension of some 10,000,000,000,000,000,000 atmospheres, while mercury has one of 0.000,000,000,000,000,1 atmosphere are as subtle as any questions that perplexed old "schoolmen" of the Middle Ages. What we know is that certain things act very much as if they had the properties we ascribe to them in our imagination. The theory that helps us to learn more and to do more is the *desideratum*. A theory is merely a means to an end, and as such should be judged (1) by its efficiency, (2) by the ratio of its probability to improbability.

On these standards, the modern German theory of dissociated ions and its sister, the Nernst theory of e. m. f. stand easily first. They give us the *concrete conceptions* that explain unknown causes in terms of known phenomena. The other theories that attempt to explain the mechanical action can be termed "also rans," to use a bit of expressive colloquialism.

Cambridge, Mass. Woolsey McA. Johnson.

To the Editors of Electrical World and Engineer:

Sirs.—In an editorial of the Electrical World and Engineer of April 27, the desirability is pointed out of establishing in our technical schools chairs of electro-chemistry and of offering instruction based upon the teachings of the Arrhenius-Van't-Hoff-Thomsen-Nernst-Ostwald school, and it is further suggested that only those having the training of this school should be selected to fill such chairs.

The desirability of instituting courses in electro-chemical engineering in our schools arises from the rapidly increasing importance which the electro-chemical industries are assuming among the industries of this country. If such industries are the result of the application of the theories advanced by the Arrhenius-Van't-Hoff-Thomsen-Nernst-Ostwald school, then the training should undoubtedly be given along those lines; but such is not the case.

Can a single electro-chemical industry be traced to the application of such teachings? Is our aluminum industry helped by the modern theory of dissociation? Is the calcium carbide industry an outgrowth of the study of osmotic pressure and electrolytic solution tensions? How far has the process of electrolytic copper refining been modified by them? Why is it that technical electro-chemistry has made more rapid progress here than abroad, in spite of the fact that there is a scarcity of electro-chemists in our country trained in the German schools? There is no reason other than that electro-chemical phenomena which have long been known have been taken up by our progressive engineers and, through their efforts the former laboratory experiments have been enlarged into industrial processes.

There is no question but that the electrolytic theories recently set forth, which have seemed to explain and classify some of the phenomena, have served as a stimulus for further investigation, but it is equally certain that a too firm adherence to such theories will be detrimental to further progress. The dissociation theories and dissociation constants apply only to dilute aqueous solutions and not to concentrated solutions with which most industrial processes have to deal. Such theories are held in reverence by certain physical chemists, while the technical men know that in all fused and non-aqueous electrolytes with which they must work, the theories do not apply. It is a noteworthy fact that recently published works in technical applications of electro-chemistry devote a few pages of the work to an explanation of modern theories and then break loose from them completely and explain the technical side of the various processes without further reference to them.

There is no question but that an explanation of what the electrolysis of an electrolyte really is will offer a great impetus to electro-chemistry, industrially applied, but in the lack of such explanation and until such is forthcoming would it not be more desirable to train our electro-chemical students so that they may be of most value under the present conditions? The technical graduate who is best equipped for entering into this promising field of applied electro-chemistry must have an engineering training, and a very broad one at that, which will enable him to repeat on an industrial scale experiments which were performed even as far back as the time of the Faraday-Berthelot school. The owners of electrical industries are not advertising for men to determine the dissociation constants at extreme dilution, or to measure solution tensions and osmotic pressures under ideal conditions, or to determine the velocity of migration of ions, but rather men who can operate machinery, design and work electrolytic and chemical appliances so that a kilowatt-hour may be made to do the greatest service. A familiarity with the teachings of the Arrhenius-Van't-Hoff-Thomsen-Nernst-Ostwald school is desirable to technical men only in showing to what a limited extent they can be applied in practical working, and there is no reason that the same intelligence, knowledge and inventive faculty which has given such impetus to our electro-chemical and electro-metallurgical enterprises in this country may not be able to produce men who can give instruction to those who are to contribute to its further progress. C. F. BURGESS.

MADISON, WIS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

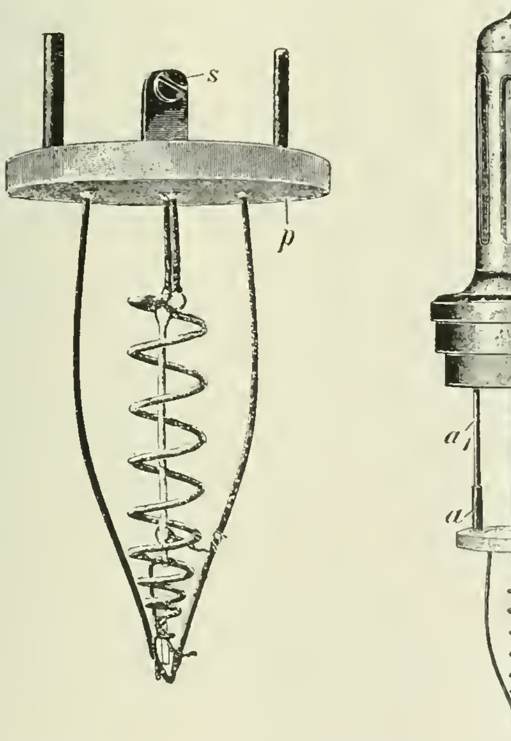
Effect of Self-Induction in the Rotor of an Induction Motor.—An illustrated didactic article setting forth the reaction taking place within the rotor of an induction motor due to self-induction, and giving formulæ for calculating the torque, at full speed and at standstill.—*Am. Elec.*, May.

Polyphase Sub-Station Machinery.—EBORALL.—An abstract of his paper read before the Brit. Inst. of Elec. Eng., noticed before in the Digest.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Direct-Current Dynamos in Parallel.—ADAMS.—An elementary article with diagrams discussing the operation in parallel of series dynamos and of compound dynamos.—*Am. Elec.*, May.

LIGHTS AND LIGHTING.

Nernst Lamp.—Some notes, taken from a circular of the General Electric Company, of Berlin, which is about to place 100 and 200-watt Nernst lamps on the English market. One hundred-watt lamps are at present made for 110 and 220-volt, but the 200-watt lamps only for 220-volt circuits. The lamp to be introduced is called model A, and is intended to replace groups of ordinary incandescent lamps. One 100-watt 65-cp Nernst lamp replaces four ordinary 50-watt 16-cp incandescent lamps; one 200-watt lamp replaces 8.5 ordinary 16-cp incandescent lamps. The lamp consists essentially of a filament, support, pendant, globe and series resistance (the latter on account of the negative temperature coefficient), and for starting the current of a parallel resistance for heating the filament, and a cut-out for breaking the circuit of this resistance when the filament is sufficiently heated to act as a conductor. Fig. 1 shows the burner, model A, in three-quarter full size, Fig. 2, the lamp with globe and hanger removed in one-quarter full size. The filament can be easily replaced without damage if only the porcelain disk, to which it is fixed, is taken hold of. The screw *s*, in Fig. 1, must first be loosened, when the whole burner can be withdrawn and a new one put in, a mistake being impossible, as the wire a_1, in Fig. 2, fits only into the tube *a*, and the wire b_1 into *b*; the operation is finished by the contacts c_1 and *c* being brought together and the screw *s* tightened. The makers calculate that the replacement of four 50-watt 16-cp ordinary incandescent lamps by one 100-watt Nernst lamp yields a saving of cost of operation of 45.75 per cent, and the replacement of 8.5 ordinary 16-cp incandescent lamps by one 200-watt Nernst lamp a saving of 51.7 per cent. The first cost of the Nernst lamp is $3.12 for the 100-watt size and $3.62 for the 200-watt size. The company is also working on 40 and 80-watt lamps, "model B," with candle-powers of 25 and 50, respectively. Fig. 3 shows the connections. When the current is switched on, the heating resistance *B*, which is made of fine platinum wire, about 46 to 50 b. w. g., wrapped on porcelain and then dipped in liquid porcelain, is in parallel with the filament *C*. When the latter becomes heated current passes through it and the electromagnet in series, the steel spring is attracted, and the circuit of the heating resistance is broken at *E*. When the current is switched off the spring flies back, remaking contact at *E*.—Lond. *Elec.*, April 26



FIGS. 1 AND 2.—NERNST LAMP.

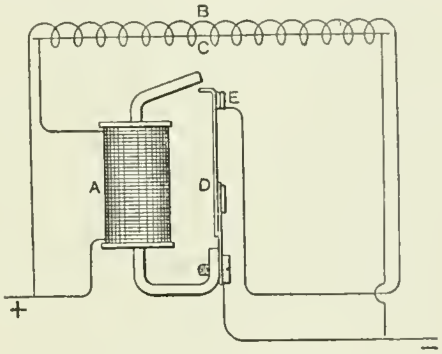


FIG. 3.—NERNST LAMP.

POWER

REFERENCES.

Waterwheel Regulation.—GARRATT.—An illustrated article on the practical side of the problem of speed regulation of water-power plants, with references to actual installations. He deals with the general design of the plant, of waterwheel gates, of waterwheel-gate connections and of waterwheel governors.—*Cassier's Mag.*, May.

Electrically Controlled Bulkhead Doors.—WALSH.—An article in which the author points out the superiority of electrically controlled bulkhead doors over hydraulic and pneumatic methods of control.—*Am. Elec.*, May.

Niagara.—BUCK.—An illustrated article on the development of the Niagara Falls transmission plant in recent years, with a summary of the different companies which are supplied with electric energy, and of the different purposes to which the energy is applied.—*Cassier's Mag.*, May.

Economy in Steam Production.—OBERT.—An article showing wherein the operating expenses of a steam plant might be considerably lessened, and pointing out the necessity of a clean and well-lighted boiler room.—*Am. Elec.*, May.

TRACTION.

The Sprague Multiple Unit System.—SPRAGUE.—An illustrated authoritative article. Over 60,000 horse-power of equipments are in use. In general, each motor car is equpiped with controllers which can be operated independently, or so arranged that when the cars are connected in one train, all of the controllers can be operated from one point by means of a pilot motor. The circuits of the pilot motor and those of the car motors are independent of the train lines. Each car equipment is controlled by the joint operation of a speed controller and reverser. The system is illustrated by several diagrams. On a car there are four distinct circuits, namely, (1) the car-motor circuit, which includes the main motors, the reverser, rheostat and motor grouping circuits, (2) the local controller circuit, which includes the magnetic coils, pilot motors or whatever moves or controls the main motor controllers, (3) the platform switch line. This on a single car is a part of the local controlling circuit and on a train energizes all the local controlling circuits, (4) the train or governing line, which is a cable running from one end of the car to the other, which at one or more points is connected to the platform switching line (3) and to the local controller circuits (2). The various uses of these circuits are described, after which views and descriptions of the principal apparatus are given.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Power Consumption of Motor Cars Using Two and Four Motors Per Car.—Two papers read before the New England St. R'y Club. The first paper is written by Mr. Pestell, electrical engineer of the Lynn & Boston Railroad. Tests were made with the same size motors, and the power consumption was between 20 and 25 per cent greater when four motors were used than with two motors. This was due partly to the increased losses in the motors and friction, and also because the motors, being heavily loaded, were working at greater efficiency. He then gave some figures showing the watt-hours per car mile, under different conditions. These varied from about 1400 to 3000. The fact that the two-motor equipment was heavily loaded was shown from the fact that the temperature after running seven hours was 94 degs. C. over that of the surrounding air, whereas the four-motor equipment reached only 66 degs. C. rise. This made the deterioration of the two motors more rapid. A second paper on the same subject was then read by Bigelow, of the Boston Elevated Railway Company. He found that the four-motor equipment took about 50 to 60 per cent more current, the weight being about 18 per cent greater than the two-motor car, but as the speed was greater the actual increase in power required was only from 12 to 27 per cent. When hauling trailers with a four-motor car he found that about 25 per cent of the weight on driving wheels on the rear rails was available for drawing trailers. If more was attemped, the wheels slipped. He did not think the depreciation when two motors were used per car was due to this fact, but was because the motors were overloaded. For this service he believed two motors per car best, though Pestell took the opposite view for his own conditions. In the discussion some figures were given on the speed of acceleration with different kinds of motors. Bradford stated that they used wattmeters on all their cars, and so checked the consumption of current by the motorman. Others followed the same practice and explained how the motormen were checked up, and testified that this had effected a saving in the total consumption of power.—*St. R'y Jour.*, April 20, and Int. Ed., May.

The Proper Way to Run Single-Motor Trucks.—HENRY.—The writer refers to the use of double-truck cars with a single motor on each truck, and states that it is usually the practice to have these motors face in opposite directions; that is, if the front wheels are driven in one truck the rear wheels will be driven in the other truck, and vice versa. He believes that it is better to have the same set of wheels driven in each truck, because the tendency of the motor to rotate around the axle to which it is connected will vary the load on that axle. Thus, in the case cited, the driven axle of the front truck will have a greater tractive effort on the rails than the rear axle of the rear truck, consequently the rear wheels will slip when the motors are running in the series position, and there may not be over 50 volts on the front motor, while the rear may have 450 volts. When the controller passes from series to parallel, there is a sudden kick or jerk on the first motor, when it is instantaneously changed from 50 to 500 volts. The writer believes that where there are steep grades the motors should be put on the rear end of each truck, and where there is no danger of slipping, on the front end, as this would be easier on the track.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Automatic Controller Handle.—This device compels the motorman to turn his controller handle slowly and so prevents him from putting an overload on his motors. There is a second handle close to the main handle, which moves the pawl to which it is connected. This pawl strikes against a projection on a ring around the controller spindle and has to be moved to allow the controller to advance to the next point. The controller handle can, however, be thrown backward from any point quickly, as the pawl is hinged so that when turned backward it will slide along the top of the ring. In another form of handle the auxiliary handle is omitted, and the pawl is actuated by moving the main controller handle back and forth.—*St. R'y Jour.*, May 4, and Int. Ed., May.

A New Rail Bond.—A description of a new bond which consists of a flexible ribbon soldered to the rail by a simple and inexpensive process. The ribbon is made of strips of annealed copper melted together at the feet, which are placed against the rails, and an arch is made in the center. It is always in sight, and therefore readily inspected, and the soldered contact remains good for an indefinite period.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Pole Setting on the New Orleans Drainage Commission Lines.—An article with diagrams showing the method of setting poles along the railroad tracks, gutters and marshy districts of New Orleans. In very soft ground the poles are fastened to piles driven 26 ft. below the surface of the ground, while the greater number of the poles are set in wooden boxes embedded in concrete settings; clean, sharp sand being poured around the pole so that in removing the latter and replacing it by another the box and concrete setting are not disturbed.—*Am. Elec.*, May.

The Proper Wheel Section for Interurban Railways.—These roads usually operate over their own right of way with an exposed rail, and at a speed of from 40 to 50 miles per hour. The proper wheel section would be very easy to determine if the cars did not also have to enter the cities at the termini over the city tracks. Usually the groove in the city tracks and crossings is built for a wheel flange not over 9-16 inch deep, and ¾ inch thick. With the cast-iron wheels used almost exclusively in American work, it is very difficult to cast chilled wheel flanges of this size without chilling the flange all the way through, and at the high speeds used outside the city these flanges are hardly strong enough. The first point made by the writer is to be sure that the wheels are put into the truck exactly square. If this is not done, the wheels will wear unevenly. He also recommends care in braking, so that the wheels will not be unduly heated up during braking. The steam roads in this country use flanges 1⅛ inch deep, but 1 inch is deep enough on practically all electric roads, while the width should be of 1 inch to 1⅜ inches, provided the grooves in the rails in the city are large enough to accommodate this size.—*St. R'y Jour.*, May 4, and Int. Ed., May.

United Power & Transportation Company.—An investment company, which owns practically all the stock of a number of operating street railway companies. These latter are all within 200 km. of Philadelphia, but the company does not plan to keep its investments all in that section of the country. Altogether, the company owns 11 electric railway power stations and 4 electric light stations. Some of these contain direct-connected apparatus, but most of them are belted, partly because they were among the early stations to be built and partly because the prevailing low cost for fuel in the territory covered has not made the reconstruction of the stations according to modern economical methods an immediate necessity. Two of the lines use three-phase transmission with rotary converters.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Gross Receipts of Companies in America.—A comparison of the gross receipts of 224 street railway properties arranged in five groups, according to their gross earnings. The average increase in earnings in the first group is 19.7 per cent., in the second group is 14.07 per cent, in the third group 21.83 per cent, in the fourth group 12.99 per cent, in the fifth group 13.12 per cent. The total average increase is 16.34 per cent.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Germany.—Several German street railway companies have been obliged to introduce 2.5 cent fares by the municipalities. The results have not borne out the sanguine expectations of those who thought that they would be profitable. A report of the Dresden company shows that while the number of passengers was greater, a larger number of cars had to be run, and the average passengers per car were only 3.9 as compared with 4.1 of the previous year. In Berlin, 9.56 per cent more passengers were carried, the receipts were 8.82 per cent greater, and 10.16 per cent more km. were run. The ratio of expenses to receipts was 59.65 against 56.24 the previous year. An abstract is then given of the report of the Hamburg Street Railway Company.—*St. R'y Jour.*, Int. Ed., May.

Son Francisco.—Some notes on the Market Street R'y of San Francisco. This road was bought by the Southern Pacific Railroad Company in 1871, and since then has developed into a very extensive system, which includes horse, cable, electric and steam power. There are many very steep grades, the cable cars in some places operating on a grade of 22 per cent, and the electric lines on 17 per cent. In running down the hills with the brakes on it is sometimes thought advisable to turn on a little current in order to keep the wheels moving and so prevent sliding on the track. Both track and wheel brakes are used. The motors are thoroughly overhauled every six weeks, and the brushes are changd every night, one set being used on alternative days. In case of fire, the current is turned off from the feeders on that section, and is not turned on again until word comes from the place of danger.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Storage Batteries at Cleveland.—An article on the use of a storage battery located 3 miles from the terminal of a railway, and 7 miles from the power station. It was found that the original cost of the battery would be only one-third that of the copper for keeping up the voltage under an ordinary load. The curve shows the variations in volts and amperes in the input and output of the battery. The voltage averages 540 while the battery is charging.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Nottingham.—The Corporation of Nottingham secured control of the old horse railway single-track line in that city a few years ago, and is converting it into an electrically operated road. The lines have been extended from 16 km. of single track to a double-track line, which is equivalent to 64 km. of single track. Before deciding upon the system of traction, a great deal of thought was given to the subject of the best system, and two engineers were sent to America to investigate the systems in use there. The overhead trolley was the one adopted. The old tracks were laid upon very meagre foundation, which has been changed throughout by the introduction of a permanent one having a heavy concrete foundation, and made upon the most modern lines. The new rolling stock consists of heavy double deck cars. The overhead construction consists almost entirely of center-pole lines, every other pole carrying an arc lamp. The power station is yet incomplete, but the site has been chosen and considrable work is already done on the buildings and machinery. At present the power is obtained for the operation of the tramway from the electric lighting station.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Boston Elevated Railway.—The structure of this road is now completed, the last girder having recently been put in place. A novel feature of the road is illustrated. Where the elevated system ends, a surface line forms a continuation. The surface lines are brought up on an incline to the same level as the elevated tracks so that passengers can change from one system to the other without ascending or descending stairways. A view of the insulator used for the third rail is given in the article.—*St. R'y Jour.*, May 4, and Int. Ed., May.

REFERENCES.

Distribution for Street Railways.—Bancroft.—A comparison of various systems of electric distribution for street railways. He first discusses distribution from a direct-current station or from an alternating-current station with converter sub-stations. He also discusses the booster system and the three-wire system, and refers briefly to the use of alternating-current motors on cars and to the storage battery system.—*Cassier's Mag.*, May.

Paris.—A table showing receipts, operating expenses, car miles run, etc., for omnibuses, horse cars and motor cars on the lines of the General Omnibus Company, of Paris. Statistics are also given of the cost per car mile of the principal different motive powers used.—*St. R'y Jour.*, May 4, and Int. Ed., May.

Sprague Multiple-Unit System.—Chilton.—A second article on the Sprague multiple-unit system, in which the author discusses specifically the car motor circuits and their controllers.—*Am. Elec.*, May.

Railway Car Notes.—Weeks.—An article giving some practical suggestions on the lubrication and care of car truck boxes.—*Am. Elec.*, May.

How to Make Non-Paying Roads Pay.—Cooper.—A continuation of his long serial. He discusses the checking and accounting of employees as well as one or two other subjects. He believes that a record should be kept of the gross earnings of each line and car for each day, and gives rules for making such a record. He then takes up the subject of recording the efficiency of employees and states that a careful record should be kept of the merits and demerits of each employee.—*St. R'y Jour.*, May 4, and Int. Ed., May.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switchboards.—Boyles.—A paper read before the Cleveland Elec. Club. He first discusses the general arrangements of switchboards, and states that it is usual in stations of moderate size to place all the conductors from each generator to the switchboard in a separate duct of iron pipe suitably insulated, terra cotta or other fire-proof material, so that in case of breakdown to any one machine the connections of the other machines would not be affected. In high potential work each bus-bar should also be in its own fire-proof compartment. With alternating-current boards with an average of from 4000 to 6000 kilowatts and from 6000 to 16,000 volts, either air switches or oil switches should be used. With the former, the different parts are separated by suitable barriers and considerable space must be allowed around the switch. With the oil switchboard the contact is broken in oil. These switches can be operated either by compressed air or electricity. The compartments around the bus-bars should be of soapstone or brick, and covered with flame-proof doors. It is often advisable to divide the bus-bar compartment into sections connected together through switches. He then describes how the cable should be supported, and the apparatus on each panel. Where the generator is large, it is better to put the field rheostat near the generator and control it electrically or otherwise from the switchboard, as this will save a considerable amount of copper. The exciter switchboard should be separate from the main current switchboard. Recording wattmeters should be used on each generator, and on each outgoing feeder. The writer then describes the equipment of the new board of the Cleveland Electric R'y, which consists of panels for one 2400-kw generator, one 2000-kw generator, one 1600-kw generator, one 500-kw generator, to be used either as a generator or a booster; three 500-kw generators, one special booster feeder, and fourteen special feeders and seven ordinary feeders. He then describes the equipment of each.—*St. R'y Jour.*, April 27, and May.

REFERENCE.

A Combined Electric Lighting and Steam Heating Plant.—Zurfluh.—An illustrated article describing a plant originally designed to light and heat two office buildings in Springfield, Ohio, but which was subsequently enlarged to take care of some commercial lighting in the business part of the city. The exhaust steam from the engines driving the generators is used for heating.—*Am. Elec.*, May.

ELECTRO-PHYSICS AND MAGNETISM.

Bodies Smaller than Atoms.—J. J. Thomson.—An abstract of a discourse held before the Royal Institution. He followed the same lines of argument as in his Brit. Assn. address of 1899. He put forward his views as to the actual existence of positive and negative electricity, the positive electricity being variable and the negative invariable, which is in a way a return to the old fluid theory of electricity. He explained the experiment he had made to determine whether the mass of the electrified ions was or was not of electrical origin. He led a stream of cathode rays into an alternating electrostatic field so that the stream impinged on two targets, one of lead and the other of aluminum. If the mass were of electrical origin, less heat would have been developed at the aluminum than at the lead target, owing to the relative transparency of the former, but by careful measurements in a tube in which one target was replaceable, so that the differences between observations should be observable when one target was lead and the other aluminum, and when both were of the same metal, the heat generated in the two cases was identical within the limits of accuracy of his experiment.—Lond. *Elec.*, April 26.

REFERENCES.

Analyzing Wave Forms.—Woodhouse.—A communication, illustrated by a diagram, in which he describes a simple graphical method for determining the constants in the Fourier series by which a given periodic function is to be expressed.—Lond. *Elec.*, April 19.

Properties of Metals and Alloys.—Guilleaume.—A long article, in which he gives a summary of recent researches on the electric and thermic conductivities, specific heat, temperature of fusion and dilution at higher temperatures.—*L'Ind. Elec.*, April 10.

Windings for Electromagnets and Solenoids.—An article giving the essentials in the determination of windings for electromagnets and solenoids, together with three comprehensive tables, which reduce the mathematical operations to a few arithmetical computations. —*Am. Elec.*, May.

Electro-Chemistry and Batteries.

Accumulator Tests.—A summary of the set of rules for the second international competition of storage batteries to be held in 1901-2 under the direction of the Automobile Club of France. The tests will commence with the beginning of June and will extend over a period of one year. Each competing battery, composed of a suitable number of elements, and contained in a "cell," to which it can be easily fitted, must furnish practically 120 ampere-hours without its p. d. falling below 8.5 volts at a current of 20 amperes. The batteries must come under one of two heads: First, batteries of high specific capacity and low rate of charge; maximum weight, 60 kilos; second, batteries of low specific capacity and high rate of charge, maximum weight 90 kilos. The trials will be made for periods of 6 days, alternating with one day rest. During these six days, the batteries will be submitted for periods of five hours, by means of an automatic apparatus, to vibrations as in ordinary automobile practice on the road. During these five hours the batteries, connected in series, will send discharging currents of various strengths, according to a certain diagram, as in the first test mentioned in the Digest two years ago (2 minutes 20 amperes, then a half minute 100 amperes, 3 minutes 50 amperes, 2.5 minutes 40 amperes, 3 minutes 70 amperes, 5 minutes 30 amperes, 4 minutes 20 amperes, 10 minutes no load). This varying discharge, to be obtained by means of a commutator rotating once in 30 minutes, is to be reproduced ten times in succession, each complete cycle corresponding to 12 ampere-hours. On the last day of the competition the batteries will be discharged at a constant output of 24 amperes for 5 hours. Charging will take place at 12.5 volts.—*The Electroch. and Met.*, April.

Accumulators.—John H. West.—A continuation of his article on recent progress in accumulator manufacture. He gives some large tables, containing quite an amount of valuable information, giving comparative data of a number of cells, chiefly those exhibited at the late Paris Exposition and those participating in the Automobile Club competition of 1899. For each cell of a certain capacity data are given for three types, relating to 10-hour, 5-hour and 1-hour discharge. The capacities are 25, 50, 100, 200, 400, 800, 1500, 3000 and 6000 ampere-hours. The data given are the weight of electrodes per ampere-hour in grams. The total weight per ampere-hour in grams; the volume per ampere-hour in cub. cm.; the discharge rate in ampere per k. g. of plate; the price per ampere-hour in pence. A curious point brought out by the tables is that the mean density of a complete cell measured over all is only about twice that of water.—*The Elec. Chem. and Met.*, April.

Allotropic Forms of Silver.—Berthelot.—There are four allotropic states of silver, viz., silver modified by the action of oxygen at 550 degs., silver precipitated by copper and not heated, the same heated afterwards, and crystallized silver. Whenever one of these varieties is opposed to another in an electrolytic cell containing a 10 per cent solution of silver nitrate, a current is generated, amorphus sheet silver being positive with respect to the other varieties. Since the amorphus variety has the greatest heat of oxidation, its electro-chemical behavior is just what one might expect. The current never lasts more than five minutes. At the end of that time the surfaces of the two electrodes are equalized by the deposition upon the cathode, of the particular allotropic variety of silver of which the anode consists. Certain irregularities to which the electroplating process with silver is subject, are probably due to these allotropic states.—*Comptes Rendus*, March 25; abstracted in Lond. *Elec.*, April 19.

Carbon for Electro-Chemical Purposes.—An article on "Carbon in electro-chemical operations." The conclusion is arrived at that for the wet electrolysis of the chlorides of the heavy metals or alkalies, retort carbon or artificial graphite carbons are most suitable; for chromium reducing ordinary artificial carbon, the raw materials of which have been carefully purified, and for calcium carbide artificial carbons made out of ordinary, not purified, materials.—*The Elec. Chem. and Met.*, April.

references.

Decomposition Voltages.—Bancroft.—A description of a simple laboratory apparatus for determining the voltage required for the decomposition in an electrolytic cell. The cell is in series with an ammeter and a source of e. m. f. Across the terminals of the cell a high resistance voltmeter is connected. By means of a variable resistance the e. m. f. at the terminals of the cell is gradually increased.—*Jour. Phys. Chem.*, Feb.

Electrolytic Deposition of Copper.—Sayer and Spiers.—The first part of an article in which they propose to discuss some small but important details in the electrolytic deposition of copper. This part deals with "corrosion," i. e., the local action by which copper is dissolved in the electrolyte.—*The Elec. Chem. and Met.*, April.

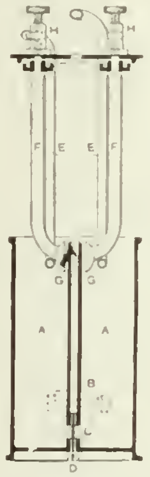
Estimation by Electrolysis.—Nathan.—The conclusion of his article. He gives a brief review of the various methods of electrolytically separating different metals from another, and gives brief suggestions on the separation of copper, cadmium, iron, cobalt and nickel, gold and lead, from other metals. The article is concluded by brief notes for the estimation of several alloys.—*The Elec. Chem. and Met.*, April.

Electrolysis in Organic Chemistry.—Hewitt.—A continuation of his article on applications of electrolysis to organic compounds. This part deals with halogen derivatives of fatty hydrocarbons.—*The Elec. Chem. and Met.*, April.

Electro-Chemical Laboratory.—Smith.—An illustrated description of the installation of the electro-chemical laboratory of the University of Pennsylvania.—*Science*, May 3.

Units, Measurements and Instruments.

Improved Caldwell Interrupter.—Ruhmer.—To obviate the disadvantages attending the wearing out of the perforated wall in the Caldwell (or Simon) interrupter, he uses the arrangement shown in the adjoining figure. The electrolytic vessel is divided into two semi-cylindrical portions *A A*, joined by means of screws *B*, and communicating through a narrow channel *C*, which is further narrowed by the introduction of a perforated porcelain plate *D*. The electrodes *F F* are of lead, having the terminal portions *G G* widened out so as to nearly cover the channel *C* when let down into position. They are kept cool by the circulation of water through *E E*.—*Der Mechaniker*, 1901, No. 6; abstracted in Lond. *Elec.*, April 26.



SIMON INTERRUPTER.

Testing Electric Light Networks.—Charpentier.—A brief abstract of a pamphlet in which he suggests a method of testing and localizing faults in electric lighting networks, which is a development of the Agthe and Kallmann test-wire system, combined with the loop system, as applied to this class of networks. He proposes to add between the two external layers of insulation of the cable, a wire spiral with a short pitch. If the cable is damaged this spiral wire will be earthed, as there is only a thin layer of insulation between it and the lead, and a continual test of it will reveal any faults. These wires are to be connected up among themselves in the same way as the working conductor of the cable, and an additional telephone wire is to be laid alongside to form an insulated return for the loop test and to facilitate communication with the station while testing outside. That journal adds: "We do not think that Mr. Charpentier's system will work as well as he anticipates. As a means of insulation testing it has the disadvantage of leaving out of account the consumer's wiring, and there would be various sources of difficulty and error in applying it for fault localization. These might perhaps be overcome, but we think that the sysem will hardly receive general application."—Lond. *Elec.*, April 19.

references.

Meters.—Janet.—A reprint in full of his very long paper on the meters exhibited at the late Paris Exhibition, an abstract of which was noticed before in the Digest.—*Bull. de la Soc. Int. des Elec.*, Feb.

The Construction of an Electrodynamometer.—Kintner.—A didactic article on the construction and calibration of an electrodynamometer for students and amateurs.—*Am. Elec.*, May.

A Simple Method of Locating Short Circuits Between Electrical Conductors.—Roe.—An article with diagrams showing how to locate short circuits in concealed electric conductors by means of an exploring coil, a telephone receiver and a battery of 3 to 8 cells, connected through an interrupter to the faulty circuit.—*Am. Elec.*, May.

Telegraphy, Telephony and Signals.

Loud-Speaking Radiophone.—Tommasina.—A description of an electric radiophone which can be heard throughout a large hall. No relay is used, and the receiver is simply in circuit with a battery and a telephone. In the coherer he uses silver filings mixed with lycopodium, sulphur or glass powder, and embedded in glycerine. The electrodes are platinum coils wound on glass. Electric waves impinging upon this coherer produce an increase of resistance which, however, only lasts as long as the impact lasts. The coherer is therefore "self-righting," and to such an extent that the author declares it to be an interrupter controlled by electric waves.—*Comptes Rendus*, March 11; abstracted in Lond. *Elec.*, April 19.

REFERENCE.

Common Battery Telephone Systems.—Henry.—Another of his series of articles on the common battery system, this one dealing particularly with the system used by the Bell Company.—*Am. Elec.*, May.

MISCELLANEOUS.

Blaze Currents as a Sign of Life.—Waller.—A description of an electrical method for estimating the vitality of seeds. It is based "upon the blaze currents" discovered by him and first described in connection with a frog's eyeball. A "blaze current" is a galvanometrical token of an explosive charge locally excited in living matter. It may be a current in the same direction as the stimulating current, or in the opposite direction. In the latter case it is equivocal, as it cannot be distinguished from a counter-current due to polarization. It is, therefore, the direct current that the author relies upon as a criterion of life. The proof that the criterion is a true one, is furnished by the author's experiments on beans of various ages. Beans not more than a year old all show blaze currents, and all germinate vigorously in the incubator. Seeds grown in 1860 show no perceptible blaze currents, and do not germinate. New seeds show only half the e. m. f. of blaze currents (i. e., about 0.02 volts) after three days' soaking in water, and none after four weeks' soaking. Anæsthetics and cold also influence the blaze currents and the germination in a parallel manner. It is evident that the author has discovered a test which enables us to satisfactorily distinguish between living and dead matter.—*Proc. Roy. Soc.*, March 25; abstracted in Lond. *Elec.*, April 19.

Smelting Iron Electrically.—An article on the question whether the smelting of iron by electricity is practicable. This question is of the greatest importance for countries which are rich in iron ore, but not in fuel. It is pointed out that a certain quantity of energy is required per pound of iron oxide, to separate the oxygen from the iron. It is calculated that with an ideal electrical process of smelting iron, in a year of continuous day and night working, one horse-power could produce 2¾ tons of iron. The coke required to make 2¾ tons of iron in the blast furnace is worth at present about $5.50, while a 24-hour horse-power of electric energy for a year is worth anywhere from $20 upwards. The conclusion is, therefore, that a process of electric iron smelting under the most favorable circumstances would be several times as great as the cost of the present method of reduction of iron by the combustion of fuel in the blast furnace.—*Eng. News*, May 2.

REFERENCES.

Atomic Weights.—A reprint of a table of "international" atomic weights, just issued by the German Chem. Soc. It is based upon O equals 16.—*The Elec. Chem. and Met.*, April.

Paris Exposition.—An illustrated description of the Worthington pumping installation, supplying water to the fountains.—*St. R'y Jour.*, Int. Ed., May.

New Book.

Reseaux Electriques. Nouvelle Methode Generale de Controle de l'Isolement et de Recherche des Defauts sur les Reseaux Electriques Pendant la Service. Par Paul Charpentier. Paris: Ch. Beranger. 23 pages, 6 illustrations. Price, 2.50 francs.

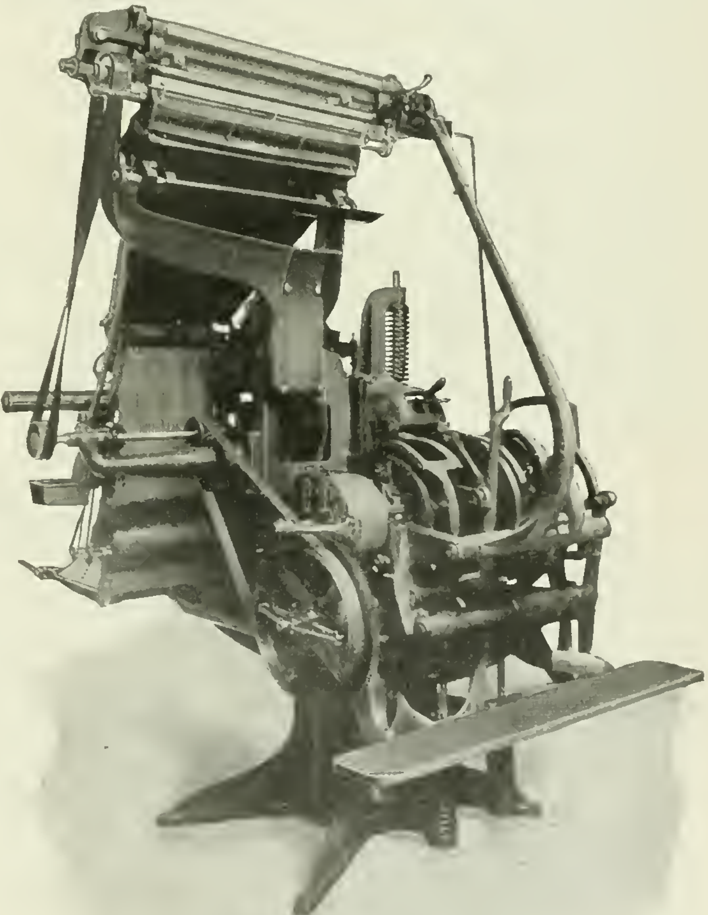
In this brief essay the author brings forward another method to be added to the many already devised for locating faults in systems of electrical distribution. The system proposed consists in installing alongside of the distribution network another network formed by a special arrangement of controlling wires: the idea being that every defect developed in the former system is reproduced equally in the second system. In addition, it is intended that in this system, grounds should be produced on the controlling system before developing on the actual distribution network. Both systems are entirely insulated, one from the other, and only come in contact at a single point at most after the development of a fault or in case of a short circuit The result is that with this set of conditions, if a fault develops it is located, not by the distribution network, but on the controlling network which follows it in close juxtaposition.

In the case of an insulated lead-covered cable, the author proposes to run a bare wire between the insulated core and the lead sheath. The defects would therefore manifest themselves on the bare pilot wire before reaching the conducting core in most instances.

The actual work of testing out in this system requires that communication be had between the central station and the tester out on the lines, this being accomplished, either by telephone or by bell signals. We consider the latter requisite the weak point in the system, and while the principles laid down are no doubt correct and workable, the methods now generally employed would appear to bring about the desired results more expeditiously and probably with quite as great a degree of accuracy in location, while involving less complication.

Jenney Linotype Motor.

The accompanying cut illustrates the special type of motor built by the Jenney Electric Manufacturing Company, of Indianapolis, Ind., for driving linotype machines. These motors are of very compact form, and are secured to linotype machines by the cap screw holding the main bearings. The power is transmitted to the linotype through an accurately cut pinion on the armature shaft that engages with a clutch gear wheel substituted for the belt-clutch pulley.



LINOTYPE DRIVEN BY ELECTRIC MOTOR.

These motors have been used by several newspapers for about two years, and have given the best of satisfaction. The Jenney Company has just completed the installation of 37 of these motors at the Chicago *Tribune* office, having, it is stated, secured this order after a competitive test for efficiency and general results with seven different motors.

Automobile Exhibits at the Pan-American.

The exhibit of the Electric Vehicle Company at the Pan-American Exposition will be the largest in the number of vehicles and most complete in the varied assortment of styles of any single display made at an exposition in this country or abroad. In all, there will be 31 automobiles of the well-known "Columbia" and "Riker" types in the company's enclosure in the transportation building and several others in practical demonstration about the Exposition grounds. Of the Columbia vehicles on exhibition there will be the following: One phaeton, one tricycle carrier, one gasoline runabout, one wagonette, one six-passenger omnibus, one runabout with wooden wheels, one runabout with buggy top and wire wheels, one Victoria with wire wheels, one Victoria with canopy top and wooden wheels, one extension front brougham, one surrey, one cabriolet, one rear-boot Victoria, one delivery wagon. The Riker list includes one piano-box runabout, one Victoria, one phaeton, one spider phaeton, one mail phaeton, one Victoria De Luxe, one delivery wagon, one two-ton truck, one Wilkesbarre bus, one theater bus, one public hansom, one railway cab, one straight front brougham, one demi-coach, one brake, one gasoline voiturette.

Both the Columbia and the Riker type are familiar sights in all the large cities throughout the country. Many of them are in use in Canada and Mexico, and more than a hundred have been shipped to England, France and Germany. In Buffalo, by the operation of the New York Electric Vehicle Transportation Company, the merits of Columbia vehicles are well known. A Columbia delivery wagon is under contract to carry the mail between the Buffalo Post Office and the Pan-American grounds, and several vehicles of a smaller type will be used to distribute mail about the Exposition grounds.

Another Columbia delivery wagon has recently been purchased by the Government for the distribution of books from the Congressional Library at Washington. Five active fields of service are included within the range of usefulness of the Columbia and Riker vehicles on exhibition, namely, ordinary pleasure riding about city and suburbs, long-distance touring and cross-country work, transportation by means of conveyances, with large seating capacity, delivery service for the department stores of large cities, and similar concerns and heavy trucking work.

The pleasure vehicles to be exhibited include runabouts phaetons, Victorias, surreys and cabriolets. Vehicles of this type are equipped with new long-distance batteries, which have a running capacity of 40 miles on one charge.

Storage Battery Tests.

An interesting test was recently made with a light electric runabout, using a set of U. S. storage cells. The vehicle was one in which another type of storage battery had been used, and for which the makers claimed a maximum distance of 20 miles on one charge. The U. S. battery installed was of the same weight as the old battery. A run was made over the roads around Brooklyn, taking hills and rough places as they came, and yet 50 miles were covered without the slightest difficulty. At the end of the run it was necessary to climb a 10 per cent grade, which showed that the batteries were not entirely exhausted.

Another set of U. S. storage cells has been in daily service in a four-passenger vehicle for three months, during which time no cell has had to be opened or repaired in any way. The wagon has been used around the city streets, and the batteries are asserted to be stronger to-day than when they were new. These tests are evidence in support of the claims made for the battery as to durability, efficiency and capacity.

The cell is not a lead battery, but made on new lines, and has been put to severe tests on other work under the most practical conditions. In smaller compass it is being used on fire alarm telegraph service very successfully.

Its construction is such, it is said, as to entirely overcome such defects as buckling, short circuiting, creeping of salts over the edge of cell, current leakage and excessive evaporation of electrolyte. It is manufactured by the United States Battery Company, of 253 Broadway, New York City, and a large sale for this new type of storage battery is predicted.

Spherical Coil Wattmeters and Phase Indicators.

As is well known, on an alternating-current circuit the product of the voltmeter and ammeter readings does not give the true watts unless the circuit is non-inductive. This is a condition never attained where there are transformer and motor loads, in the latter case the discrepancy sometimes reaching 50 per cent. On the other hand, a properly constructed wattmeter indicates the actual delivery at a glance. The accompanying illustration shows a wattmeter constructed for alternating-current service, and based upon the dynamometer principle, which permits of absolutely correct readings of alternating-current power. A movable coil attached to the pointer is suspended within the field of a fixed coil. The fixed coil carries the main current of the circuit and through the movable coil the pressure is taken. The winding of the fixed coil is of a hollow spherical form from which the instrument takes its name. The movable coil and pointer are delicately suspended in jeweled bearings, and their motions are dampened by an air dash-pot, making the instrument dead-beat. It is not affected by frequency or wave form, nor by inductive or leading loads of any power factor. It is equally available and efficient for direct-current work and is reported most satisfactory under all circumstances. With a resistance of approximately 30 ohms per volt in the pressure circuit the spherical coil wattmeter is of remarkable efficiency.

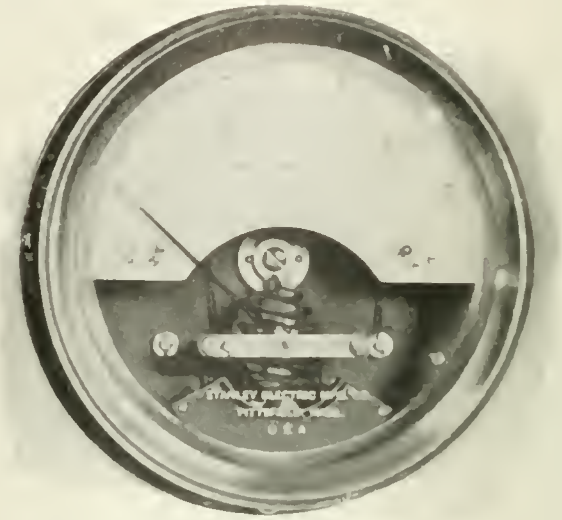


FIG. 1.—SPHERICAL COIL WATTMETER.

Station instruments of 150 amperes or less capacity and for use on circuits of less than 5500 volts have the resistance self-contained in their cases, and the total current is introduced into the fixed coil. With instruments of a greater capacity or for use on circuits of a higher voltage than this, series transformers are regularly provided. If instead of the instrument taking the total current through its fixed coil, the series transformer is used, it must be calibrated on the frequency for which it is intended, as the introduction of a series transformer makes the instrument subject to frequency errors. A special adjustment is also made in the instrument for use with a series transformer, which compensates for any change in the phase relations, making the instrument correct on inductive loads.

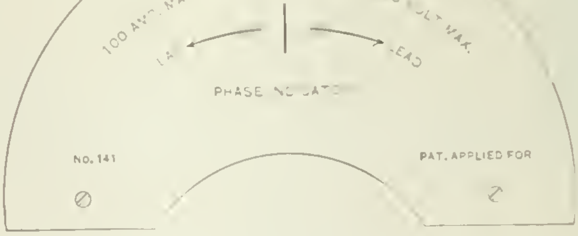


FIG. 2.—PHASE INDICATOR.

Potential transformers, regularly furnished for voltages over 1200, have standard ratios, the resistance for the secondary voltage being self-contained in the instrument case. Sufficient series resistance for any voltage, however, can be furnished if desired and specially requested. A feature of these instruments, worthy of special mention, is that they have practically the same case and base as the well-known type of S. K. C. hot-wire ammeters and voltmeters of the same make; that is, a rubber base-plate set in a brass rim, rubber cylinder for the sides, spun brass cap and beveled plate-glass front. They are insulated for extremely high potentials and may be subjected to pressures as high as 10,000 volts between case and working parts without danger.

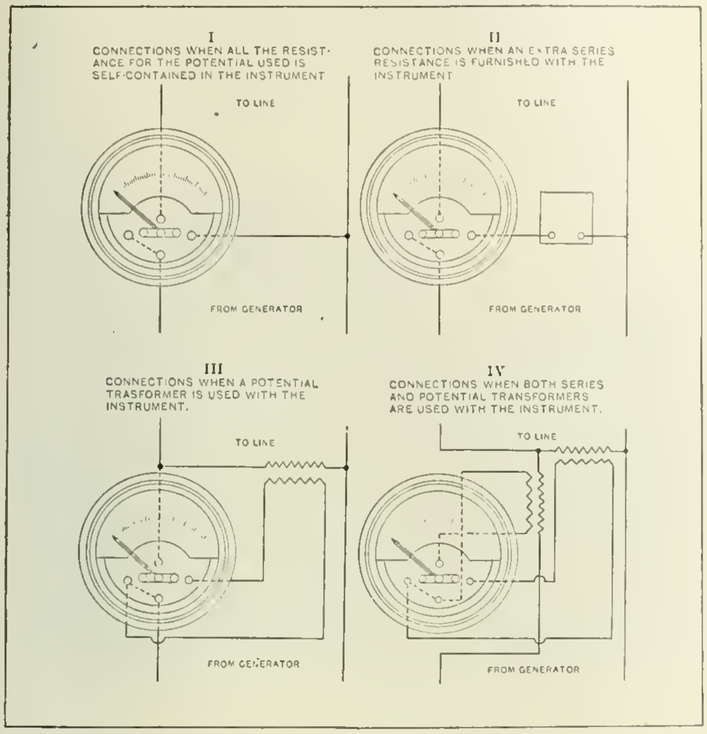

I
CONNECTIONS WHEN ALL THE RESISTANCE FOR THE POTENTIAL USED IS SELF-CONTAINED IN THE INSTRUMENT
TO LINE
FROM GENERATOR
II
CONNECTIONS WHEN AN EXTRA SERIES RESISTANCE IS FURNISHED WITH THE INSTRUMENT
TO LINE
FROM GENERATOR
III
CONNECTIONS WHEN A POTENTIAL TRASFORMER IS USED WITH THE INSTRUMENT.
TO LINE
FROM GENERATOR
IV
CONNECTIONS WHEN BOTH SERIES AND POTENTIAL TRANSFORMERS ARE USED WITH THE INSTRUMENT.
TO LINE
FROM GENERATOR

FIG. 3.—DIAGRAMS OF CONNECTIONS.

The S. K. C. phase-indicating instrument, shown in Fig. 2, is a modified spherical coil wattmeter, having its zero in the center. Two arrows pointing to the right and left, respectively, take the place of the wattmeter scale.

Disturbances, due to a heavy lagging or leading load on a line having connected to it synchronous motors, can be counteracted by varying the field current of the synchronous motors. Synchronous motors take a lagging current if under-excited and a leading current if over-excited. At one point in their excitation the current taken is in phase with the impressed e. m. f. In order to determine the most desirable excitation of a synchronous motor, it is necessary therefore to be able to ascertain the condition of the phase relation of current and e. m. f. of its circuit.

The phase indicator shown gives correctly and at a glance just this information. The pointer deflects to the left if the current lags behind the e. m. f., remains at zero when the current is in phase and deflects to the right if the current leads the e. m. f. For situations where motors are being run from the same machines which supply the lighting load it is obvious that such an instrument is of great value, as by its indications the point of proper excitation of the synchronous motors is quickly and exactly determined, and thus the regulation of the whole system is materially increased.

The instrument depends for its action upon the principle that no force is exerted betwen two coils carrying currents 90 degs. apart. Hence, if we take a wattmeter and introduce in its fixed or series coil a current, and through its movable or pressure coil another current differing in phase with the series current by 90 degs., the pointer will stay at zero. If, however, the current in the series coil should change its phase relation to that in the pressure coil by more than 90 degs. the pointer would deflect to the left, indicating a lag. If less than 90 degs. a deflection to the right would result, indicating a lead.

Fig. 3 shows the manner in which the instruments are connected in circuit. In instruments designed for operation on single phase systems, the pressure is taken directly into the instrument by means of step-down transformers or series resistance. The pressure circuit in the instrument is made completely inductive, the current through the pressure coil lagging 90 degs. In two-phase systems the pressure is taken from one phase and the current from the other. The pressure is introduced by means of a transformer and the instrument circuit is non-inductive and has no capacity. With three-phase circuits, two of the pressures are compounded and the 90 degs. lag between the series coil and the e. m. f. is thus secured.

Variable Speed Motor Drive for Engine Lathes.

The accompanying illustrations show a Commercial double commutator motor direct geared to a heavy pattern engine lathe. By a specially constructed saddle casting, the motor is mounted upon the standard head stock casting, thus requiring no changes in the lathe patterns. By the system of gearing used, the motor drives a simple sleeve that replaces the ordinary step pulley or cone in the head stock of a belt driven lathe. The motor is of the semi-enclosed type, is very compact, and so arranged that the greatest torque is secured at the lowest speeds. By means of various combinations of motor windings and gearing, 12 different speeds of the spindle are secured, ranging from 2½ r. p. m. to 450 r. p. m., without the use of any resistance in the armature circuit of the motor, so that there is no waste of electric power when running at slow speed; and when set to a given speed, that speed remains practically constant.

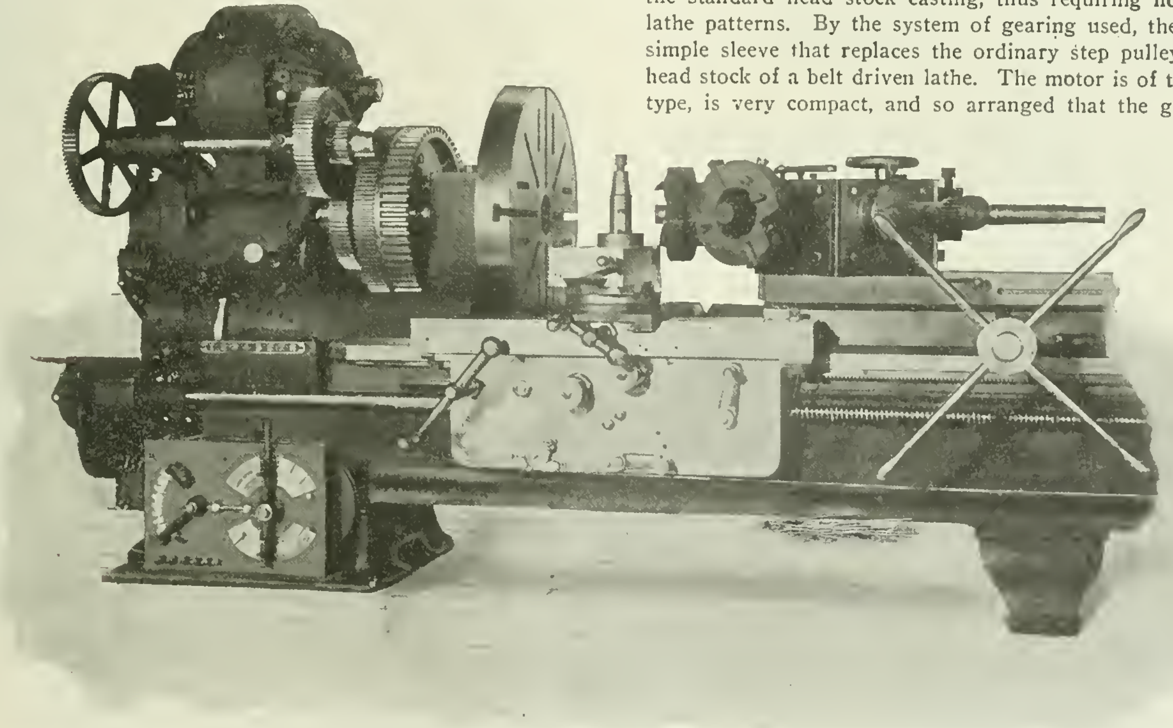


FIG. 1.—MOTOR DIRECT-GEARED TO ENGINE LATHE.

The starting and stopping of the lathe is accomplished at the apron of the lathe carriage. The controller is constructed with an interlocking mechanism that makes it impossible for incorrect combination of the circuits to be made, or for the motor to be started without the speed governing lever being locked in its correct position. By the use of this motor system, heavier cuts can be taken and more work can be done in a given time than by the ordinary speed lathe, for the reason that the capacity of the lathe is limited by the driving power of the belt, which is practically found inadequate for the work that other parts of the lathe could easily perform.

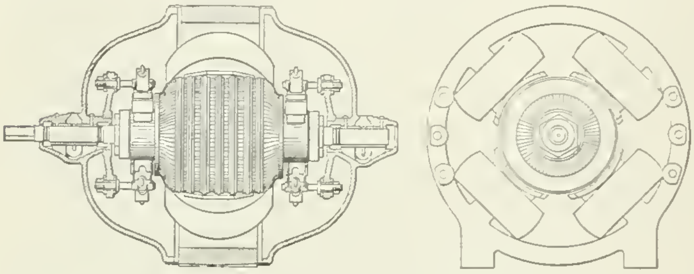
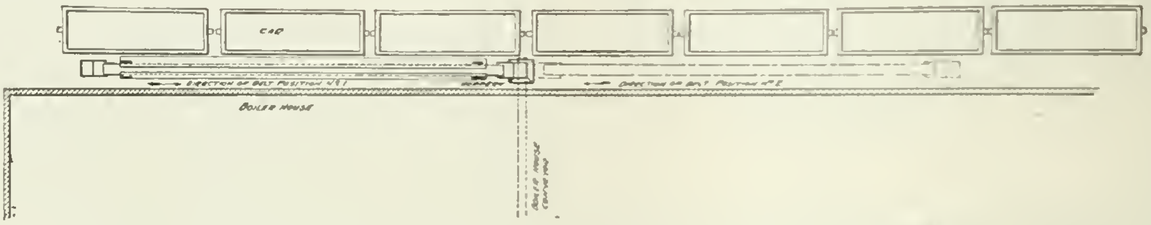


FIG. 2.—DOUBLE COMMUTATOR MOTOR.

By the elimination of all belts and shafting, this lathe may be placed in any desired position in the shaft with regard to location of the main driving shaft, and may be placed directly beneath a traveling crane, with the operation of which a belt driven lathe in a similar position would interfere. Experience has demonstrated that the operation of this tool has increased the production of one class of work 35 per cent over that of the same lathe driven by belt, and that at the same time, considerable saving in power has been effected.


CAR
DIRECTION OF BELT POSITION NO 1
HOPPER
DIRECTION OF BELT POSITION NO 2
BOILER HOUSE
FIG. 1.—PLAN SHOWING POSITION OF BOILER HOUSE, COAL CARS AND TWO POSITIONS OF MOVABLE CONVEYOR.

Movable Coal Conveyor of the Chicago Edison Plant.

Where coal is brought to the consumer in gondola cars, the cost of unloading is a serious item. This is especially true where several cars per day must be unloaded. The Robins Conveying Belt Company has offered two solutions for this problem, both of which can be seen in operation in Chicago. The first installation was at the power plant of the South Side Elevated Railroad, where fixed conveyors were built alongside the railroad track. Running in opposite directions, they both deliver the coal into the same hopper from which it is fed into a cross conveyor and carried into the storage bins. A more novel arrangement is that at the Harrison Street station of the Chicago Edison Company. Here, fixed conveyors could not be considered, as it was necessary to keep the yard clear for the handling of machinery. To meet these conditions the Robins Company built the machine, which is herewith illustrated, Figs. 1 and 2. The conveyor is mounted on a movable frame work, which is 90 ft. long and about 4 ft. high, and supported on three sets of wheels, which run on a narrow-gauge track. One electric motor serves to drive the conveyor and also to move the entire machine forward and backward. The method of using the conveyor is clearly illustrated by the half-tone and diagram, the dotted lines in the latter showing that the coal from six cars can be carried to a common point without its being necessary to shift the cars.

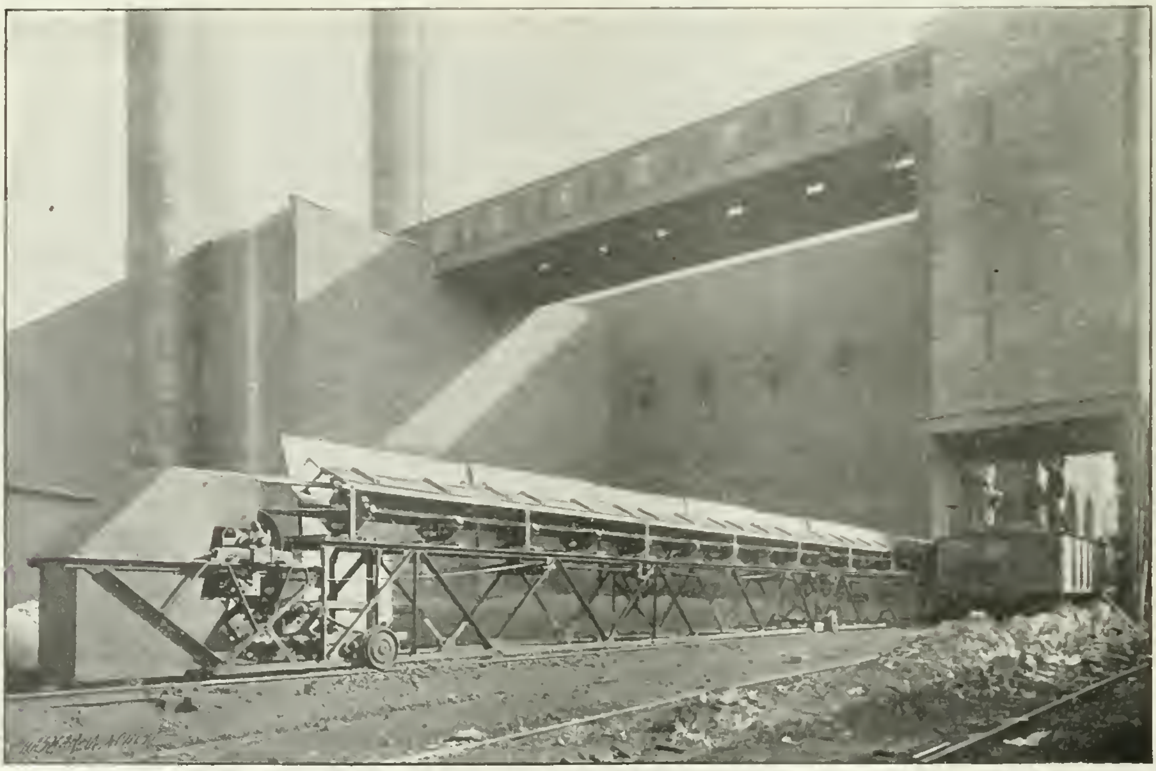


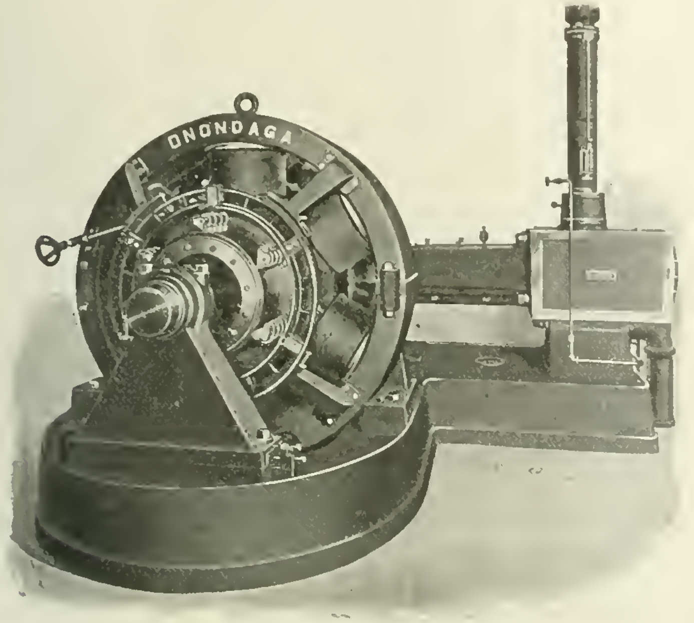
FIG. 2.—GENERAL VIEW OF MOVABLE COAL CONVEYOR.

Apart from the convenience and economy of space gained by this arrangement, there must also be noted the large capacity and the small expenditure of power. This point is brought out by the following figures, which are the results of tests made by the engineers of the Edison Company: To drive the conveyor running empty requires 3¾ hp; to drive it when it is loaded by 14 men scooping from the cars at the rate of 67½ tons per hour, 4⅛ hp is required, and to move the entire apparatus, takes 5⅛ hp.

From the diagram, it will be seen that when the conveyor is moved to the second position the direction of the belt's motion is reversed. This is accomplished with a reversing switch at the motor. To move the frame along on its track, power is communicated to the driving wheels through a friction clutch at the end of the conveyor furthest from the motor; the conveying belt being used to transmit the power. This conveyor was built under the supervision of Messrs. Sargent & Lundy, consulting engineers of the Chicago Edison and other electric companies.

A Pan-American Installation.

The Onondaga Dynamo Company, of Syracuse, N. Y., has made a very pretty and effective installation in the court in the Machinery and Transportation Building at the Pan-American Exposition. It is herewith illustrated. The unit shown comprises a 75-kw Onondaga generator direct connected to a straight line engine, all on one base, and constituting a remarkably compact plant, as handsome as it is efficient. This plant is employed to light the buildings and also to furnish current for some of the electric lighting displays that form one of the most striking beauties of the show at Buffalo.

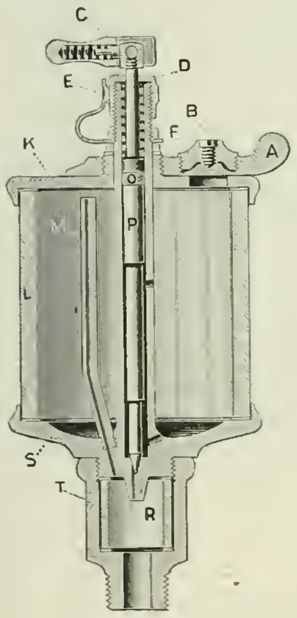


A COMPACT UNIT AT THE PAN-AMERICAN.

Gas Engine Lubricator.

The form of gas engine lubricator shown herewith is manufactured by the Lunkenheimer Company, and designated by the trade name "Paragon." The filling arrangement consists of a screw-down slide filler. Referring to the sectional illustration it will be seen that the slide *A* screws down on and around the lid of cup and has a loose plug which covers the filling hole when the slide is swung over to a closed position. This loose plug is so arranged that its wear can be adjusted by turning down the screw *B*. The whole construction is heavy, and the slide can be depended upon to seat perfectly and remain tight for an almost indefinite period. On account of this construction it is possible to secure a large filling hole, which, as users know, is a desirable feature.

The feed can be put on or off by raising or lowering the cam lever *C*. The rate of feed can be adjusted by turning the nut *D*, which is prevented from loosening by the spring *E*. By this arrangement the feed can be set and turned on or off without disturbing the rate of flow. The cup is packed both around the stem and at the top and bottom of body and sight-feed glasses and cannot become leaky. The whole cup is secured together by a lock-nut construction which makes it impossible for the cup to jar apart, due to the shaking of the engine, and also dispenses with the annoyance of oil leaks. The sight-feed glass, *R*, is quite large and can be readily cleaned by unscrewing the upper part of the cup from the base piece.

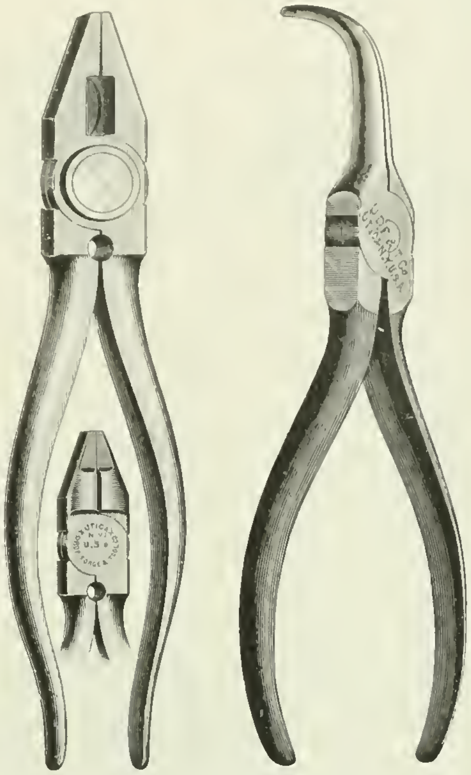


SECTION OF LUBRICATOR.

New Pliers for Linemen.

We illustrate herewith a new roller rivet type of knot-tying and splicing side cutting plier made by the Smith & Hemenway Company, 296 Broadway, New York City. This is made in 6, 7 and 8-inch sizes. A feature of this tool is the grooved roller, ¾ inch in diameter, which revolves around the large pivot, and the splicing device directly underneath it. By this means a lineman is saved the carrying of one tool, viz., a splicer. In use, each end of the wire in turn is passed around the roller and twisted neatly around the main line, thus splicing a break or connecting two sections. The smaller cut is a view of the cutter side.

Fig. 2 shows the bent or curved nose plier of the same company.



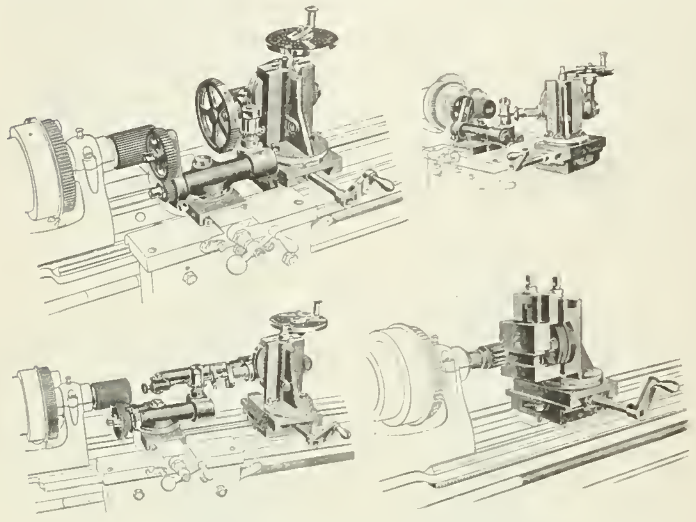
FIGS. 1 AND 2.—PLIERS.

This is especially adapted, we are told, for electricians, machinists, textile mills, oculists and jewelers. The utility of this tool can be seen at a glance.

Universal Gear-Cutting and Milling Attachment for Lathes.

The accompanying cuts show a new attachment for lathes which will take the place of gear-cutting and milling machines for many kinds of work It is designed for use by tool and model-makers, experimental and all workers desiring to do fine, accurate work. The bracket piece which contains the driving mechanism is attached to the cross-feed slide of the lathe in place of the regular tool block. The driving arbor which runs through this bracket piece transmits motion to the upright or cutter spindle by means of a pair of spiral gears which are encased so that they are free from dirt and chips. The driving arbor receives its motion from the head stock lathe spindle through a train of three spur gears, one of which is screwed onto the nose of the lathe spindle and has a wide face which allows a longitudinal travel of three inches for the cutters. Any of the regular change gears furnished with the lathe may be used for the other two driving gears, and by using different combinations a large number of speeds for the cutter may be secured. The intermediate gear is on an adjustable quadrant which swivels on the frame piece and allows a cross movement of the entire frame piece and slide rest and accommodates the cutters to the various sizes of work. The automatic longitudinal feed or the hand crank may be used to feed the cutter to the work.

The base of the swivel dividing head is securely clamped to the lathe bed by means of two bolts and a binder plate, and has cross and vertical feeds, which are operated by a hand crank. The upright part swivels on the cross-feed slide, which is graduated and renders it capable of fine adjustment to any horizontal angle. The frame piece containing the spindle, indexing mechanism and the overhanging arm swivels on the vertical feed slide which is graduated and allows fine adjustment to any vertical angle. By means of these two feed adjustments and the cross and vertical feeds, cuts of any desired angle may be made.



FIGS. 1, 2, 3 AND 4.—GEAR-CUTTING AND MILLING ATTACHMENT.

For milling operations requiring a vise, the frame piece containing the spindle, indexing device and overhanging arm, is removed and the vise arrangement is attached to the vertical slide. This may also be swiveled to any angle. In using this vise arrangement, the milling cutters may be driven by the head stock spindle.

Chucks, centers, etc., may be used on both the head stock spindle of the lathe and the spindle of the swivel dividing head, as the taper holes and hose of both spindles are of the same size. Gears may be cut as large as the swing of the lathe. There is a complete index, and all numbers of teeth may be cut from 1 to 50, and nearly all numbers up to 360. Brown & Sharpe or any standard milling and gear cutters can be used. Figs. 1 and 2 show the attachment arranged for cutting spur, bevel or mitre gears, milling cutters, etc. Fig. 3 shows the attachment arranged for cutting flutes in taps, reamers, etc., and Fig. 4 shows it arranged for slabbing and various milling operations requiring a vise.

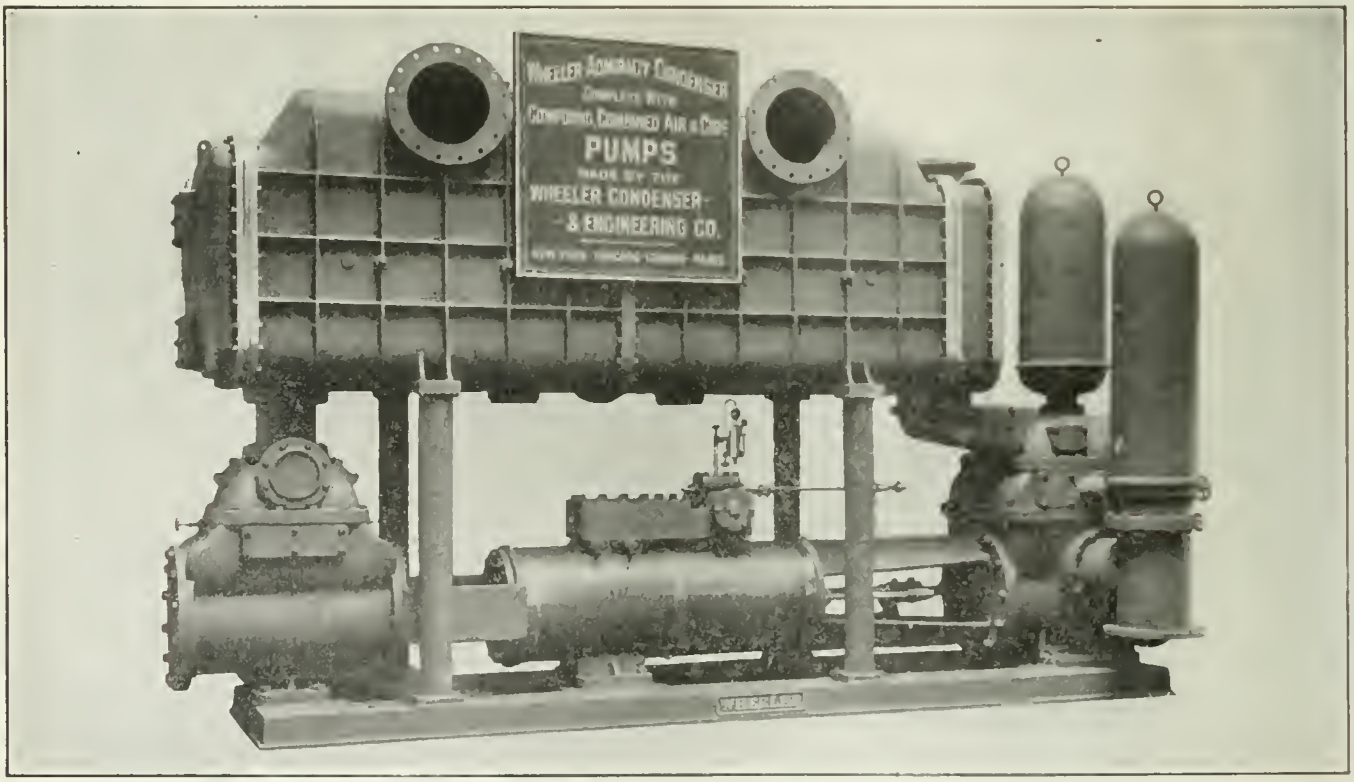
This attachment is designed by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y., for use on their "Star" foot and power engine lathes, 9 to 13-inch swing.

Gas Engines in Automobile Works.

It is not generally known that the De Dion-Bouton Motorette Company, of Brooklyn, N. Y., employs gas engines as a source of power in its various departments. A large twin cylinder gas engine was installed when the factory was first equipped, over a year ago, and last week a smaller engine of 25 horse-power arrived. This machine will be fitted up at once, as the increasing business demands larger manufacturing facilities. The nickel-plating department has a little power plant of its own, consisting of a 3½-hp water jacketed De Dion motor, such as drives No. 1 type "motorettes." A standard "motorette" gasoline tank is placed above the motor, while the vaporizer occupies its usual position. The muffler is outside, it being connected to the exhaust port by a steel tube. A copper tube ⅝ inch in diameter connects the water port to the source of supply. The dynamo is driven at a speed of 1600 r. p. m. by a 3½-inch belt. The motor runs so steadily that no equalizing device is required, the fluctuations of the dynamo current being hardly perceptible. The whole nickel plating outfit is very interesting, as it shows a thoroughly practical application of the well-known De Dion motor.

Large Steam Condensers at the Pan-American Exposition.

Several of the features of the steam plant at the Pan-American Exposition will be of interest, in spite of the fact that the Exposition depends for much of its attractiveness upon the utilization of power transmitted from Niagara Falls. It is recognized, however, that a great many of the people who visit the Exposition have not got Niagara at their back and are interested in steam utilization. Moreover, Buffalo itself is one of the cities in this country where steam power is used most largely and economically.



General View of Steam Condenser.

One of the steam exhibits at the Pan-American shown in Machinery Building is the Wheeler Admiralty surface condenser, herewith illustrated. It has been installed complete with compound combined air and circulating pumps. It is used in connection with 14 engines, aggregating not less than 2000 horse-power, thus constituting a demonstration of a large scale of work with surface condensers.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Early in the week quotations for money for call loans rose to 6@8 per cent, and later the figures fell to 2@3 per cent. It was not until Thursday, however, when the panicky condition of the stock market, caused by the Northern Pacific corner, became so acute that money advanced to an extreme figure. On that day money loans were called, and the demand for additions became urgent, resulting in 40 to 60 per cent being quoted on the Exchange. The severity of the pressure was relieved by the announcement that a number of bankers had combined to lend a large sum at the market rate. On Friday large sums were offered at 6 per cent, and the tone was eased, the extremes for the day being 3@13 per cent. Time loans were also affected in the same way, the quoted figures being 4½@5 per cent for 30 to 60 days, and 4½ per cent for longer arrangements. Commercial paper is quoted at 4@4½ per cent for double names. Last week was experienced the most sensational panic or break in stock values that Wall Street has ever seen, but at the close of the week the market had steadied and recovered part of its severe declines. The panic was due to the contest between two interests for the control of the Northern Pacific Railroad, and to the corner on the common stock of that road. Fortunately, on Friday the panic was checked by the action of a pool of 15 of the leading banking institutions in loaning $20,000,000 at the market rate, the price for money having rushed upward to 60 per cent on call on Thursday, as above noted. Speculators suffered heavy losses in the enormous decline of Thursday's market, which extended throughout the whole list and represented liquidation of contracts on a colossal scale. The recovery of the market from such conditions, however, was quick. Tractions and electric stocks suffered heavy declines with the general list. General Electric on Wednesday closed at 220, and on Thursday at 200, representing a net loss of 20 points in 24 hours. The highest quotation reached during the week was 229½, and the lowest 200, which point was reached on Thursday, the closing price being 220, representing a net loss for the week of 7¾ points. Brooklyn Rapid Transit lost 8½ points on Thursday, some of which was regained, the closing price being 77¼, a net loss of 6¼ points; the sales of stock were 126,700 shares, the extreme figures for the week being 85 and 68½. The highest price for Metropolitan Street Railway was 171¾, and the lowest 150, the closing price being 163, representing a net loss on the week's transactions of 6¾ points. This stock on Thursday dropped 14¼ points. Manhattan Elevated also suffered a severe loss on that day, dropping 38⅞ points. Western Union during the week passed par, reaching 100¼, and closed at 92½, a net loss of 4½ points. The most remarkable fluctuation in price in securities in the outside market was 180 points in Standard Oil, which, were it indicative of actual values, would represent a shrinkage of $180,000,000. The percentage of loss in other stocks was even greater. The recovery in Thursday's trading followed by further gains on Friday have left the general list at prices which show a decisive decline from the closing quotations of the week previous. Among the net losses were General Carriage, ⅝, and New York Transportaion 2⅛. Following are the New York and Chicago closing prices, quotations from Boston and Philadelphia not being reported:

NEW YORK.

	May 4.	May 11.		May 4.	May 11.
General Electric	227¾	220	Electric Vehicle	10	10
Brooklyn Rapid Transit	83½	77¼	Electric Vehicle, pfd	18	*24
Metropolitan Street Ry	169¾	163	General Carriage	2¾	2¼
American Tel. & Cable	98	100	Illinois Elec. Veh. Tran.	¾	⅞
Western Union Tel	97	92½	Hudson River Tel	120	120
American Dist. Tel	40	40	N. E. Elec. Veh. Tran	2¾	2¾
Commercial Cable	185	186	N. Y. Elec. Veh. Tran	4¾	2¾
Electric Boat	18	17	Tel. & Tel. Co. of Am	5	*6½
Electric Boat, pfd	45	43	N. Y. & N. J. Tel	162	160
Electric Lead Reduc'n	4½	—			

BOSTON.

	May 4.	May 11.		May 4.	May 11.
New England Telephone	—	—	Erie Telephone	59	—
Mexican Telephone	2⅛	—	General Electric, pfd	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel	176½	—
Westinghouse Elec., pfd	—	—	Boston Electric Light	240	—

PHILADELPHIA.

	May 4.	May 11.		May 4.	May 11.
Electric Storage Battery	67	—	Philadelphia Electric	6¼	—
Elec. Storage Battery, pfd	74	—	Pa. Electric Vehicle	1¼	—
Elec. Co. of America	8½	—	Pa. Elec. Veh. pfd	1	—
General Electric Auto	—	—	Am. Railways	43½	—

CHICAGO.

	May 4.	May 11.		May 4.	May 11.
Chicago Edison	171	170	Chicago Telep. Co	250	—
Chicago City Ry	250	—	Union Traction	15	14½
National Carbon	15¾	15¾	Union Traction, pfd	56½	56
National Carbon, pfd	85	83⅞	Northwest Elev. Com	40	—

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*Asked.

ELECTRIC RAILWAY COMBINATION.—Plans have been perfected for the absorption of the American Railways Company, and the Electric Company of America. Both corporations are Philadelphia enterprises; the former operating entensively in railways in the West and New Jersey, and the latter controls electric-light plants of Atlantic City, Altoona, Scranton and other Pennsylvania towns. The American Railways Company has full paid capital, $3,000,000, and Electric Company of America, $20,337,050 outstanding, on which $7.50 per share has been paid. The plan is for the formation of a new company, with increased capital to take over these concerns issuing its bonds and stocks therefor. American Railways is to be taken on basis of $55 per share and Electric Company of America 11½ per share.

CHICAGO EDISON.—Notices have been mailed to the stockholders of the Chicago Edison Company that at the annual meeting to be held June 10, a proposition to increase the authorized capital stock to $10,000,000 will be submitted to vote. The new stock is to be issued from time to time, as the directors shall decide that additions to the company's plant are necessary. The annual report of the company shows: Gross earnings, $2,517,219; operating expenses, $1,614,260; net earnings, $902,958; interest, $279,791; dividends, $477,688; total charges, $757,479; surplus, $145,479. The report of the sub-organization, the Commonwealth Electric Company, showed gross earnings of $629,046, against $517,131, and a net of $218,870, against $177,961, an increase of $40,909.

CHICAGO ELEVATED ROADS.—Consolidation of the Chicago elevated traction companies is in progress and will be perfected soon. Leading officials and financiers representing the Northwestern Elevated, Lake Street Elevated, Metropolitan Elevated, South Side "L," and Union Loop are working on the plans in New York City. Efforts have been made for some time to merge the associated interests controlling the Northwestern, and the Lake Street elevated lines and Union Loop with the Metropolitan and South Side companies, which are in independent hands.

OHIO TROLLEY CONSOLIDATION.—The consolidation of various trolley lines in the eastern part of Ohio will result in a continuous line from Erie, Pa., to Youngstown, Ohio, via Sharon, Meadville and Cambridge Springs. The capital of the consolidation will be $2,000,000. George B. Kerper and Henry Burkhold, of Cincinnati, are reported as purchasing for Cincinnati interests the control of the Toledo, Bowling Green & Southern Traction Company. This purchase is for the Cincinnati Street Railway property of the Elkins-Widener syndicate.

LOUISVILLE CONSOLIDATION.—The People's Electric Light Company has been consolidated with the Citizen's General Electric Company. The People's Company was organized with a nominal capital of $25,000. John L. Wells, L. B. Grant, of Brooklyn, and Charles H. Werner, of New York, are stockholders. The Citizens' General Lighting Company will be organized to take over all the gas and electric companies in Louisville with a total capital of $6,000,000.

INTERNATIONAL POWER COMPANY.—President Hoadley, of the International Power Company, states that the $300,000 mortgage on the Corliss Steam Engine Company, held by the Industrial Trust Company, of Providence, R. I., has been paid by the company. The International Power Company owns the following companies: The Corliss Steam Engine Works, Rhode Island Locomotive Works, Providence; the American-Wheelock Engine Works Company, Worcester, Mass., and the Cooke Locomotive Works, Paterson, N. J.

CINCINNATI CAPITALIZATION.—The Cincinnati Gas Light & Coke Company last week increased its capital stock from $9,280,000 to $28,280,000, in accordance with consolidation effected with the Edison lighting interests, and then changed the name to the Cincinnati Gas & Electric Company. The State's fee was $18,000. This step marks the end of a bitter fight between the lighting companies of Cincinnati.

DIVIDENDS.—The Niles-Bement-Pond Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 20. The Kings County Electric Light & Power Company, of Brooklyn, N. Y., has declared the regular quarterly dividend of 1½ per cent. The third quarterly dividend of 1 per cent (50 cents per share) has been declared by the American Railways Company, payable June 15.

HAVANA ELECTRIC.—Havana Electric Railway stockholders have ratified the action of directors in voting to increase the capital stock from $10,000,000, of which $5,000,000 is preferred and $5,000,000 common, to $11,000,000, the increase of $1,000,000 to be common stock.

CONNECTICUT RAILWAY & LIGHTING.—J. & W. Seligman & Co. and Redmond, Kerr & Co. have offered at 100 and interest $8,355,000 first and refunding mortgage 4½ per cent gold bonds of the Connecticut Railway & Lighting Company, secured by first mortgage, subject only to $995,000 underlying bonds upon 161 miles of street railway, in 23 cities and towns in southern and western Connecticut, one of the most prosperous districts in the United States, and comprising a population of over 465,000, an increase of 35 per cent in the last 10 years. Among the cities and towns included are Bridgeport, Milford, Stratford, Southport, Shelton, Derby, Ansonia, Westport, Saugatuck, Norwalk, South Norwalk, Darien and Stamford. The company also owns four electric plants supplying New Britain, Southington, Waterbury, Naugatuck, South Norwalk, Norwalk and Greenwich, and controls the gas companies supplying Waterbury and Norwalk. These properties earned, under separate management, $505,335 net, and it is expected that the consolidation will result in a large increase in earnings and a reduction of the cost of operation. The interest charges of the consolidated company are approximately $420,000. A majority of the stock is owned by the United Gas Improvement Company, of Philadelphia, and the management of the company will be under its supervision. A large amount of the bonds have already been sold to investors.

GENERAL ELECTRIC COMPANY ELECTION.—The annual meeting of the stockholders of the General Electric Company was held at Schenectady on May 14. About 60 per cent of the outstanding stock was represented. All the directors were re-elected except Thomas Edison, in whose stead Frederick P. Fish was chosen. The new board of directors is as follows: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord, Robert Treat Paine, second, George Foster Peabody, Charles Steele.

DETROIT TROLLEYS.—The Detroit United Railway has purchased the Detroit & Northwestern Suburban trolley line between Detroit and Plymouth, 30 miles. The price is said to be $800,000 in 4½ per cent bonds for the stock. It is said to be the purpose of the Detroit United Railway Company to ultimately purchase all the suburban roads running into Detroit, and reorganize as the Detroit United and Surburban Railways.

THE AMERICAN LIGHT & TRACTION COMPANY, which filed articles of incorporation in New Jersey six weeks ago, has filed a certificate showing it had increased its capital stock from $2,000 to $40,000,000. Of the whole 400,000 shares, 250,000 are preferred and the balance common. The incorporators of record are Emerson McMillin, C. F. Scoville and Charles N. King, of Jersey City.

NEW GENERAL ELECTRIC STOCK.—The New York Stock Exchange has listed $2,551,200 additional General Electric common stock.

LIGHTING PLANTS IN NEW YORK STATE.—The Fulton & Oswego Electric Light & Power plants have been sold for $65,000 to Street, Wykes & Co., of New York.

Commercial Intelligence.

THE WEEK IN TRADE.—It is fortunate that the convulsion in the stock market last week had no apparent effect on general trade or the industries. There will not be, in fact, as *Bradstreet's* says, a bushel of wheat or a ton of coal less in the country as a result of the upheaval. General trade advices during the week were in the main rather more favorable than those of the previous week, mainly because of the improvement in crop prospects. The lull in the active buying demand for iron and steel is more pronounced than it was at the time of the last report. This is mainly because mills and furnaces are already heavily sold ahead, and large consumers having placed orders are now waiting delivery. New business is less notable in iron and steel than for some months past, but prices are steady and firm at the quotations of the previous week, with mills and furnaces running to their full capacity. A feature of interest in the trade during the week was the practical completion of arrangements to consolidate the ship building and locomotive building of the country into two great concerns. Gross railway earnings continue to show satisfactory increases. The most significant gain during April being that of 27.8 per cent contributed by the Southwestern lines. The Granger lines show an increase of 2.1 per cent over April last year, thus showing recovery from the effects of the failure of the last spring wheat crop. The total earnings for the month aggregated $49,776,913, against $45,679,174 for April last year, an increase of 8.9 per cent in favor of April this year. The failures for the week as reported by *Bradstreet's*, numbered 193, as compared with 163 the week previous, and 174 the same week last year. In the metal market there is no change recorded as to copper. The leading producers are still holding to their figures of 17 cents for spot and 16⅝ cents for electrolytic. It is stated that large quantities of ore are now coming down the lakes.

SOUTHERN TROLLEY ACTIVITY.—In its issue last week the *Manufacturers' Record* gave a review of electric railroad construction in the South, which shows that part of the country to be the center of remarkable activity. In the State of Kentucky alone it is estimated that nearly 200 miles of trolley lines are planned to be built in the near future, or are actually under construction. But the work is by no means confined to a few portions of the South. In West Virginia a system is being extended around Wheeling. Several important projects are under way in Maryland, including a 25-mile line in the Western section and a line in the Eastern part of the State, to terminate at Wilmington, Del. A company has been organized in Louisiana to build 45 miles in the southern portion of the State. Augusta, Ga., and Aiken, S. C., are to be connected by a 15-mile road, and 30 miles of line will probably be built within the next 12 months in Southern Mississippi. In addition to these projects, the street railway companies in a number of the larger Southern cities will increase their mileage in the near future.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the Chloride Accumulator, has recently closed a contract with the Minneapolis General Electric Company for the enlargement of its present storage battery, which was installed in October, 1899, and the removal of it to a new location. The original installation consisted of 140 elements in lead-lined tanks, and had a capacity at the normal rate of discharge of 4000 ampere-hours. By burning eight additional plates to the bus-bars of each element, this capacity is now brought to a normal discharge rate of 5000 ampere-hours.

THE CINCINNATI MILLING MACHINE COMPANY has been awarded the contract of the British Westinghouse Electric & Manufacturing Company for the entire equipment of plain and universal milling machines and universal cutter and tool grinders. The order consisted of over 60 machines, and was taken in competition with all the prominent builders of this country and Europe. This is the largest order for this class of machines ever placed at one time, and indicates the high opinion held by practical men of the product of the Cincinnati Milling Machine Company.

THE ALLIS-CHALMERS COMPANY, which is to absorb a number of machinery-making plants, reference to which has been made in these columns recently, was incorporated at Trenton, N. J., May 7, with an authorized capital stock of $50,000,000. The incorporators are John F. Charlton, Henry S. Wardner and Stuart Lyman Of the capital stock, $25,000,000 is to be preferred, bearing a 7 per cent cumulative dividend.

PLANT FOR SOUTH AFRICA.—Mr. Elliott, the retiring manager of the Government railways of the Cape of Good Hope, has been commissioned to choose a system for electrically lighting the railways and to purchase locomotives and cars and material for the construction of the proposed light railways. He will sail for England on May 15 and will make a tour of Europe and the United States in fulfillment of his commission.

THE BULLOCK-WAGNER SALES ORGANIZATION has established a district office at No. 1624 Marquette Building, Chicago. It will be in charge of Mr. H. B. Foster, who has for about two years served the Wagner Company as sales agent. He will have the able assistance of Mr. E. W. Goldschmidt, formerly of the Western Electric Company in covering this most important field.

THE WESTERN ELECTRIC COMPANY, Chicago, is receiving an exceedingly heavy demand for fan motors this season. It is claimed that its total sales thus far for 1901 have by far exceeded those of any previous year. The demand from foreign trade is especially heavy, unusually large orders coming from India and, in fact, throughout the British Possessions.

WEEKLY HALF-HOLIDAY FOR EMPLOYEES.—The General Electric Company has announced that it has decided to give its employees a weekly half holiday with full pay, beginning last Saturday. A petition asking for this has been in circulation for some time.

BOILER CLEANERS.—The Ford Automatic Boiler Cleaner Company, St. Louis, is now equipping two boilers for the Cumberland Electric Light & Power Company, the Maxwell House at Nashville, Tenn.; Morris & Betts' plant at Kansas City, Carleton Building at St. Louis, and several plants in Indianapolis.

THE PITTSBURG REDUCTION COMPANY, Pittsburg Pa., has ordered from F. R. Dravo & Co., local representatives of the Ball Engine Company, Erie, Pa., a 350-hp engine for direct connection to a generator.

THE AMERICAN BRIDGE COMPANY has received a contract from the Atlantic City Railroad for a 65-ft. turntable at Atlantic City.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended May 2: Antwerp—16 packages electrical material, $645. Argentine Republic—175 cases electrical material, $6,224; 16 packages electrical machinery, $1,632. Aberdeen—27 cases electrical goods, $350. British Possessions in Africa—3 cases electrical material, $255; 1 case motor vehicles, $1,725. British Guiana—23 packages electrical material, $530. Bergen—1 case electrical material, $15. Brazil—245 packages electrical material, $16,807. Bremen—21 packages electrical material, $665. British Australia—2 cases electrical material, $145; 2 packages electrical material, $15. British East Indies—3 cases electrical machinery, $232. British West Indies—45 packages electrical material, $1,265. Birkenhead—159 packages motor trucks, $3,475. Central America—70 cases electrical material, $932. Cuba—218 cases electrical material, $2,177. Chili—4 cases electrical material, $484. Christiania—1 case electrical material, $150. Dutch East Indies—1 case electrical material, $95. Ecuador—15 cases electrical material, $293. Glasgow—31 cases electrical machinery, $5,041; 8 electric launches, $6,400; 38 reels cable, $11,659. Genoa—70 packages electrical material, $5,066. Hull—55 packages electrical machinery, $2,750. Hamburg—6 packages electrical machinery, $5,750; 72 packages electrical material, $3,710; 1 auto vehicle and parts, $200. Hayti—1 case cable machinery, $60. Havre—19 packages electrical material, $911; 236 cases electrical machinery, $30,323. Liban—3 cases electrical machinery, $500. Liverpool—82 packages electrical machinery, $14,224; 93 packages electrical material, $5,029. London—286 packages electrical material, $19,246; 239 packages electrical material, $15,978. Madrid—11 cases electrical machinery, $900. Milan—7 cases electrical material, $280. Marseilles—1 case electrical material, $40. Middlesborough—2 cases electrical material, $139. Mexico—166 packages electrical material, $2,191. Manchester—18 packages motor trucks, $2,400. Nova Scotia—8 cases electrical machinery, $1,125; 2 bags electrical material, $11. New Castle—1 case electrical material, $34; 12 packages electrical machinery, $3,900. New Foundland—5 packages electrical material, $174. Naples—1 case electrical material, $5. Peru—14 packages electrical material, $903. Port Said—2 packages electrical material, $26. Preston—15 packages electrical material, $525. Portsmouth—1 case electrical material, $300. Santo Domingo—28 packages electrical material, $554. Sheffield—1 case electrical material, $111. Stockton—10 cases motor trucks, $1,220. Southampton—15 packages electrical material, $1,230; 1 case electrical machinery, $313. United States of Colombia—30 cases electrical material, $1,218. Venezuela—8 packages electrical material, $161. Vienna—3 cases electrical material, $366. The following were the exports of electrical material from the port of New York for the week ended May 8: Argentine Republic—18 packages of electrical material, $309. Antwerp—1 package electrical material, $37; 19 packages electrical material, $362. British Possessions in Africa—99 packages electrical material, $6,282; 52 packages electrical material, $6,385. British West Indies—40 packages electrical material, $877; 4 cases electrical machinery, $375. Berlin—46 cases electrical material, $3,542; 14 cases electrical machinery, $112. British Guiana—12 packages electrical material, $316. Bremen—7 cases electrical material, $324. Brazil—2 packages electrical material, $26. British Australia—51 packages electrical material, $6,534. British E. T.—12 packages electrical material, $1,105. Central America—77 packages electrical machinery, $1,271. China—6 packages electrical machinery, $270. Cuba—170 cases electrical machinery, $2,787. Glasgow—89 packages electrical machinery, $3,848; 34 packages electrical machinery, $3,080. Genoa—1 case electrical machinery, $10; 8 packages electrical material, $185. Hamburg—1 package electrical machinery, $765; 70 packages electrical material, $2,393. Havre—53 packages electrical material, $3.952; 1 package electrical machinery, $150; 13 packages electrical machinery, $537. Japan—49 cases electrical machinery, $24,134; 67 cases electrical material, $5,352. London—31 packages electrical machinery, $7,783; 16 cases electrical material, $914. Lisbon—11 packages electrical material, $208. Leicester—2 packages electrical material, $50. Liverpool—153 packages electrical material, $5,565; 11 packages electrical material, $618. Marseilles—75 cases electrical machinery, $800. Milan—3 cases electrical material, $100. Mexico—404 cases electrical material, $10.108. Market Harborough—3 cases electrical material, $364. Naples—10 packages electrical material, $65. Philippines—117 packages electrical machinery, $6,780; 1 case electrical material, $30. Preston—2 cases electrical material, $40. Peru—2300 packages electrical material. $17,715. Santander—5 cases electrical material, $151. Suez—1 coil cable, $834. Southampton—64 cases electrical material, $6,944. San Domingo—4 cases electrical material, $35. St. Petersburg—6 packages electrical material, $326. U. S. of Colombia—11 packages electrical material, $45. Venezuela—26 packages electrical material, $405.

POWER IN MONTANA.—A large force is at work on the electric power plant of the Missouri River Power Company, 16 miles from Helena, Mont., putting in a forebay and increasing the electric installation at the dam from four dynamos to ten, preparing for the transmission of the electric power to Butte. The additions to the plant will cost in the neighborhood of a million dollars. The Missouri River Power Company has sold all of its power to the mines at Butte, and there is a demand for an additional 15,000 horse-power at that place. The company is seriously considering the plan of constructing another dam seven miles below the present one. People representing the Missouri River Power Company have secured options on the lands and rights of the company owning the site seven miles below, and are now in New York arranging the details. The power from the new dam will be taken over the same pole lines to Helena and Butte. It is estimated that there are 100,000,000 tons of ore in this deposit that will average $2.50 per ton in gold. This ore cannot be treated except at the Missouri River, because of the lack of water for a mill of sufficient capacity to treat the ore at a profit.

TROLLEY IN CONNECTICUT.—The reported and probable acquisition by the New York, New Haven & Hartford Railroad Company of the Worcester & Webster and Webster & Dudley Street railways, outlines a trolley enterprise of large magnitude. When the system is completed the New Haven Company will control in eastern Connecticut and southern Massachusetts 60 or 70 miles of trolley track, much of it paralleling its Norwich and Worcester division. The company is thus in the unique position of paralleling its own lines by a system of trolleys. But the Norwich and Worcester division is essentially a freight road. As against the sacrifice in part of local passenger traffic, the company seems to have met shrewdly the development of a local trolley traffic in passenger traffic, the supply of light and power in various towns, the prevention of freight competition which was threatened by the trolley enterprise under outside ownership, and, finally, the prospective development of freight traffic by trolley laterals to factory points nearby but not reached directly by the steam road.

POLICE AUTOMOBILES.—Extract from the annual report of Chief of Police Bill of Hartford, Conn., to the Court of Common Council on the operation of a Mark XI. Columbia wagonette by the local Police Department, says: "The electric wagonette which has been used instead of the patrol wagon, drawn by horses, for several weeks, pending the delivery of the new electric patrol wagon, has given satisfaction. It has exceeded my expectations under the most severe tests. It is superior to the conveyance previously used in cleanliness and speed, and can be run more economically. The wagon does the work of four horses at a nominal expense of about 18 cents per day for power. I can safely say that the wagon is admirably adapted for the use to which it is put, and the Department has occasion to feel proud that it is one of the first in this country to be equipped with a vehicle that is modern and ornamental as well as useful."

ELECTRIC CANAL BOATS.—A special dispatch from Cleveland repeats what has become a rather old story, as follows: Cleveland capitalists are financing a company that will propel canalboats by electricity from Toledo to Cincinnati. It will be known as the Miami & Erie Canal Transportation Company. Power will be furnished by small motors. The time of the trip from Toledo to Cincinnati will be lessened two-thirds. The line will cost $6,000,000. Warehouses will be established along the line, and an extensive business carried on. Work on the plan will begin immediately between Cincinnati and Dayton.

ELECTRIC CANAL OPERATION.—The *Journal of Commerce* publishes a London dispatch, saying that Frank W. Hawley, of the Erie Canal Traction Company, has secured Government concessions which place the control of the canals of Holland and Belgium in the hands of his company, which is closely identified with the Morgan interests. The experiments here and abroad were recently illustrated and described in the pages of the Electrical World and Engineer.

TROLLEY CONTRACT.—The contract for constructing the standard gauge electric railway between Tacoma and Seattle has been awarded to Carl G. M. Miller, of Boston. The money has been furnished by N. W. Harris & Co., New York; Kidder, Peabody & Co. and Stone & Webster, of Boston. Construction has already commenced. Work has also been begun on the extension of the Tacoma trolley lines to Spanaway Lake, 10 miles south, where a summer resort is to be opened.

SPANISH FUEL EXHIBITION.—An exhibition is to be held at Barcelona of apparatus for utilizing fuel, and American exhibits have been granted admission until June 20. They should leave not later than June 1 by Spanish direct steamer, Compania Transatlantica, Ceballos & Co., agents, 80 Wall Street. Mr. Kendall Park, 11 Calle Cristina, Barcelona, will look after American interests. Grates, smoke appliances, automatic stokers, etc., are all included in the exhibition which is intended to develop Spanish coal interests.

BOILER WANTED.—The city of McLeansboro, Ill., is in the market for a tubular boiler, 60 inches in diameter, by 18 ft. long, to have 50 4-inch tubes, capable of hydraulic test of 200 lbs. pressure and 125 lbs. safe working pressure. Mr. B. D. Clover is the engineer.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Christian Co-operative Telephone Association, which operates lines in and around Sunnyside, Wash., has decided to double the capacity of its equipment this season. The Pacific States Telephone & Telegraph Company will soon extend its lines to Sunnyside and compete with the Christians.

EAST ST. LOUIS, ILL.—The Kinloch Telephone Company is increasing the number of its subscribers in Venice, Granite City and Madison, Ill. Fifty new stations have been installed in the past month. Miss Stella Baughan is representing the company, and is probably the only woman in Illinois to whom is intrusted the work of superintending telephone construction. She is in charge of the Madison central office.

STRONGHURST, ILL.—The Henderson County Telephone Company is enjoying an excellent growth. It has recently installed thirteen telephones in Oquawka and a like number in Stronghurst. Business is increasing so rapidly that it will be necessary to construct a number of new country lines. The company expects to put up full copper metallic toll lines in the near future to replace the grounded circuits now in use. The company's lines now cover 200 miles of territory in Henderson and adjoining counties in Illinois. Mr. H. E. Scovern is general manager.

INDIANAPOLIS, IND.—The Charlottsville Rural Telephone Company, of Hancock County, has been incorporated. Capital stock, $2,000.

INDIANAPOLIS, IND.—A chess tournament is being conducted in this city by telephone. There is an "uptown" and "down town" club, each maintaining three tables, presided over by a conductor, who receives and announces the moves made by the respective players.

TERRE HAUTE, IND.—The Retail Merchants' Association decided to use only the telephones of the new local company, and to take out the telephones of the Bell Company, on the ground that "the lowering of rates is directly due to the advent of the Citizens' Company."

ST. LOUIS, MO.—New telephones have been placed in the Board of Education building for the use of the officers of the board. There are eleven of them.

JEFFERSON CITY, MO.—The Stet-Rockingham and Norborne Telephone Company, of Stet, has been granted incorporation papers. The capital stock is $5,000. The incorporators are John B. Early, J. H. Bryan and others.

HENDERSON, N. C.—The Henderson Telephone Company has increased its capital stock to $100,000, and will this coming summer build a number of new exchanges and toll lines. The Carolina & Virginia Telephone Company will build about 200 miles of copper toll line to connect its different exchanges and those of the Henderson Company.

ITHACA, N. Y.—The Century Telephone Construction Company, of Cleveland, which is building a number of exchanges in New York State, has made application for a franchise here.

NEW YORK'S MANY TELEPHONES.—Low rates and energetic pushing for business have done wonders for the New York telephone system. A few years ago there were barely ten thousand telephones in New York. To-day there are over sixty thousand, forming the largest city telephone system in the world. The growth of the telephone list during the last few years has been one of the remarkable features of the general improvement in communication that has marked the past decade. A very short time ago a system of 10,000 subscribers was considered a large exchange even for a city of the first magnitude. Now such a figure seems small, as the net increase in New York during the last year was over 15,000 stations. For the year before that it was 12,500, and for the previous year over 8,000, so that the rate of growth is increasing each year. If this keeps up New York bids fair before long to realize the telephone man's ideal, which is a telephone to every place of business and in every residence in the city. New Yorkers have of late years taken very kindly to the telephone as an adjunct to the comforts of home. A few years ago the telephone was rarely seen except in business places, but now it is rapidly being adopted by residences and by the better class of retail stores.

SEBRING, OHIO.—The Columbiana County Telephone Company has completed its exchange at this point.

CANAL WINCHESTER, OHIO.—The Franklin County Telephone Company has opened its exchange in this place with 55 subscribers.

NAPOLEON, OHIO. The Henry County Home Telephone Company has been incorporated to operate in this county. Capital stock, $50,000.

SPRINGFIELD, OHIO.—The United States Telephone Company has been given a franchise to operate a toll line and long-distance station in this city.

NEW PHILADELPHIA, OHIO.—The Tuscarawas County Telephone Company has been incorporated to build an exchange in this place. Capital stock, $200,000.

SPENCERVILLE, OHIO.—The Spencerville Telephone Company has been incorporated by A. C. Burr, H. M. Ashton and others to build a local exchange. Capital stock, $20,000.

ALLIANCE, OHIO.—R. Beacon, general manager of the Stark County Telephone Company's exchange, will in the future have charge of the Canton exchange as well as the Alliance.

THE HOME TELEPHONE COMPANY, of Greenville, Ohio, claims to have secured the largest number of contracts this year of any independent concern in the Central West.

PAINESVILLE, OHIO.—The Painesville Telephone Company has purchased a building site and will erect and equip a new exchange building. E. L. House is general manager of the company.

TOLEDO, OHIO.—Construction work on the Toledo & Detroit Shore Line Railway has been started by the Erie Construction Company, which has a subcontract for building forty miles of road.

SALEM, OHIO.—The Columbiana County Telephone Company has closed a deal with the Phœnix Telephone Company, of Toronto, for the purchase of the exchanges at Toronto and New Cumberland. Both exchanges will be remodelled and will be given long-distance service.

CLEVELAND, OHIO. The Federal Telephone Company is said to have practically completed a deal for the purchase from the National Telephone Company of Ft. Wayne of a dozen independent exchanges on a line between Van Wert and Toledo, including all of the company's properties in Ohio.

NAPOLEON, OHIO. The Henry County Telephone Company has been incorporated, with $50,000 capital stock, by E. L. Barber, Joseph Brailey, S. M. Heller and F. D. Prentiss. The company will build an exchange at Napoleon, with toll lines through Henry, Fulton, Defiance, Wood and Ottawa counties.

CLEVELAND, OHIO. The flood in the Ohio River Valley entirely disabled the service of the United States Telephone Company at Uhrichsville, Newcomerston and several other points. It was only within the past few days that the waters have receded sufficiently to commence work of rebuilding the lines.

MADISONVILLE, OHIO. The Madisonville Telephone Company (Bell) will open its exchange in this place within the next thirty days. Rates will be as follows: Business private line, $2.50 per month, four party line, $2.00 per month; residence, private line, $2.00; six party line, $1.50. Connection will be made with the Cincinnati exchange.

TOLEDO, OHIO.—The Toledo Home Telephone Company, which is known as the Graves Company, and which is supposed to be backed by the Federal Telephone Company of Cleveland, has secured about 2,[illegible]00 contracts for telephones. This is one of three companies which are working for a franchise in Toledo.

EATON, OHIO.—The two independent companies in Preble County are at war with one another. The difficulty arose through the alleged failure of the Eaton Telephone Company to account to the West Alexandria Company for a share of the business done over its lines. The West Alexandria Company is soliciting subscribers in Eaton and the Eaton Company is returning the compliment by working for business in West Alexandria.

CLEVELAND, OHIO.—H. W. Crumb, of the Pittsburg & Allegheny Telephone Company, was in this city recently perfecting arrangements for the completion of the long-distance line which his company is building in connection with the United States Company between Cleveland and Pittsburg. This line will be completed within the next two weeks and will give connection with 4,000 telephones at Pittsburg and Allegheny besides many exchanges in Pennsylvania.

YOUNGSTOWN, OHIO. Messrs. A. F. Adams, Jules Voutrot, Jr., of this city; C. B. Shelby, of Warren, and S. B. Claypool, formerly of this city, but now located at Seattle, have secured an option on the properties of the Columbia Telephone Company of Portland, Oregon. The gentlemen mentioned propose to build an exchange at Tacoma and consolidate with the Portland and Seattle companies, which are already built. The consolidated company will have a capital stock of $1,000,000.

CLEVELAND, OHIO.—Judge J. M. Thomas, general manager of the United States Telephone Company, in speaking of the effects of the recent snow and sleet storm upon the lines of the independent companies in Ohio, stated on account of the superior construction used, the lines were not seriously affected. "In fact," said Judge Thomas, "we were able to give first class service on nearly all of our lines every moment of the time. We had to move a few telephones temporarily at two or three exchanges along the Ohio River, but the independent companies suffered no loss worth considering." General Manager Mark Davis, of the Cuyahoga Company, stated that a few lines were temporarily thrown out of service, but the company did not lose a single pole. The Cleveland Telephone Company (Bell) lost a large number of poles in various portions of the city.

CLEVELAND, OHIO.—The Detroit People's Telephone Company, which is owned largely by the Everett syndicate of this city, has completed plans for the erection of an expensive office and exchange building in the business portion of that city. Maxime Reber and James B. Hoge, of the Reserve Construction Company, which will build the exchange, have placed a contract with the Kellogg Company for the switchboard for the exchange which will have an ultimate capacity of 12,000 lines. The promoters of the Detroit Company are also interested in a large exchange being installed at Pontiac, Mich. Both exchanges will be connected with the lines of the United States Telephone Company, which is now building long distance lines covering nearly all the independent exchanges in Southern Michigan.

PORTLAND, OREGON. The Portland city council is about to take action upon the petition of the Pacific States Telephone & Telegraph Company for an extension of franchise. The petition asks for a franchise granting the company the right to continue to maintain and operate a telephone and telegraph system in the city of Portland for thirty-five years.

PITTSBURG, PA. The Central District & Printing Telegraph Company has sent notices to a number of the suburban districts notifying its subscribers that in the future it will no longer allow the rebate, which it has been customary to give. This order will affect from 800 to 900 telephones in Greensburg and Sharon, Pa., and it means a difference of about 50 per cent. in the yearly rate.

PITTSBURG, PA.—The corporations committee of councils of Allegheny City approved an ordinance granting the Pittsburg & Allegheny Telephone Company the right to use the city poles for stringing its wires. The ordinance provides that the Telephone Company shall pay a yearly tax of $2 per pole, the city to keep the poles in repair. This tax is additional to the 2 per cent. of the company's gross receipts which has been provided for in the original franchise ordinance.

PITTSBURG, PA. The Pittsburg & Allegheny Telephone Company is installing a number of automatic toll stations in this city as well as across the river, and the charge for three minutes' conversation will be five cents, which is half the amount charged by the local Bell Telephone Company. The new company has made wonderful headway here, and has now a total of 4800 subscribers on the list, 1600 having been added within the last three months.

PITTSBURG, PA.—In order to make the appearance of the telephone girls as nearly uniform as possible, the Pittsburg & Allegheny Telephone Company recently issued an order for all of its women employees to dress in black skirts and blue waists. Some of them took exception to this rule and they refused to comply with it. But the company sent home all of those who objected, with instructions not to return until they felt disposed to obey. For a few days some of them remained stubborn, but when they realized that the company was determined in the matter they all came around in black and blue.

RICHMOND, VA.—The new long distance telephone system in Virginia is about two-thirds completed. Charlottesville, Harrisonburg, Lexington, Richmond, Staunton, Buchanan, Roanoke, Bedford City and Lynchburg are connected and Petersburg and Newport News will be connected by about July 1. N. C. Watts, general manager and superintendent, says the system is as nearly perfect as modern appliances can make it. Other extensions are contemplated.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Mountain Copper Company has closed a contract with the Keswick Electric Power Company, H. H. Noble, president, for 1,500 horse-power, to be transmitted to Keswick as soon as the company has completed its new electric transmission plant near Shingletown, Calif.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company recently transmitted electric power from the North Yuba generating station to San Jose, Calif., a distance of about 190 miles. The test was satisfactory, and the company will soon be supplying current over this line to the distributing system of the Standard Electric Company, whose generating plant will not be completed for six months or more.

SAN FRANCISCO, CALIF.—The new Indian School, which is to be established in Riverside, Calif., will have an independent electric light and power system. Proposals will be received until June 5 by the Commissioner of Indian Affairs, Washington, D. C., for twelve brick school buildings and electric light, steam heat and water and sewer systems for the new institution. Further information can be obtained by applying to Harwood Hall, superintendent Indian School, Perris, Calif., or at the office of Indian Affairs, Washington, D. C.

COLUMBUS, GA.—On account of the slipping of a belt resulting in the shattering of the belt wheel at the electric light plant, the town has been thrown into temporary darkness. The accident, it is said, may result in the city's purchasing a modern plant.

ATLANTA, GA.—The Atlanta Railway & Power Company has accepted a franchise for electric lighting offered by the city, and has filed a bond of $40,000 to begin the installation of the plant within sixty days and to complete the system within one year. Ernest Woodruff, the president, states that within ninety days the company will be furnishing power and lights in the central portion of the city.

BLOOMINGTON, IND.—The Bloomington Electric Light Company, recently organized here, has secured a 50-year franchise.

LAFAYETTE, IND.—The Royal Center Electric Light Company, of Royal Center, has been incorporated. Capital stock, $10,000.

ANDERSON, IND.—This city is arranging to erect a new electric light plant, to be paid for on the instalment plan at 5 per cent. interest.

MISHAWAKA, IND.—The Dodge Manufacturing Company is receiving bids with a view of letting the contract for the installation of an extensive electric light plant for its immense establishment.

INDIANAPOLIS, IND. The Board of Public Works is being strenuously opposed by the people in its efforts to let a new electric light contract. The present contract does not expire for two years.

TERRE HAUTE, IND.—The Root Mercantile & Industrial Company, of this city, contemplates the operation of an independent electric light plant of sufficient capacity for lighting its own buildings and others in the vicinity.

HAMMOND, IND.—The Hammond Illuminating Company has been incorporated, with a capital of $350,000. The company proposes to supply gas and electric light to the city and the citizens. The board of directors is headed by Senator Wm. H. Gostlin.

WABASH, IND.—Frank Clark, chief electrical engineer of the Big Four Railway, is installing electric light plants for the company at this place and at Brightwood. All of the round-houses, offices and station buildings at these and other points are to be lighted by electricity.

LAWRENCEBURG, IND.—Fox & McKim have been awarded the contract for the new municipal plant here, which will be installed on the franchise basis, at an approximate cost of $31,000. The equipment will include a Greenwald engine and a Ft. Wayne 75-kw low frequency alternator. Enclosed arcs will be used.

ALEXANDRIA, IND.—The Lake Erie & Western Railway Company has appealed from a $50 fine imposed by this city for failure to maintain arc lights at the street crossings. This appeal is to test the validity of a city's right to compel a railroad to erect and maintain lights at crossings. If the decision is adverse to the railroads other cities will pass like ordinances.

BRAZIL, IND.—This city is arranging to purchase an electric light plant on the deferred payment plan, and to install it next January, when the contract with the local company expires. The city authorities report an offer from Indianapolis parties to put in a plant to be paid for in annual installments, not to exceed the amounts now paid for light. The city will then bid for domestic service.

BOSTON, MASS.—About 500 electric linemen in Boston and vicinity struck on May 4 for a nine-hour day and $3 pay. The companies affected are the Boston Elevated, New England Telegraph & Telephone, Cambridge Electric Light, Brookline Electric Light, Malden Electric Light, Suburban Gas & Electric Light, Somerville Electric Light, Quincy Electric Light, and the Boston Electric Light.

ST. LOUIS, MO. The draft of an ordinance for a municipal electric lighting plant to supply light to the public buildings and city institutions has been furnished to the mayor by the president of the board of public improvements.

OSWEGO, N. Y.—The Fulton & Oswego Electric Light & Power plants have been sold for $65,000 to Street, Fykes & Company, of New York City.

ALBANY, N. Y.—The Rome Gas, Electric Light & Power Company, of Rome, has been incorporated. Capital, $400,000. Directors: James T. Lynn, of Detroit; Martin B. Daly, of Toledo, Ohio, and John D. McMahon and others, of Rome

ALBANY, N. Y.—The Middleport Gas & Electric Light Company, of Middleport, Niagara County, has filed its papers of incorporation with the Secretary of State. It has a capitalization of $50,000 and its directors are W. C. Johnson and F. A. Dudley, both of this city, and L. E. Sterritt, of Middleport.

LONDON, OHIO, has purchased a Babcock & Wilcox water tube boiler of about 300-hp; also a 175-hp Russell four valve engine and a 100-kw Ft. Wayne alternator with new switchboard and auxiliary apparatus, an increase of its present lighting plant.

CINCINNATI, OHIO. The new board of directors of the Cincinnati Gas & Electric Company, with $28,000,000 capital, organized on May 8. Andrew Hickenlooper, of the old gas company, was elected president, and C. W. Wetmore, vice-president, in charge of the electrical department.

OTTAWA, ONT.—Mr. Louis Simpson, formerly manager of the Montreal Cotton Mills, has secured concessions at a place known as Chats Falls, some twenty miles above Ottawa, where, he says, he has 100,000 horse-power at his command. Mr. Simpson states that industries of equal magnitude to those of Sault Ste. Marie will be established at the falls in the near future. Outside capital is behind the enterprise.

NORFOLK, VA.—At the annual meeting of the Norfolk Heat, Light & Power Company, Geo. M. Bunting, of Chester, Pa., was chosen president. The company's new power-house will soon be completed.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The London & San Francisco Bank recently purchased at execution sale all of the property of the Salem Light & Traction Company, of Salem, Oregon. This action was taken in pursuance of the foreclosure of a mortgage held by the bank. The property was bought in at the amount of the judgment, including accrued costs, $144,013. There will be no immediate changes in the local management.

SAN FRANCISCO, CALIF.—It is reported that a new company, organized for capitalists representing the Fair and Crocker estates, has completed plans for constructing a standard gauge electric railroad from Bully Hill, Calif., to the Sacramento River, a distance of twelve miles. It is said that there will be no stock placed on the market, as the company is assured freight contracts from mining companies that will make the line very profitable. Rights of way have been secured for building the road from a connection with the Southern Pacific near Kennett to the De la Mar mine at Bully Hill. The Shasta Electric Light & Power Company has contracted to supply the electric power by Nov. 10.

COLORADO SPRINGS, COL.—Colorado Springs, Denver and Pueblo will be joined by a trolley line to cost $2,500,000. It will be built by Chicago, Detroit and Cleveland capitalists.

NEW HAVEN, CONN.—It is stated that an arrangement has been made, allowing the Middletown Street Railroad Company to extend its system several miles to Highland, on the Waterbury, Meriden and Cromwell steam railroad.

WILMINGTON, DEL.—The City Railway Company has awarded to Patrick Fahey the contract to build a new power house along the Brandywine, the cost being $150,000.

DOVER, DEL.—The Delaware General Electric Railway Company filed with the Recorder of Deeds for Kent county, Del., a mortgage of $1,000,000 to the Knickerbocker Trust Company, of New York, for the construction of the Kent county trolley.

ATLANTA, GA.—The Atlanta Railway & Power Company has re-elected all of the old officers. Mr. E. Woodruff is president.

SHIRLEY, IND.—A company headed by A. J. Miller is projecting an electric railway to connect this city with Muncie and Greenfield.

INDIANAPOLIS, IND.—The Washington and Loogootee Railway Company has been incorporated, with a capital stock of $20,000.

MUNCIE, IND. F. G. Brownell has sold his proposed electric road from Muncie to Hartford City to Messrs. Baxter and Schoner, of Cleveland, Ohio.

RICHMOND, IND.—The Richmond Street & Suburban Railway Company, capital $500,000, has filed articles of incorporation. Henry B. Smith, of Hartford City, is president, and Charles Murdock, of Lafayette, secretary.

RICHMOND, IND.—The Richmond Street Railway plant has been transferred to James Murdock and associates of Lafayette, who have for the past year contemplated the building of an electric line from Richmond to Cambridge City, and from that point to Greenfield.

EVANSVILLE, IND.—The Evansville Street Car Company, which has been in the hands of a receiver for two years, has been sold at public sale for $100,000 to John Elliott Bolles, of New York City, representing old bondholders. The company had recently obtained a fifty-year franchise.

CHICAGO, ILL.—It is stated that the Chicago City Railway Company proposes to place its electric feeder cables underground in the paved streets along its main line.

BALTIMORE, MD.—The Baltimore & Washington Electric Railway Company, which intends to build a trolley road from here to Washington, with a branch to Annapolis, organized here on May 7 and acquired the charter for the road to Annapolis, having already secured the franchises between Baltimore and Washington. It is understood that the capital stock will be $1,500,000, and that there will also be a bond issue.

AUGUSTA, ME.--The railroad commissioners have approved articles of association of the Saco Valley Electric Railway Company, whose road will run from Saco to Buxton and thence to Standish, a distance of twenty miles. The company is capitalized at $250,000.

BOSTON, MASS.—The railroad commission has dismissed the petition of the Palmer & Monson Street Railway for issue of $195,000 mortgage bonds, as in the opinion of the board the value of the road does not equal the amount of capital stock and debt.

CITY OF MEXICO, MEX.—It is proposed to extend the electric street railway line, which now connects Villa Lerde and Gomez Palacio, to Torreon, in the State of Durango, Mexico.

CITY OF MEXICO, MEX.—The board of directors of the company owning and operating the street railways in the City of Mexico, at their annual meeting decided best, as a matter of business convenience, to separate the original corporation into two companies or divisions to be known as the Mexico Electric Tramways, Limited, and the Compania de los Ferrocarriles del Distrite. The latter organization really represents the interest of the old holders of the 6 per cent. purchase bonds. The following board was elected of the Mexico Electric Tramways, Limited: President, Hon. Chandos S. Stanhope; vice-president, Joaquin D. Casasus; vocales, Captain Perfirio Diaz, Jr., A. E. Worswick and Charles Clegg.

HOBOKEN, N. J.—The Bergen Turnpike Company contemplates constructing a trolley line from Hoboken to Hackensack.

TRENTON, N. J.—The syndicate headed by Tom and Albert L. Johnson has purchased the Trenton, Morrisville and Yardley trolley line, which runs from Morrisville to Yardley on the Pennsylvania side of the Delaware River.

ALBANY, N. Y.—The West Chester Electric Railroad Company proposes to extend its road from its present terminus in New Rochelle.

NEW YORK, N. Y.—The stockholders of the Havana Electric Railway Company have voted to increase the common stock from $1,000,000 to $11,000,000.

SANDY HILL, N. Y.—The Greenwich & Schuylerville electric road has made a connection to-day with Glens Falls, Sandy Hill and Fort Edward, at the latter place.

CORTLAND, N. Y.—C. D. Simpson, of New York, bought at a foreclosure sale for $50,000 the Cortland & Homer Traction Company and the Cortland & Homer Electric Company.

NEW YORK, N. Y.—W. B. Strong, Jr., of 15 Wall Street, has closed a contract with the Everett-Moore syndicate of Cleveland, Ohio, for the building of the Detroit & Toledo Shore Line, which will be constructed as a trolley line.

ALBANY, N. Y.—The Troy, Rensselaer & Pittsfield Railroad Company has been incorporated. Capital stock, $350,000. The route covered is through Troy and the towns of Brunswick and North Greenbush, Rensselaer County, City of Rensselaer, Town of Nassau and Town of New Lebanon, Columbia County.

CORTLAND, N. Y.—The franchises and property of the Cortland & Homer Traction Company were recently sold at a mortgage foreclosure sale. The mortgages were held by the Farmers' Loan & Trust Company of New York. Only one bid, $50,000, was made by C. Simpson, of New York, who is understood to represent the bondholders.

NEW YORK, N. Y.—The cable service of the Lexington Avenue division of the Metropolitan Street Railway system has been finally abolished in favor of the electric conduit system. For the present passengers are required to change cars at Twenty-third Street and Broadway until the Broadway line has been changed over to the electric system.

NEW YORK, N. Y.—The Rapid Transit Commissioners have voted to adopt a plan which will provide for the construction of a three-track road above 103d Street on the West Side branch. The plans will have to be approved by the Municipal Assembly before they can be carried out. It was also decided to have a station for the road under City Hall Park.

LYONS, N. Y.—The Lux Electric Railroad combination, which proposes to connect Rochester and Syracuse by an electric road, has incorporated the Macedon Electric Railroad Company, capitalized at $30,000. The combination now has similar companies in Clyde, Lyons, Newark and Palmyra. The directors of the Macedon Company are Charles A. Lux, Albert C. Lux, Daniel E. Lux, Charles F. Lux, Thomas Robinson, Charles A. Rooker, Samuel P. Nichols, Elliott B. Norris and Nicholas A. Mestler.

NEW YORK, N. Y.—The Metropolitan Street Railway Company has rearranged its transfer system in this city. The readjustment was made in anticipation of the changing over of the last cable line to electric traction, which will be completed about June 1. The change will so increase the facilities of travel as to make unnecessary the separate transfer points now in existence at points where cable and electric cars meet, as though traffic can then be established. The new transfer system is much simpler than the old.

THE BUFFALO, EAST OTTO AND CATTARAUGUS RAILWAY COMPANY has been incorporated, with a capital stock of $800,000, to construct and operate an electric railroad line from Cattaraugus, Cattaragus County, to Hamburg, Erie County, or to Buffalo, a distance of thirty-five miles. The directors are: N. L. Upson, of Orchard Park; L. F. Boies and W. J. Hayes, of Buffalo; H. L. Moench, W. A. Oakes and S. F. Burger, of Cattaraugus; J. O. Hammel and C. H. Mason, of East Otto, and T. P. Truby, of Otto.

ALBANY, N. Y.—The employees of the United Traction Company, of this city, went on a strike on May 7. The cause of the strike is said to be the refusal of the company to accede to certain demands made by the employees. On May 8 the employes at Troy joined the ranks of the strikers, making a total of 1,000 men out. The street railway service in Albany, Troy, Rensselaer, Watervliet and Cohoes was completely suspended. Up to Tuesday morning quiet prevailed, but when the company attempted to run cars with non-union men on Tuesday morning a riotous demonstration ensued. The police were unable to cope with the situation, so part of the militia was called out. As we go to press troops were already in Albany at the scene of disorder.

ROCHESTER, N. Y.—The Rochester & Southern Traction Company has been incorporated, with a capital of $1,000,000. Among the incorporators are: Dr. J. Arthur Jackson, Dr. James E. Crisfield, William Kramer, Frank J. McNeil, and B. H. Oberdorf of Dansville; William H. Gray, Groveland; James B. Frazer, West Sparta; H. E. Gore, John F. Donovan, and John F. Connor, Mount Morris; E. W. Horton and E. F. Youngs, Geneseo; J. M. E. O'Grady, Charles Van Voorhis, Norman Van Voorhis, Willian C. Gray, A. J. Grant and I. M. Ludington, Rochester, and Frederick St. John, of New York.

AKRON, OHIO.—The Northern Ohio Traction Company has voluntarily increased the wages of motor men and conductors on city lines.

COLUMBUS, OHIO.—The Columbus, Delaware & Northern Railroad Company has increased its capital stock from $10,000 to $1,000,000.

DEFIANCE, OHIO.—The Defiance County commissioners have granted a franchise to the Northern Ohio Electric Railway for its road to Bryan.

NILES, OHIO.—The Niles Manufacturing Company will shortly be incorporated with a capital stock of $200,000 to manufacture street cars.

MARYSVILLE, OHIO.—Thomas N. Kerr, treasurer of the Union Electric Railway Company, has secured a 25 year franchise for his road through this city.

CINCINNATI, OHIO.—The Central Traction Company has been organized at Indianapolis, Ind., to build an electric line between Indianapolis and Richmond.

CINCINNATI, OHIO.—The Cincinnati Traction Company will make extensive improvements in the power house at the Bellevue Incline. New engines and machinery are to be put in.

YOUNGSTOWN, OHIO.—Park & Hamilton, the local contractors, will build the Sharon & New Castle Electric Railway. Contracts for the equipment are to be closed in the near future.

CINCINNATI, OHIO.—The Cincinnati Traction Company has placed a contract for twenty-one miles of the Trilby slot rail amounting to $147,000. The contract will aggregate about $175,000.

YOUNGSTOWN, OHIO.—Messrs. John Stambaugh, Jr., S. D. L. Jackson and other wealthy cietizens of this place are organizing a company with $500,000 capital stock to build a line to Steelton.

LORAIN, OHIO.—The Lorain County commissioners have granted a twenty-five-year franchise to the Sandusky & Interurban Railway Company, which will enable it to complete its line into Lorain.

TIFFIN, OHIO.—The commissioners of Seneca and Crawford Counties have granted franchises for two lines connecting Tiffin with Bucyrus. One road is promoted by Gen. E. B. Findley, of Bucyrus.

MANSFIELD, OHIO.—The Richland County commissioners have granted a 25-year franchise to L. M. Coe and F. D. Carpenter, of Cleveland, for the construction of a line between Mansfield and Crestline.

CLEVELAND, OHIO.—The Cleveland, Painesville & Ashtabula Railroad Company has increased its capital stock from $1,000 to $1,[illegible]00,000. This company is to build the extension of the Cleveland, Painesville & Eastern Railway.

CLEVELAND, OHIO.—The Osborn Engineering Company will shortly call for the equipment of the power house of the Cleveland & Southern Railway Company, which is building a road from Berea to Medina and Wooster.

CLEVELAND, OHIO.—The Pomeroy syndicate, which owns the Cleveland, Elyria & Western Railway and other roads, has secured an option on the Tuscarawas Electric Railway operating between New Philadelphia and Canal Dover.

SPRINGFIELD, OHIO.—In return for the disruption of their union by the street railway motormen, the Springfield Street Railway Company has voluntarily granted an increase of from 1 to 2½ cents an hour, taking effect May 1.

COLUMBUS, OHIO.—The Defiance, Ottawa, Kenton & Columbus Interurban Railway Company has been incorporated by Daniel J. Ryan, George H. Jones, Charles Kinney, Nelson E. Mathews, John M. Sheets and H. A. Fisher. The capital stock is $50,000.

DELAWARE, OHIO.—The Columbus, Delaware & Northern Traction Company, of which James Loren, of Columbus, is president, has completed the purchase of the property of the Delaware Street Railway Company, giving it a right of way through the city.

CLEVELAND, OHIO.—H. T. Clark and J. P. Barthoff, of Cleveland, have secured a fifty-year franchise at St. Joseph, Mich., for a new company, to be known as the Chicago, St. Joseph & Southwestern Michigan Railway. Much of the right of way has been secured.

STRASBURG, OHIO.—There is an opening for capital investment in this place in the form of a street car line. The Strasburg Electric Company was recently incorporated here for the purpose of conducting a business of electric lighting. Mr. Thomas Kemp is president.

TIFFIN, OHIO.—The Toledo, Tiffin & Sandusky Railway Company, which was organized about two years ago, is now being backed by S. B. McKinnon, of Chicago, representing a large syndicate of capitalists, and it is stated that construction work on the line will start at once.

YOUNGSTOWN, OHIO.—The consolidation of trolley lines now in operation or in process of construction has been decided upon. This will give a continuous line from this city to Erie, Penn. The new company will be incorporated under the laws of New Jersey, with a capital of $2,000,000.

CINCINNATI, OHIO.—The Cincinnati & Cleveland Railway Company has amended its charter to enable it to build several branch lines. Officers of the company have been chosen as follows: Powell Crosley, president; Wm. F. Hart, secretary, and the above, with Emert G. Simon, Oliver E. Conner, D. H. Hunt, W. Crosley and E. E. Williamson, directors.

CINCINNATI, OHIO.—The Scioto Traction Company is constructing an electric road from Columbus to Circleville and expects to have cars in operation by early winter. It is building on private rights of way. The company has placed an order for 8,800 tons of steel rails with the United States Steel Corporation. The steel is for tracks from Columbus to Chillicothe and Lancaster.

FREMONT, OHIO.—A contract for the construction of the roadbed of the Lakeside, Napoleon & Western Railway has been placed with H. D. Blodgett, of this place. It is stated that a contract has been placed with the Westinghouse Electric & Manufacturing Company for the equipment of the power house which will be located at Fremont. Construction work on the road will start at once.

AKRON, OHIO.—The Canton, Massillon & Akron Railway Company has been incorporated by E. W. Moore, Barney Mahler, F. A. Henry, J. R. Nutt, Will Christy, A. M. Snyder and L. E. Beilstein. The temporary capital stock is $1,000, which will be increased to $1,000,000. The company will build the extension of the Northern Ohio Traction Company from Akron to Massillon and Canton.

CLEVELAND, OHIO.—The Osborn Engineering Company, Cleveland, is preparing plans for the power house and construction of the Kansas City & St. Joseph Electric Railway Company, which is preparing to build a fifty-mile road in Missouri. Bids for the equipment of the power house will be called for in the near future. Perry N. Gibson, of Erie, Pa., is president of the company.

CINCINNATI, OHIO.—The Cincinnati & Eastern Electric Railway Company has organized with the following officers: George H. Strugham, president and general manager; Lee H. Brooks, vice-president; J. N. Kennedy, secretary and treasurer; William E. Hutton, assistant secretary and treasurer; E. G. Inkhead, general counsel. The company will build a 30-mile line extending east from Cincinnati.

CLEVELAND, OHIO.—The syndicate headed by M. J. Mandelbaum & Company, of this city, which is securing control of properties in the vicinity of Chicago, has purchased another road, the Aurora, Yorkville & Morris Railroad Company, which is projecting a line running twelve miles southwesterly from Aurora. The syndicate will build a gap of three miles at Geneva, Ill., giving through service from Elgin to Aurora and Chicago.

STEUBENVILLE, OHIO.—The new management of the Steubenville Traction Company will spend $500,000 in improving the system. The road is to be extended to Toronto. The two power plants owned by the company are to be remodeled and contracts have been placed for two 100-kw generators, two engines and boilers of 900-hp. A new storage battery plant will be located between Alikanna and Toronto and a large car barn will be built near Alikanna.

DAYTON, OHIO.—The Ft. Wayne, Dayton & Cincinnati Traction Company, which has been incorporated in Ohio and South Dakota, with $1,000,000 capital, has elected officers as follows: Dr. S. F. George, Dayton, president; D. W. LaFreta, New York, first vice-president; Charles L. Hyde, Pierre, S. D., second vice-president; C. W. Gebhart, secretary; C. E. Lucius, treasurer; A. J. Miller, general superintendent; W. H. Pulse, general superintendent, and Ira Hodgson, engineer, all of Dayton.

CLEVELAND, OHIO.—Since January the Everett-Moore-Mahler syndicate has purchased 56,000 tons of steel rails to be used in building projected lines. Of this amount $20,000 tons were placed last week with the Carnegie Company in anticipation of the advance of $2 per ton recently announced. Eight thousand tons will be used in the construction of the Detroit-Toledo Shore line, 8,800 tons for the Scioto Valley Traction Company running south from Columbus, and 2,300 tons for the extension of the Cleveland, Painesville & Eastern Railway. It is stated that the syndicate is projecting nearly 600 miles of road.

FINDLAY, OHIO.—A meeting of the directors of the Findlay & Southern Electric Railway Company was held here recently. The promoters are R. Rosenstock, of Cleveland; M. D. Hammond, Mt. Blanchard; Dr. Jefferson Odenbaugh, Sandusky, and T. I. McConico, of Findlay. The capital stock was increased from $10,000 to $2,500,000, and arrangements were effected with I. W. Newcomer, representing Barney & Company, Philadelphia bankers, for the floating of $2,500,000 in bonds. The road will extend from Findlay to Kenton and Delaware, and eventually will be extended to McComb, Deshler and Toledo. R. Rosenstock & Company, of Cleveland, are the engineers, and construction work will start in the near future.

CLEVELAND, OHIO.—The Little Miami Traction Company which was promoted by John Martin, of Xenia, to build a road from Springfield to Xenia, and later to Lebanon and Cincinnati, has completed arrangements for financing in this city. The company will incorporate with an authorized capital stock of $500,000 and $500,000 bonds, of which $400,000 will be issued at once. The bonds and stock have been underwritten by a syndicate composed of M. J. Mandelbaum & Company, F. T. Pomeroy, W. H. Lamprecht and E. W. Christy, of Cleveland; J. R. Nutt and Will Christy, of Akron, and W. E. Hutton & Company, Cincinnati. The officers of the company are: John T. Martin, president; F. T. Pomeroy, vice-president; H. C. Lang, secretary; J. R. Nutt, treasurer. The Cleveland Construction Company will build the road under the direct supervision of Will Christy.

OKLAHOMA CITY, OKLA.—The Oklahoma Street Railway, Light, Power & Improvement Company has been organized here with a capital stock of $100,000. Following are the officers: Charles F. Colord, president; C. E. Bennett, vice-president; Charles F. Gilpin, secretary and treasurer.

PITTSBURG, PA.—The Pennsylvania Railroad Company has broken ground on the power house, which is to be erected in connection with the new Union Station building the company is now constructing in this city. The structure will cost $110,000.

PITTSBURG, PA.—The board of directors of the Consolidated Traction Company has elected Mr. Joshua Rhodes, president of the company, to succeed Mr. C. L. Magee, who recently died, and Mr. W. Kesley Schoepf was elected vice-president and general manager.

WILKESBARRE, PA.—The Wilkesbarre & Hazleton Railroad Company, composed of the leading spirits of the Lehigh Traction Company, owning electric lines in Hazleton and vicinity, purposes building a traction line between Hazleton and Wilkesbarre. It is to be about twenty-five miles long, or one-half of the distance covered by the steam roads. Work has already begun. The line will connect Scranton and Hazleton and cover the entire Wyoming Valley coal fields.

MONTREAL, QUEBEC.—At a meeting of the Demerara (West Indies) Electric Company, held in this city on April 24, the reports read showed that the road had been so liberally patronized during the last two months, that it was decided to send down more cars to meet the requirements of the rapidly growing traffic. The electric light business is also increasing very fast, and another large generator has been installed.

PROVIDENCE, R. I.—The franchise of the Columbia Street Railway Company for a line from Pascoag, in the town of Burrillville, was transferred to the Woonsocket Street Railway Company.

LYNCHBURG, VA.—Lynchburg's street car lines, gas works, and electric light plants have been purchased by Philadelphia and Lynchburg capitalists and consolidated. The Lynchburg & Rivermont Street Railway Company and the Lynchburg Electric Railway & Light Company will now be merged into the Lynchburg Traction & Light Company, with Richard D. Apperson president and general manager and R. Colston Blackford secretary and treasurer.

BELOIT, WIS.—The Beloit, Delavan Lake and Janesville Electric Railway Company has been granted a 30-year franchise.

MERRILL, WIS.—An electric interurban railway will be built between this city and Wausau, a distance of eighteen miles. Power will be generated at Merrill from water power to be developed.

MILWAUKEE, WIS.—The Milwaukee Electric Company's new plant will be located at West Allis and $40,000 will be expended at present. The entire plant will be most modern in every respect.

MILWAUKEE, WIS.—The common council has under consideration the granting of a franchise for an elevated track system which the Milwaukee, Burlington & Lake Geneva Electric Railway Company wishes to build as its Milwaukee terminal.

SHEBOYGAN, WIS.—The interurban electric railway, which is planned to run from here to Elkhart Lake, will be one of the finest roads in the State, and will carry both passengers and freight. The power-house will be located at Sheboygan Falls. It is estimated that the line will cost about $350,000.

APPLETON, WIS.—The property of the Green Bay & Mississippi Canal Company has been transferred to the Wisconsin Traction, Light, Heat & Power Company. This property will be used for the development of vast improvements of the company's present system and to extend the system of interurban railroads.

EDUCATIONAL.

UNIVERSITY OF MAINE.—The University of Maine in its catalogue this year gives illustrations of the various buildings and a map showing the University campus, location of the buildings, etc.

ROSE POLYTECHNIC INSTITUTE.—The nineteenth catalogue of the Rose Polytechnic Institute, Terra Haute, Ind., contains the calendar for 1901-1902, with an outline of the courses of study and the plan of instruction.

NORTHWESTERN UNIVERSITY.—It is announced that the Northwestern University, at Evanston, Ill., will next year establish a department of electrical and mechanical engineering. The plans are to have the courses equal to the first two years of work at the Massachusetts Institute of Technology. The work will be under the direction of Professor Henry Crew, the present head of the physics department. The services of Dr. Baskin, who is at present doing fellowship work at the University, and F. H. Starkweather, of Boston, have been secured.

SYRACUSE UNIVERSITY.—A new college is opened this year—the College of Applied Science. It comprises courses in civil engineering, electrical engineering and mechanical engineering, the last of which is now offered for the first time at Syracuse University. All this is made possible by the generosity of one of the most enterprising citizens of Syracuse, Mr. Lyman Cornelius Smith, the well known typewriter manufacturer. A fine building is now being erected on the campus to accommodate the department of mechanical engineering. It is 133 by 56 feet, with five floors and a basement, and a drafting room in the lantern roof. Rooms are provided for testing machines, shops, laboratories, lecture and reception rooms, departmental library, museum, etc. The building and apparatus represent the latest and best thought in engineering instruction. Among the courses offered in mechanical engineering are principles of mechanism, carpentry, wood turning, and pattern making, forging, filing, etc., machine tool work, steam engine and thermodynamics, machine design, metallurgy of iron, etc., etc. Twenty-two courses are given in civil engineering, and ten in electrical engineering.

OBITUARY.

E. S. DE MITKIEWICZ. The death took place on May 14 at Asbury Park of "Count" E. S. de Mitkiewicz, a Polish adventurer, who had a romantic career in this country, and was involved in many financial escapades. One of these related to the introduction of the telephone into China, and became an international sensation. The Chinese did not get the telephone.

PERSONAL.

MR. F. P. FISH, although soon to take up his new duties as president of Bell Telephone, has just been elected a director in the General Electric Company.

MR. J. BAILEY, of Scranton, succeeds Mr. I. T. Lerch as general superintendent of the Pennsylvania Telephone Company, with headquarters at Reading, Pa.

MR. W. E. MANDELICK, for many years connected with Sprague Electric interests, is going to England to become associated with the Yerkes underground railway enterprises in London.

MR. THOMAS V. HALL, C. E., has been appointed by the board of aldermen of West Point, Miss., as engineer to design and supervise the construction of a $15,000 electric lighting plant. Contracts will be let about June 15.

MR. E. H. JOHNSON, who for some time past has been prevented by illness from attending to business matters while in this country, is now in much better health, we are glad to note, and has returned to England to look after matters there.

MR. R. L. AMES has opened an office for the practice of patent law at 1462 Monadnock Building, Chicago. Mr. Ames was for six years an examiner in the electrical department of the patent office, and has recently practiced law in New York City.

MR. W. H. HOLMES, president of the Metropolitan Street Railway Company, of Kansas City, was "constructively confined" in the local jail for ten days recently, for contempt of court, in not submitting the company's books and vouchers to the Grand Jury.

MR. T. S. McLOUGHLIN, 824 Union Street, New Orleans, is the electrical engineer engaged upon the electrical work for a big new seven-story office building at Beaumont, Texas, the new oil centre. He has also contracted for the complete electrical equipment of the new theatre.

MR. ERNEST KILBURN SCOTT, M. I. E. E., etc., has taken offices at Clun House, Surrey Street, London, W. C., as English manager and engineer for the International Electric Company of Liege, Belgium, which has already a number of plants in operation in the British Isles.

MR. R. F. HAYWARD, electrical engineer of the Utah Light & Power Company, of Salt Lake City, passed through New York last week on his way home to England for a brief vacation. He speaks of power conditions as very hopeful. The utilization of electric power by the mines is now universal.

MR. OLIN SAFFORD BLAKESLEE, mechanician and electrician, who by his numerous inventions and calorimeter appliances has been of great service to Wesleyan University, Middletown, Conn., will sever his connection with the institution at the end of the college year, and remove to the West.

MR. ARTHUR VAUGHAN ABBOTT, Chief Engineer of the Chicago Telephone Company, gave an address on high-frequency electrical oscillations with experimental illustrations before the Western Society of Engineers at Chicago May 8, 1901. Mr. Abbott has done considerable research along these lines.

MR. JOHN I. SABIN took up his duties as president of the Chicago & Central Union Telephone Companies on May 10. Mr. W. A. Jackson, his predecessor in the Central Union, will be connected officially with the American Telephone & Telegraph Company. The former president of the Chicago Telephone Company, John M. Clark, has been elected chairman of the board of directors.

HON. C. A. SCHIEREN has an interesting article in the *Saturday Evening Post* telling "Why Young Men Should Begin at the Bottom." In the course of it he describes how some years ago when dynamos first came in, he devised his well known "electric" belting by punching the belt full of holes so as to relieve the air cushion. The article is full of valuable and helpful suggestions to young men.

JOHNSON-STOCKLY.—The marriage is announced to take place on May 23 at noon at the Presbyterian Church, Lakewood, N. J., of Mary Galt Stockly, daughter of Mr. and Mrs. G. W. Stockly, to Mr. Owen McMahon Johnson, son of Mr. R. N. Johnson, the well known editor of the *Century*. Young Mr. Johnson has just made a notable success with his first novel, "Arrows of the Almighty." Mr. Stockly, it will be remembered, was at one time president of the Brush Electric Company.

MR. CHAS. L. ACKERMAN, one of the earliest employees of the old Edison Electric Light Company and the Edison Company for isolated lighting, and now a resident of San Francisco, is in destitute circumstances and affected with incurable locomotor ataxia. Several of his friends have joined together and are proposing to raise a fund to instal him as a life inmate of a home for incurables, providing meantime for his immediate wants. It is desired to raise between $1,000 and $1,500, and Mr. Samuel Insull, president of the Chicago Edison Company, has consented to act as treasurer for the fund. Contributions are now being made, and we desire to commend this good object to the assistance of our charitable readers, who should send their checks to Mr. Insull.

MR. T. P. GAYLORD.—An illustrated lecture on "Alternating Current Power Work," in the series arranged by the Mechanical Engineering and Electrical Engineering Society of the University of Illinois, was delivered April 30 by Mr. T. P. Gaylord, of the Westinghouse Company. The treatment of the subject was thoroughly interesting. Electric generators, oil-cooled transformers, rotary converters and constant and variable speed induction motors of the Tesla type were shown and described. The most recent type of motor shown has been largely and successfully introduced by this company for cranes and hoists, woodworking shops and foundries, and many other industries requiring variable speed. Excellent views and descriptions were given of the large shops of the company at Pittsburg.

MR. HERBERT A. WAGNER, the well known electrical engineer, who has done considerable work in electric lighting development in St. Louis, is opening a New York office as consulting engineer in the *Times* building, New York City. For some time past, owing to the calls upon him for expert advice, Mr. Wagner has had to visit this part of the country frequently. He has of late been engaged by the Edison Electric Illuminating Company of Boston and the Boston Electric Light Company to give assistance on the plans and direction of their proposed extension, as noted in the comprehensive article in this issue. As an inventor Mr. Wagner has also made his mark, and he is a very welcome addition to professional circles in New York City.

MR. I. T. LERCH, who has been general superintendent of the Pennsylvania Telephone Company, with headquarters in Reading since 1891, and previously division superintendent for three years, has tendered his resignation. Mr. Lerch's principal duties with the Pennsylvania Telephone Company were the construction of new lines and maintenance of the system, which covers the eastern part of Pennsylvania and portions of New Jersey. He first engaged in the telephone business at Bethlehem in 1880 as night operator and inspector. The business was then extended from Easton to Hazleton. Later the company sold out to the Pennsylvania Telephone Company, and Mr. Lerch was made manager of the Lehigh district, with headquarters at Easton. He went to Reading in the fall of 1888. Under his administration many improvements were made in the service, and perhaps the most important was the placing of the wires underground there and at other points. In 1888 there were 520 telephones in Reading. To-day there are 2,000. Mr. Lerch will now identify himself with the People's Electric Light Company, which recently secured a franchise from the city. He has purchased the Reading Electrical Construction Company, from J. K. Righter, who runs the business under a limited partnership at present. This firm will be discontinued and a charter applied for to conduct the business under a corporation. It will be enlarged into a supply and construction house.

Trade Notes.

INTERNATIONAL SPECIALTY COMPANY has opened a Chicago office at 1005 Monadnock Block.

THE BROWN ENGINE COMPANY, incorporated at Milwaukee, Wis., to build Corliss engines, will be located at Western Union Junction.

WESTON INSTRUMENTS.—The Weston Electrical Instrument Company has changed its Newark address to Waverly Park, Essex County, N. J.

EXHAUST HEADS.—The Burt Manufacturing Company, of Akron, Ohio, has just entered an order for Burt exhaust heads from the British Government.

THE BARTH MANUFACTURING COMPANY'S plant at Milwaukee, Wis., has been destroyed by fire. The company built electric elevators and was building its own motors.

THE EXETER MACHINE WORKS, Pittston, Pa., in a recently issued catalogue illustrates the Exeter noiseless gravity bucket, conveyors, coal crushers, belt conveyors, etc.

ELECTION OF OFFICERS.—At a recent annual meeting of the stockholders of the Joseph Dixon Crucible Company, Jersey City, N. J., the old board of directors and the present officers were re-elected.

THE VARIETY IRON WORKS, of Cleveland, Ohio, are preparing to erect a new power plant and have placed a contract for a 300-hp Buckeye engine. It is understood that boilers and generators have not yet been contracted for.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has established a branch sales office at 26 South Fifteenth Street, Philadelphia. Mr. James E. Cutler, late of the New York office, has been appointed district manager.

STOCK REPORT.—The Emerson Electric Manufacturing Company has issued from its New York office, at 136 Liberty Street, its Stock Report No. 10, showing the stock of Emerson desk and ceiling fans on hand in the New York warehouse on May 4.

THE RICHMONDT ELECTRIC WIRE COMPANY writes: "We have now removed to our new factories at Waukegan, Ill., where we shall have a greatly increased output. Business in New York is very satisfactory and we propose to carry a very extensive stock here."

THE BUCKEYE ELECTRIC REPAIR WORKS, Columbus, Ohio, has built up quite an extensive business in the coal mining districts, repairing armatures, motors, transformers, etc., and has found it necessary to open a branch shop at Nelsonville, Ohio, to take care of it.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY, New York, has recently opened a Western branch at 254 Madison Street, Chicago, where it will be represented by Mr. A. E. Barlow. This will facilitate the business of this company to a considerable extent.

McROY CLAY WORKS have removed their Chicago office recently to 1030 Monadnock Building, where they have established comfortable and convenient Western headquarters. Mr. E. F. Kirkpatrick is in charge, and reports an excellent outlook for conduit business throughout his large territory.

ARC LAMPS.—The Fort Wayne Electric Works, Fort Wayne, Ind., in a pamphlet of recent issue illustrates and points out the principal features of the "Wood" direct-acting shunt feed series arc lamps. The various styles of these lamps are shown and many of the constituent parts are also illustrated.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing to the trade a price list of I. X. L. weather proof wire, double galvanized telephone wire, annunciator, office, and magnet wires and lamp cord. This company also calls attention to its well known Okonite wires and National telephone cables.

THE MEXICAN INTERNATIONAL INFORMATION & COMMISSION BUSINESS OFFICE has been organized in the City of Mexico, Mexico, to carry on the lines of business indicated by its title. The company desires to secure circulars, catalogues, discount rates, etc. Mr. H. Barron is manager, with office at Polilla, No. 5¼.

McROY BLOTTER.—The McRoy Clay Works are sending out a neat desk blotter which contains the well-known illustration of the company, showing a section of McRoy conduit supporting a heavy load of pig iron. It also contains three verses of poetry, entitled, "Have You Joined the Buffaloes?" In the lower left-hand corner is a calendar for May.

ELECTRICAL SIGNS.—A new system of making electric light signs by pegging lamps into a cork board, so that changes could be made very rapidly, was illustrated and described recently in the ELECTRICAL WORLD AND ENGINEER. The system is now in the hands of the National Electric Improvement Company, 40 Wall Street, in care of Emerson, McMillin & Co., for development.

ENGINE TYPE GENERATOR.—The Northern Electrical Manufacturing Company, Madison, Wis., has issued a bulletin illustrating and describing its 8-pole, engine type, direct-current generators. These machines are built in sizes up to 1000-kw. They are declared to be scientifically correct in design, and as far as appearances go, this claim seems to be substantiated.

THE STANDARD EQUIPMENT & MACHINERY COMPANY, of Cleveland, Ohio, recently bought out the equipment of the old power-house of the

Decatur Traction Company, Decatur, Ill., consisting of four 175-hp Ideal engines and four 65-kw T.-H. generators. The generators have been sold to the Excelsior Electric Company, Port Huron, Mich., and the East End Electric Company, Kansas City, Mo.

GOOD ADVICE.—The H. C. Roberts Electric Supply Company, 831 Arch Street, Philadelphia, Pa., in a pamphlet of recent issue tells how to keep cool and save money all summer. To attain these desirable conditions it recommends the use of Emerson desk fans. These desk fans, while keeping the atmosphere cool, it is claimed effect a saving of 20 per cent. in current for the same size fan blade and amount of air moved.

TRANSFORMERS.—The Kuhlman Electric Company, Elkhart, Ind., in a recently issued pamphlet gives some facts concerning its steel case transformers. The advantages claimed for these transformers are, close regulation, high efficiency, low core loss, and low heat. Three types of transformers are illustrated, the steel case, the oil type, and the subway type. The company manufactures transformers from 50 to 100,000 watts' capacity.

AUTOMOBILE SUPPLIES.—Mr. A. L. Dyke, Linmar Building, St. Louis, Mo., has just issued two catalogues of automobiles, parts and supplies, one No. 20 and the other No. 20A, being a supplement thereto. No. 20 contains illustrations and descriptions of automobiles built up from Dyke's automobile parts, engines, running gear, etc. The supplement, No. 20A, gives illustrations of and information about castings and working drawings of Dyke's automorette, No. 0.

CLING-SURFACE AT THE PAN-AMERICAN.—The Cling-Surface Manufacturing Company, of Buffalo, N. Y., will have a working exhibit in the machinery Building, belting section. This will consist of two similar belts running from a 10-hp motor to two similar 5-hp dynamos. One belt will be treated with cling-surface, the other will be run as it comes from the maker and run tight. The company proposes to show, in light-banks, the slack belt doing more work than the untreated tight belt.

READY DRESSED COGS.—Among useful inventions most highly prized by practical machinery men are those which facilitate the repairing of machinery when the inevitable breakdown comes. The ready dressed mill cogs of the N. P. Bowsher Company, of South Bend, Ind., possess interesting features. These cogs are ready to run as soon as driven and keyed, making it possible to fill a wheel in a few hours without taking it from the shaft. This saves both time and money as compared with the old process of renewing cogs.

"WITHIN REACH."—This is the title of a little folder issued by Harvey Hubbell, Bridgeport, Conn., illustrating the Hubbell chain pull-socket for incandescent lights, which was described and illustrated in a recent issue of the Electrical World and Engineer. This socket possesses many advantages which should be investigated by all users of incandescent electric lights. It matters not how far beyond reach the lights are situated, they are brought within easy reach by means of this simple device. Every light is under immediate control, irrespective of wall switches.

JOHNSON & MORTON, Utica, N. Y., the makers of the "J. & M. Standard" junction boxes, have just moved into a new factory. Their present office, storerooms and workrooms are practically four times as large as their former quarters, and in putting up their new building they have made provision for the addition of an extra floor, permitting the doubling of their capacity at a small expense and with great promptness when required. The rapid increase which their business has shown in the two years of their existence would indicate that this extra floor will soon be needed.

THE ACTINIC RAYS.—Messrs. Kliegl Brothers, 1393 Broadway, and 129 West Thirty-eighth Street, New York, have issued a pamphlet of 16 pages describing the actinolite for the production of the actinic rays and the Kliegl arc light bath. Actinic rays in the treatment of tuberculosis and skin diseases have become a recognized therapeutic agent of especial value and efficacy The actinolite is fitted with powerful lenses and is capable of producing the most intense chemical rays, which are so finely regulated as to be under complete control at all times. The pamphlet briefly discusses this branch of therapeutics in an interesting manner. Two styles of the actinolite are illustrated.

WIRT ELECTRIC COMPANY has moved its Philadelphia factory to 4523 Tacony Road, that city, where it will have two and a half times the previous floor space. It is making a considerable investment in tools and machinery, particularly in special machinery suited to its output. It is now preparing for this year's dimmer business, and will be in a position to turn out twice as much work as last year. The "Universal" type of dimmer marketed in 1900 proved so successful that it has already orders for a considerable number of them. The concern is now distributing to the trade a small pocket rule as an advertising novelty, and will be glad to send them to such electrical engineers, architects and trade houses as make application for them.

MILLING MACHINES.—The Becker-Brainard Milling Machine Company, of Hyde Park, Mass., is exhibiting in Block 44, Machinery Hall, at the Pan-American Exposition, the following distinctive types of machine tools: a No. 5B vertical spindle milling machine, driven by a direct connected, 8 pole, variable-speed motor; a No. 5B plain horizontal milling machine in operation; a No. 14½ tool room universal milling machine; a 24-in. complete automatic geared cutter in operation, and a No. 3 cutter grinder in operation. These machines are selected to represent as fully as the limited space will permit the principal lines of tools manufacture by this company. They only give an idea of the extent and variety of designs which this company's large facilities enable it to furnish.

"A LITTLE TALK ON TALK."—General Manager Mark Davis, of the Cuyahoga Telephone Company, of Cleveland, is mailing to friends and patrons of the company an attractive little brochure entitled, "A Little Talk on Talk." It contains full illustrations of the Cuyahoga exchange and the building in which it is located, as well as the various kinds of instruments furnished by the company. The book also contains a large number of amusing parodies of popular poems adapted to the beauties of the party line, in the composition of which Mr. Davis has acquired a national reputation among independent telephone people. Among them are: "Mary Had a Little Lamb," "Yankee Doodle and the Party Line," "Comin' Through the 'Phone," "Lochinvar," "Old Oaken Bucket," etc.

GENERAL ELECTRIC COMPANY'S TRADE LITERATURE.—We have received from the General Electric Company a batch of trade literature of recent issue, which includes five price lists and two bulletins. The price lists are devoted to the following-named subjects: Parts of form 1 direct-current (series) power circuit arc lamps for 220 and 500 volts; parts of form 1 carbon feed alternating constant current (series) enclosed arc lamps; parts of carbon feed enclosed arc lamps, form 3, for alternating current multiple circuits; parts of LWP-5 motors; parts of form 3 carbon feed direct constant current (series) enclosed arc lamps. The bulletins relate to sewing machine motors and power circuit enclosed arc lamps for 220 or 550 volts. The latter bulletin is illustrated with many interior and exterior views showing the manifold uses of these lamps.

NEW BERNSTEIN LAMP.—The Bernstein Electric Manufacturing Company, 286 Roxbury Street, Boston, in a recently issued pamphlet describes a new type of incandescent lamp to which the trade name "Lowatt" has been given. The lamp includes a complete metal reflector entirely within the bulb and directly behind a multi-coiled filament, the design of the reflector being such as to utilize all of the reflecting surface in a scientific manner. One form of reflector is concave in order to concentrate the light directly below the lamp, and another is convex, in order to throw a diffused light in all directions and about equally to a point considerably above the horizontal. In still another form a concave reflector is placed at the side of the bulb. It is claimed that with this lamp there is a saving on the basis of useful light 40 to 50 per cent. in replacing ordinary 16-cp lamps.

PHILADELPHIA BRANCH OF WESTERN ELECTRIC COMPANY.—Thousands of Philadelphians were gratified on Wednesday, May 8, by the exhibit of the Western Electric Company at the new stores at 931 and 933 Market Street, Philadelphia. From an early hour until late at night visitors thronged the building, and expressions of surprise and wonderment were heard on every side. Never before in the history of this or any other electric company has there been such a display of electrical supplies of every variety, from a "Midget" push button to a dynamo of immense proportions. On the eighth floor, their guests thronged to see the finest display of talking machines that has ever been exhibited. Mr. Thomas A. Edison had sent a number of gold-plated machines of the various types so well and favorably known by users of his wonderful phonograph. The Columbia Phonograph Company also displayed some of its beautiful outfits. The Victor Gramophone came in for its share of praise and admiration, and the artistic furniture and beautifully decorated parlors of the Western Electric Company's Talking Machine Department, were a constant delight to all who witnessed the exhibition.

ELECTRICAL MEASURING INSTRUMENTS.—The Keystone Electrical Instrument Company, Ninth Street and Montgomery Avenue, Philadelphia, has favored us with a copy of its new Catalogue No. XI of Keystone standard direct-reading instruments for either direct or alternating current circuits in the switchboard and portable types. The catalogue, which contains 88 pages, is divided into eight sections. Section I relates to portable direct-reading instruments for direct-current circuits; Section II is devoted to portable direct-reading instruments for alternating-current and direct-current circuits; Section III to switchboard voltmeters and ammeters for direct-current circuits; Section IV to switchboard instruments for alternating and direct-current circuits; Section V to volt-ammeters for electric vehicles; Section VI to arc light volt meter, constant potential ground detector, polarity indicator, and detector galvanometers; Section VII gives dimensional diagrams and sample scales of switchboard instruments, and Section VIII gives directions for the selection, use and care of electrical measuring instruments and directions for ordering. The catalogue contains a good deal of information on the general subject that will be of value to the electrical engineer.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 7, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg, N. Y.]

673,376. ELECTRICAL SIGNALING SYSTEM; H. R. Bennett, San Francisco, Calif. App. filed Aug. 9, 1900. The apparatus comprises a number of vibrating transmitting devices and an equal number of vibrating receiving devices, one of which receiving devices is capable of vibrating in synchronism with all the others.

673,381. PRINTING TELEGRAPH INSTRUMENT; L. M. Casella, London, Eng. App. filed Aug. 19, 1900. Details.

673,391. CURRENT REGULATOR; J. P. Erie, New York, N. Y. App. filed Jan. 4, 1901. A current regulator comprising a movable series of segments, a flexible band contact connected to one of the segments, and means for bringing the band into engagement with or disengaging it from the segments progressively.

673,392. RHEOSTAT SUPPORT; J. P. Erie, New York, N. Y. App. filed Sept. 13, 1900. An insulating core or support for electric conductors comprising a body portion provided with interlocking portions whereby a core is adapted to interlock with a similar core.

673,418. APPARATUS FOR USE IN WIRELESS TELEGRAPHY; J. Burry, Fort Lee, N. J. App. filed Sept. 2, 1899. One object of the present invention is to provide intervals of time in which the imperfect electrical contact shall be cut off from the collector of the oscillations or manifestations of the ether, during which time the said contacts may be restored to their normal condition of poor conductivity (or the reverse) either by self-recovery or by means appropriate to the particular kind of contact in use.

673,428. CURRENT REGULATOR; J. P. Erie, New York, N. Y. App. filed Sept. 17, 1900. This current regulator comprises a series of segments and means for electrically including a longer or shorter segment in the circuit.

673,429. LONG DISTANCE TYPEWRITER; A. J. Farmer, Detroit, Mich. App. filed June 4, 1900. Improvements in the various parts of a machine adapted for use either as a transmitting or receiving instrument.

673,441. TROLLEY BASE; F. A. Merrick and F. W. Garrett, Johnstown, Pa. App. filed Aug. 16, 1900. Details.

673,449. TELEGRAPH KEY; F. J. Raab, Toledo, Ohio. App. filed June 14, 1900. The key is in the form of a pencil, having a small push-button on the outside, which can be operated to close and open the circuit.

673,476. DEVICE EMPLOYING ELECTRIC RESISTANCE; C. Robinson, Elwood, Ind. App. filed March 15, 1900. Details of construction relating to the manner of disposing of the resistance inside of a flatiron of other electrically heated apparatus.

673,478. CONDUIT THREADER; C. B. Rodgers, Bordentown, N. J. App. filed March 15, 1901. The invention relates to the construction of the creeping shoes attached to the threader and to the method of operating the same by means of suitable cords.

673,480. APPARATUS FOR SIGNALLING BY NIGHT; L. Sellner, Vienna, Austria-Hungary. App. filed April 3, 1897. Relates to the construction of signal lanterns and to the machinery for switching the current so as to show different colors and intervals of light.

673,504. TELEPHONE SWITCHBOARD; I. J. Kusel, Chicago, Ill. App. filed Sept. 27, 1900. Details.

673,512. MICROTELEPHONIC APPARATUS; J. Berliner, Hanover, Germany. App. filed Dec. 4, 1900. The transmitter and receiver are mounted upon a single handle, which also supports switching devices to be manipulated by the user to connect and disconnect the instrument while he is using them.

673,513. SHUT OFF MECHANISM FOR ENGINES; C. F. Cowdrey, Fitchburg, Mass. App. filed Jan. 15, 1901. A steam turbine, arranged to close the stopper valve, is itself controlled by an electro-magnetic valve which admits steam to the turbine in case of emergency.

673,516. BRUSH HOLDER AND BRUSH; C. A. Eck, Newark, N. J. App. filed Nov. 24, 1900. The brush is adapted to break when it has worn to a predetermined extent and the inward movement of the spring backing up the brush is limited to avoid contact with the commutator.

673,517. BRUSH AND BRUSH HOLDER; C. A. Eck, Newark, N. J. App. filed Feb. 27, 1901. A modification of the preceding.

673,519. MULTIPLE TELEGRAPH; S. T. Foster, Jr., Laredo, Texas. App. filed March 14, 1899. Details.

673,521. MANUFACTURE OF SOLENOID OR OTHER ELECTRIC COILS, J. A. Heany, Philadelphia, Pa. App. filed Feb. 18, 1901. The wire, bare or covered, is wound upon a sheet of yielding insulating material and the spaces between the wires filled in with an insulating cement.

673,531. ELECTRIC RAILWAY CONTROLLER; E. M. Bentley, Lawrence, N. Y. App. filed June 17, 1899. The combination with two or more sets of motors and two or more series-multiple switches, of a rheostat adjustable in capacity modifying the controlling effect of all the said switches in common.

673,538. ELECTRIC RAILWAY CONDUIT; F. Hewer, Chiswick, England. App. filed June 12, 1900. Details.

673,553. APPARATUS FOR USE IN WIRELESS TELEGRAPHY; J. Burry, Fort Lee, N. J. App. filed Sept. 9, 1898. Intervals of time are provided for during which the imperfect contacts are restored to their normal condition of poor conductivity or the reverse.

673,563. SAFETY CATCH FOR INCANDESCENT ELECTRIC LAMPS, G. B. Millen, San Francisco, Cal. App. filed July 14, 1900. The catch prevents unscrewing of the lamp until it is released.

673,564. RHEOTROPE; W. Morrison, Chicago, Ill. App. filed June 18, 1900. An arrangement of contacts on a controlled cylinder.

673,565. ELECTRIC CONTROLLER; W. Morrison, Chicago, Ill. App. filed June 18, 1900. Details to avoid sparking at the contacts.

673,567. ELECTRIC TRANSFORMER; L. M. Pignolet, Orange, N. J. App. filed Sept. 10, 1898. The terminals of the section of the secondary are grouped in a peculiar manner to avoid an excessive number of soldered joints.

673,628. ELECTRO-MAGNET AND ANNUNCIATOR. C. E. Scribner, Chicago, Ill., and F. R. McBerty, of Downer's Grove, Ill. App. filed April 6, 1893. The coil is surrounded by metal of low magnetic permeability adapted to be threaded by the lines of force of the magnet; means for closing at will either current of constant direction or alternating through the magnet, whereby the pole of the magnet presented to the armature is excited only by current of constant direction.

673,652. STORAGE BATTERY CELL, J. C. Chamberlain, New York, and H. R. Sutphen, Highbridge, N. Y. App. filed Sept. 11, 1899. The cover of the cell incloses the terminals which are connected between cells by cross pieces passing through opening in the cover.

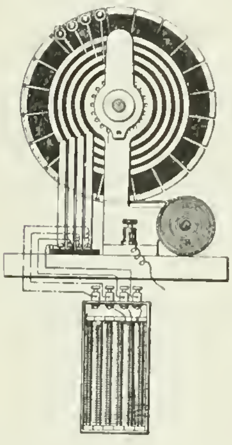
673,656. BUSHING FOR ELECTRICAL OUTLET BOXES; H. Krantz, Brooklyn, N. Y. App. filed Feb. 9, 1901. A terminal for conduits which also acts as a connector with the walls of the outlet box.

673,660. RAIL BOND; W. T. Pringle, Landsdowne, Pa. App. filed Jan. 15, 1900. The ends of the bond are formed into tubes adapted to enter holes in the rail and be filled by a securing rivet.

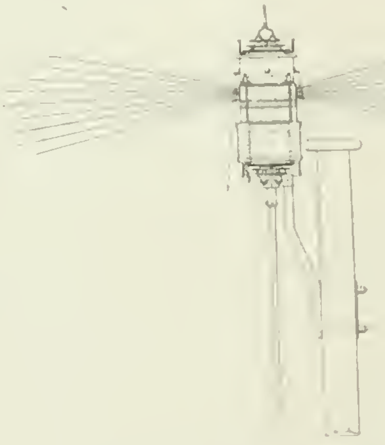
673,678. STORAGE BATTERY; J. C. Chamberlain, New York, N. Y., and H. R. Sutphen, Highbridge, N. Y. App. filed Sept. 11, 1899. A group of cells in a tray are separated by insulators.

673,694. MACHINERY FOR COVERING ELECTRICAL OR OTHER WIRES FOR INSULATING PURPOSES; W. W. Colley, London, Eng. App. filed June 4, 1900. Details.

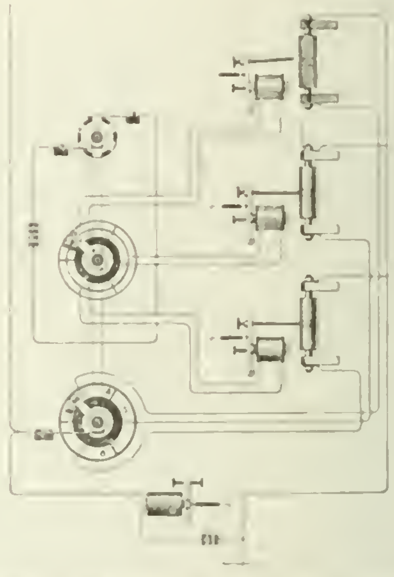
673,710. TERMINAL AND BINDING SCREW FOR ELECTRIC BATTERIES AND CONNECTIONS; W. R. Edwards, Weybridge, England. App. filed Nov. 2, 1900. Lead washers are set between the clamping faces and squeezed tightly when the connection is made, to form a packing



673,391. Current Regulator.



673,480. Apparatus for Signalling by Night.



673,553. Apparatus for Use in Wireless Telegraphy

673,713. SPARK DISCHARGING DEVICE FOR ELECTRIC LIGHTING FOR GAS BURNERS; P. Hoffmann, Charlottenburg, Germany. App. March 24, 1900. Details.

673,731. ELECTRIC MOTOR CONTROLLER; O. F. Shepard, Jr., Madeira, Ohio. App. filed Oct. 3, 1900. The invention consists in a controller comprising two sets of partial circuits connected, respectively, with different motor windings, means included in the partial circuits of each for inserting each set of partial circuits in its respective motor circuit, the inserting devices for one set being controlled by the devices of the other set

673,754. PROCESS OF ELECTROLYTIC DECOMPOSITION; G. & G. W. Bell, Liverpool, Eng. App. filed June 7, 1898. (See Current News and Notes.)

673,761. PROCESS OF REDUCING SODIUM COMPOUNDS. A. H. Cowles, Cleveland, Ohio. App. filed July 20, 1895. (See Current News and Notes.)

673,765. TELLTALE FOR RAIL BONDS; J. A. Emery, Atlanta, Ga. App. filed Oct. 4, 1900. The bonds are placed behind the fish plate and a telltale wire sticks out from behind the plate to show where the bond is located.

673,766. OVERHEAD TROLLEY; H. C. Eno, Pittsfield, Mass. App. filed July 7, 1900. The axle of the wheel is set in two blocks easily removable from the harp.

673,792. STORAGE BATTERY; D. W. Beebout, Pittsburg, Pa. App. filed Feb. 19, 1900. Details.

673,794. ELECTRIC SIGNAL AND TELEPHONE SYSTEM; C. L. Fortier, Milwaukee, Wis. App. filed June 12, 1899. A district telegraph and telephone system embodying a single circuit and a number of subscribers connected therein, so arranged that when one subscriber is telephoning all the others are cut out.

673,796. TELEPHONE SERVICE APPARATUS; U. S. Jackson, Ossipee, N. H. App. filed Nov. 22, 1900. Details.

673,807. CONTROLLER FOR ROTARY TRANSFORMERS; T. S. Watson, Milwaukee, Wis. App. filed June 4, 1900. Details of construction.

Electrical World and Engineer

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A NOBLE GIFT.

At the annual meeting of the American Institute of Electrical Engineers this week, announcement was made officially of the gift to it by Dr. Schuyler Skaats Wheeler of the magnificent Latimer Clark electrical library, the finest and most complete collection of its kind in the world. If our readers will refer to the article elsewhere in this issue they will realize what a prize the generosity of the donor has secured for the Institute. While the sister society in England may deservedly boast its superb Ronalds library, the American Institute has beyond doubt secured the best thing of its kind extant, with a grand total of nearly 7000 entries, all relating specifically to electricity.

This is the first gift that the Institute, now nearly 18 years old, has received from any of its members, some of whom pass for millionaires, with fortunes made entirely out of the development of electrical industry. Dr. Wheeler is not at all a rich man, as values go in these times, but he has always shown a keen appreciation of the truth of Lord Bacon's dictum, that a man owes not a little to his profession. It is mere justice here to record that Dr. Wheeler, in this latest evidence of professional feeling, only exemplifies the impulses that have marked his whole career. He was the first life member of the Institute, and some years ago, when it was proposed to secure a home for the body, his was the first subscription to go on the list and be paid.

The Institute now has the finest electrical library in the world. But such gifts carry obligations on the part of the recipient, and there must be reciprocity. The society has the library, but it must be housed and catalogued and rendered available to the public, and here lies an opportunity for every individual member. We nourish the belief that the Wheeler gift will stimulate the professional pride of every member of the Institute, and lead to an outpouring of contributions that will at once double and quadruple the intrinsic value of the society's possessions. There have been other electrical book collections in this country of notable merit—the Benjamin, Weston, Graham Bell, and others—but for the first time the literature of the art, its records, its genealogy, and its beginnings have now been made available to all comers. It is impossible to handle these old volumes in monkish Latin, black letter, archaic English, high Dutch, and all manner of phraseology, without realizing the sweep and continuity of it all, from Albertus Magnus down to the recent Conversazione.

Dr. Wheeler suggested conditions for his deed of gift which were accepted by the Institute. They are reasonable, being aimed at securing the greatest public benefit from a unique collection, which can never be duplicated. Just now the press is ringing with the story of the purchase of the Leyland steamship line by Mr. Morgan, and our friends in England seem to be perturbed over the transaction. We may be in error, but it strikes us as an altogether better, nobler and more fruitful achievement to have secured for America once and for all this greatest electrical library, whose influences and inspirations will go on and on, long after steamship lines have ceased to be. In such gifts lies enduring fame.

NEW CONSTITUTION OF THE A. I. E. E.

The new constitution adopted this week at the annual meeting of the American Institute of Electrical Engineers, gives that body a carefully-considered and up-to-date set of rules for its guidance. The desirability of a radical revision of the constitution just superceded, which was adopted in 1884 and amended in parts in 1885, 1892, 1894 and 1896, has been considered by the Council repeatedly in the past six or seven years. Several committees during that period have made drafts of constitutions, and the instrument just adopted, though containing some original features, is largely based upon these previous drafts. Perhaps the most important changes introduced in the governing rules by the new constitution are the provisions for State and District organizations; the definition of qualifications for full membership; the addition of the two junior past-presidents to the managing body; the increase of full membership dues, and the method whereby the constitution may be amended. Many minor changes are incorporated, most of which have for an object to give the Institute a more thoroughly National character and to render it more difficult for its governing body to fall under the control of a faction, or should this occur, to limit the injury that may be done. Legislative action affecting the policy or organization of the Institute is now restricted to the annual or corporation meeting in May and the annual convention. A change made in the date when the officers take office, gives the president almost an entire year of encumbancy previous to the annual convention, thereby enabling him to make this meeting the crowning success of his administration. The importance of this meeting is further enhanced by the provisions whereby territorial bodies of membership may send delegates whose traveling expenses will be borne by the Institute.

Owing to the laws under which the Institute is incorporated it was found advisable to change the name of the governing body, which is now to be known as the "Board of Directors," instead of "Council." The addition to this body of the two junior past presidents is an important feature, since it will conduce to greater continuity in policy and action. Under the old constitution it was possible to adopt amendments at any monthly meeting in New York City. Hereafter proposed amendments must be submitted for action to the entire membership, and only once annually. The definition of the qualifications necessary for full membership, though radical as compared with that in the constitution superceded, merely renders definite and authoritative the criteria which for several years past have been applied by the Board of Examiners and Council in passing upon applications for transfer. An increase in the dues of the full members was not contemplated originally, but knowledge of the large additional expense to which the Institute would soon be subjected through its library, rendered it imperative that the income of the Institute be increased. We believe the entire membership will be satisfied that the burden should fall rather on the full members than be distributed so as to include associates, if for no other reason than that the objects of the Institute appeal with much greater force to the former than to the latter. A change affecting those in the future transferred to full membership, consists in the requirement of a fee of $10 upon transfer. As an offset to these increased burdens, the offices of president and vice-president are restricted to full members.

The rules for the nomination and election of officers are not materially changed, but two important provisions have been added. One of these requires that in the preparation of the "Directors' Nominees" ticket the names for the office of vice-president shall be selected with a view to maintaining a geographical distribution of incumbents of that office. The desirability of this provision is illustrated in the recent council ticket, the three nominees for vice-president which it bore being all from New York City, and two from the same college. The other addition referred to is that which provides for placing the name of a second nominee on the "Directors' Nominees" ticket, to be selected from the four names receiving the highest number of nominating votes for president. As the official nominees are under normal conditions invariably elected, the choice of president lay in the past practically with the council. In the selection of the second name by the Board of Directors, considerations of the relative number of nominating votes will probably not have as much weight as when there was but a single name, which condition should give to the independent engineer a better opportunity than he has had in the past, to attain to the presidency against the odds in favor of a candidate connected with a great commercial interest or with a university having a numerous alumni representation in the Institute membership.

THE NEW EDISON STORAGE CELL.

It was with great interest that we have seen the facts concerning Mr. Edison's new storage cell definitely set forth in the paper upon this subject read this week before the American Institute of Electrical Engineers, and reproduced in this issue. So many inaccurate notions have been formed of late concerning this cell, partly owing to a certain German patent recently granted to Mr. Edison for a cadmium storage cell, that it is gratifying to receive a clear and practical authorized statement of the facts.

The great advantage of the new cell is that it is structurally composed of steel instead of the eternal lead of the past, a relatively weak and heavy metal. Mr. Edison is said to have observed some years ago that if the Creator had intended that lead should be used in a storage cell, he would not have given to that metal its high specific gravity. With steel plates the structure of the cell can be designed for strength and rigidity with the minimum mass of inactive material. Another advantage of the cell is its absence of "formation," or the period of incubation through which the leaden cell has to pass in order to develop its storage capacity. We understand that when the chemical salts are inserted in the receptacles of the plates, they are ready for charging in the ordinary way, which is an obvious advantage. There is one disadvantage about steel for plates, however, and that is that it cannot be cut or molded with the same facility as lead, and that special dies and tools are necessary for the stamping and filling of the plates. This means, of course, some extra delay in the preparation of the cell for the market. It would seem that all the measurements and experience collected upon this cell under Mr. Edison's direction and supervision within the last six months, have been made on small plates containing each a single pocket or briquette of active material, and that although the machines for cutting and pressing larger, or multiple-briquette plates, are in course of manufacture, the full-sized cells have not yet made their appearance.

Although the e. m. f. of the new nickel-iron cell is only a little more than half that of the lead cell, yet if 14 watts per pound of cell can be obtained from it, the nickel-iron cell will deliver at least twice as much electrical energy as the same weight of lead cells of which we have reliable data based on extended use. Of course, pasted lead cells can be made to give, when new, even more than 14 watts per pound; but their lives under active work would be short and have not the merit of being even merry. The fact that the alkaline solution of the cell does not enter into chemical combination, but remains chemically unaltered during charge and discharge, is another advantage. Part of the fall in e. m. f. of the lead cell during discharge must be attributed to local chemical exhaustion of the acid solution in the pores of the plates. Although it will not be possible to gauge the degree of charge or discharge of the new cell by means of the specific-gravity indicator, yet the voltmeter may perhaps give sufficiently this important information. As for the change from an acid to an alkaline electrolyte, there is but little to be said. One can destroy carpets, clothes and epidermis, almost equally effectually with acid as alkali. The alkali will probably, however, have to be kept out of free communication with the air, or it will absorb atmospheric carbonic dioxide, to its own detriment, and the grief of the user.

We are glad that Mr. Edison has once more turned his great inventive talents to electrical problems. The storage battery for tractive purposes is a crying need of the day. We understand that this new cell is the result of more than half a year's research on his part, not including the work of his assistants. With a good, reliable storage cell, the electric automobile can distance all the competition of steam and gasoline for city work. The noiselessness, cleanliness, smoothness of running and convenience of the electric automobile would easily give it the preference to-day if it were not for the weight and depreciation of the leaden storage battery, which handicaps it like a veritable old man of the sea on the back of Sindbad the sailor. We sincerely hope that Mr. Edison has thrown off the incubus. Curiously enough, the substances entering into the action of the cell are all magnetic substances. The grids or plates are of steel. The active materials are oxides of nickel and iron, the two most magnetizable known substances, while oxygen, the active transfer has also a relatively high magnetic permeability.

POWER TRANSMISSION FOR CENTRAL STATIONS.

We are publishing this week an interesting resumé of high voltage power transmissions as practiced in New York City, in a paper by Mr. Calvin W. Rice, prepared for the National Electric Light Association. This power transmission work has developed so quietly, and with so little spectacular effect, that its amount and importance is hardly realized until one comes to take account of stock in detail. We fancy that the first paragraph of Mr. Rice's paper will rouse the controversial spirit of the convention in a way that will be enlivening even if not entirely edifying. Without desiring to take sides violently upon a mooted point regarding which so much can be said from many standpoints, we would mildly suggest the following paraphrase of the paragraph as being more strictly in accordance with a conservative view of the facts. "In America the system which first came upon the field, and which deeply rooted itself in nearly every large city before a rival came into sight, was the low tension Edison 220-volt direct-current, three-wire system. It has proved to be remarkably well adapted to miscellaneous lighting power and industrial work." While recognizing its many valuable properties, we are not prepared to admit that if one could start *de novo* in any large city, an equally efficient and economical and generally useful system could not be installed using a distribution exclusively by alternating currents. But in this workaday world we have to take things as we find them, and the fact is that the Edison system has fixed itself so firmly, has invested so large an amount of capital and established so complete a network in almost every large American city, that its extension along similar lines is almost a necessity even if it were not a matter of choice. Obviously the Edison tube system which has been so successful and in which so great an investment is locked up, does not lend itself readily to distribution by alternating currents, and even if the Edison companies desired to change their system, which is by no means the case, they would hesitate, even if it were shown that the alternating system would be decidedly superior in a new plant—a thesis which is as yet far from being proved. Hence logically, the growth of such systems must take place, for the present at least, along the lines which Mr. Rice has so clearly indicated.

The importance of linking together the whole network of a city has made the power transmission at high voltage imperative and, thanks to the development of high-voltage generators and the introduction of rotary converters, the process of transmission and conversion has been rendered very efficient. With rotaries at both ends of a line, permitting an interchange of current between two generating stations, Mr. Rice states that a complete efficiency of 81 per cent has been reached reckoned from one direct-current switchboard to the other. This implies admirable machinery and good engineering, both of which the New York Gas Company, whose system Mr. Rice chiefly describes, certainly has at its command, as the record of past years testifies. Mr. Rice's description of the great waterside station with its projected capacity of 125,000 horse-power is most striking and instructive, but with the skill and enterprise exhibited in this colossal undertaking and the immense investment required, we are impelled to ask, as we have more than once suggested in these columns, what good reason there is for adopting a frequency which prevents the successful distribution of alternating current for incandescent lamps, in case such a step should ever become desirable? There is from an engineering standpoint absolutely no good reason for carrying the frequency just below, instead of just above, the point at which incandescent lamps can be readily operated. It seems a bit short-sighted not to provide for so possible a contingency. Of course, frequency changers are always available for small auxiliary alternating work, but the use of such apparatus on any considerable scale is simply a confession that somebody has blundered. It must be remembered that substantially all the revolutionary suggestions for improved electric lighting apparatus which has been in the air, as it were, during the past five years, imply the use of alternating current in the lamps, and there is at least a possibility that some of these may materialize, perhaps in the very near future. Of course, there is a chance that 25 cycles would prove advantageous even in such a contingency, but it seems, on the whole, a considerable handicap.

A very interesting feature of Mr. Rice's paper is the practical information given concerning high-voltage underground work. An instructive point is the limiting size of cable that can be installed in an ordinary three-inch duct. One would hardly suppose that a 2⅝-inch cable could be installed with considerable facility, while one only a sixteenth of an inch greater in diameter involved really serious difficulties, but such proved to be the case. The one size was just approaching the limit, the other had reached it. As to the insulation required for such cables, this and much other recent experience seems to show that for rubber compound containing 30 to 40 per cent of pure Para, a thickness of about 1-32 of an inch per 1000 volts around each conductor is necessary at pressures of 5000 volts and upwards. It is interesting to note that the paper-insulated cables have given good results as a substitute for rubber, and recent advices from abroad seems to show that cables for underground work are likely to depend less and less on the use of rubber, which, in the growing scarcity of that commodity, is rather gratifying information. We never remember seeing the heating limit in the underground ducts before stated in the simple terms set out in this paper. Two watts energy dissipated per duct foot is an easy figure to bear in mind and is well worth remembering. The device of serving the cables at manholes with a fireproof covering of asbestos and steel tape should also be noted as a good insurance against accidents. In high-voltage underground work the results of a short circuit may be so serious and difficult to remedy, that the only really safe procedure is to take extraordinary precautions against such mischances. The history of early experiments on underground service is full of tales of woe, but in the present state of experience many valuable lessons have been learned, and with the present precautions there has been very little interruption of service, even of a trivial and temporary character. The record of the metropolitan lighting systems in this particular is wonderfully good, considering the difficulties with which they have had to contend, and they deserve great credit for the issue.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers, which was held in New York on the evening of May 21, was largely attended, and the proceedings were marked by a lively interest on the part of the members present. President Carl Hering was in the chair, and announced, after the regular business of the meeting had been concluded, that the Latimer Clark library, recently described in these pages, and of which a more detailed account is given elsewhere in this issue, had been presented to the Institute by Dr. Schuyler S. Wheeler. The announcement of this generous gift of Dr. Wheeler's was received with enthusiastic applause by the attending members. A number of prominent members of the Institute were necessarily absent attending the National Electric Light Association Convention at Niagara Falls, and a telegram was read from the absentees expressing their regret at not being able to be present at the annual meeting, and voicing their appreciation of the magnificent gift of Dr. Wheeler.

The next business in order was the action to be taken upon the adoption of the new constituion, which has been in preparation for some time, and which presents a number of notable changes relating to the Institute's organization. Mr. John W. Lieb moved the acceptance of the constitution, and Mr. Charles P. Steinmetz seconded the motion, both gentlemen speaking strongly of the painstaking labor which had been devoted to the work. It represented not the result of a few hours in consultation, but was the outcome of many years of careful thought and much study into the needs of the Institute and the best governmental policy. After an animated discussion as to the advisability of accepting certain sections, notably those in reference to the ineligibility of associate members for the offices of president and vice-president, and the wording of the section referring to the majority vote of a quorum, the vote was called for, and the constitution declared adopted, there being only three dissenting voices among the members present.

The reading of the paper of the evening then took place, the subject of which was "The New Edison Storage Battery," by Dr. Arthur E. Kennelly. This paper is reprinted elsewhere in this issue. During the reading of the paper samples of the plates of the battery were passed around among the members, and at the conclusion Dr. Kennelly showed a number of lantern slides on the screen, which illustrated the details of construction. Some curves were also shown, which brought out certain peculiar points of the battery. The discharge curves gave a very sharp "knee" near the end of the discharge, the voltage falling off very rapidly at this point. Taking the voltage over the entire range the average result was 1.1 volts, while by stopping before the "knee," that is, a short time before the battery was completely discharged, the average voltage was 1.2. With a quick discharge this battery gives no less in ampere-hours but less in watt-hours. In summing up the paper, Dr. Kennelly pointed out this new use of steel, a metal which has done so much towards the advancement of civilization, and paid a tribute to Mr. Edison's great perseverance in investigation, which resulted in overcoming the difficulty of finding a salt of iron applicable to this purpose which would not deteriorate or become soluble in the electrolyte.

In opening the discussion, Dr. Keith pointed out that there seemed to be great danger of local action between the carbon and nickel, and the carbon and iron, and he objected in moderate terms to the implied simplicity of the chemical reactions. The transfer of oxygen between the plates must entail much more complicated conditions than is borne out by the wording of the paper. Mr. Steinmetz said that storage batteries are all right when large weight is no objection and careful attention was possible. He also spoke of the complication of chemical formulæ in the lead cell and the undoubted similarity in reactions in the nickel-steel cell. President Hering asked if there would not be corroding action at the surface of the liquid where it comes in contact with the plate and perhaps necessitate floating oil on the top of the electrolyte. Later in the discussion he asked as to the effect of high-charging current. In answering, Dr. Kennelly said he did not have at his disposal any data from which satisfactory conclusions could be drawn. Mr. C. O. Mailloux pointed out the importance of what is known as "coefficient of drop and restitution," and Dr. S. S. Wheeler inquired what the remedy would be in service for the large drop. Mr. Justus B. Entz said that he had done much work in alkaline cells, but had never been able to produce an oxide of iron which was not soluble in the solution. He thought that, unlike a lead battery where the transference of active material from one plate to another is of no great detriment to the battery, in this cell the two plates being composed of entirely different substances, local action must ensue if any of the material should be carried over from one plate to the other, and this local action would continue indefinitely, resulting in great injury.

Mr. C. J. Reed spoke of similar cells with which he had been experimenting, and pointed out the advantages of having the plates near together with the corresponding decrease in resistance. He mentioned possibilities of increasing the output by thermal action and the difference between the lead and the nickel-steel accumulator in producing by the discharge a non-conductor instead of a conductor. The great desideratum of the storage battery is mechanical strength, and freedom from deterioration, and it was asked whether the presence of graphite would not produce local action as well as other deleterious results, and if the iron would not deteriorate in time. It was also asked if the cell would keep its voltage when standing, and what the effect of impurities in the electrolyte would be.

Many questions were asked as to the weight of the battery per kilowatt, the chemical action of the nickel on the steel briquettes, etc. Dr. Kennelly, in speaking of the danger of local action between the graphite and the metallic substances in the briquettes stated that the graphite seems to be normally inert, but may become active on a heavy charge. No matter what are the actual salts formed, we know that there is more oxygen, etc., on the positive plate charged than when discharged. The complete chemical formula is, of course, impossible to give, as the actual composition of the so-called nickel superoxide and iron oxide is not known, although assumed in the case of the former to be NiO_2. When discharged this superoxide, NiO_2, may become Ni_2O_3. The voltage fall of the cell is due to superficial action on the briquette and not to local action; and, of course, if the solution is not pure trouble will result.

At the close of the discussion the retiring president, Mr Hering, in a few well-chosen words thanked the Institute for its support during his term of holding the executive office, and particularly expressed his gratitude to the committees for their aid and efficient work in carrying on the many difficult undertakings which have marked the year's history of the society. The tellers' report on the balloting for officers was then read, and the following officers were declared elected:

President: Charles Proteus Steinmetz, Schenectady, N. Y.

Vice-Presidents: Professor Samuel Sheldon, Brooklyn Polytechnic Institute; Professor George F. Sever, Columbia University; Professor M. I. Pupin, Columbia University.

Managers: Professor W. E. Goldsborough, Purdue University; Charles F. Scott, Pittsburg, Pa.; John W. Lieb, Jr., New York City; Captain Samuel Reber, U. S. Army.

Secretary: Ralph W. Pope, New York City.

Treasurer: George A. Hamilton, New York City

Before the motion to adjourn was carried the president-elect, Mr. Charles Proteous Steinmetz, in his felicitous style, addressed the members present, and said that he would do all in his power to keep up the standard set by the retiring president, and to deserve the trust put in him by the Institute.

Features of the Report of Patent Commissioner.

In the last annual report of the Commissioner of Patents some interesting facts are given. From a comparative statement of the business of the office from the years 1837 to 1900, inclusive, it appears that caveats are declining in favor. The number of applications has been growing less since the year 1868, when the highest number (3705) were taken out. In 1900 the number was 1731, the rate of decline since 1868 being quite steady. A particularly interesting part of the report is the list of names of inventors to whom more than 100 patents have been issued between the years 1872 and 1900. The list is headed by Thomas A. Edison with 742 patents to his credit. Other well-known names in the list, with the number of patents taken out by each, are: Elihu Thomson, 444; Charles E. Scribner, 374; Edward Weston, 280; Rudolph M. Hunter, 276; Charles J. Van Depoele, 245; George Westinghouse, 239; Sydney H. Short, 178; Rudolf Eickemeyer, 171; Milo G. Kellogg, 159; Hiram S. Maxim, 146; George D. Burton, 144; Elmer A. Sperry, 132, and James F. McElroy, 121. There are 30 names in the list, of which 14 are well-known electrical inventors.

Electrical Development at Manchester, N. H.

A SINGLE sub-station in Manchester, N. H., receives electrical energy from five generating plants and distributes it in four different towns. This novel condition has been made possible by the consolidation of all the electrical supply interests of Manchester and vicinity.

The importance of these interests is evident from the fact that about 30,000 incandescent lamps, 1200 arc lamps, 1500 horse-power in stationary motors, and 68 electric cars, running over 28 miles of track, are operated by the present system. All of the generating plants and distribution equipment employed for these several kinds of service are owned by the Manchester Traction, Light & Power Company, a New Hampshire corporation with a capital stock of $1,500,000. Mr. J. Brodie Smith, the moving spirit in the consolidation of electrical interests at Manchester, is the general manager of this corporation.

Like the electrical industry, as a whole, the great system here described has come up from very small beginnings. Electric lighting began in Manchester in 1882, with six Weston arc dynamos of 10 lamps capacity each. These dynamos were driven by power rented of the Amoskeag Manufacturing Company, and were devoted to commercial lighting. The lamps were of the short arc type, taking about 25 volts and 20 amperes. In 1884 a contract was made with the city to supply 10 arc lamps for street lighting, and in 1888 this number was increased to 250. About 1886 the Electric Company moved its plant to what is known as the Brook Street station, which was operated then as now by steam power.

In 1890, the Union Electric Company was formed to build a dam and electric power station at Kelley's falls on the Piscataquog River, about three miles west of the Brook Street station. This second company and all of its equipment was absorbed by the Manchester Electric Company, or the one operating the Brook Street station in 1894. In this same year the Union Electric Company had acquired a water power site at Gregg's Falls on the river just named, and about six miles from the Brook Street station.

An electric street railway was started at Manchester in 1895, and has now come to include 28 miles of single track, laid with 56, 60, 70 and 90-lb. T and girder rails, over which 68 cars are operated. Energy to operate the street railway has been supplied from the start by 500-volt generators devoted to that purpose at the Brook Street station.

Coincident in time with the later electrical developments at Manchester, two water power stations for electric lighting were started on the banks of the Merrimac River some miles to the north. One of these stations is in the town of Hooksett, 10 miles from Manchester, and the other at Garvin's Falls, four miles further up the river. At Hooksett the electric plant was originally started for local use, and the dynamos at Garvin's Falls supplied light to the village and mills of Suncook.

The Manchester Traction, Light & Power Company has been formed to own and operate all of the water-power plants, electric stations and systems just named, and much advantage and further development is expected from the unity of management thus attained. The four water-power stations named have capacities far greater than can be utilized in their respective localities, and the great bulk of the energy developed by them, as well as much of that generated at the Brook Street station, is delivered to a sub-station about 150 ft. distant from this Brook Street plant. Through the use of this sub-station energy developed at any one of the five generating plants can be delivered at any of the others, or the energy from all plants can be supplied to the distribution lines centering at the sub-station.

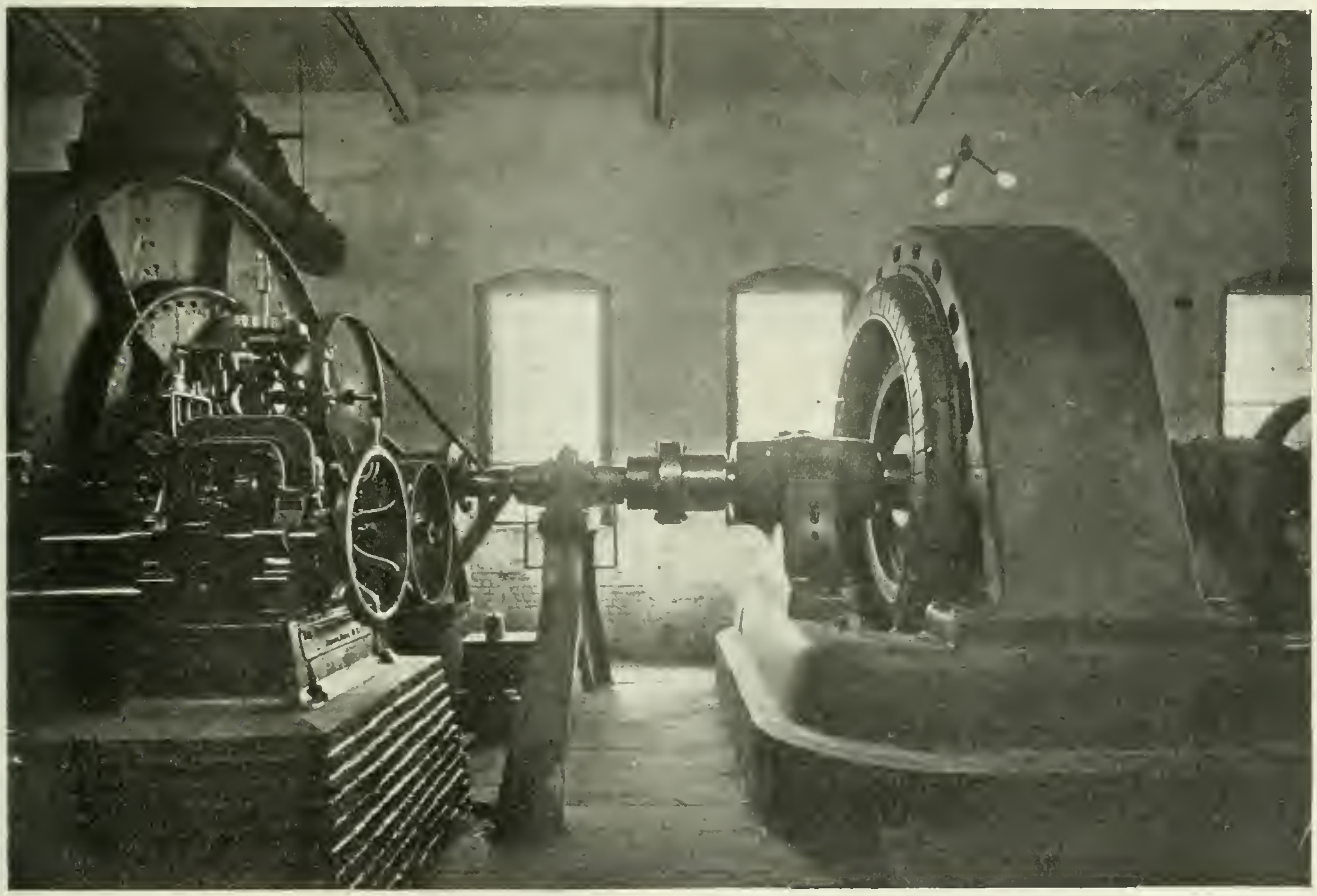


FIG. 1.—1200-KW THREE-PHASE GENERATOR, GREGG'S FALLS.

In Fig. 2 are shown the relative positions of the city of Manchester, the several towns supplied with light, and of the five generating plants and the sub-station, which gives some idea of the rather unusual problem that is being solved by this system. To bring out the conditions of the problem more clearly the several elements of the system will be taken up under separate headings.

STEAM POWER PLANTS.

The Brook Street station, not far from the center of the city of Manchester, on a spur track of the railway, and near the Merrimac River, depends entirely on steam power. The station contains two rooms, one 120 by 40 ft., the other 140 by 50 ft. Here are located 12 tubular boilers of 125 nominal horse-power capacity each, though capable of working up to fully 2500 horse-power, as they have been required to do at times in the past. George's Creek coal is burned under these boilers, and they evaporate about 9 lbs. of water per pound of coal burned, the boiler feed being heated by engine exhaust to 160 degs. The boilers deliver steam at 115 lbs. gauge pressure, and the water for them is pumped directly from the river. Two brick chimneys furnish natural draft. The engines at this plant include one 1200-hp Providence-Green cross compound, one 800-hp Philadelphia-Green tandem compound, and two Woodbury tandem compounds, one of 400 and the other of 600-hp capacity. This makes a total of 3000 nominal horse-power. All of the engines are supplied with individual condensers and exhaust into a vacuum of 3 lbs. absolute pressure. Water for the condensers is pumped from the river, and its only cost is the expense of pumping. One of these engines is belted directly to a railway generator; the others all drive onto countershafts.

The only other steam plant included in the system of the Manchester Traction, Light & Power Company is that which supplements the water power at Kelley's Falls. A brick dynamo and engine room one story high and 125 by 65 ft., also a two-story boiler house, 40 by 40 ft., make up the station at Kelley's Falls. In the boiler house are three upright Manning tubular boilers, each 5 ft. in diameter, 15 ft. high and rated at 200 horse-power. An iron stack 5 ft. in diameter and 80 ft. high furnishes natural draft for these boilers. George's Creek coal is burned. This station being directly on the river bank, water for boilers and condensers is readily pumped from it.

There are two engines at this plant, one 14 by 28 by 18-inch Stearns vertical compound, and one 18 by 30 by 16-inch vertical Westinghouse compound. Each engine is provided with a Bulkley condenser. A line of 6-inch shafting is driven with belts, by either or both of these engines, and the dynamos make belt connections with it.

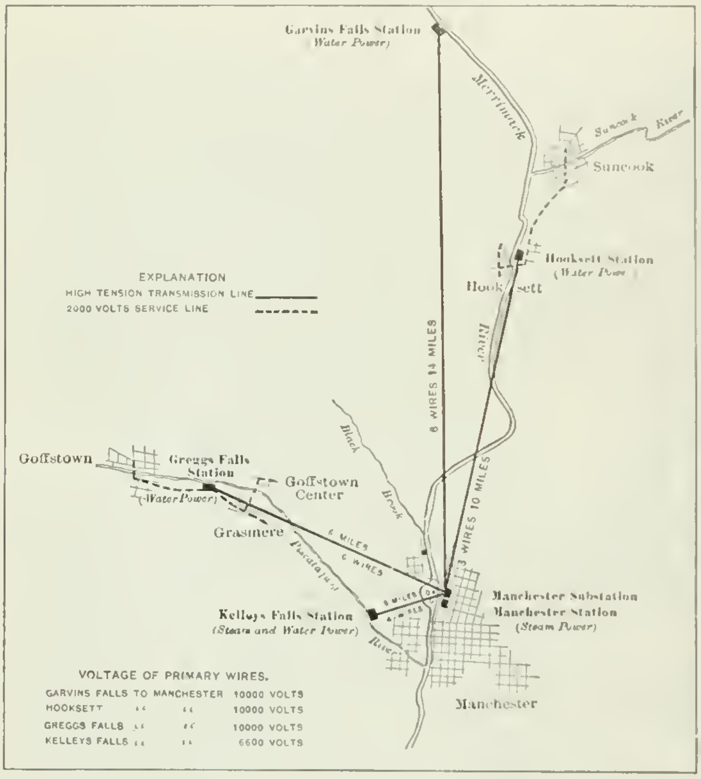


FIG. 2.—MAP OF STATION AND TRANSMISSION.

WATER POWERS.

The four water powers of the Manchester Traction, Light & Power Company probably represent a greater combined capacity than that owned by any other electric company in New England. At Kelley's Falls the company owns the exclusive water privilege on both sides of the Piscataquog River, which has been improved by the erection of a timber dam, stone filled, and with masonry wings. The entire flow of the river has a fall of 24 ft. at this point. Two Rodney Hunt horizontal turbine wheels, each 33 inches in diameter, are fed through an 11-ft. diameter steel penstock. About 1000 horse-power is thus developed with only a fraction of the water available at most times of year. These turbine wheels are arranged to drive the shaft previously mentioned, so that either water or steam power may be applied to the dynamos. The steam power is only used at times of low water. At Gregg's Falls, three miles further up the river just named, the company has erected another stone and timber dam, with masonry wings, and owns the entire water privilege.

The stream falls 51 ft. at this point, and is estimated to yield 3000 horse-power, with a moderately good flow of water. A one-story brick station, 89 by 32 ft., has been erected just at the foot of these falls, on a shelf of solid rock, and two steel penstocks, each 10 ft. in diameter, enter it. One of these penstocks remains unused, and the other terminates in a wheel case containing three Rodney Hunt horizontal turbine wheels, 27 inches in diameter each, and operating at 333 r. p. m. to develop about 1600 horse-power. The speed of these wheels is regulated by a Replogle governor.

To the shaft extending from the wheel case the single main generator at this station is coupled. The station is designed to allow the present generating equipment to be doubled.

Next among the water powers to be considered is that at Hooksett on the Merrimac, 10 miles from Manchester, where there is a fall of 16 ft. Already 1000 horse-power here is devoted to driving dynamos in the electric station, but more power can be had by additional development.

Four miles above Hooksett the Merrimac takes a plunge of 30 ft., at what is known as Garvin's Falls. Here the company owns 1000 acres of land, and is preparing to utilize a considerable part of the great power that now goes to waste. At present the Garvin's Fall electric plant requires only 350 horse-power, but contracts have already been let that call for a plant of nearly 4000 horse-power. This new plant will include a brick station with 4000 square ft. of floor space, and direct connected wheels and electric generators to the capacity of 2600 kilowatts.

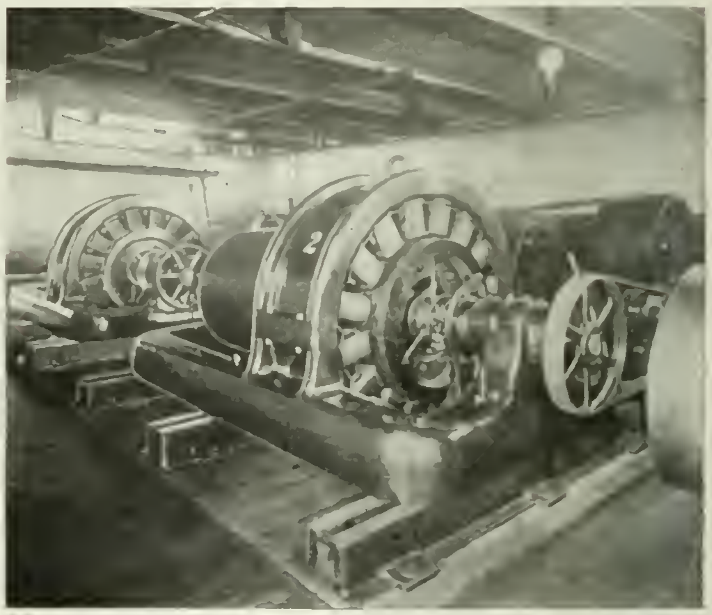


FIG. 3.—INTERIOR OF BROOK SRTEET STATION.

To sum up for these four water-power plants, their present and partly completed equipments involved the development of about 9000 horse-power by the electrical machinery, while the capacity for future increase may easily double this figure.

GENERATING MACHINERY.

At the Brook Street station the electrical equipment includes three 600-volt generators for railway work, with capacities of 500, 300 and 200 kilowatts, respectively. Two of these generators are belt driven from the main shaft previously mentioned, and one of them is belt driven directly by its engine. All three of these railway generators deliver their energy at a switchboard in their own station, and this energy operates the electric railway previously mentioned.

At this same station are also located two direct-current, 500-volt generators for stationary motor service, one being 100 and the other 60-kw capacity. The direct-current arc light dynamos include four 125-lamp, three-circuit Brush machines, and eight 50-light, T.-H. machines, all for lamps of nominal 2000 candle-power. These are machines connected with their own switchboard in the Brook Street station, and are largely devoted to city lighting, 487 arc lamps being supplied for the streets of Manchester.

It will be noted that the three classes of dynamos just mentioned are connected to the distribution lines without passing through a sub-station. In contrast with this practice, the alternating generators at his plant deliver their energy to the switchboard in the sub-station. These alternating generators are four in number, with capacities, one of 100, two of 250 and one of 650 kilowatts, all being three-phase, 60-cycle, at 2000 volts, and of the General Electric make. The four alternating generators are belted to the main shaft which drives the railway, stationary motor, and arc dynamos, and when sending out energy are driven by the steam engines connected to this shaft. Exciters for these alternating generators are also included in the equipment.

The station at Kelley's Falls contains four alternating generators, one 300-kw, three-phase, 2000-volt machine of General Electric make, one 450-kw, two-phase, 2000-volt, and one 180-kw, two-phase, 2000-volt Stanley machine, and one 160-kw, two-phase, 2000-volt Westinghouse generator. These alternators and their exciters are belt-driven from the main shaft, and connected through a marble switchboard 30 ft. in length. From this switchboard connections are made to transformers in the same station, which raise the energy to a pressure of 6600 volts for transmission to the sub-station, three miles away.

At Gregg's Falls there is a single General Electric alternating generator, with exciter direct connected to the turbine shaft. This generator is of the rotating field type and 1200-kw capacity, three-phase, 60-cycle, at 10,000 volts. After passing to the switchboard most of the energy from this machine is transmitted to the sub-station in Manchester. Transformers at the Gregg's Falls plant reduce a small part of the energy to a pressure of 2000 volts to light Goffstown and Grassmere.

Two General Electric three-phase alternating generators are operated at the Hooksett station, each developing 300 kilowatts at 1000 volts. A part of the energy from these machines is distributed at 1000 volts to Hooksett and Suncook, and the remainder is raised by transformers to 10,000 volts and transmitted to the sub-station at Manchester.

At Garvin's Falls the greatest of the four water powers, four General Electric generators, direct-connected to the shafts of turbine wheels, will shortly be operating in a station now under construction. Each of these generators has a capacity of 650 kilowatts, three-phase, 60-cycle, at 10,000 volts, and is of the rotating field type. As soon as erected, the four dynamos at Garvin's Falls will be connected by a line 14 miles long with the Manchester sub-station.

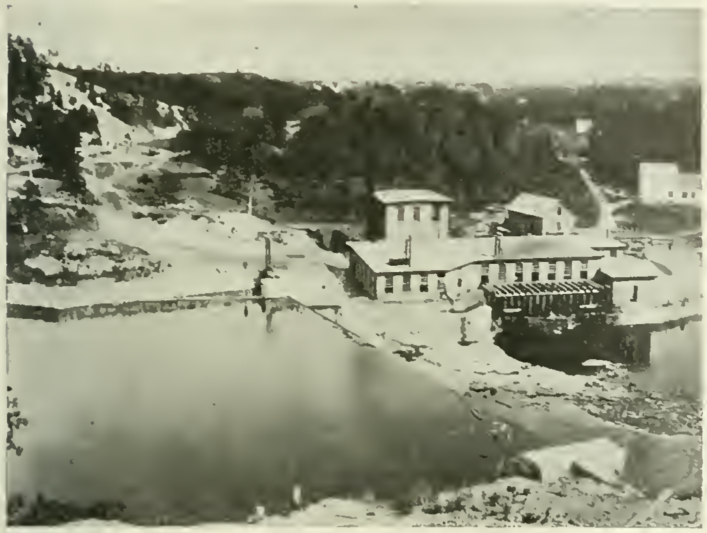


FIG. 4.—KELLY'S FALLS.

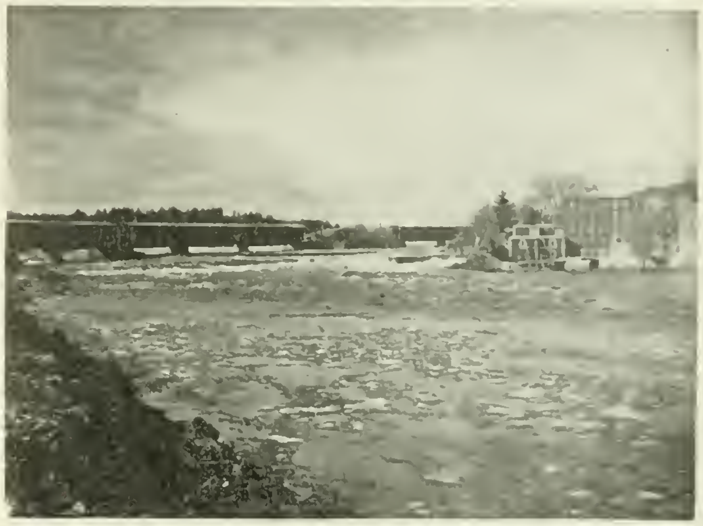


FIG. 6.—POWER STATION AT HOOKSETT, N. H.

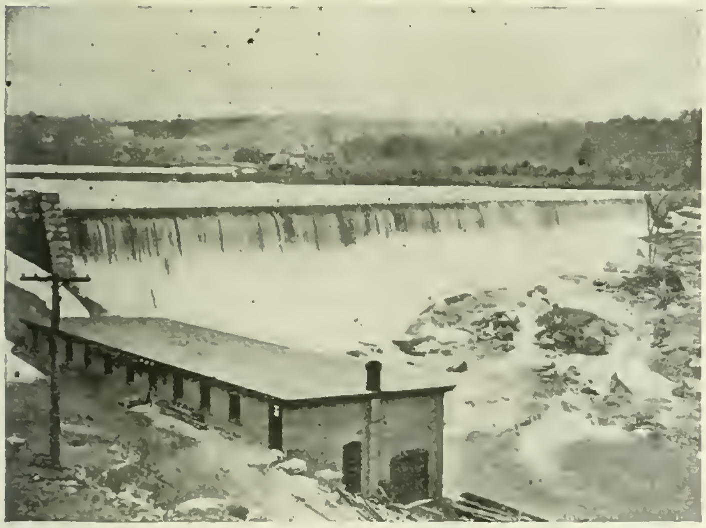


FIG. 5.—POWER STATION, GREGG'S FALLS.

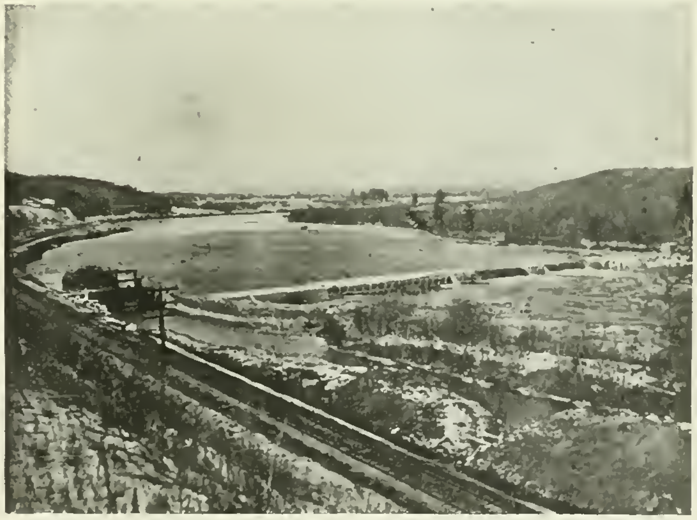


FIG. 7.—GARVIN'S FALLS.

ELECTRICAL DEVELOPMENT AT MANCHESTER, N. H.

THE SUB-STATION.

From the foregoing it is seen that the system under consideration includes five generating stations; one operated entirely by steam power, one by steam and water combined, and three by water-power alone. It is desired that all of these stations deliver the greater portion of their energy for use on distribution lines in the city of Manchester, and also that each station may draw energy from any of the others at times when its machinery is not in operation. To accomplish these results energy from all the stations must be available at a common point for regulation and transfer, and this point is established in the Manchester sub-station.

This sub-station is located about 150 ft. from the Brook Street station, is one story high, 42 by 73 ft. on the ground, and is built entirely of brick, stone, cement and iron. Underneath the main floor there is an air-tight basement which is intended to serve as an air-pressure chamber. Two blowers, each driven by a three-phase motor direct connected, are provided to maintain the air in the basement at a higher pressure than that outside. Over openings in the main floor the necessary transformers to receive the lines from generating stations are placed. These transformers are of the General Electric make and type, adapted to be air cooled, and the excess of pressure maintained in the basement causes a rapid flow of air through them. Besides the transformers the main apparatus in the sub-station is the switchboard and its equipment, designed by Hollis French and Allen Hubbard, consulting engineers, of Boston, Mass.

This switchboard deserves particular attention because of its size, construction and the rather novel service it performs. The length of the switchboard is 56 ft., its height 7.5 ft., and it is composed of two parts, duplicates as to length and height, one part being 2 ft. and the other 6 ft. 8 inches from the side wall of the sub-station. Marble set in a wooden frame is the material used for the switchboard, the wood being so prepared as to be practically incombustible. Wood was preferred to steel for this frame because it does not increase the danger with high voltages. The front part of the switchboard, or that further from the wall, is divided into 13 panels (Fig. 8), each panel being provided with instruments for a particular purpose.

Lines from the water-power stations terminate in transformers at the sub-station, and the pressures are reduced from 6600 and 10,000 volts to 2000 volts on the transformer secondaries. These secondaries and also wires from the four 2000-volt alternating generators in the Brook Street station, are run to the rear half of the switchboard, or that nearer the wall. All distribution circuits also leave this rear part of the board. Series and potential transformers for each circuit are mounted on the rear board, and circuits are carried thence to the front part of the switchboard.

Three-phase alternating currents of 60-cycles, at 2000 volts, are thus supplied by all main circuits feeding the board. To distribute this energy to the various supply circuits, the front board is provided with two sets of three conductor bus-bars. The lower set is divided by switches into nearly as many sections as there are panels in the board, and the upper set is divided into two sections. Triple-pole, single-throw oil switches are provided to unite the sections of each set of bus-bars when desired. Each main circuit conveying energy either to or from the board is provided on the front half with a triple-pole, double throw oil switch, so that it may be connected to either the upper or the lower set of bus-bars.

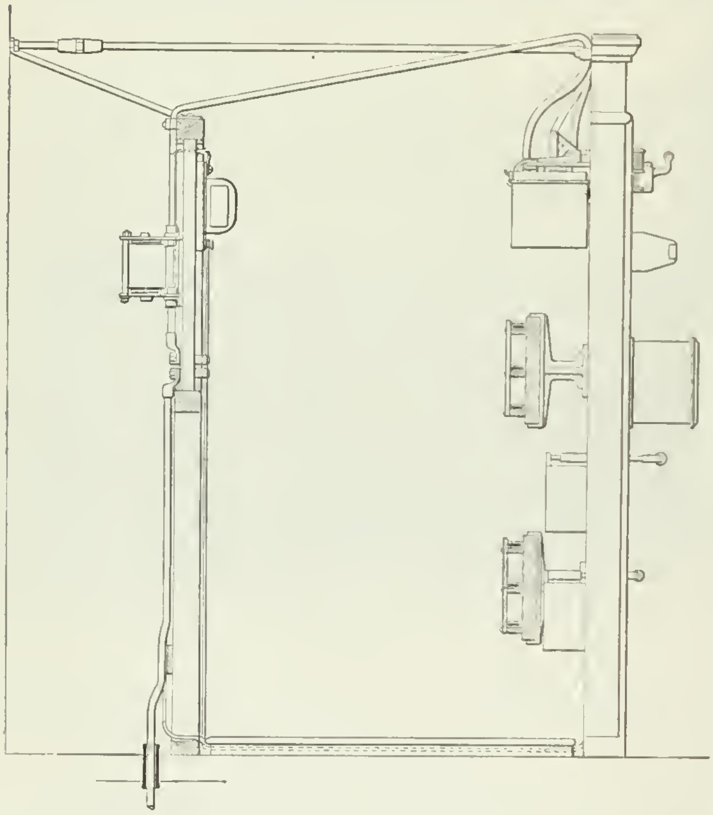


FIG. 8.—SWITCHBOARD IN SUB-STATION.

In addition to this switch, each main circuit from the sub-station transformers, or from the alternating generators in the Brook Street station, is provided on the front half of the board with an automatic overload, oil circuit-breaker, an indicating wattmeter, a polyphase recording wattmeter, and an alternating-current voltmeter. Each main distribution circuit running from the board has besides the switch an automatic, overload, oil circuit-breaker, three alternating-current ammeters, and a polyphase recording wattmeter.

Both the field and armature circuits of the alternating generators in the Brook Street station, also the circuit and instruments for their exciters, are brought to the switchboard in the sub-station. The switchboard is also provided with synchronizing switches and lamps, ground detector and instruments and connections for the sub-station lamps and blower motors. S. B. Condit, Jr., & Co., of Boston, were the contractors for this board.

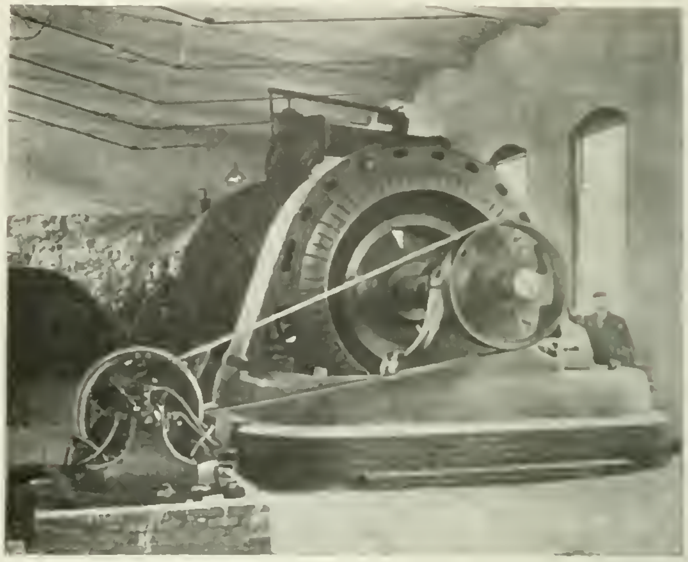


FIG. 9.—1200-KW THREE-PHASE GENERATOR, GREGG'S FALLS

OPERATION.

Under normal conditions the four water-power stations and the steam power station on Brook Street all deliver energy in the form of alternating currents to the sub-station. Through the transformers there the pressure of energy from the water-power plants is reduced, so that it reaches the switchboard, in common with the energy from the alternating generators in the Brook Street station, as three-phase, 60-cycle currents of about 2000 volts pressure. As each main line from generators or transformers to the switchboard terminates there in a triple-pole, double-throw switch, connecting with either the upper or lower bus-bars, and as the lower set of bus-bars can be divided by switches into as many sections as there are main supply lines from generators and transformers, each of these main lines may be connected in multiple with other similar lines on the upper set of bus-bars, or may be put onto an isolated bus-bar section of the lower set.

Each main distribution line coming to the switchboard terminates there in one of the triple-pole, double-throw switches, and may be connected through this switch either to the upper set of bus-bars or to one of the sections of the lower set. Each section of the lower set of bus-bars that connects with the switch of a supply line from a generator or transformer, also connects with the switch of a distribution line. As switches are provided that may be used to unite any or all of the sections of the lower set of bus-bars consecutively, a single main supply line may be connected to a number of these sections. The utility of these arrangements of upper and lower bus-bars and switches is that any particular transformer or generator may be devoted to the supply of certain distribution lines. In this way the pressure losses in different distribution lines may be compensated for by the connection of each distribution line to that set of bus-bars or to that section of a set, having a pressure that most nearly equals the sum of the loss in it and of the constant pressure desired at the transformers of consumers.

As the distribution service from the sub-station includes three-phase induction motors of large capacities, one of the Manchester mills supplied using 400 horse-power, and another 1200 horse-power of these motors, the loads on some of the distribution lines are subject to rapid and large variations. It is often undesirable to allow such variations to occur in the loads on transformers or generators that are supplying circuits for commercial lighting, because of the resulting fluctuations of pressure at lamps. The sections of the lower set of bus-bars allow one or more transformers or alternating generators at any time to be devoted exclusively to one or more of these variable loads, thus avoiding its undesirable effect if connected to the general distribution system.

Obviously the arrangement of bus-bars and switches mentioned makes it possible to operate all of the generating stations in parallel on the alternating distribution lines, through the sub-station, or to supply any particular distribution line from either station. It is also possible to operate the local service from any water-power station, as that at Hooksett and Suncook, by energy from any one or from all of the other stations, when the generators at the station from which the local service starts are shut down. This result is reached through the transformers in the sub-station, which may be employed to draw energy from either set or section of the bus-bars at 2000 volts, and to deliver it to the transmission line running from the sub-station to the non-operative water-power station at 10,000 or 6600 volts, as the case may be. At this water-power station the energy from the sub-station is then reduced in pressure by transformers to 2000 volts for the local distribution lines.

The equipment and methods of operation outlined make it possible to supply the entire alternating-current load of the Manchester system from the four water-power plants, provided that these plants have sufficient capacity, which will be the case as soon as the 2600-kw station at Garvin's Falls is started. It is also desirable to operate the load of street railway motors, direct-current stationary motors, and direct-current arc lamps by the several water powers. These loads are now carried by machines in the steam power Brook Street station previously named, and with a capacity of 1000 kilowatts in railway generators, 160 kilowatts in 500 generators for stationary motors, and of 900, 2000-cp arc lamp capacity, or about 450 kilowatts, in direct-current arc dynamos, making a total of 1610 kilowatts.

After the plant at Garvin's Falls is completed so as to give sufficient capacity, the just mentioned machinery at the Brook Street station will also be operated by water power to a large extent if not entirely.

As previously mentioned, all of the electric generators at the Brook Street station, except one railway dynamo, are belt driven from the main shafting. Among the generators thus driven are four 2000-volt three-phase alternators, previously mentioned, which have a combined capacity of 1250 kilowatts. These three-phase machines can, of course, operate either as generators or as motors, and when used as motors they are capable of driving the main shafting and nearly all of the direct-current dynamos at the Brook Street station, except the single railway generator now belt-connected to an independent engine. These alternating machines, being connected to triple-pole, double-throw switches on the switchboard in the sub-station, may be supplied with current from either set of bus-bars, and thus drive the other dynamos connected to their shaft, as soon as the combined water-power capacity is great enough to carry the entire load.

LINES.

Apart from the distribution circuits in the city of Manchester and in the several towns served, the system of the company includes more than 33 miles of pole line for transmission wires. Double petticoat glass insulators are now used on all of the 6600 and 10,000-volt lines, glass having proved more reliable than porcelain for the purpose. The wires of all the high-pressure transmission lines are bare copper, it being thought that the glass insulators alone should be relied on for such voltages. Where the transmission lines pass through the city, on their way to the sub-station, they are carried above all other wires, to prevent accidents by crosses with broken circuits. Distribution lines in Manchester and in the towns served for the street railway, the 2000-volt alternating current, the 500-volt stationary motors and the direct-current arcs, are all weather-proof wire.

The collection of energy from these scattered water powers, and its delivery at the sub-station in Manchester, has already made the electrical interests there nearly, and in a short time will make them quite, independent of a coal supply. But this is only the beginning. Manchester is a city of manufactures, mostly carried on by steam. Many hundreds of electrical horse-power are even now sold to manufacturers there at prices that have led them to discard the steam engine. In the future, when the great resources of the the electrical system have been fully developed, the larger part of the machinery may be driven by distant waterfalls.

An Electrical Tide Indicator.

By Grahame H. Powell.

The fire of the guns of a modern coast defense fort is affected by many conditions of wind, temperature and atmosphere, all of which must be accurately gauged and allowed for before a single shot is fired from the heavy guns constituting the armament.

With a vertical base system of range finding in use it becomes necessary to know at all times the exact height of the instrument above the level of the sea, and as this is constantly changing under the influence of the tides, means must be employed to keep the range finder operator always informed as to the height of the water that his instrument may be kept in adjustment, as on this depends the accuracy of the observations taken.

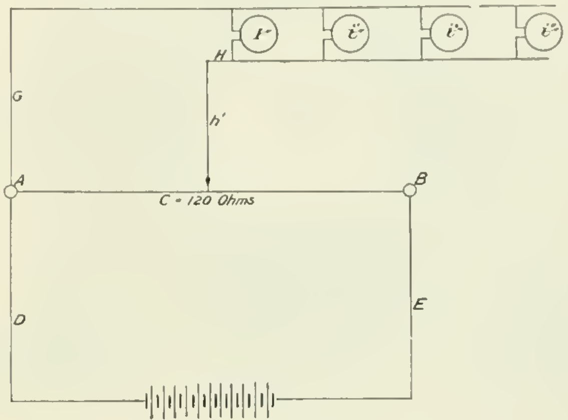


FIG. I.—SIMPLE DIAGRAM OF CIRCUITS.

This has hitherto been done by means of a simple float actuating a hand on a large dial placed near the water's edge. Excursionists on boats passing through the Narrows in New York Harbor may have observed such a dial on the dock at Fort Hamilton on the Long Island shore. This dial was used as the indicator for Fort Wadsworth a mile away on Staten Island, and could only be read by means of a glass. A device recently designed and constructed by Mr. Alexis Le Blanc, an electrical engineer of New York City, overcomes all the difficulties and inconveniences of the old methods of tide-gauging.

Reference to Fig. 1 will readily show the operation of the system. *A* and *B* are two points connected to a battery *F* by means of leads *E* and *D*, the battery maintaining a difference of potential of exactly 10 volts between *A* and *B*.

Across the terminals *A* and *B* there is connected a fixed resistance *C* of 120 ohms, which completes the battery circuit. One line terminal *G* is connected to the point *A*, the other line terminal *H* to the movable slide *h'*, the indicating instruments (specially wound 10-volt voltmeters) being connected in parallel, as shown.

If the slide *h'* rests at *A* there is, of course, no difference of potential in the line circuit, and in consequence the pointers of the indicators are at rest. On the other hand, if the slide *h'* is brought in contact with *B* the full potential of 10 volts will be in the line circuit and the needles of the indicating instruments will point to the highest mark on the scale.

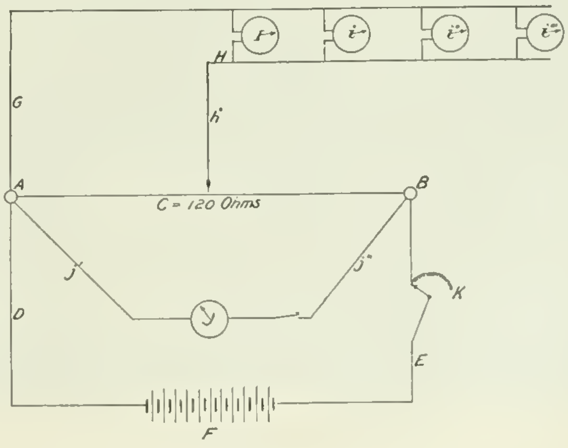


FIG. 2.—DIAGRAM OF CIRCUITS.

Taking for example the tidal conditions in New York Harbor, where there is a maximum range of 4 ft. below and 8 ft. above mean low water, a total of 12 ft., a scale was selected having 12 full divisions sub-divided into tenths, making a total of 120 lines, one for each 1-10-ft. change in level.

Assume that the slide *h'* is at *A*. Now suppose the tide to be rising and moving the slide towards *B*. For every one ohm resistance of *C* passed over by *h'* in traveling towards *B* the needles of the indicating instruments will show 1-10-ft. rise of tide. With a falling tide the operation is, of course, simply reversed. In order that the points *A* and *B* can be readily adjusted to 10 volts, a voltmeter *J* and a variable resistance *K* are inserted, as shown in Fig. 2.

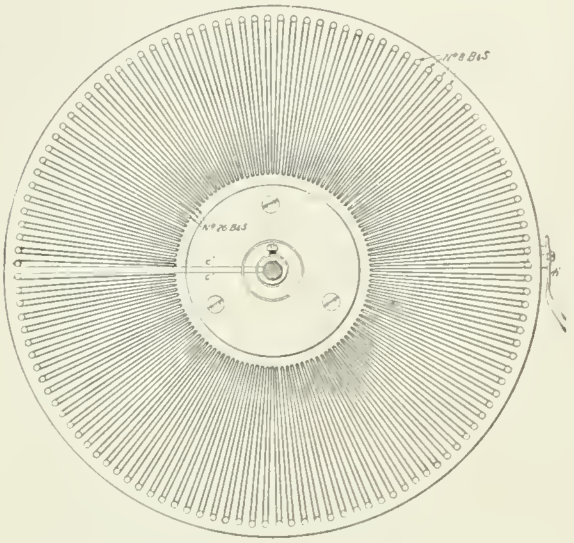


FIG. 3.—RESISTANCE DISK.

In the actual construction of the instrument a slight variation is made from the foregoing description in that the slide *h'* is made stationary, while the resistance *C* is made to pass under it, the latter being embedded in a hard rubber disk (*C*, Fig. 4), the slide being shown as a fixed brush (*h'*, Fig. 4).

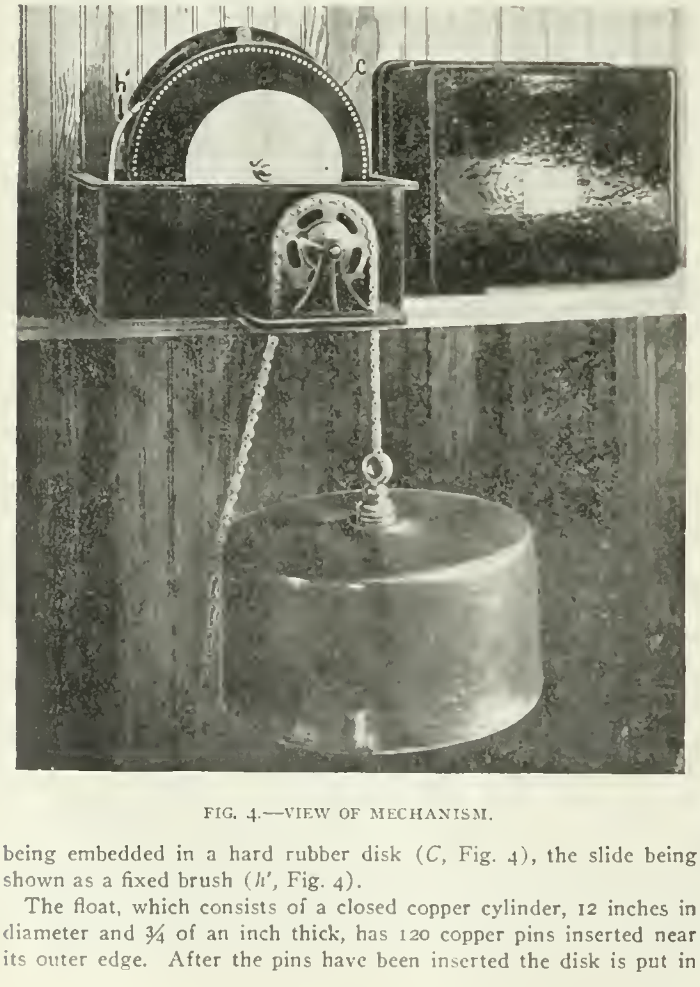


FIG. 4.—VIEW OF MECHANISM.

The float, which consists of a closed copper cylinder, 12 inches in diameter and ¾ of an inch thick, has 120 copper pins inserted near its outer edge. After the pins have been inserted the disk is put in a lathe and a slot turned in its periphery just deep enough to cut away one-third the diameter of the pins, thus leaving a neat commutator surface for the brush *h'* to slide on. The disk is then slotted at right angles to its axis, and 120 resistance wires of exactly one ohm are looped from pin to pin around the entire circumference, except the first and last pins, which are flexibly connected to points *A* and *B*. Fig. 5. represents the indicator.

The entire apparatus is enclosed in a moisture-proof cast-iron box, the line and battery wires passing through glands packed with soft rubber. The indicators of the instrument may be placed in the several range finder houses, and thus all the operators kept constantly informed of the state of the tide, which, as before remarked, is essential to the proper working of the adopted system of vertical base range finding.

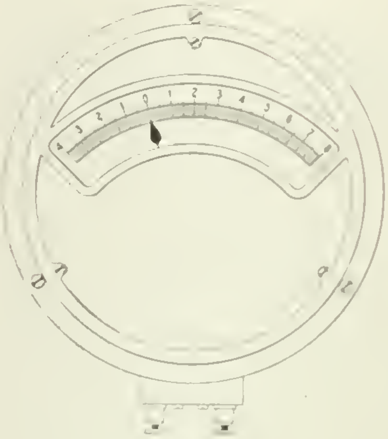


FIG. 5.—INDICATOR.

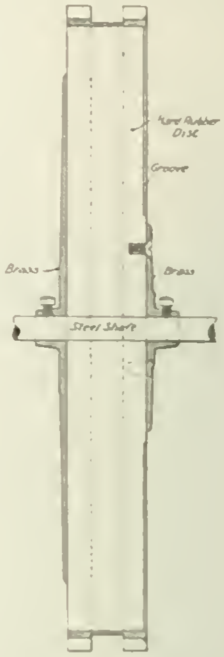


FIG. 6.—DETAILS OF APPARATUS.

Signal Corps Work in China.

General Chaffee, commanding the American troops in China, makes hash of an article written recently by a war correspondent named Millard, depreciating in many ways the work and equipment of the American troops in China. One passage of General Chaffee's criticism is as follows: "No one objects to the high admiration expressed by Mr. Millard for the Japanese army, its equipment, etc. However, when he says, 'On the march to Pekin their field telegraph line prevented the allied army from losing connection with its base; the American Signal Corps, a branch our service is wont to boast of, did manage to string a wire and keep it open at least part of the time, being on all sorts of improvised poles in a treeless country, it naturally fell by the wayside with annoying frequency; not so with the Jap telegraph. It was provided with telescopic metal poles and braces, and when once set stood. An hour after the camp was pitched after a day's march the Japanese field telegraph would open up communication with the next station in the rear'—he is dallying with error. The fact is, the British and American telegraph line, jointly constructed and operated, was the only line brought forward with the troops."

"The Gauss."

The two Antarctic exploring expeditions which are expected to start some time in August next—the German in the Gauss, which has just been launched at Kiel, and the English in the Discovery, recently launched at Dundee—are rapidly completing their arrangements for the great undertaking. The German vessel, named after the great German authority on terrestrial magnetism, is slightly smaller than the English vessel. She is 168 ft. long and 35 ft. broad, the Discovery being 172 ft. in length at the water line and 34 ft. in breadth. It is expected that the English vessel, fully loaded, will have a displacement of about 1750 tons, whereas the Gauss will not exceed 1450 tons. Both vessels are strongly built of oak and sheathed with greenheart. The bows are made with a great sheer, so that the vessel will tend to ride upon the ice and break it with her weight. There are no openings whatever on the sides of the Discovery, all light for the cabins being obtained from the deck skylights.

Elements of Illumination—XXV.

By Dr. Louis Bell.

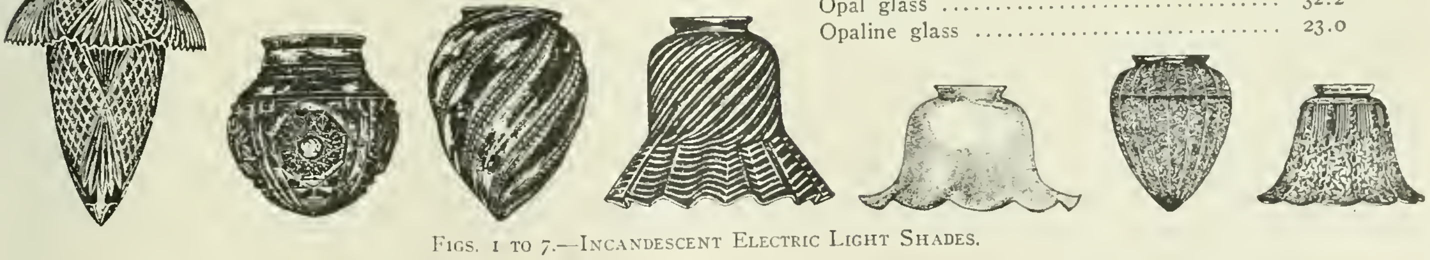
SHADES AND REFLECTORS.

As has already been pointed out, the success of lights in common use leave much to be desired in the distribution of light, and have, for the most part, too great intrinsic brilliancy. The eye may suffer from their use, and even if this does not occur the ilumination derived from them is less useful than if the intrinsic brilliancy were reduced.

Hence the frequent use of shades and reflectors in manifold forms. Properly speaking, shades are intended to modify the light by being placed between it and the eye, while reflectors are primarily designed to modify the distribution of the light rather than its intensity. Practically the two classes often merge into each other or are combined in various ways. There is, besides, a considerable class of shades of alleged decorative qualities, which neither redistribute the light in any useful manner nor shield the eye to any material degree. Most of them are hopelessly Philistine, and have no æsthetic relation to any known scheme of interior decoration. Figs. 1 and 2, a stalactite and globe, respectively, of elaborately cut glass, are excellent examples of things to be shunned. Cut glass is not at its best when viewed by transmitted light, and neither diffuses nor distributes the light to any advantage. Such fixtures logically belong with an onyx bar inlaid with silver dollars, and to that class of decoration in general almost equally bad are shades that produce a strongly streaked or mottled appearance like Figs. 3 and 4. These neither stop the glare from a too intense radiant nor render the illumination more practically useful by improving its distribution. These shades happen to be all of them for incandescent lamps, but they are evil in both principle and application, and would be equally bad in connection with any other kind of illuminant.

With open gas flames a shade may be of some use as a protection from draughts, but generally its purpose is to improve the illumination, and if it fails of this it has no excuse for being. For artistic reasons it is sometimes desirable even to reduce the illumination of a deep mellow glow quite irrespective of economy, and in such case shades may be made ornamental to any degree and of any density required, or lights may be distributed for purely decorative purposes, but gaudy spotted and striped affairs, like those just shown, are useless even for these purposes.

The first requirement of a shade is that it shall actually soften and diffuse the light it shelters. If it does not do this no amount of ornamentation can make it tolerable from an æsthetic standpoint. Almost any kind of ornamentation is permissable that does not defeat this well-defined object. Translucent porcelain, ground and etched glass are all available in graceful forms. If perfectly plain shades, like Fig. 5, seem too severe, then those finely etched in inconspicuous figures, like Figs. 6 and 7, may answer the purpose. The main thing is to conceal the glaring incandescent filament or mantle so that it will not show offensively bright spots. Hence the general objection to cut glass which, if used at all, should for the display of its intrinsic beauty be so arranged that it can be seen by strong reflected light rather than by that which comes from its interior.



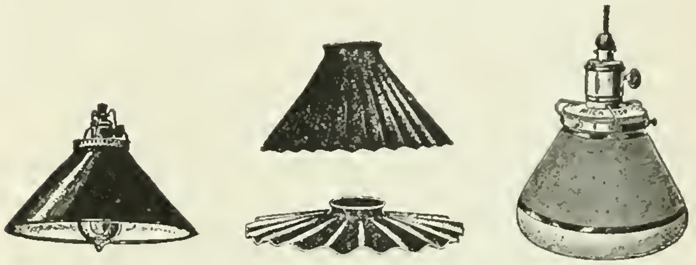
Figs. 1 to 7.—Incandescent Electric Light Shades.

Thin paper and fabrics may be most effectively employed for shades, and can readily be made to harmonize with any style of ornamentation or color scheme that may be in hand. In this respect these materials are far preferable to glass or porcelain, although more perishable and less convenient for permanent use on a large scale. They also entail much loss of light, and are far better suited to domestic illumination than to larger installations. The real proportion of light cut off by such shades has not, to the author's knowledge, ever been accurately measured, and, indeed, by reason of the immense variety in them, it would be almost impossible to average. It is safe to say, however, that it is generally over 50 per cent, although the light is so much softened that the loss is not seriously felt in reading or other occupations not taxing the eyes evenly.

With respect to porcelain and glass shades the proportion of light absorbed has been measured many times, and on many different kinds of shades, so that actual, even if diverse, figures are available. The following table gives the general results obtained by several experimenters on the absorption of various kinds of globes, especially with reference to arc lights.

	Per cent.
Clear glass	10
Alabaster glass	15
Opaline glass	20-40
Ground glass	25-30
Opal glass	25-60
Milky glass	30-60

The great variations to which these absorptions are subject are evident enough from these figures. They mean, in the rough, that clean, clear glass globes absorb about 10 per cent of the light, and that opalescent glasses absorb from 15 to 60 per cent, according to their density. Too much importance should not be attached to this large absorption, since it has already been shown that in most cases, so far as useful effect is concerned, diffusion and the resulting lessening of the intrinsic brilliancy is cheaply bought even at the cost of pretty heavy loss of total luminous radiation.



Figs. 8 to 11.—Shades and Reflectors.

The classes of shades commonly used for incandescent lamps and gas lights have been recently investigated with considerable care by Mr. W. L. Smith, to whom the author is indebted for some very interesting data on this subject.

The experiments covered more than 20 varieties of shades and reflectors, and both the absorption and the redistribution of light was investigated. One group of results obtained from 6-inch spherical globes, intended to somewhat diffuse the light without changing its distribution resulted as follows, giving figures comparable with those just quoted:

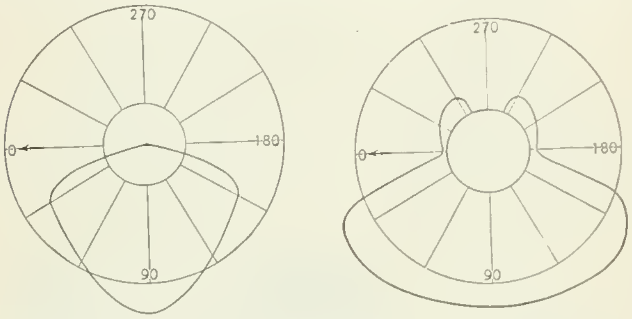
	Per cent.
Ground glass	24.4
Prismatic glass	20.7
Opal glass	32.2
Opaline glass	23.0

The prismatic glass globe in question was of clear glass, but with prismatic longitudinal grooves, while the opal and opaline globes were of medium density only.

Etched glass, like Figs. 6 and 7, has considerably more absorption than any of the above, being equivalent to coarse and dense grinding. Their diffusion is less homogenous than that given by ordinary grinding, so that they may fairly be said to be undesirable where efficiency is to be seriously considered.

A plain, slender canary stalactite behaved like the balls as respects distribution, and showed just the same absorption as the ground glass globe, i. e., 24.4 per cent, but permitted an offensively brilliant view of the filament within.

Another group of tests had to do with reflecting shades designed to throw light downward, in some cases giving a certain amount of transmitted light, in others really opaque. The characteristics of some common forms of such shades are plainly shown by the curves of light distribution made with the shades in shape. Figs. 8 and 9 show two thoroughly typical examples of these shades. Fig. 8 is the ordinary enameled tin 8-inch shade, green on the outside and brilliant white within, a form too often used over desks. Fig. 9 is almost as common, being a fluted porcelain 6-inch shade, used in about the same way as Fig. 8. Figs. 12 and 13 give the respective vertical distributions produced by these two shades, the outer circles showing for reference the nominal 16-cp rating. The porcelain not only gives a more uniform reflection downwards, but transmits some useful light outwards. The case as between it and the tin shade of Figs. 8 and 12, which gives a strong but narrow light downward, may be tabulated as follows:

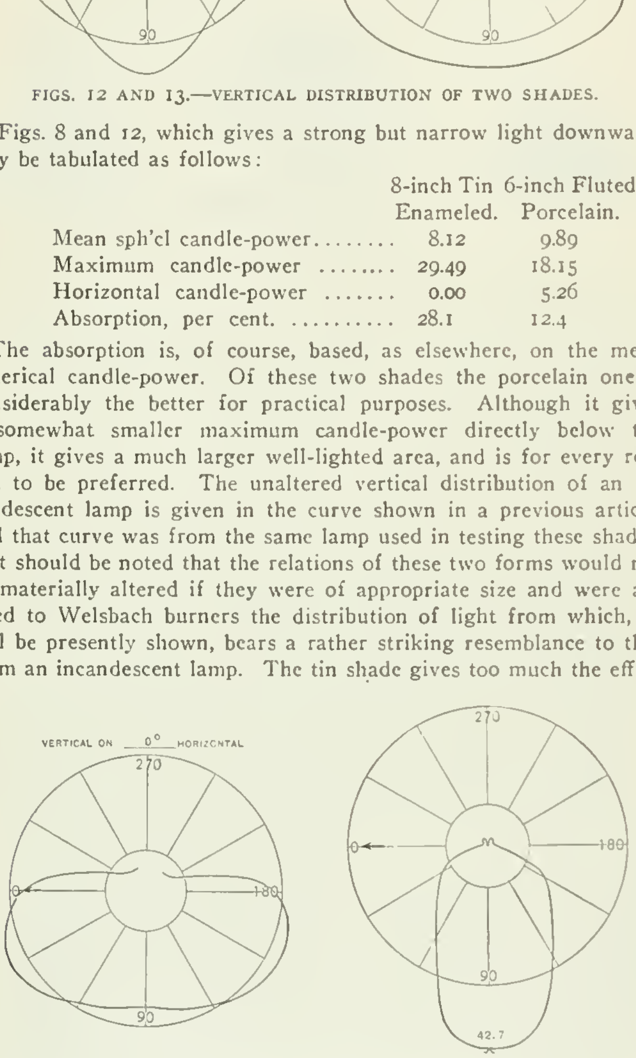


FIGS. 12 AND 13.—VERTICAL DISTRIBUTION OF TWO SHADES.

	8-inch Tin Enameled.	6-inch Fluted Porcelain.
Mean sph'cl candle-power	8.12	9.89
Maximum candle-power	29.49	18.15
Horizontal candle-power	0.00	5.26
Absorption, per cent.	28.1	12.4

The absorption is, of course, based, as elsewhere, on the mean spherical candle-power. Of these two shades the porcelain one is considerably the better for practical purposes. Although it gives a somewhat smaller maximum candle-power directly below the lamp, it gives a much larger well-lighted area, and is for every reason to be preferred. The unaltered vertical distribution of an incandescent lamp is given in the curve shown in a previous article, and that curve was from the same lamp used in testing these shades.

It should be noted that the relations of these two forms would not be materially altered if they were of appropriate size and were applied to Welsbach burners the distribution of light from which, as will be presently shown, bears a rather striking resemblance to that from an incandescent lamp. The tin shade gives too much the effect of a bright spot to be really useful for most purposes. If such a concentrated beam is desired it is far better obtained by other and more perfect methods.



FIGS. 14 AND 15.—CURVES OF DISTRIBUTION.

Figs. 10 and 11 show two other forms of reflecting shade in somewhat common use, the former to give the light a general downward direction, the latter to produce a strong and uniform downward beam. Fig. 10 is a 6-inch fluted porcelain shallow cone, while Fig. 11 is the well-known and excellent McCreary shade, 7-inch. They are intended for widely different purposes which come out clearly in the curves of distribution, Figs. 14 and 15.

The flat porcelain cone, Fig. 14, merely gathers a considerable amount of light that would ordinarily be thrown upward and scatters it outwards and downwards. It has a generally good effect in conserving the light, and whether applied to an incandescent lamp or a Welsbach deflects downward a good amount of useful illumination.

The McCreary shade, on the other hand, is deliberately intended to give a rather concentrated beam, softened, however, by the ground glass bottom of the shade. As Fig. 15 shows, it accomplishes this result quite effectively, giving a powerful and quite uniform downward beam. The annexed table shows in a striking manner the difference in the two cases:

	Flat Porcelain Cone.	McCreary.
Mean spherical candle-power	9.84	7.50
Maximum candle-power	15.72	42.72
Horizontal candle-power	13.94	2.29
Absorption, per cent.	12.8	33.5

The small absorption in the first instance is merely due to the fact that the shade is not reached by any considerable portion of the light, while the large absorption in the later case only indicates that nearly the whole body of light is gathered by reflection, and sent out through a diffusing screen. The porcelain cone is irremediably ugly, but a less offensive shade having the same general properties may often be put to a useful purpose. The McCreary shade is purely utilitarian, but neat, and does its work well in producing a strong, directed illumination—a bit too concentrated, perhaps, for ordinary desk work, but most useful for work requiring unusually bright light. Of fancy shades modified in various ways there are a myriad, usually less good than the examples here shown.

Wireless Telegraphy in the Navy.

Admiral Bradford, Chief of the Naval Bureau of Equipment, has given out the following extract from the report of the board which has investigated the question of transmitting messages by wireless telegraphy:

From the examination of the subject as outlined in the orders of the Department the board makes the following recommendations:

1. That the use of homing pigeons be discontinued as soon as wireless telegraphy is introduced into the navy.
2. That, pending such action, no new pigeon cotes be established.
3. That wireless telegraphy be adopted by the navy for transmission of messages between distant points.

Referring to the last recommendation, the board is of the opinion that a high degree of special electrical training is demanded for the successful operation of any system of wireless telegraphy, and it therefore suggests as necessary the establishment of two stations sufficiently far removed from each other for the training officers and men. In its opinion this requirement would be best met by the establishment of such stations at the navy yard, Washington, and the Naval Academy, Annapolis.

If wireless telegraphy fulfills what now seems to be its possibilities, the cadets should be thoroughly trained in it.

As the investigation made by this board is not technical, there being no apparatus of any kind ready for test, but general in its character, such partial examinations as outlined above would not change the recommendations already made.

The selection of any special system of wireless telegraphy is, in the opinion of the board, very largely a matter of business detail.

If, for any reason, any competitive test of different systems is thought desirable, the board recommends, in view of the fact that the improved Marconi apparati will not be available for several months, and that improvements in any other systems may occur in that interval, that it be made only after due notice and preparation therefor, and by a special board of experts appointed for the purpose.

Engine Builders' Association.

The second meeting of the Engine Builders' Association of the United States will be held at the Denison Hotel, Indianapolis, Ind., on May 27 and 28. The meeting will be opened by an address of welcome by President J. E. Sweet, and the following papers will be read: "Experiences with Throttling Engines," by Professor J. B. Stanwood; "The Engine, the Heart of the Modern Building," by C. G. Armstrong; "The Relationship of Architects to the Engine Builder," by S. H. Brubaker; "Conditions and Warranties of Construction Contracts," by E. H. Burdick. On Monday evening, May 27, an informal smoker will be held in the rooms of the Commercial Club. On Tuesday evening at 8 p. m. the Association banquet will be held.

Presentation of the Latimer Clark Library to the American Institute of Electrical Engineers.

Following is the letter of Dr. Wheeler, presenting to the American Institute of Electrical Engineers the Latimer Clark library. The Council of the Institute accepted the conditions accompanying the gift:

To the Council and Members of the American Institute of Electrical Engineers:

It is my privilege to be able to announce the completion of negotiations by which I have become the possessor of the very remarkable collection of electrical books of the late Mr. Latimer Clark, of London.

My object in securing this collection was to present the books to our Institute, and make it the custodian of the most complete electrical library in the world, as well as to stimulate such interest that the Institute may in time own a permanent home in New York.

The assurances received from those who have co-operated with me in this undertaking, that the collection is very complete and includes practically every known publication in the English language previous to 1886, on Magnetism, Electricity, Galvanism, the Lodestone Mariner's Compass, etc., have been more than verified by my own examination of the books since their arrival in this country. There are among its 7000 titles many books which are not to be found in either of the famous libraries with which it has been compared, and I find that there are even some of the very earliest examples of printing.

I have always been a strong believer in the principle that every professional man is under obligation to contribute in some way to the welfare of the profession in which he is engaged, and in obedience to this idea I now desire to present this library to you complete, reserving to myself only the photographs, autographs and such duplicate books as I may add to my own collection without detracting from the completeness of the library.

As an early contributer to the Institute and one of the original members of its Building Committee, I am interested in securing for it permanent headquarters and adding to its importance, dignity and strength. It is my desire that the Institute accept the library and, through its Library Committee and a suitable librarian, administer it in such a way as to make it generally useful, and I hope that the possession of these books will add to the Institute's prestige.

I am inclined not to suggest rules for the management of the library, believing that those who are in charge from time to time are in the best position to know what is desirable, but in order to fix its general character, and secure its permanence, I condition the gift upon the acceptance by the Institute of the following provisions:

First.—The library to be kept insured against loss by fire as fully as it may be practicable to determine its value, and an annual appropriation of $1,500 to be provided for its maintenance.

Second.—A complete catalogue raisonne to be published in the name of the Institute, reciting the conditions of gift and explaining the features of interest of each book for the convenience and information of members. This catalogue to be prepared at once, and a bound copy of it to be placed in the hands of each member of the Institute.

Third.—The library to be in charge and control of a Library Board or Committee made up of members of the Institute, and not more than one-quarter of the whole number of members of this committee to be allied with any one commercial or other interest.

Fourth.—The library to remain in New York City, and to be a reference library, free to all, including non-members, and available for consultation at least three days in the week, and some evenings and some Sundays, as soon as the Institute is in permanent quarters.

Fifth.—Rare books—that is, books which it is practically impossible to replace—to be exhibited under glass with suitable explanatory cards, and to be subject to closer examination only at the library, and upon suitable introduction of the visitor to the Library Committee or their representative, the librarian, and under such other precautions as will positively assure the preservation and safety of the books.

And further, it is my earnest desire that the Institute shall, within five years, raise a sufficient fund by subscription, and provide itself with a permanent home for its meetings and library, and that this home shall be centrally located, reasonably safe from fire and not heavily mortgaged.

In case of the failure of the Institute to comply with the substance or spirit of these conditions, or with the desire expressed above for a permanent home, the library shall revert to me or my heirs or assigns.

Having in view the sole purpose of encouraging the Institute to attain the position which I feel sure all of its members desire, I have sought to name conditions easily within its reach.

Schuyler Skaats Wheeler.

Ampere, N. J., May 17, 1901.

The Latimer Clark Library.

At the annual meeting of the American Institute of Electrical Engineers held at their rooms, No. 12 West Thirty-first Street, Tuesday evening, May 21, Dr. Schuyler S. Wheeler donated to the Institute library the entire collection recently purchased by him from the executors of the estate of the late Latimer Clark, F. R. S., M. Inst. C. E., M. I. E. E., who, it will be remembered, was one of the founders of the British Society of Telegraph Engineers and became its president in the year 1875.

Reference has already been made in our columns to the extraordinary monetary value and to the extreme scarcity of many of the earlier works which have thus been secured, and we are glad to note that the appeal made in our issue of Feb. 23 last brought forth such an immediate response on the part of one of the Society's most active members. Upon learning that the Latimer Clark library was offered for sale outside of the United Kingdom, with the view to carrying out the testamentary instruction of its original owner that it should ultimately find, if possible, a suitable home in this country, and upon realizing the great benefit it would unquestionably prove to the members of the American Institute of Electrical Engineers as well as to all others likely to be interested in the early sciences, Dr. Schuyler S. Wheeler promptly entered into negotiations with the representatives of the estate and was finally successful, as already stated. But for this, the collection would, in all likelihood, have passed into the hands of agents from other countries, notably from Germany and from Japan, who had long been actively corresponding on the subject. It was, in fact, at one time Mr. Latimer Clark's avowed intention that the library should preferably go to the last-named country, in the possible event of its not finding a home in the United States, and, in a letter to Mr. P. F. Mottelay under date Feb. 21, 1898, Mr. Clark writes: "Should it fail to go to America, I would be inclined to leave it by will to Japan, a rising country, which would greatly value such an unique collection."

We have already pointed out, in a previous article, some of the rarities among the ancient works named in Mr. Clark's catalogues in order to give somewhat of an idea of the intrinsic value of Dr. Wheeler's gift, and as in our necessarily restricted space it would be difficult to do justice to the 6000 or more different entries embraced in the library proper, we regret we must now again confine ourselves to the mention of but few of such of the very early and admittedly rare works which bear a date and which are likely to whet the curiosity of those interested in magnetical and electrical literature:

1497. Pliny, C. Natural History. An exceedingly fine copy of this folio edition.

1517. "Polydori Vergilii Urbinatis de Inventoribus rerum—Libri tres."

1520. "C. J. Solini Polyhistoria." This extraordinarily rare edition contains the celebrated map of Apianus, whereon the name of America first is seen.

1541. Ptolemaii, C. "Geog. Enarrationis—libri octo . . ."

1546. Blondus, Michael Angelo. "De Ventis et Navigatione. Cum descriptione distantiae locorum a Gadibus ad novum orbem." One of the earliest tracts, 18 pages, on navigation and one of the scarcest books concerning America. It contains an engraving of a new mariner's compass, which is called "Pixis vel buxolus," from buxus, box, hence the Italian and French words *bussola* and *bussole* are derived.

1549. Affaytatus, Fortuni. "Physicae et astronomicae considerationes." Mr. Clark remarks that "Affaytatus (Affaidatus, Affaidaties) was the first to publish the declination of the magnetized needle. The credit of this has been usually ascribed to Robert Norman in his 'Newe Attractive,' 1581. George Hartman had, however, observed the phenomenon at a still earlier date." Copies of both the Norman and Hartman works are also in the library.

1555. Gesner, Conrad. "De raris et admirandis herbis . . . Et obiter de aliis etiam rebus quae in tenebris lucent."

1555. Medina, P. de. "L'arte de navegar . . . " the sixth book of which treats of the compass.

1556. Agricolae, G. "De Re Metallica."

1557. Zwingero, T. "Scrutinum magnetis physico-medicum."

1557. Cardanus, H. "De Rerum varietate." Contains many early allusions to magnetism.

1560. "Procli, in primum Euclidis Elementorum librum commentari."

1562. Ptolemacus. Geographia. Ptolemy, who wrote in the first century, originated the story of the magnetic mountains in the Indian Ocean which drew the iron nails out of ships. The earlier editions were printed before the discovery of America, which latter is not shown on the maps.

1565. Cusa, Nic. de. "Opera."

1566. Nonius, P. "Opera . . . instrumenta artis navigandi . . ."

1569. Danti, E. "Trattato dell 'uso e della fabbrica dell' astrolobio." Danti was the first manufacturer of a dial sufficiently large to correctly fix the equinoxes and solstices, and he also constructed the large dial at Florence, described by Lalande in his "Astronomie."

1571. Baccius, A. "De thermis, de aquarum natura . . . cum terris, ignibus, metallis . . ."

1572. Biringuccio, C. "La Pyrotechnie."

1599. Wright, E. "Errors in navigation." A very scarce, early, work containing a full description of the mariner's compass and its use.

1600. De Sunde (i. e., Daniel Schwenter). "Steganologia and Stegagnographia." Mr. Clark notes that "De Sunde gives a more interesting description of the magnetic telegraph than does any other writer. He calls the attention of his correspondent by ringing the bells by means of bar magnets. His needles are also moved by bar magnets, and the letters are formed by one, two or three strokes to the right or to the left, as in Cooke and Wheatstone's system."

1602. Blundeville, Thomas. "Theoriques of the seven planets . . . and descriptions of Dr. Gilbert's two instruments for seamen finding the latitude."

1609. Kepler, J. "Astronomia nova." One of the most prominent works on astronomy ever published.

1617. Stradae, F. "Prolusiones Academicae." Contains the poem on the Imaginary Lover's Telegraph, afterward translated and published in the *Spectator*, December, 1711.

1625. Carpenter, Nath. "Geography delineated forth in two bookes."

1625. Le sicur Zacani. "Livre d'Arithmétique . . . un traicté de la boussole."

1626. Leurechon, J. (i. e., Van Etten). "Récréation mathématique composée de plusieurs problèmes." The library also contains the English edition "Mathematicall Recreations," of 1633, containing, at page 104, the earliest English description and figure of the sympathetic telegraph.

1627. Fromondi, L. "Meteorologicorum, libre sex." This is the very rare first edition which is in few libraries. It is not in the British Museum, nor is it in the Ronalds collection, now belonging to the Institution of Electrical Engineers. It is stated, at page 328 of the Libri catalogue of 1861, that it is a work replete with curious information. *The pulsations of the heart, reckoned at 4450 for each hour, are employed by the author to calculate the distance of thunder.*

1632. Galilei, Galileo. "Dialogo sopra i. due sistemi del mondo Tolemaico e. Copernicano." This is the "suppressed" work which brought its author to the dungeons of the Inquisition. The library also contains Galilei's "De Systematie Mundi" of 1635, wherein, at page 88, the celebrated astronomer refers incredulously to the sympathetic telegraph.

1635. Gellibrand, Henry. "A discourse mathematical on the Variation of the Magnetic Needle, together with the admirable Diminution lately discovered." The library also contains the Berlin reprint, which was made directly from Mr. Clark's copy in 1897.

1636. Schwenter, Daniel. "Delicae Physico-Mathematicae."

1637. Servius, Petrus. "De Natura artis que miraculis."

1644. Mersenne, F. M. "Cogitata Physico-Mathematica." Contains not only a very interesting treatise on navigation, but likewise many letters from leading scientists of that period, not to be found elsewhere.

1646. Browne, Thomas. "Pseudodoxia Epidemica." This is an exceptionally fine copy of the first issue, which ran through six editions in 27 years. The library also contains the very scarce "Pseudoloxia Epidemica," edition of 1658.

1647. Arrighii, F. "Sapientiae pignus amabile philosophia universa. Treats of many sciences—astronomy, meteorology, etc.

1651. Riccioli, J. B. "Almagestum novum astronomiam."

1657. Turner, Robert. "The notary art of Solomon, showing the cabalistical key of magical operations." This is the first English writer who gives a figure of the magnetical dial.

1661. Glanvill, Josh. "The vanity of dogmatizing," also Glanvill's, 1665, "Scepsis Scientifica, or confessed ignorance the way to science," which contains, at page 149, a very interesting allusion to the imaginary magnetic telegraph.

1665. Garzoni, T. "La piazza universale di tutte le professioni del mondo . . ." As its title indicates, the author has touched upon almost everything. The work contains articles upon astronomy, alchemy, astrology, arithmetic, etc.

1684. Lanis, F. Tertius de. "Magisterium naturae et artis, opus physico-mathematicum." A veritable encyclopedia of all sciences connected with natural philosophy.

1685. Frederici, J. B. "Cryptographia." Contains, at page 234, the earliest specimen of the "Morse" code.

1694. Wilkins, J. "Mercury, or the silent and swift messenger . . ." An unusually fine copy.

1695. Hale, Sir Matthew. "Magnetisums magnus, or metaphysical and divine contemplation on the magnet or loadstone."

1696. Zahn, J. "Specula fisico-mathematico historico."

The true relative value of the Ronalds library, which has by many been hitherto considered the most prominent of all known collections of works on the early sciences, can best be established when it is stated that of all the above-named entries, but *one*, the 1635 Gellibrand, and a later copy of Stradae, the Mediolani, edition of 1626, are to be found in the catalogue issued during 1880.

Of the more modern works, dating from 1700, the collection may be considered complete. To a friend Mr. Clark wrote in January, 1897: "I have been collecting everything I could find in all languages for 47 years. . . . I, of course, in that long time (during which I kept a skilled librarian) succeeded in getting all English books, both old and new. I also got a very large quantity of all foreign works, especially the *rarer* and *older* ones. . . . In the line of pamphlets connected with early telegraphy, my collection is quite unique, and comprehends 125 volumes. . . . Although I still search catalogues, I rarely find anything that I have not got."

From the *Journal* of Proceedings of the Institution of Electrical Engineers, 1899, part 141, vol. xxviii., and from other articles, we extract the following: "The library, so far as electrical works are concerned, is unequaled. There are few if any works of importance missing. All are preserved and bound with the book-lover's conception of appropriateness and permanence, and in many cases they have valuable annotations regarding the significance of the facts disclosed in them. In this work, and in the preparation of catalogues, alphabetic and chronologic, Mr. Clark found congenial work in his leisure hours, especially of later years. The research involved gave him a rare acquaintance with the past history of electrical sciences, which found occasional expression in rectifying errors in chronology, and in giving credit where it was due. . . ."

Of the first five works picked out of the 1700 list of books exhibited upon the occasion of the opening of the library of the Society of Electrical Engineers, W. H. Preece, president, Nov. 10, 1880, *not one* of the following is to be found in the Ronalds collection:

Earl of Abercorn. "Attractive virtue of loadstones," 1729.

Swedenborg, Em. "Principia rerum naturalium," 1734. Containing a remarkable experimental treatise on magnetism.

Swaammerdam, J. "Biblia Naturali." 2 vols., 1737-8. Describing the experiments made at that early date before the Grand Duke of Tuscany as to the galvanic effect of metals, notably on the legs of the frog.

Scot's Magazine for February, 1753. Containing, at page 73, a letter by C. M., i. e., Charles Marshall, in which a real electric telegraph is for the first time invented and described.

We pass over all succeeding dates, for, in face of all that precedes and of the later works quoted in a previous article, it would be ridiculous attempting to name any particular line of modern works treating of electrical science or apparatus.

From the numerous periodicals found in the library, we select the following, representing in all some 1300 volumes: *Annales Telegraphiques, American Journal of Science, Athenaeum, Annales de L' Electricite, Annals of Philosophy, Bulletino Telegrafico, Bulletin de la Societe Int. des Electriciens, Brewster's Journal of Science, Centralblatt für Elektrotechnik, Der Elektro-Techniker, Engineer, Engineering, English Mechanic, El Electricite, Elektrotechnische Zeitschrift, Engineer and Architect's Journal, Electrician, English Mechanic, Electrical Engineer, Gehler's Physikalisches Wörterbuch, Ingénieur Electrique, El Telegrafista, Journal Telegraphique, Journal of the Telegraph, Journal of the Society of Arts, Journal of Natural Philosophy, La Nature, Lumiere Electrique.* Monthly Magazines—*Mechanics' Magazine, Nature, Naturae Novitate, Newton's Journal* *of Arts. Proceedings:* Institute of Civil Engineers, Institute of Electrical Engineers, Royal Society, Physical Society, Royal Astronomical Society, etc.; *Philosophical Magazine, Philosophical Transactions, Philosophical Journal, Repertory of Arts, Repertory of Patent Inventions, Revista Telegrafica, Reports of British Association for the Advancement of Science, Scientific American, Science, Telegraphic Journal and Electrical Review, Telegrapher, Telegrafi Italiana, Zeitschrift, Angenandte Elektricitat, Zetzche. Electreschen Telegrafica, Zeitschrift Telegraphen Verein.*

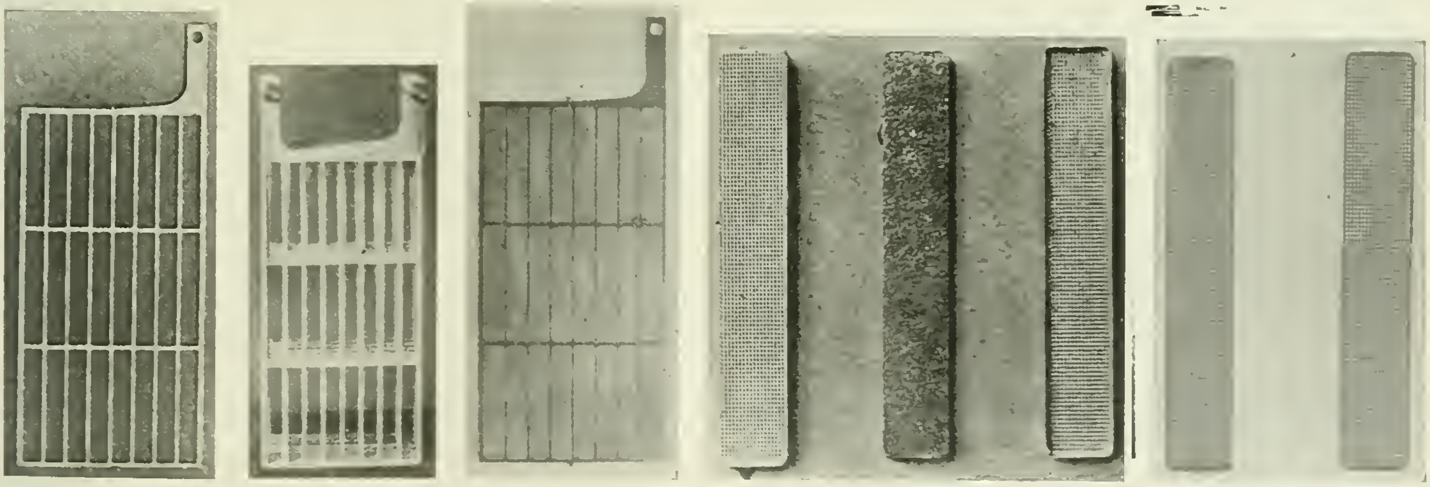
It is the intention of the Institute to prepare a catalogue of the library upon a much more elaborate scale than any hitherto attempted, in which the titles of all except the later and better-known works will be followed by a note giving an indication of the contents, or, in the case of the rare old volumes dealing only incidentally with electricity, the reason for their presence in an electrical library.

The New Edison Storage Battery.*

BY DR. ARTHUR E. KENNELLY.

IT is well known that the history of the storage cell is essentially that of the lead cell discovered by Plante in 1860, in which lead peroxide is the depolarizing substance. An enormous amount of labor has, in the aggregate, been expended upon the improvement of this cell in the hands of experimentalists. As a result of that labor, the storage battery has at last become a recognized adjunct to direct-current central stations, but it has limitations that seem to withstand further attempts toward improvement. Of recent years, hardly any success has been met with in the direction of reducing its weight for a given energy-storage capacity, without detriment to endurance, and this weight is the great drawback of the storage battery in electric storage traction, and has been the principal obstacle to its advance in this direction for the past 20 years.

In practice, the storage-energy per unit mass of the modern lead battery, is from 4 to 6 watt-hours per pound of battery (8.8 to 13.23 watt-hours per kilogramme. Expressed in another way, a battery weighs from 124.5 to 186.5 lbs. per horse-power-hour at its terminals (75.5 to 113.4 kilos per kilowatt-hour); or, if its stored energy available at terminals were all expended in gravitational work, a battery could raise its own weight through a vertical distance of from two to three miles (3.2 to 4.8 kilometers).



FIGS. 1 TO 5.—GRIDS, BRIQUETTE AND BRIQUETTE POCKETS, EDISON STORAGE BATTERY.

While it is possible to increase the energy per unit mass by making the electrodes very light, yet this is always found to be followed by a very heavy deterioration.

Many attempts have also been made to perfect storage cells of the alkaline-zincate type, but the great difficulty of depositing zinc in coherent form from the solution, as well as the lack of a depolarizer that shall be insoluble in the electrolyte, has stood in the way of this cell's success.

Mr. Edison set himself the task of finding a cell which should possess the following advantages:

1. Absence of deterioration by work.
2. Large storage capacity per unit of mass.
3. Capability of being rapidly charged and discharged.
4. Capability of withstanding careless treatment.
5. Inexpensiveness.

He believes that the cell here shown may claim these advantages in a very satisfactory degree. The negative pole, or positive element, corresponding to the zinc of a primary cell, or the spongy lead of a secondary cell, is iron. The positive pole or negative element, corresponding to the carbon of a primary cell, or lead peroxide of a secondary cell, is a superoxide of nickel believed to have the formula NiO_2. The cell is therefore a nickel-iron cell, a name which suggests the structural material—nickel-steel. The electrolyte is potash; viz., an aqueous solution containing from 10 to 40 per cent by weight, but preferably 20 per cent of potassium hydroxide, the freezing temperature of which is 20 degs. below zero F. or—30 degs. C.

The initial voltage of discharge after recent charge is.......1.5 volts
The mean voltage of full discharge is approximately........1.1 volts
The normal discharging current rate per unit area of active element
(positive or negative) is ....60 $\frac{\text{milliamperes}}{\text{sq. inch.}}$
or..8.64 $\frac{\text{amperes}}{\text{sq. foot}}$
or..0.93 $\frac{\text{amperes}}{\text{sq. decimeter.}}$
The storage capacity of the cell per unit of total mass of the cell is ....14 watt-hours per pound of battery
or ....30.85 watt-hours per kilo
Expressing the same statement in another way, the weight of battery per unit of electric energy at terminals is...53.3lbs. per e. h. p. hour
or..................................32.4 kilos per kilowatt-hour
Or the battery gives energy at its terminals sufficient to lift its own weight through a vertical distance of approximately,
7 miles or 11.26 kilometers.
The mean normal discharging power-rate per unit mass of total cell is......................4 watts per pound or 8.82 watts per kilo
Corresponding to a normal discharge period of............3½ hours
The cell may, however, be discharged at a relatively high rate, in approximately ....1 hour
Corresponding to a discharging power rate per unit of total cell mass of.....................12 watts per pound or 26.46 watts per kilo.

Charging and discharging rates are alike. That is to say, the cell may be charged at the normal rate in 3½ hours; or, it may be charged at a relatively high rate in one hour, with no apparent detriment beyond a somewhat lowered electrical charge efficiency. In other words, the cell does not appear to be injured by overcharging or discharging, and only suffers in electrical efficiency under such treatment.

The positive and negative plates are mechanically alike, and can scarcely be distinguished by the eye. They differ only in the chemical contents of their pockets. The samples here exhibited, which are intended for automobile batteries, illustrate the construction. Each plate is formed of a comparatively thin sheet of steel, 0.024 inch (0.61 mm) in thickness, in which rectangular holes are stamped, so as to leave a grid or frame somewhat resembling a window-frame. In the plate here shown, there are three rows of eight rectangular holes or recesses, or 24 recesses in all.

Each opening or recess is filled with a pocket or shallow box containing the active material. These boxes correspond to the panes of glass in the window-frame analogy. The panes instead of being thinner than the frame, as in an actual window, are thicker than the frame, or project slightly beyond the surface of the steel grid. They are perforated with numerous small holes to admit the electrolyte, but entirely conceal the contained active material from view. All that meets the eye, therefore, in any of the plates, is the steel frame, and its embedded "windows" of perforated steel.

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*A paper presented at the Eighteenth Annual Meeting of the American Institute of Electrical Engineers, New York, May 21st, 1901.

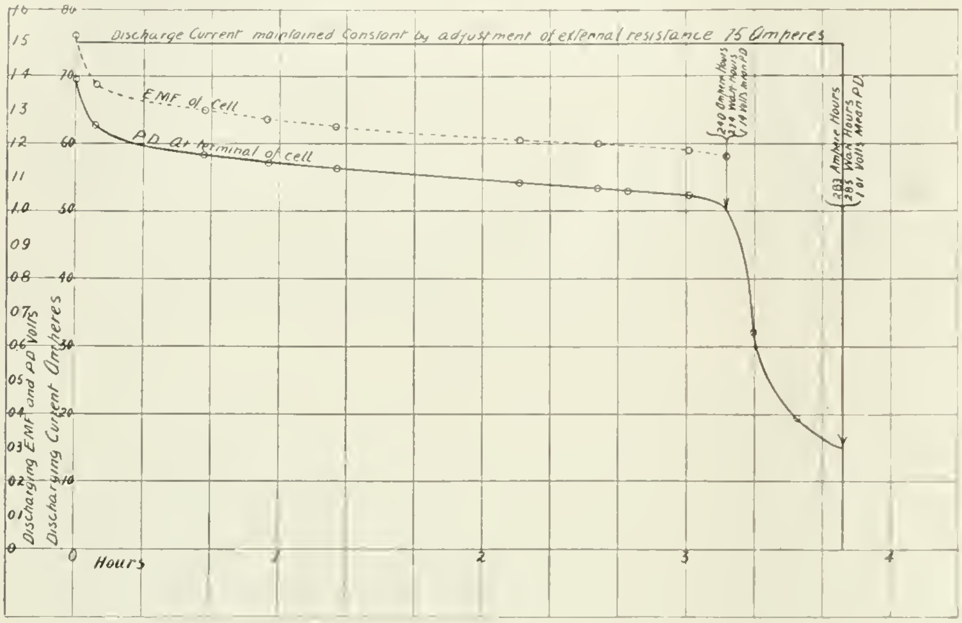


FIG. 6.—DISCHARGE CURVE OF EXPERIMENTAL CELL.

The active material is made in the form of rectangular cakes or briquettes, and one such briquette is lodged in each pocket or "window pane" of the plate. Each of the plates shown, therefore, supports, or contains, 24 briquettes of active material, all in rigid contact with its own substance.

Each briquette is placed in a shallow, closely fitting nickel-plated box of thin, perforated crucible steel, cut from a long strip of that material 0.003 inch (0.075 mm.) thick. A cover or lid of the same material is then laid over it, so that the briquette is closely enveloped by the sides and walls of its perforated steel box. The boxes are then placed in the openings or holes in the nickel-plated steel grid, and closely fit the same. The assembled plate is then placed in a hydraulic press, and subjected to a total pressure of about 100 tons. This pressure not only tightly closes the boxes, but it also forces their metal sides over the adjacent sides of the recesses in the steel grid, thus clamping the whole mass into a single solid and rigid steel plate with the hollow "window panes" full of active material. The nickel-plating of both grids and boxes aids in securing good permanent electric connections between them. The finished plate has a grid thickness of 0.024 inch (0.56 mm.), and a "window" or pocket thickness of 0.1 inch (2.5 mm.). This is the maximum thickness of the plate at any point, but being of steel, the plate has ample rigidity.

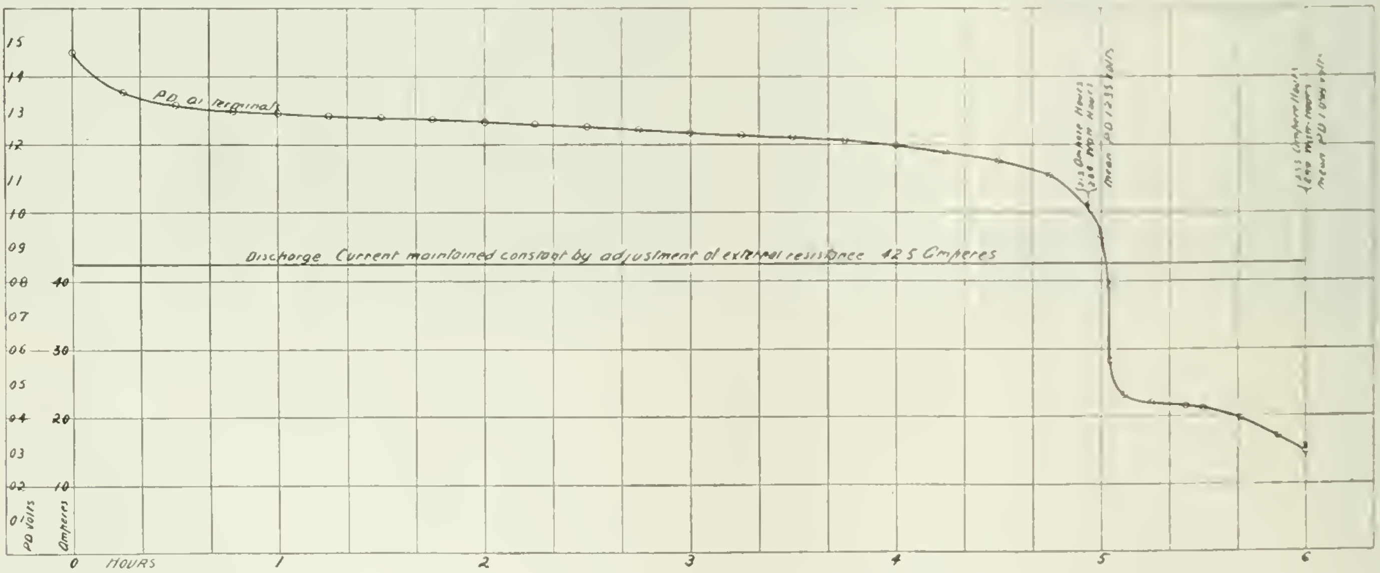


FIG. 7.—DISCHARGE CURVE OF EDISON EXPERIMENTAL STORAGE CELL.

The positive briquettes (zincs of a primary cell) are made by mixing a finely divided compound of iron obtained by a special chemical process with a nearly equal volume of thin flakes of graphite. The graphite does not enter into any of the chemical actions, but assists the conductivity of the briquettes. The graphite is divided into very thin laminæ by a chemical process, and these are passed through sieves or screens so as to leave a size or area of flake that is much larger than the area of the perforation in the steel windows. The mixture is then pressed into briquettes in a mold, under a hydraulic pressure of about two tons per square inch. The briquettes have a surface area of nearly 3 inches by ½ inch on each face.

The negative briquettes (carbon of a primary cell) are made by similarly mixing a finely divided compound of nickel, obtained by special chemical means, with a nearly equal bulk of fine flakes of graphite, and solidifying the mixture in a mold into briquettes of the same size as above.

A suitable number of positive and negative plates are assembled together, being separated from one another only by a thin sheet of perforated hard rubber.

The assembled plates are placed in a vessel or external cell of sheet steel containing the potash solution, which, of course, does not attack steel. There was, however, much difficulty from the action of the potash on the soldered seams of the steel containing vessel. After many trials, however, Mr. Edison found a solder which seems to be entirely unaffected by the alkali.

In charging, the current is, of course, sent into the positive pole and its attached negative nickel-plate, through the electrolyte, and into the positive plate of the iron compound which carries the negative pole. This current deoxidizes or reduces the compound to spongy metallic iron and carries the oxygen through the film of electrolyte to the nickel compound, oxidizing it to the superoxide of nickel Ni O_2, a higher oxide than the peroxide. In other words, the charging current simply carries oxygen in the opposite direction against the forces of chemical affinity, from the iron to the nickel, and stores the energy in the reduced iron, which is, of course, unaffected and passive in the presence of the potash solution. On discharge, the current passes from the positive pole through the external circuit to the negative pole, and its attached iron or positive plate, and then through the solution to the negative or superoxide plate. In so doing the oxygen moves back against the current and partially reduces the nickel superoxide Ni O_2 while oxidizing the spongy iron. The energy of burning of the iron and oxygen which would be developed as heat in the ordinary chemical process is now liberated in the circuit as electrical energy.

The cell is an oxygen-lift. Charging pulls the oxygen away from the iron and delivers it temporarily to the nickel. The condition is then stable, until the circuit of the cell is completed. Discharge then allows the oxygen to fall back from the nickel to the iron with the natural affinity of iron and oxygen.

This action is very different from that which takes place in the lead storage cell. Here, neglecting complications, the action is usually regarded for practical purposes as being represented by the equation

$$PbO_2 + 2H_2SO_4 + Pb = 2Pb\,SO_4 + 2H_2O \ + 100 \text{ watt-hours},$$

where the left-hand side represents the condition of charge and the right-hand side the condition of discharge. Here oxygen is not simply transferred in discharge from the peroxide to the spongy lead, but the solution is changed (theoretically) from an aqueous solution of sulphuric acid to plain water. Of course, the discharge could not practically be carried to the point of denuding the solution of all sulphuric acid, and a surplusage of acid must be used. The equation gives a mere theoretical outline of admittedly very complex reactions. In other words, the specific gravity of the sulphuric acid solution falls during the discharge, and the solution enters into the chemical combination. Theoretically, for every 445 grammes of active material on both plates, 196 grammes of sulphuric acid are required to effect the combination, or 44 per cent by weight of the active elements, and in practice it is usual to allow a weight of sulphuric acid nearly equal to half the weight of the elements, or about one-quarter of the total weight of the cell.

In the new Edison cell, on the other hand, the theoretical action of the potash solution is merely to provide the proper channel through which the oxygen ions may travel in one direction or the other—positive plate to negative plate in charge, and negative plate to positive plate in discharge. Consequently, the amount of solution needs only to be sufficient to fulfill mechanical requirements. It is believed that the weight of solution will in practice be only about 20 per cent of the plate weight or about 14 per cent of the cell weight. In fact, the cell may be worked in the same manner as the so-called primary "dry-cells." Moreover, if the solution should escape, or be carried away, by gasing in charging, the only detriment seems to be the loss of active surface thereby occasioned, and it will only be necessary to fill up the cells to the proper level with water from time to time, as evaporation or gasing may lower the level. For the same reasons the specific gravity of the electrolyte does not appreciably vary during charge and discharge.

The briquettes of active material slightly expand on receiving oxygen, and slightly contract on delivering it, that is to say, the iron briquettes contract and the nickel briquettes expand during charge, while on discharge the iron briquettes expand and the nickel briquettes contract. The level of the solution is in this way scarcely affected. The expansions and contractions of the briquettes appear to be well within the elastic limits of the spring-steel containing boxes, and consequently the electric contact is always secure. The covers or sides of the window pockets merely approach to or recede from each other slightly during charge and discharge. Fortunately, steel is the metal which possesses this mechanical elasticity in a marked degree.

The action of the charging and discharging current upon the briquettes seems to be transferred from their external surfaces inwards in a manner similar to the transfer of carbon and oxygen in the process of making malleable cast-iron in the furnace on the principle of cementation. No active material has been found to be ejected from the briquettes through the window perforations, even under the deliberate overcharging and discharging. Such gas as is thereby produced makes its appearance on the external surface of the windows.

If the nickel compound had no affinity for oxygen, so that energy was neither developed nor absorbed in the deoxidation of further oxidation of that substance, then the energy would be entirely that due to the energy of combination or oxygen and iron, stated to be 79.7 watt-hours, and representing an e. m. f., theoretically obtainable, of 1.47 volts. If the combination of oxygen with the nickel compound be exothermic or energy-releasing, then the watt-hours delivered (and the e. m. f.) will be lessened by the energy necessarily paid back to break up the combination.

If, on the other hand, the combination is endothermic or energy-absorbing, then the watt-hours delivered (and the e. m. f.) will be increased by the energy restored on breaking up the combination. Since the superoxide seems not to have been known hitherto, no information concerning its energy of combination is obtainable. The e. m. f. of the cell seems to be so near to that of the union of iron and oxygen as to suggest that the nickel superoxide is not far from being neutral, or that the nickel compound has but little affinity for oxygen, although the superoxide appears to be quite stable in the cell.

The new cell does not seem to be appreciably influenced by changes of temperature, and should stand a very low temperature without detriment. The electrolyte—potash—does not attack any of the ingredients of the cell, nor are any of the ingredients soluble therein. No local action occurs in the cell so far as has yet been observed since the e. m. f. is below that necessary to decompose water.

The cell may be fully discharged to the practical zero point of e. m. f. without detriment. In fact, a cell has not only been completely discharged, but recharged in the reverse or wrong direction, and after bringing it back to its originally charged state by proper restoration of the direction of charging current, the storage capacity remained unaffected. It would seem, therefore, that the cell should be capable of withstanding much abuse.

Diagrams are shown on screen giving the curves of discharge of experimental cells.

Mr. Edison states that "the negative plate (nickel) either charged or discharged, can be removed from a working cell, and dried in the air for a week, without appreciably injuring it, and when the plate is finally replaced in the cell its charge is practically undiminished.

The positive (iron) plate, if similarly removed from the cell will be likewise uninjured, but it soon loses its charge by the oxidation of the spongy iron with accompanying liberation of heat and appreciable rise of temperature extending over a period of several hours. On replacing the electrode, however, in the cell the storage capacity is unaffected on recharge.

As regards cost, Mr. Edison believes that after factory facilities now in course of preparation have been completed, he will be able to furnish the cells at a price per kilowatt-hour not greater than the prevailing price of lead cells.

Having now considered the action and properties of the cell, a brief description may be given of the difficulties encountered in developing it.

The phenomenon of passivity has probably kept inventors from finding this cell in the past. Mr. Edison believes that of all the very numerous compounds of iron, and of which he has tried many hundreds, the particular compound which he prepares, is perhaps the only one capable of being used in this way.

If the dried hydrates, or oxides of iron native or artificial, are subjected to electrolytic reducing action in any alkaline solution, they remain inert and unaffected.

On the other hand, if finely divided iron obtained by reducing a compound of iron under the action of a reducing agent, such as hydrogen, or carbon monoxide is subjected to electrolytic oxidation in an alkaline solution it is inert and cannot be oxidized. It assumes the well-known passive state.

The same difficulty of passivity affects the use of nickel or the negative element. Finely divided nickel, reduced from a nickel compound, remains inactive when subjected to electrolytic oxygen in an alkaline solution. The monoxide and the black-oxide or peroxide are also inert. No oxide of nickel is active or can be made active by electrolytic action, and the peroxide does not act as a depolarizer.

Trolley Automobile Line in Germany.

Consul-General Guenther, at Frankfort, says that a Berlin engineer has constructed a trolley automobile line, similar to that exhibited at the Paris Exposition, at Eberswalde, near the German capital. In this system the automobile receives its motive power from an overhead wire by means of a trolley, which is connected with the automobile by a movable cable. This allows the vehicle to turn out at any place on the road. The consul-general adds that the line has been favorably inspected by experts, and that the system is expected to meet with general favor in Germany.

Death of A. Langstaff Johnston.

THE LATE A. LANGSTAFF JOHNSTON.

We regret to announce the death of Mr. A. Langstaff Johnston, which occurred at his home in Richmond, Va., May 15. Mr. Johnston was 50 years of age on Aug. 16 last, and for the past several months has been in poor health. He is survived by his widow and four children, two sons and two daughters.

Mr. Johnston was born in Richmond, and was graduated from the Virginia Military Institute. After his graduation he was employed in the construction of the Chesapeake & Ohio Railway, and was assigned to important tunnel work, in which he acquitted himself with credit.

In 1876 he was made city engineer of Manchester, Va., where he designed and established a system of street grades, and introduced other extensive improvements. From 1870 to 1880 he was engaged as assistant engineer on river and harbor improvements with Colonel William P. Craighill, afterward chief of engineers, United States Army. In 1888 and 1889 he constructed part of the railway system of the Richmond Railway & Electric Company. His next important work was for the New Orleans & Carrollton Railway Company, for whom he built 28 miles of track. He was later appointed chief engineer of the Hestonville, Mantua & Fairmount Passenger Railway Company, for whom he supervised the electric conversion of that road. He also acted as chief engineer or constructing engineer for railway companies in Meadville, Pa., and elsewhere.

In 1896 Mr. Johnston was awarded the John Scott medal by the Franklin Institute, of Philadelphia, for a complete system of electrical railway bonding. A few months ago Mr. Johnston was urged to let his name go before the Philippine Commission for appointment in charge of electrical engineering on the islands, but this he declined. Mr. Johnston was a member of the American Institute of Electrical Engineers, of the American Society of Civil Engineers and the Franklin Institute.

CURRENT NEWS AND NOTES.

NERNST LAMPS AT HARTFORD.—The Hartford Electric Light Company promises to have the distinction of being the first electric lighting company to install Nernst lamps. The first building in which the lamps will be installed is the State House.

GLASGOW INTERNATIONAL ENGINEERING CONGRESS.—One of the nine sections of the International Engineering Congress to be held in Glasgow Sept. 3, 4, 5 and 6, will be devoted to electricity, the honorary secretary being Mr. W. G. McMillan, secretary of the British Institution of Electrical Engineers. Professor John Perry is one of the vice-presidents of the congress, and Mr. Alexander Siemens a member of the executive committee. Mr. T. C. Martin has been nominated an honorary member from the United States.

REPORTING ARRIVAL OF STEAMERS BY WIRELESS TELEGRAPH.—The New York *Herald* announces that it has been given authority by the United States Lighthouse Board to establish a wireless telegraph station on the Nantucket Shoal lightship for the primary purpose of reporting ship news. The Marconi system will be used. The plan is to establish a land station at Sankaty Head on Nantucket Island, which will be connected to the mainland by a cable to Wood's Hall, Mass., by way of Martha's Vineyard. At Sankaty Head there will be a mast 130 ft. high, and on the lightship a pole 47 ft. high will be attached to one of the masts. It is stated that steamers equipped with wireless telegraph apparatus will be enabled to report their arrival off the American coast 13 hours earlier than under the present method. It is expected that the system will be in operation by July 1 next. It is also reported from Portland, Ore., that a wireless telegraph station is to be established at the mouth of the Columbia River for the reporting of the arrival and departure of vessels. A station will also be established at the entrance of the Straits of Fuca.

PROTECTION OF ROTARY CONVERTERS.—It is well known that if the circuit of the alternating-current side of a rotary converter is broken when the field of the converter is weakened a dangerous speed may be attained by the machine operating as a direct-current motor. Now it frequently happens that it is desirable to weaken the field of the converter when in operation in order to cause the alternating-curren system to supply a lagging current at no load, which may change to a leading current under heavy loads by reason of the energizing action of the series field magnet winding. In other cases the series field magnet current may be stronger than is desired, and the shunt field magnet current will therefore be weakened correspondingly to give the desired field strength. In order to avoid difficulty arising under the above-named conditions, as well as when the field magnet circuit is interrupted, is the object of a patent issued May 14 to B. G. Lamme. The means provided consists in the employment of a circuit breaker in the shunt field, whereby the circuit of the direct-current side of the rotary will be broken when the shunt field current is reduced below the safety limit or is interrupted by the breaking of its circuit.

INTERCONNECTED ALTERNATING AND DIRECT-CURRENT DISTRIBUTION.—A patent issued May 14 to B. G. Lamme describes a system for transferring energy from an alternating to a direct-current system and vice versa, in order to accommodate changes in load in either or both systems. As illustrated, the polyphase circuit is connected with one side of a rotary converter and the direct current with the other side, the exciter of the rotary being either independently driven from the alternating-current side, or from the armature of the rotary. With this arrangement the rotary tends automatically to transfer energy from either system to the other, dependent upon the conditions of load, speed, etc., of the prime movers of the two systems. Assuming first that the alternating-current system is overloaded and drops in its speed or rate of alternations, the rotary will also drop in speed, its field will be weakened by reason of the drop in speed of the exciter, and consequently the armature of the rotary will tend to speed up and pull ahead of the alternating-current system. This is a condition for feeding energy into the alternating-current system corresponding to the case of two alternators connected in parallel. Assuming now that the direct-current system is overloaded and consequently its voltage falls off, the direct-current voltage of the rotary will tend to remain normal, since its speed is controlled by the alternating-current system, and its field constant and unaffected by the drop in the e. m. f. in the direct-current system. If both the direct and alternating systems have inherently rising e. m. f.'s with increase of load, the automatic transfer of energy may not take place in the right direction, but with falling characteristics the transfer will be such as will tend to assist the overloaded machine.

DETAILS OF ELECTROLYTIC LAMPS.—Two patents issued May 14 to A. J. Wurts relate to details of the Nernst lamp, the subject of one being an arrangement for automatically switching glowers into circuit, and the other relating to a form of heating arrangement for the glower. The first-mentioned patent describes means whereby only a single glower or single set of glowers will be in service at any one time, but if a glower or set of glowers becomes broken by accident or through long use, another will be automatically put into service to take the place of that rendered inoperative. As illustrated, for a pair of glowers three electromagnets are employed, whose windings are so connected with the glowers and with the heater circuit that if a glower shall become broken the interruption of current will de-energize two of the electromagnets and the circuits of the heater and the remaining glower will thereby be closed. As soon as the remaining glower becomes conductive the heater circuit will be interrupted by one of the magnets, and the lamp will operate as before. The second patent relates to means for making the circuits of the glowers and that of the heaters independent of each other, it having been discovered that there is danger of flashing taking place between the glowers and the heater wire when the circuits supplying these parts are connected. To this end the heaters are placed in the low-potential secondary circuits of transformers, and the glowers in a circuit of higher potential supplied by the same generator as the transformer, or by an independent generator. As illustrated, the primary of the transformer is connected across the same mains as the glower, and the heater is in the transformer secondary. In series with the glower is a solenoid. When the glower has been sufficiently heated to become conductive, the current passing through the coil of the solenoid is sufficient to draw up the core thereof and operate a switch so as to break the primary transformer circuit and thus cut out the heater.

OHIO ELECTRIC LIGHT ASSOCIATION.—The next annual meeting of the Ohio Electric Light Association will be held at Hotel Victory, Put-in-Bay, Lake Erie, on Aug. 20, 21 and 22.

FRENCH SUBMARINE CABLES.—The submarine cable which has just been laid between Marseilles and Tangiers inaugurates an elaborate system of cables by which France proposes to put herself at a cost of $25,000,000 in direct communication with her remote colonies and foreign countries. That the system can pay commercially seems impossible.

UNDERGROUND WIRES IN MONTREAL.—The question of compelling the electric companies to remove their poles and wires from the streets and place the wires underground has been under consideration in the City Council. It is stated that their charters and the contracts between the companies and the city give the city authority to compel the companies to put their wires underground, except in the case of the Montreal Street Railway Company.

TELEPHONE MILEAGE IN CANADA.—During a recent inquiry in the Dominion House of Commons as to the mileage of the Bell Telephone Company's system in Canada, the following figures, representing the length of lines in operation in the various Provinces, were given: Ontario, 53,000 miles; Quebec, 30,000 miles; Manitoba, 4000 miles, and in the Territories, 169 miles. Lines are proposed as follows: In Ontario, 5000 miles; in Quebec, 2000 miles; Manitoba, 299 miles, and in the Territories, 25 miles. The number of subscribers in Ontario is 23,000; in Quebec, 22,000; in Manitoba, 2000, and in the Territories, 302.

ENGLISH MUNICIPAL OWNERSHIP.—We are often told of the beauties of municipal ownership as exemplified at Birmingham. Mr. Labouchere, M. P., in his well-known satirical journal, has this on the subject: "Who was it that first sang the praises of Birmingham as the best-governed city in the world? The emptiness of the boast is now generally recognized, and if any doubt remained it would surely be dispelled by the graphic articles in the *Birmingham Daily Gazette* on 'Scenes in Slum-land,' which I recently mentioned, and which have since been reprinted in pamphlet form. The best-governed city in the world, forsooth! I question whether there is any town in the country where the poor are herded together amid such conditions of filth and horror, in such hotbeds of disease and immorality, as those revealed in these articles. The state of affairs which Mr. J. Cuming Walter has depicted shows that there must have been disgraceful apathy and negligence on the part of the sanitary authorities. But the public conscience of Birmingham must be dead indeed if the present exposure does not result in a radical change of municipal policy in this respect."

ASYMMETRIC CONDUCTOR.—Two forms of asymmetric conductor, of considerable theoretical interest, and differing radically in principle from those electrolytic rectifiers employing an aluminum electrode, form the subject of patents recently granted to Mr. L. W. Hildburgh, of New York City. It will be recalled that an article by Mr. Hildburgh on the subjects of these patents appeared in our issues of April 14 and 21, 1900. In each case two electrodes are used in connection with an aqueous electrolyte, one of them being polarizable for a current in a given sense, and the other not, the depolarization being effected either by immersing one electrode in a liquid capable of oxidizing hydrogen, or by providing one electrode of a material soluble in the electrolyte, the other being inert with respect thereto. However accomplished, the effect is to permit the accumulation upon one electrode only of an insulating sheath of gaseous products of the electrolysis when the current passes in a given direction, whereas a reversal is followed by gas evolution at both terminals, the result being an asymmetric effect due to the gas envelopes, upon which are superposed such effects as may arise from the e. m. f. of the cell functioning as a battery, and from the counter e. m. f. from the liberated products of the electrolysis. It is clear that the "asymmetric efficiency" of such a system must depend upon many factors, chief among which is the ratio of the electrode surfaces, as governing both the thickness of the gas sheath and the period required for the counter e. m. f. to reach its full value. No data are given from which an estimate may be formed as to the value or limitations of the cell as a current rectifier.

LETTERS TO THE EDITORS.

Single Phase Electric Traction.

To the Editors of Electrical World and Engineer:

Sirs.—You will realize that the important question of the day, as per the editorials in your valuable paper, is deeply interesting to me. I have done everything I could to point out the advantages of electric traction with alternating-current motors.

I am interested in just the matters that your editorials deal with, and several that they do not deal with. As you know, I have been experimenting for some years on electrical apparatus, especially for street railway and trunk line service from various standpoints, viz., direct current, alternating current and the explosive engine.

You say there is no reason why the polyphase motors are not practical machines for traction work. I have developed one system that solves the speed control problem for any system, direct current, alternating current of any number of phases, and also for gas or any other power systems.

Your editorial of March 23 says, "The whole question of speed control is one which up to this time engineers have shied at." Now, I want to say that one of them has not "shied" at his problem, for its solution was one of the easiest that I have had to deal with. My patents have been allowed without a citation or rejection, and I should be pleased to show you how extremely easy this matter becomes, and how simple the apparatus is in practice.

I have two full size cars at Philadelphia, equipped throughout, and for control of speed and economy of such control, I will state that practical results demonstrate beyond dispute that there is absolutely no railway equipment that will compare with it.

Now that Ganz & Co. have produced a polyphase system which they are willing to install at a price $1,000,000 cheaper than the representatives from this country can touch, I will say that if a single-phase equipment were installed under my system, it could be done at a price fully $1,000,000 cheaper than the Ganz Company's price.

On dynamos and motors we can cut way under either domestic or foreign prices. I don't at all mind being in the same position as a champion of the single-phase system that other engineers have occupied in endeavoring to promote the multi-phase systems.

That the engineers in this country can, with profit, follow the Ganz Company's development and application of polyphase traction apparatus closely certainly seems true, but I suggest that in order to keep the American development and application at the head of the line that the single-phase motor and single-phase distribution system should be developed and applied.

I have developed such a motor and system of distribution, and can state without fear of contradiction that I will convince any engineer or committee of engineers that under my system a single-phase traction equipment is the superior of any polyphase system that ever was or ever will be developed. If you feel that you would like to put me in position where I can demonstrate what I say to be true, and knowing that you say that while such things "are expensive, but should be tried for the benefit of those who come after us," I ask that you publish this letter.

Philadelphia, Pa. Gordon J. Scott.

Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs.—Your editorial in the issue of April 27 and the communication by Mr. Edgar F. Smith on instruction in electro-chemistry have been read with considerable interest.

You will probably find that in most of the larger universities of the Middle West at least not only is instruction given in the most recent developments in electro-chemical theory, but the commercial applications are also studied.

The Department of Chemistry of the University of Illinois offers three courses in electro-chemistry, and reference to the synopsis of these given in the annual register will show that they are certainly not based on methods a quarter of a century old.

The Department of Electrical Engineering offers three elective groups for the last year and a half of its four-year undergraduate course in electrical engineering, namely: (1) regular electrical engineering course; (2) the electro-physical course, or (3) the electro-chemical course. On the satisfactory completion of any one of these four years' courses of study with the presentation of a thesis, the student receives the degree of Bachelor of Science in Electrical Engineering.

In addition to this, all undergraduates following the regular electrical course are required to take a course in electro-metallurgy. This includes a brief study of the theory of electrolysis as developed by Nernst, Van't Hoff and Ostwald, and its application in the study of primary and secondary cells, electro-plating and typing, the electrolytic production and refining of metals, applications of the electric furnace, electrolytic manufacture of chemicals, sewage purification, applications of the transformer in heating and welding, etc.

While there is no recent text-book in English which takes up the technical side of this subject still the material contained in the German, English and French periodicals is certainly not small, and one must always go to the journals for the latest and best practice in any branch of electrical engineering.

Wm. Hand Browne, Jr.

Champaign, Ill.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Polyphase Machinery.—Eborall.—An abstract of the first of a series of lectures on "polyphase working." He examined the features of inductor machines and the reasons for their gradual abandonment by Continental makers. Not only is half of the armature copper wasted in these machines, as compared with the now ordinary type of rotating field magnets with alternate polarity, but the leakage flux, which is great, induces a back e. m. f. in the idle part of the windings. In a revolving field alternator the magnetic leakage can be compensated for by adding more windings. It is mere leakage and does not produce back e. m. f.; then there is more trouble with the inductor type of machine if the revolving part becomes slightly eccentric. The only advantages of the inductor alternator are the absence of slip-rings and the use of less field magnet winding. For use with steam turbines, however, he thinks inductor alternators might yet be retained, as they are pre-eminently suitable for high speeds. After comparing revolving field and revolving armature machines, he discussed the relative advantages of star and mesh winding. He prefers star winding, whatever the output of the machine, on account of the cross currents, which may be obtained in mesh armatures under unfavorable conditions. He recommends one or two slots per pole per phase for high pressure machines, and three or four slots per pole per phase for low-pressure machines. He prefers to laminate merely the pole tips of the field magnet rather than the whole pole pieces, and considers that all well designed alternators should have oval poles with laminated shoes cast into the pole core. The question of magnetic leakage he considers to be the most important factor in polyphase alternator design. He prefers to wind the magnets with copper strip set on edge, and previously compressed hydraulically, and to excite the magnets with separately driven dynamos, as these are better than direct-driven exciters in view of pressure regulation and good parallel running. He recommends the following numbers: Peripheral speed of field magnets 5600 to 6000 ft. per minute. Flux densities in lines per square inch; in cast iron, 40,000; in cast steel, 90,000; in pole cores, 90,000; in pole shoes, 105,000; in air-gap, 60,000; in armature teeth, 720,000; in armature iron, 40,000. Current densities: 800 to 1000 amperes per square inch in field, and 1500 to 2000 in armature.—Lond. *Elec.*, May 3.

Short Circuit of Three-Phase Machines.—Rosenberg.—A paper, illustrated by diagrams, on a phenomenon occurring in short circuited three-phase machines. In a star connected three-phase generator, on which only the external terminals are short circuited, there is a measurable e. m. f. between the common connection point (neutral point) and the short circuit point. This was found to be 440 volts for a short circuit of 61 amperes in a 1000-volt, 20.2-ampere, 50 periods, eight-pole three-phase generator. He shows that this is due to the fact that the wave form is not a pure sine wave. He gives a complete mathematical theory of the phenomenon with the aid of diagrams in which he uses solid geometry. He recommends the use of solid geometry diagrams for the investigation of cases in which the action of alternating currents of different frequency or of alternating currents and direct currents, is combined. —*Elek. Zeit.*, April 25, May 2.

REFERENCES.

General Transformer Diagrams.—Kuhlmann.—An illustrated article on dynamos for special cases of the general transformer. He develops the Ossanna diagram for ordinary three-phase induction motors and deals also with the case of a transformer operating with constant secondary-phase difference.—*Elek. Zeit.*, April 18.

Three-Phase Motors.—Goldschmidt.—A theoretical article on three-phase induction motors. He begins with general remarks about pure sine fields and deformed fields, and the effects due to the deformation of fields, and applies his results to the short-circuiting and the starting of three-phase induction motors.—*Elek. Zeit.*, April 18.

Synchronous Converters.—Colles.—A continuation of his long illustrated article on "Rotary transformers, their history, theory and characteristics." He continues the discussion of the theory of the single coil rotary transformers, and deals with the terminal pressure as affected by phase relations, pressure adjustment, pressure regulation for variations of load, current relations, output, efficiency, hunting. He then gives briefly the theory of the two-coil transformers.—*Jour. Frank. Inst.*, May.

Lights and Lighting.

REFERENCE.

Miners' Lamps.—Walker.—The first part of a paper read before the Brit. Inst. Elec. Eng. on electrical miners' safety lamps. In the present part he discusses in detail the difficulties common to both primary and secondary battery lamps, those peculiar to the secondary battery form of lamp, and those peculiar to the primary battery form of lamps, and gives a review of the different types of secondary battery lamps.—Lond. *Elec.*, May 3.

Power

REFERENCE.

Gas Power Plant.—An illustrated article on a gas power plant with electric distribution, using for fuel wood or local bituminous coal, in successful operation in a mine in Mexico. Electric motors are used to drive the several departments of the reduction plant.—*Eng. and Min. Jour.*, May 11.

Traction.

Electric Automobiles.—Simons.—A long paper read before the Electrotechnical Society of Cologne. He first deals with the mechanical construction of an electric automobile. The load ought to be distributed upon both axles, but more upon the driving axle than the other one. One should, however, take care not to place nearly the whole weight upon the driving axle. "A brake which really meets all requirements and which is not too expensive at the same time, is still to be invented." The development of storage battery manufacturing has taken place in two directions. Some manufacturers aim at high capacity with low weight, which means in general a low charge and discharge rate, other manufacturers aim at a high discharge current with a possibility of frequent charges and discharges. For the latter purpose the Plante plate has been further developed, while for the former purpose Faure plates are used. He gives a table of the weight, price, capacity and maximum discharge current per k. g. of weight of cell of several commercial batteries of German make. The highest capacity in ampere-hours per k. g. of weight of cell for a discharge of five hours is 11.55; the maximum discharge current of the same battery per kgr. of weight of cell is 3.46 amperes (Fulmen cell). The cell which has the greatest maximum current per k. g. of weight of cell, namely, 4.8 amperes, is that of the Acc. Works, Oberspree. He then discusses the motors. In Cologne compound motors are in use. Their advantages over series-wound motors are high-starting torque, variable speed, and the possibility of braking, when at high speed the motor is made to run as shunt motor or as a compound motor. The disadvantages of the compound motor are that its construction is more complicated, and that the controller must be designed with great care and must be very reliable. There have been so far no difficulties in Cologne with compound motors. Passenger automobiles consume on fair roads 57 to 150 watt-hours per ton kilometer, according to speed and construction. The best freight automobiles consume at low speed 60 watt-hours. The automobile company of Cologne estimates for good weather a consumption of about 80 watt-hours per ton-kilometer. He also discusses at some length the commercial question of automobile companies.—*Elek. Zeit.*, April 18.

Electric Resistance of Gas and Water Pipes.—Meagin.—A communication on measurements made in Dresden of the electric resistance of joints of gas and water pipes. This is of interest for the question of electrolysis by the return currents of tramways. The resistance of the several joints which originally had been made in an exactly identical manner, was found to be very different. The resistance of 14 joints of a gas pipe which had been buried for 35 years, varied between 0.1 ohm and 1200 ohms. The resistance of 18 joints of a waterpipe which had been buried for 20 years varied between 0.02 and 115 ohms.—*Elek. Zeit.*, April 18.

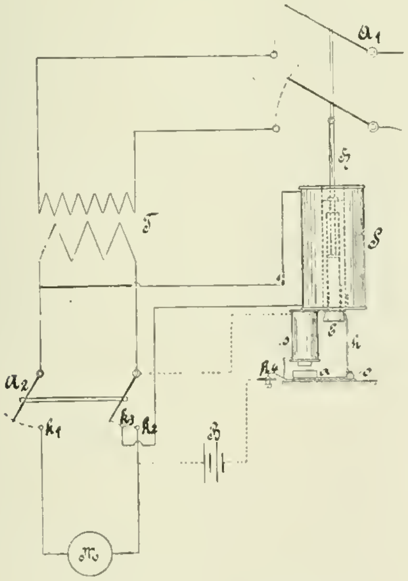
REFERENCES.

Electric Locomotives.—An illustrated description of new electric locomotives, built by a British firm for the City & South London R'y. —Lond. *Elec. Rev.*, May 3.

Automobile.—A long illustrated description of the New York Electric Vehicle Transportation Company's new station.—*Elec. Rev.*, May 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Preventing the No-Load Loss in Transformers.—Scholtes.—An illustrated description of a device by which the primaries of a transformer are automatically disconnected from the mains when the secondary circuit is broken, so that losses at no-load are prevented. The arrangement is shown in the adjoining diagram. The instrument consists of a magnet coil S with a movable iron core H and a small electromagnet s. The coils of both magnets are not supplied constantly with current, but only at the moments of opening or closing the circuit, namely S from the secondaries of the transformer and s from a small separate source of current B, like a dry cell. A lever with two arms can rotate around o. The one arm is horizontal and bears at its end the magnet armature a and the contact k_4; the other h is vertical and serves for arresting the movable iron core H. The upper end of this iron core forms the switch for the primary circuit A. In the illustration the instrument is shown for disconnected motor and transformer. When the motor M is to be connected to the circuit, the switch A_2 is closed. Current then flows from the cell B to the small electromagnet s, which is excited and attracts the armature a mounted in the one arm of the lever; the other arm h is thereby also moved, so that the iron core H is released, falls down by its weight and closes the switch A_1 of the primary circuit of the transformer. The circuit containing the cell B remains open, as the lever arm h remains out of the perpendicular position by the depth of the groove E and therefore the horizontal lever arm is also slightly out of the horizontal position, so that the contact k_4 is open. When the motor is to be disconnected, the switch A_2 is brought into the position shown in the figure. During this motion the switch arm touches the contact k_3 for a moment, and in that moment the magnet coil s is strongly excited for an instant by the secondary current of the transformer, the iron core H is attracted upward until it is arrested by the lever arm h catching the groove E, and the primary circuit is broken. The advantages of the instrument are that it has only two movable parts; that the primary circuit is opened after the secondary has been opened, so that only the small no-load current is broken, and that the magnet coils are not supplied with current continually. The apparatus has been in successful use for a year in Nuernberg.—*Elek. Zeit.*, April 25.



NO-LOAD LOSS IN TRANSFORMERS.

Electric Installation in a Packing House.—An illustrated article on the electric installation of the Cudahy Packing Company at Kansas City, Mo. Direct current at 230 volts is used for both power and lighting. There are about 40 motors scattered throughout the plant, ranging from ¼ horse-power to 75 horse-power, and aggregating about 700 horse-power. There are about 3000 incandescent lamps and 15 enclosed arc lamps. The power plant contains two units of 350 kilowatts and 200 kilowatts, respectively.—*West Elec.*, May 4.

REFERENCES.

Manchester.—An illustrated description of two direct-current generating sets among the recent additions to the Manchester electric plant. Each is rated at 750 kilowatts, and consists of a Westinghouse multipolar generator direct coupled to a Ferranti steam engine.—Lond. *Elec.*, April 26.

Wigan.—An illustrated description of this new British lighting and traction plant. The direct-current three-wire system is used for lighting, with 230 volts on the consumers' terminals. The dynamos may be used for either lighting or traction, generating in the latter case at 500 to 550 volts.—Lond. *Elec. Rev.*, April 26.

Denver.—An illustrated article on the Lacombe central station in Denver. It has two departments, one providing energy for 1250 arc lights of 2000 candle-power, the other for commercial lighting; the latter contains two 375-kw two-phase generators.—*West. Elec.*, May 11.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Soldering of Aluminum.—An article of a general nature on the soldering of aluminum wires. It seems to contain nothing new.—Lond. *Elec. Rev.*, April 26.

ELECTRO-PHYSICS AND MAGNETISM.

Sine Currents.—Wien.—A description of an apparatus for producing sinusoidal alternating currents with frequencies as high as 8500 periods per second. A disk of wood or brass carries a number of pieces of transformer sheet-iron around its rim, and the latter moves between the poles of an electromagnet. The alternations thus generated are reinforced by what the author terms "electric resonance," which consists in bringing the proper period of the electric system into unison with the frequency, by inserting a suitable capacity, and regulating the inductance. By this device the amplitude of the main current is greatly augmented, while the overtones remain small as before. None of the higher components have an amplitude exceeding 1 per cent of the main amplitude. The latter is 0.2 ampere, with a resistance of 100 ohms. For experiments in which the currents need not be very purely sinusoidal, double the frequency may be produced with the same apparatus, viz., 17,000 periods per second.—*Arn. der Physik.*, No. 3; abstracted in Lond. *Elec.*, April 19.

Coherer—Guthe.—An account of an experimental investigation of the action of the coherer. He urges experimenting with coherers of a form as simple as possible. He investigated coherers with one contact only. He used spherical surfaces stamped out of metal sheet. The resistance could be adjusted by means of a fine screw. He had formerly found that the p. d. during the passage of the current increases with the latter, finally reaching a constant value which is independent of a further increase of the current or changes in the applied e. m. f. He had called this value the critical value of the coherer and had determined it for a few metals. He has not extended this investigation to a large number of metals. The critical voltage varies appreciably when different metals are used. He also studied the "negative action," by which he means the increase of resistance under the influence of electric waves. He shows that it is due to disturbing influences, and cannot be considered a normal phenomenon, as Bose supposes. He also investigated the influence which the heating of the contact has upon the resistance of the coherer. The higher the temperature of the contact the lower appeared to be the resistance of the coherer under otherwise similar conditions, and the resistance returned to its original high value when the heating ceased. He believes that in the action of the coherer the heating of the contact plays an important part. By it the first impulse to the lowering of resistance is given. It may be called the first stage. When the contact is not heated by the current passing through the coherer, the resistance very soon increases on cooling, while after actual cohesion has taken place, a metallic contact is produced and the resistance returns only very slowly to its high value.—*Phys. Rev.*, April.

REFERENCES.

Propagation of Polyphase Currents Along Parallel Wires.—Morton.—A mathematical paper in which he calculates the speed of propagation and the attenuation in a number of parallel wires arranged in a regular polygon and alternating currents with a constant phase difference between consecutive wires. The assumption is made that the radii of the wires are small compared with their mutual distances. The different cases up to 12 wires are worked out numerically and the results are exhibited graphically.—*Phil. Mag.*, May.

Brush Discharge.—Przibam.—An illustrated account of experiments made to investigate the nature of the brush discharge by photographic methods. He discharges the electrode directly upon a rotating photographic film.—*Acad. Wiss.*, Vienna; an illustrated abstract in Lond. *Elec. Rev.*, April 26.

Electro-Chemistry and Batteries.

Electro-Chemical Action.—C. J. Reed.—The first part of an illustrated Franklin Inst. paper on "Electro-chemical action." This part deals mainly with the general principles of electro-chemical action and with an exposition of Thomson's rule. A thermo-electric process is called exothermic or endothermic, respectively, if heat is evolved at the expense of chemical energy of the system or if heat is absorbed with the accumulation of chemical energy within the system. He suggests an analogous nomenclature for an electro-chemical process. It is called "electrogenic" or "electrothanic," when chemical energy is changed into electrical energy or electrical energy into chemical energy, respectively. Electro-chemical action always takes place at the bounding surface of a reacting body, and only at the surfaces through which an electric current is either entering or leaving the reacting body, i. e., the electrolyte. An electro-chemical system always comprises two electrodes, each in contact with an electrolyte. The electrolyte is necessarily a compound body separable into two constituents, one of which undergoes chemical change at one terminal and the other at the other terminal. These two reactions, occurring in series at the two terminals, are always of an opposite or different character, and are so related to each other that the reaction at one terminal is impossible without the reaction at the other. A cell with two copper electrodes and copper sulphate as electrolyte. is an "agenic" cell. If, by means of an external source of electric energy, current is sent through this cell, at one electrode copper is dissolved. at the other deposited. The reaction at the first electrode is electrogenic, at the second electrothanic, both reactions are equal and opposite, so that in the whole neither electrical energy is changed into chemical energy, nor chemical energy into electrical energy. In the case of a Daniell cell which generates current, the reaction at the zinc electrode is electrogenic and corresponds, according to Thomson's rule, to the generation of 2.3 volts, the reaction at the copper electrode is electrothanic and corresponds to the absorption of 1.21 volts, hence the whole cell has an e. m. f. of 1.09 volts, so that the calculation of the e. m. f. from the thermo-chemical data is in agreement with the facts. He then gives a long list of substances, the compounds of which have positive formation heats, and a brief list of substances some compounds of which have negative formation heats. He then defines the "electrogenic power of a compound" as the "intensity of the electrical energy evolved by the electro-chemical formation of the compound. It is proportional to and measured by the formation heat of the same compound, formed thermo-chemically. Electrothanic power is merely negative electrogenic power." He then gives a long and useful table of electrogenic powers of chlorides, bromides, oxides and sulphates, giving in three columns the chemical symbols, the formation heats in gram-calories, and the corresponding electro-chemical e. m. f.'s or electrogenic powers. A result of this table, which is of particular interest, is the simple numerical relation between chlorides and bromides, which apparently indicates that the energy of combination is the sum of two or more constants inherent in the several elements. (This appears to lead to Le Blanc's theory of the "Haftintensität" of the several ions.) The table enables one to calculate the e. m. f.'s of a large number of cells, due to electro-chemical action. About 4.5 volts is the upper limit of electro-chemical e. m. f. theoretically obtainable in any single electro-chemical system by any combination of known substances, except perhaps caesium.—*Jour. Frank. Inst.*, May.

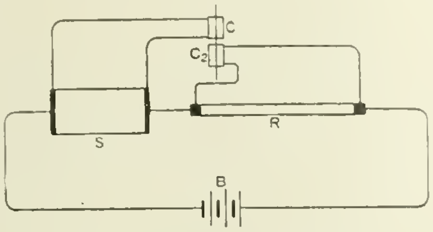
Calcium Carbide Industry.—Some notes from an article by Rose, on the present European calcium carbide industry, due to over-speculation and overproduction in recent years. During 1900 the price of carbide has fallen from $20 to $10 per ton at Hamburg, and at the latter price many of the works have ceased to yield profit. There is no hope of a decided recovery in price. At Thusis, in Switzerland, aluminum is to be manufactured in place of carbide, while the power of the carbide works at Ruhr is to be devoted to the manufacture of woodpulp. At Lauterbach, in Switzerland and at Milan, the carbide works have been closed for an indefinite period. It is said that acetylene illumination will have a future, although its field of utilization can never be a very extensive one.—Lond. *Elec.*, April 19.

Smelting Iron Electrically—An article on the question whether the smelting of iron by electricity is practicable. This question is of the greatest importance for countries which are rich in iron ore, but not in fuel. It is pointed out that a certain quantity of energy is required per pound of iron oxide, to separate the oxygen from the iron. It is calculated that with an ideal electrical process of smelting iron, in a year of continuous day and night working, one horse-power could produce 2¾ tons of iron. The coke required to make 2¾ tons of iron in the blast furnace is worth at present about $5 50 while a 24-hour horse-power of electric energy for a year is worth anywhere from $20 upwards. The conclusion is, therefore, that a process of electric iron smelting under the most favorable circumstances would be several times as great as the cost of the present method of reduction of iron by the combustion of fuel in the blast furnace.—*Eng. News*, May 2.

Copper-Cadmium Storage Battery.—Gahl.—A communication referring to the recently published English patent of Edison and giving in some diagrams the results of some tests of a copper-cadmium battery. The discharge e. m. f. was always 0.4 volt, and the watt efficiency was very low. He thinks that, therefore, such a battery cannot compete with the present lead storage battery.—*Elek. Zeit.*, April 18.

Units, Measurements and Instruments.

Measuring Low Resistances in the Workshop.—Edgecumbe.—An illustrated communication in which he described a direct reading differential instrument for the rapid comparison of low resistance on a commercial scale, the connection being shown in the adjoining diagram. *B* is a source of direct current, not necessarily constant, *S* is the standard with which the unknown resistance *R* is to be compared. From the terminals of *S* and *R* wires are run to two coils *C* rigidly fixed to the same axis, which is so pivoted as to allow the coils to rotate in a strong permanent magnetic field, as in the ordinary moving coil instrument. The two coils are connected in such a way that they tend to turn in opposite directions, and the pole pieces of the magnet are so cut away that, as it moves around, one coil gets into a stronger and stronger field, while the other gets into a weaker and weaker field. The result is, that for any given ratio between the voltage drop in *R* and *S*, the moving system takes up a definite position, which is quite independent of the current flowing, and which is indicated by a pointer carried by the coils and moving over a graduated scale. A number of standards *S* are provided, any one of which can be inserted in the circuit by means of a plug. Besides being perfectly dead-beat and direct-reading, the instrument has the advantage of enabling a resistance to be measured at its normal working current, and without removal from the circuit in which it may be connected. Thus, for example, the resistance of the coils between neighboring commutator bars can be readily compared without disconnection from the lugs, and a fault immediately localized.



MEASURING LOW RESISTANCES.

While not capable of the same accuracy as the potentiometer method it has the great advantage that any available source of current may be used; whereas by the former method an absolutely constant current is necessary. The two coils being in the same case, temperature errors are eliminated.—Lond. *Elec.*, May 3.

Ammeter and Voltmeter with Adjustable Field.—Menges.—The instrument is of the D'Arsonval type, and the permanent magnet is provided with an iron piece, acting as a magnetic shunt, the position of which can be adjusted by a screw. The iron core between the poles of the magnet is capable of slight eccentric motion about a horizontal axis, so that the attractions of gravity and of the magnet tend to move it in opposite directions. The magnetic shunt is adjusted until these two attractions are in equilibrium—a condition which corresponds to a definite strength of the field in the air-gap. With a variation of 30 per cent in the strength of the magnet, the strength of the field can in this way be adjusted to within 1 per cent. —*Soc. Franc. Phys. Bull.*, 155, p. 2; abstracted in *Science Abstracts*, April.

REFERENCES.

Differential Galvanometer.—Crawley.—A brief illustrated paper, read before the Brit. Inst. of Elec. Eng., on the use of the differential galvanometer for special purposes, especially for adjusting low resistances. He looks on the differential galvanometer as a potentiometer, only instead of balancing opposing e. m. f.'s one balances the m. m. f.'s. The differential galvanometer is especially suitable for adjusting a set of wires having resistances of a constant ratio, for instance, 1, ½, ¼, etc., ohm.—Lond. *Elec. Rev.*, April 26.

Ballistic Galvanometer.—Robertson.—The conclusion of his mathematical article on the apparent resistance of a ballistic galvanometer of the moving coil type, and a method of allowing for the damping current.—Lond. *Elec.*, April 26.

The Construction of an Electrodynamometer.—Kintner.—A didactic article on the construction and calibration of an electrodynamometer for students and amateurs.—*Am. Elec.*, May.

Brake Dynamometer.—Hubert.—An illustrated description of an adjustable brake dynamometer which has several mechanical advantages.—*Elek. Zeit.*, April 18.

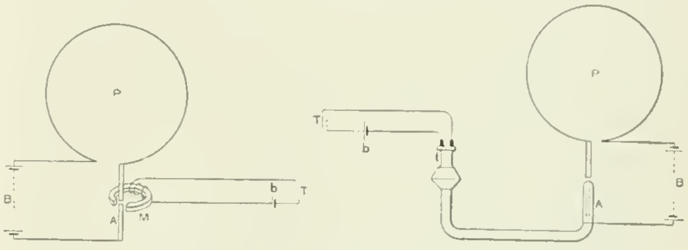
Measuring Hysteresis.—Crook.—An illustrated description of a yoke with intercepted magnetic circuit, for measuring hysteresis.—*Am. Jour. of Sc.*, May.

Meter Testing.—Smith.—An article in which he gives some practical rules for testing electric meters.—Lond. *Elec. Rev.*, May 3.

Telegraphy, Telephony and Signals.

Photographone.—Ruhmer.—A description of an interesting method of reproducing sounds from photographic records. Photographic records are the most sensitive and accurate records of sound vibrations, and good photographic records have been obtained both from the ordinary phonograph cylinder and from sensitive flames. His method of reproducting the sounds from the photographic records is as follows: He photographs a "speaking arc" or other sensitive flame on a moving film, and reproduces the sound by projecting light through the film onto a selenium cell in circuit with a battery and telephone. Every variation of the light impinging upon the selenium cell produces a sound in the telephone, and the reproduction is superior in sensitiveness and clearness to the Poulsen telegraphone. Moreover, the film can be made of very considerable length without losing its lightness and portability, which cannot be said of either the wax cylinder or the telegraphone wire. Another great advantage is that any number of equally good prints can be taken off the same negative. Cylindrical lenses are used for concentrating the light upon the film.—*Der Mechaniker*, No. 7; abstracted in Lond. *Elec.*, May 3.

Wireless Telephony.—Wilson and Evans.—An illustrated description of two fundamental experiments with a direct-current arc. In Fig. 1 *M* is an electromagnet with laminated core energized by currents from a small battery *b* in circuit with a telephone transmitter *T*; the magnet and the transmitter were placed in two different rooms, and were connected by a twin wire. The current in the arc *A* was supplied by a battery *B* and passed through a coil 4 ft. in diameter, consisting of 40 turns. "A similar coil placed opposite *P* served as a secondary and included a telephone receiver in its circuit." With a silent arc the voice at *T* could be heard in the telephone in this secondary circuit. In the second experiment Fig. 2, a loud-speaking receiver *t* was connected by an india-rubber tube to the lower end of a carbon *A*, from which the core had been extracted. *T* and *A* are in different rooms. The voice could be heard in the telephone in the secondary circuit placed opposite the primary *P*. "With both these arrangements the best conditions appeared to be that the arc should play all round the periphery of *A*, so that it sustained the full effect of the vibrations."—Lond. *Elec.*, May 3.



FIGS. 1 AND 2.—WIRELESS TELEPHONY.

Exciters for Wireless Telegraphy.—Braun.—A description of two devices for compensating the damping of the oscillations by their own electromagnetic radiation, in order to get nearly pure sine oscillations, favorable radiation conditions, and only a very slight damping. One of the devices consists in attaching the open exciter to a closed condenser circuit. Not only does the capacity of the latter reduce the damping by the spark, but it restores the energy radiated to the exciter. In the second device the exciter is quite detached and represents an interrupted wire. Its lower end is wound into a coil, and in this coil the oscillations of the primary condenser circuit are reproduced by induction. The exciter is then quite sparkless, but, all the same, amplitudes of potential variation may be produced in it of such magnitude as would be valueless if the exciter, with its small capacity, contained a spark-gap. Resonance between the primary and secondary circuits is very essential.—*Phys. Zeit.*, March 23; abstracted in Lond. *Elec.*, May 3.

REFERENCES.

Simultaneous Telephony and Telegraphy.—Jentsch.—An illustrated description of the system of simultaneous telephony and Hughes telegraphy on telephone wires, which is in successful use on several long-distance lines in Germany and between Germany and Austria.—*Elek. Zeit.*, April 18.

Telephone and Trolley Wires.—An illustrated description of two new devices, brought out by an English firm, for directly earthing a broken trolley wire or a broken telephone wire which is in contact with a trolley wire, and thus ensuring the passage of sufficient current either to blow the fuse in the junction box, or to release the circuit breaker at the station.—Lond. *Elec. Rev.*, April 26.

Early Telephony.—Lockwood.—An illustrated article giving some reminiscences of early telephone days in Boston.—*Tel. Mag.*, May.

Sandusky.—Dobbs.—An illustrated article on the new equipment of the Sandusky Telephone Co.—*Elec. Rev.*, May 4.

Statistical.—The conclusion of the statistical article on telegraphy and telephony in Hungary in 1898 and 1899; comparative statistical tables on telegraphy in 1899 in different countries of the world.—*Jour. Teleg.*, April 25.

Telegraphone.—An illustrated description of Poulsen's instrument, repeatedly referred to in the Digest. The wire type and the ribbon type are on view at the offices of the Telegraphone Syndicate in London. The idea of using the instrument as a telephonic relay has not yet been put into practice in such a way as to obtain definite results.—Lond. *Elec.*, April 26.

Submarine Signaling.—An illustrated article on the experiments made by Mundy and Elisha Gray in submarine signaling.—*Tel Mag.*, May.

MISCELLANEOUS.

The Thermite Welding Process.—A note on "An interesting demonstration" of the Goldschmidt method of welding, recently made in England. The process was repeatedly referred to in the Digest. In that demonstration several pipes were welded with great ease, as also were two lengths of steel tramway rails. The ends to be welded are filed, the separate pieces are clamped firmly together, and the joint is then surrounded by a sheet-iron casing, jacketed externally with moist sand, which again is kept in place by a box surrounding it. The thermite, consisting of aluminum and oxide of iron in about the proportions of one to three, is then prepared in a crucible lined with magnesia or alumina, and a small quantity of superoxide of barium is sprinkled over the mixture, after which the whole is ignited with an ordinary match. The chemical reactions are very vigorous, the whole becoming molten in a very short time, when the mass, which has separated into two layers, may be poured into the mold. The top layer consists of an oxide of aluminum, which immediately forms a thin coat round the pieces, thus effectually preventing the iron which follows being welded to them. When the welding temperature is reached the clamps are slightly tightened, and, after cooling, the whole mass can be easily removed. By a simple modification, the iron from the thermite mixture can also be welded onto the joint. This consists in having a small opening at the bottom of the crucible covered by a piece of sheet iron. The crucible is in this case placed over the mold, and when the reaction takes place the sheet iron is melted, and the iron at the bottom of the crucible touches the joint before the slag, and is welded to it. A 3-inch pipe 0.16 inch thick can be welded with 5 lbs. of thermite. The distance of the sheet iron mold from the pipe is 0.72 inch, and the length of the mold 3.2 inches. The welding temperature is reached 1½ minutes after the thermite is poured in. The makers claim that the cost of welding two 2-inch tubes is from 50 cents to $2, according as the thickness ranged from 0.10 to 0.24 inch, the prices including crucible, mold and labor.—Lond. *Elec.*, May 3.

REFERENCES.

Manufacturing Plant.—The first part of an illustrated article on the works of the Westinghouse Co.—*Elec. Rev.*, May 11.

Manufacturing Plant.—The first parts of an illustrated description of plants in Germany which will be visited in this year's trip of the British Inst. Elec. Eng. These parts deal with the machine factory and the instrument factory of the Gen. Elec. Co., of Berlin.—Lond. *Elec. Eng.*, April 26, May 3.

Paris Exposition.—Picou.—A paper read before the Internat. Soc. of Elec. in Paris on the electric light and power service of the Exposition.—*Bull. de la Soc. Int. des Elec.*, March.

The conclusion of the illustrated serial on electric exhibits. This part deals with the O'Keenan meter, the Lux meter, the Hackl arc lamp of Ganz & Co., the Mougin arc lamp and searchlights exhibited. —Lond. *Elec.*, May 3.

New Book.

Kalender fur Elektrochemiker. Sowie Technische Chemiker und Physiker fur das Jahr 1901, mit einer beilage jahrgang. Von Dr. A. Neuberger. Berlin: M. Krayn. 524 pages, 21 illustrations. Beilage, 432 pages. Price, 5 Marks.

A peculiar German custom is to publish pocket reference books in the form of a diary with dated blank pages, followed by the book itself, hence the name "calendar" which they often bear. In Germany, where nearly every engineer always carries with him his slide rule, reference book, diary and pencil, this has its advantages, while for those who do not care to use the diary part, the 80 pages devoted to it do no harm. But the great advantage of publishing pocket reference books in the form of an annual is that the edition is (or should be) revised each year and brought up to date; and to the publisher it has the advantage that many buy the new edition each year and discard the old.

The present work is this year's edition of a pocket reference book on electrochemistry, and is prepared in the usual pocket book style, with this difference, that only the first part is bound for the pocket, the second half, being in paper and containing such information as is not wanted sufficiently often to carry in the pocket, but can better be kept on the desk. A curious result of this sub-division, however, is that the desk part is the one which contains the rules concerning the immediate assistance and treatment of those who have been severely shocked by electric currents, or poisoned, the very information one needs in the greatest hurry.

For any one working in electrochemistry, this reference book is of great value and no electrochemist should be without it, or one like it if such exists. It contains such information as one expects to find in a small reference book, and is limited largely, though not exclusively, to electrochemistry. Like most books of its kind, it is a compilation, and it is all the better for it, as what is wanted is the result of the best work and data existing, and this never the production of one brain. Moreover, the author is the editor of one of the first journals published exclusively on electrochemistry, and therefore he may be expected to be posted on what is being published from month to month on this subject.

The book is also of value in that it is, we believe, the only pocket reference book published on electrochemistry. It may therefore be recommended highly as being very useful. But this must not be construed as an endorsement of everything in it, as we regret to say that it is not at all well edited. The author has in many cases merely copied tables and data, without stating clearly the meanings of the figures, the units in which they are given, and such other information which is so necessary in order to use the tables or constants. In some cases this missing information could be supplied by an experienced engineer who may either know it or could determine it by comparisons with known data, but this is troublesome and annoying. In other cases, however, the data becomes absolutely useless for the want of some essential information. Of what use, for instance, are the internal resistances of batteries without their dimensions? In many cases the numbers in tables are not reduced to modern units, thus involving a further time-robbing reduction by those who use the data during the year 1901 for which this book is intended. For instance, the pages of specific resistances of liquids are given in terms of the now ancient Siemens unit Others are given for a foot-cube Conductivities are given without any reference to any unit, although there are as many units of conductivity as there are of resistance A careful author would have been very particular about supplying all necessary explanation of the data and would have reduced all the constants to modern terms.

Nor can claims be made for reasonable completeness, notwithstanding the fact that very large quantities of data are given; there are omissions which in a fifth edition should have been supplied, especially as claims are made in the preface that this edition has been thoroughly revised and brought up to date. Moreover, there is no index, but merely a table of contents in the order of the pages which involves much labor in looking for any particular subject especially as the classification is not the one many others would have chosen. Matters are made much worse by the fact that even in this table of contents there are inexcusable errors. For instance, for the subject of the heat of formation the table of contents gives page 416 in the second volume, which however contains nothing at all on this subject, nor does that page in the first volume; a page by page search shows it to be on page 452 of the first volume. The index for the second volume is only in the first.

The reviewer has not examined the data for correctness, but from some isolated cases it seems as though no great care was taken to obtain the most recent and best data. Cases might be multiplied to show that the author has been careless, which is very unfortunate. Nevertheless, there is much in the book that is of value, and it is to be hoped that more care will be taken with subsequent editions.

The book also devotes much space to the general laws of electricity, which have no connection with electro-chemistry; also to chemistry, physics, mathematics, mechanics, machines, fuels, laws, and miscellaneous information, chiefly of use in Germany. Whether all this should be included in a book on electro-chemistry is a matter of opinion. The reviewer believes that much of it is out of place and should be left to reference books on those particular subjects, as there exists too much useful reference matter in each branch to try and include it all in one small book.

Directory of Electrical Societies, Etc.

Canadian Electrical Association. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

Independent Telephone Association of the United States. Next meeting, Buffalo, N. Y., June 11, 12 and 13, 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

New York State Street Railway Association. Next meeting, Rochester, N. Y., September, 1901.

Northwestern Electrical Association. Next meeting, Sheboygan, Wis., last week in June, 1901.

Ohio Electric Light Association. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

Old Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

Pennsylvania State Street Railway Association. Next meeting, York, Pa., Sept. 4, 1901.

6000 H. P. Westinghouse Engine for the New York Gas, Electric Light, Heat and Power Company.

The latest Westinghouse engine and the largest yet built, is a 6000-hp Westinghouse-Corliss engine. It is the first one of eight similar ones intended for the waterside power station of the New York Gas & Electric Light, Heat & Power Company.

The engine is of the familiar inverted cross-compound type. The base consists of three rectangular pieces weighing in the aggregate 100 tons. Upon this base are set the three housings with circular flange tops. Each housing, consisting of two parts which bolt together, is very stiffly ribbed. Bolted on the housings are the crosshead guide frames of which there is one for each housing. Each guide frame is surmounted by its cylinder, there being one high pressure, and two low pressure, the middle one being a high-pressure cylinder and the outer ones being low pressure. There are three platforms circumscribing the engine, the first platform at the height of the housing and the second at the height of the guide frame, the third platform surmounts the tops of the cylinders.

The high-pressure cylinder is 43½ inches in diameter, and the two low-pressure cylinders each 75½ inches in diameter. The stroke is 60 inches and the speed 75 r. p. m. The high-pressure cylinder is not jacketed, and from this cylinder the steam passes into a receiver 4 ft. 6 inches in diameter and 23 ft. in length over all. The volume of this receiver is 210 cubic feet, and it contains 110 tubes, giving about 1200 square feet of heating surface. This heater is placed horizontally across the rear of the guide frame portion. The low-pressure cylinders are steam jacketed.

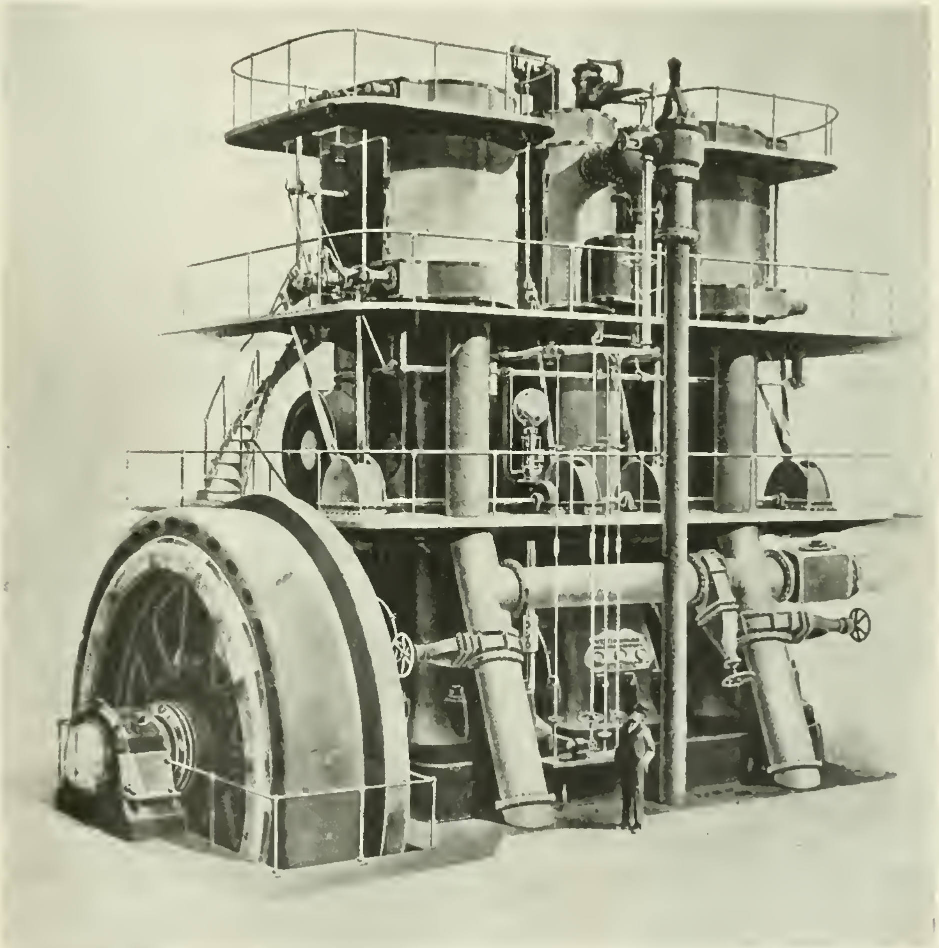
The valves are all double ported, and as close together as will allow of proper valve gear construction. The high-pressure cylinder has balanced poppet valves actuated by a releasing gear, and the low-pressure cylinders Corliss valves operated by the usual wrist plate and tie rods. This unusual combination of valves was substituted for all Corliss valves because of the high temperature at which steam enters the high-pressure cylinder. This steam, which is under a pressure of 175 lbs., is superheated 200 degs., making its total temperature 577 degs. At this temperature it is practically impossible to provide the efficient lubrication necessary to the proper working of Corliss valves.

Each connecting rod is a steel forging, and is 13 ft. 9 inches long between centres. The top end of each connecting rod is of the ordinary solid type with wedge adjustment, and the bottom end is of the so-called marine type. The crosshead pins are 14 by 14 inches, and the crank pins, 14 inches in length, are 22 inches in diameter. The cranks are of cast steel, and are of the usual type, not as is customary, set 120 degs. apart, but at unequal angles, selected to give the best possible turning movement, which, owing to the service of the engines, is a matter of capital importance.

The main shaft is of open hearth, fluid compressed, hydraulically forged steel, as are the connecting rods, and was supplied by the Bethlehem Steel Company. This shaft is hollow, and of 10 inches internal diameter at the wheel fit and 9 inches at the bearings. The total weight of the main shaft is 136,000 lbs.

An interesting departure from ordinary engineering practice is to be found in the way motion is given to the eccentrics that control the valve movements. Usually the eccentrics are mounted directly on the main shaft. In this instance the eccentrics are mounted on a lay shaft located at the level of the first platform. This auxiliary shaft is driven by a spiral gear. The advantages to be derived from moving the eccentrics in this way are manifold. The chief one is, however, the saving of energy by reducing the size of the eccentric straps. The diameter of the main shaft is 29½ inches, while the diameter of the lay shaft is 6 inches. The eccentric straps and the friction caused by their rubbing surfaces are reduced accordingly.

The flywheel is of novel design and comparatively small, because a more uniform turning moment is given by the three unequally spaced cranks than is possible with two cranks. The center is of air-furnace iron, and the arms and rim of cast steel made in five sections, each comprising 72 degs. of rim and two of the ten radial arms. These five sections are joined together by I-links shrunk into pockets, and are bolted into the hub, forming a wheel 23 feet in diameter and of 9 inches face, having a radial depth of 30 inches.



6000-HP WESTINGHOUSE-CORLISS ENGINE.

Upon either side of this wheel are riveted upon its rim and flush with its face, five circular pieces of 72 degs. angular length each. These pieces are 3¾-inch face and 27½-inch depth, making a total face width of 16½ inches. These side segments are also fastened together by I-links, but the joints are broken with those of the central wheel rim. The peripheral speed is 5416 ft., or about a mile a minute.

An automatic stop-valve is provided which shuts off the steam supply in case the speed exceeds any fixed limit. In brief, it may be described as a valve which is closed by steam admitted through a three-way cock. In a pocket in the face of one of the high-pressure crank checks is pivoted a short weighted lever, balanced against centrifugal force at normal speed by a helical spring. Should normal speed be exceeded, the weighted lever flies out, and engages with a spring lever pivoted on the engine base. This action turns the three-way cock above mentioned, admitting steam to a chamber of the angle stop valve on the steam supply main, and this valve is promptly closed. There is also provision at a number of points about the engine for hand control of this same stop valve.

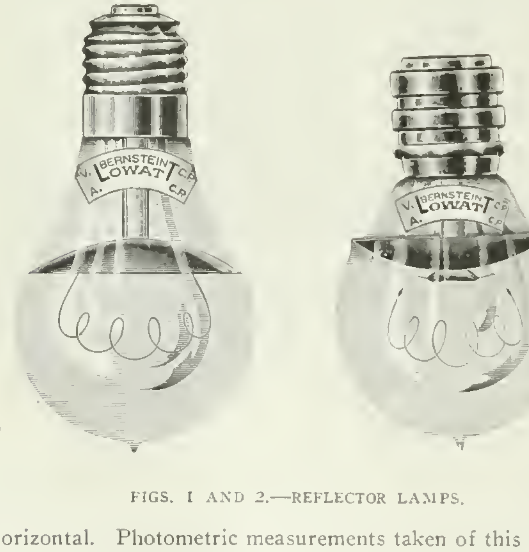
The engine is 37¼ ft. from the floor line to the top of the cylinders; 41 ft. across the front and 23 ft. from front to rear. Its entire weight is more than 1,500,000 lbs., and above 15,000 separate pieces go to make it. So strongly built is this engine that it can deliver, in an emergency, 10,000 horse-power, which is almost double its most economical rating. Each engine is to be coupled direct to a 5000-kw generator of the revolving field type. The armature of this generator is to be pressed on the shaft alongside the flywheel, and in addition to being securely keyed to the shaft it is to be rigidly attached to the flywheel hub by means of direct bolting. The outer end of the generator shaft is to be supported by a heavy pedestal carried on an iron sub-base.

◆

Reflector Incandescent Lamps.

There are many situations where the distribution of illumination from the ordinary incandescent lamps is not the most convenient or efficient, and this is particularly true where the illumination is dependent upon a few lamps or a single lamp. In order to meet this condition the Bernstein Electric Manufacturing Company, of Boston, Mass., has perfected and placed on the market a type of lamp, the direction of radiation from which is controlled by means of a metal reflector contained entirely within the bulb of the lamp. One of the forms of this type, shown in Fig. 1, concentrates and throws the light directly away from the socket. This lamp is especially desirable for show windows, signs and in halls, and elsewhere where the lamp is in a high location. For desk, library and general use the lamp is frosted.

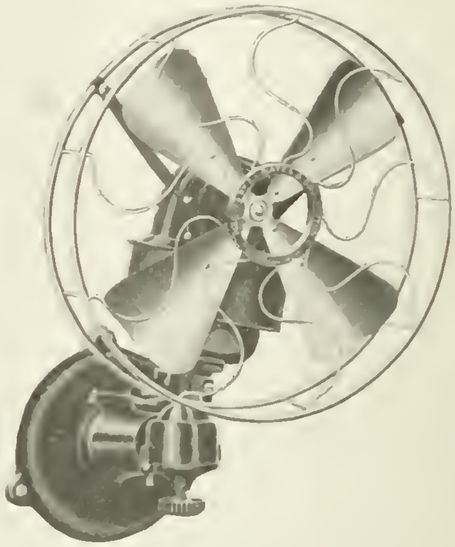
Fig. 2 shows the lamp with a convex reflector, which distributes the light about equally in all directions to an angle somewhat above the horizontal. Photometric measurements taken of this lamp shows an almost perfectly spherical distribution of the rays. In still another form of lamp the reflector is at right angles to the socket. This form is especially intended for car headlights, theater footlights and show window side lighting.



FIGS. 1 AND 2.—REFLECTOR LAMPS.

Bates Bracket Fan.

The fan illustrated herewith is the direct-current bracket pattern manufactured by Messrs. D. L. Bates & Brother, Dayton, Ohio. The field magnet is of the bipolar, inverted type, provided with end caps screwed to the pole pieces for the protection of the armature and commutator. The magnet core is of forged steel. The machine illustrated is provided with universal adjustment, which permits of the motor and fan being set at any angle.



BRACKET FAN

The 12-inch fan has a maximum speed of 1900 r. p. m., and consumes 31 watts at 110 volts; the 16-inch size takes 60 watts, its speed being 1600 r. p. m.

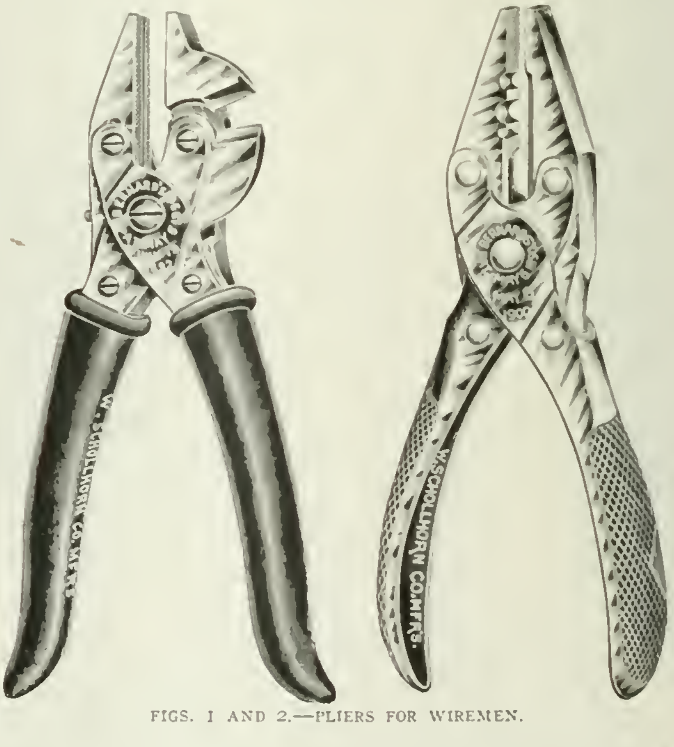
These motors are also made in the pedestal pattern for desks, tables, etc.

◆

Wiremen's Pliers.

Two new forms of pliers recently placed on the market by the William Schollhorn Company, New Haven, Conn., are shown in the accompanying cuts. Both tools have such a mechanism that the jaws are parallel at all points of their motion.

Fig. 1 shows a pair of electric cutting pliers, with rubber handle covers. The plain jaws are always parallel to each other. The two cutting jaws are mounted respectively on the two parts of the handle. Fig. 2 shows a tool specially made for cutting and stripping insulated wire. In this case also the jaws are parallel and the tool unites the functions of pliers, cutter and stripper.

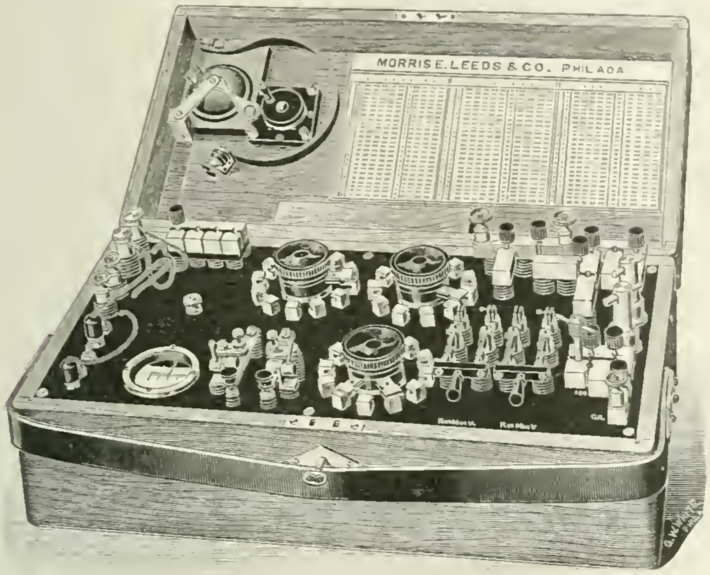

W. SCHOLLHORN CO. N.H. CT.
W. SCHOLLHORN CO. N.H. CT.

FIGS. 1 AND 2.—PLIERS FOR WIREMEN.

A New Cable Testing Outfit.

The portable cable testing set shown in the accompanying illustration was recently designed by Mr. Henry W. Fisher, of the Standard Underground Cable Company, Pittsburg, and represents the latest ideas in apparatus of this class. It is designed for tests where a strictly portable set is required, and therefore is compact and comparatively light in weight. In addition to measurements of capacity insulation and conductivity resistance, it is possible to locate faults by the Murray or Varley loop tests. Mr. Fisher has also introduced a method for locating breaks in cables where the conductor has parted, and a new method for measuring capacity in which a telephone is used in place of a galvanometer. To operate the apparatus rapidly and without complication, a set of double-throw switches change the connections from one test to another without the use of inconvenient flexible cords and without the necessity for remembering a complicated scheme of connections.

For use with this new testing set a portable D'Arsonval galvanometer of high sensibility has been designed, and is so constructed that the apparatus can be used in a laboratory or out of doors, as may be required. Although this cable testing set has not been placed on the market more than a few weeks, it was perfected by Mr. Fisher some time ago, and is entirely beyond the experimental state. Telephone engineers will find this outfit of great value in cable testing. The apparatus is manufactured by Morris E. Leeds & Co., and is handled by James G. Biddle, Philadelphia, who is sole selling agent for the manufacturers.



CABLE TESTING OUTFIT.

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Enclosed Arc Lamps.

One of the most important events that has occurred recently in regard to lighting for some time was the report of the municipal committee of the city of Cincinnati, pertaining to the best form of street illuminant. It is encouraging to all manufacturers of electrical apparatus, both of dynamos, as well as arc lamps, as it passed a decided verdict against Welsbachs and in favor of enclosed arcs, as noted in these columns.

The report above referred to, will be very pertinent to manufacturers of enclosed arc lamps, and though there are many such companies in the field, it is possible that others will still be added to the list. One well-known concern making lamps of this type, though in the business but a few years, is the Lea Electric Manufacturing Company, of Elwood, Ind. This company has gained considerable prominence, by bringing out a miniature direct-current lamp for either 110 or 220 volts. The growing demands for this miniature lamp proves that its popularity is increasing.

One of the most important features of this company's enclosed arc lamp is the swinging cover, invented by William H. Northall. By pressing a spring the lamp opens and the cover divides vertically, each half being raised to a horizontal position and supported by automatic catches. When the catches are released, the cover may be closed to with a snap. These covers are supplied to all of the lamps that the company now manufactures. The mechanism of the lamp is very simple, consisting of an iron-clad armature, surrounding a solenoid, the clutch rod and dashpot, the resistance being two grooved porcelain spools, supported from above by a rod and "T." The standard of the lamp is hollow, and the carbon is entirely enclosed in a vacuum. The company has recently brought out standard and miniature alternating lamps for either 60 or 120 cycles. These are also equipped with the swinging cover, which, from its easy accessibility to the interior parts will make the lamps very popular.

Recent tests have shown that the lamps of this company have very high efficiency, having especially long life without retrimming. The company has a fine exhibit of its product in space "Q," Electrical Building, Pan-American Exposition. Attention is called there to the announcements by this company of its product, such as standard alternating lamps for 60 and 120 cycles on silk pennants, supported on brass standards in the Exposition colors, orange and olive. The company gained considerable prominence at the convention through its male quartette, composed of workmen from its factory, whose singing made them decidedly popular with all the members, and gained them many admirers.

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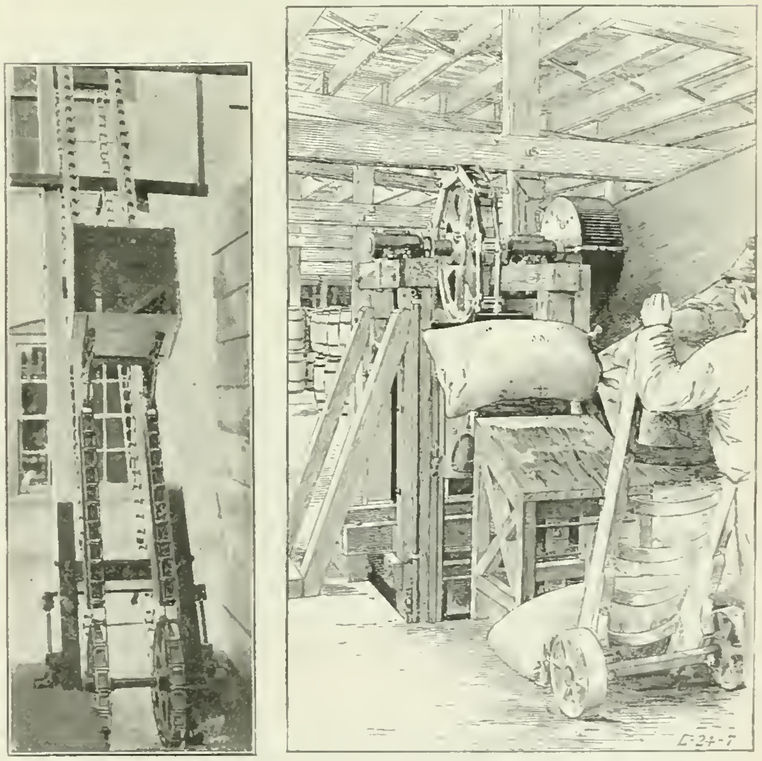
Link-Belt Elevator.

The economic handling and disposition of empty packing cases or other empty receptacles often presents most vexatious problems. To get them out of the way and accessibly stored with all possible expedition is not only desirable, but sometimes imperative.

The empty box elevator illustrated in Fig. 1 was installed for this purpose for the Scott Paper Company, of Philadelphia, by the Link-Belt Engineering Company of the same city. A double strand of "Ewart" link-belting is employed, and at intervals of 5 ft. a straight arm is attached, one to each belt. The machine is mounted in a wooden frame and carries empty boxes from the ground to the upper floor of the warehouse at the rate of 12 per minute.

Another application of this link-belting, adapted for much heavier work, is the link-belt barrel and sack elevator, shown in Fig. 2. This machine is provided with automatic arms, which permit of barrels and sacks being elevated and gently delivered to any floor while simultaneously others are being carried down on the other side. The machine illustrated is in use in the Lehigh Valley Railroad Company's Jersey City freight house. It has 37-ft. centers, and uses heavy malleable iron chain belts, with carrier arms attached every 10 ft. The machine is provided with an adjustable stop so arranged that the barrels are discharged at the proper height to be rolled away on the floor, or the sacks for convenient removal by hand trucks. The head is driven by worm gearing, encased in a housing, and the worm runs in a bath of oil.



FIGS. 1 AND 2.—LINK-BELT ELEVATOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed nominally at 3 per cent. Time money during the week grew more abundant, owing to the recent liquidation in the stock market. The rates are 4½@5 per cent for 30 to 60 days, 4@4½ for three, four, five and six months. Mercantile paper is quoted at 4 per cent for 60 to 90 days indorsed bills receivable, 4@4½ for choice four to six months single names and 5@6 for others. The prices of stocks during the week were firm and generally advanced on the announcement that a compromise had been effected between the interests in contest for control of the Northern Pacific precipitated by the violent break and corner of the week previous. Heavy liquidation of weak speculative accounts marked the early part of the week and renewed declines took place. Transactions were on a decidedly smaller scale, and the public was largely eliminated as a factor in the market. United States Steel stocks, after suffering from heavy liquidating sales, showed strength on reports of early commencement of dividends on both classes of shares. In the traction list Metropolitan Street Railway recovered some of the loss recorded the previous week. It closed at 168, representing a net gain on the week's trading of 5 points, the sales being 73,000 shares. Brooklyn Rapid Transit did not gain any of the losses of the week previous, closing with a net loss of ¼ point. There was some activity in trading, however, the number of shares sold being 153,175. In the electric list, General Electric showed some strength and closed with a net gain of 2 points, the price of this stock ranging between 210¼ and 225, the closing figure being 223. There were 11,200 shares sold. Western Union closed with a net gain of ⅞ points, and American Telegraph & Cable lost the gain of 2 points made the previous week, closing at 98. In outside securities the movement of prices during the week was generally upward, though there were few marked improvements. In the electric list Electric Boat suffered losses in the price of both common and preferred; Electric Vehicle is a little stiffer as to the common issue, and 2 points off on the preferred. The rest of the list stands about the same as at the time of our last report. Following are the closing quotations:

NEW YORK.

	May 11.	May 18.		May 11.	May 18.
General Electric	220	223	Electric Vehicle	10	11
Brooklyn Rapid Transit	77¼	77	Electric Vehicle, pfd	*24	16
Metropolitan Street Ry	163	168	General Carriage	2¼	2
American Tel. & Cable	100	98	Illinois Elec. Veh. Tran.	⅞	⅞
Western Union Tel	92½	93⅜	Hudson River Tel	120	120
American Dist. Tel	40	—	N. E. Elec. Veh. Tran	2¾	3⅛
Commercial Cable	186	—	N. Y. Elec. Veh. Tran	2¾	1⅛
Electric Boat	17	14	Tel. & Tel. Co. of Am	*6½	5
Electric Boat, pfd	43	40	N. Y. & N. J. Tel	160	167
Electric Lead Reduc'n	—	2½			

BOSTON.

	May 11.	May 18.		May 11.	May 18.
New England Telephone	—	—	Erie Telephone	—	*60
Mexican Telephone	—	2⅝	General Electric, pfd	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel	—	174
Westinghouse Elec., pfd.	—	—	Boston Electric Light	—	*240

PHILADELPHIA.

	May 11.	May 18.		May 11.	May 18.
Electric Storage Battery	—	66	Philadelphia Electric	—	6
Elec. Storage Batt'y, pfd	—	65	Pa. Electric Vehicle	—	1¼
Elec. Co. of America	—	9⅝	Pa. Elec. Veh. pfd	—	1
General Electric Auto	—	—	Am. Railways	—	48¾

CHICAGO.

	May 11.	May 18.		May 11.	May 18.
Chicago Edison	170	173	Chicago Telep. Co	—	260
Chicago City Ry	—	250	Union Traction	14½	14¾
National Carbon	15¾	15⅜	Union Traction, pfd	56	57
National Carbon, pfd	83⅞	82	Northwest Elev. Com	—	43

*Asked.

PHILADELPHIA COMPANY.—The Philadelphia Company, of Pittsburg, is quite a miscellaneous affair, with its oil territory, gas wells, electrical interests, etc. During the year 67.7 miles of two-wire telephone lines were built. The total amount of telephone lines operated by the company are now 446.7 miles of two-wire system and 27.5 miles of single-wire line. Since Nov. 1, 1899, the company in pursuance of the stockholders' authorization, has acquired by the issue of 126,909⅛ shares of its common stock, 338,425 common shares of the United Traction Company, of Pittsburg, together with the sum of $339,425, being $1 per share required by the terms of the authorization to be paid by the stockholders of the United Traction Company. This fund is being used from time to time in the acquisition of the floating debt of the United Traction Company, and its notes taken for the amount of floating debt are being carried as bills receivable, it being the intention to so carry the debt unless all of the common shares are acquired by this company when the indebtedness should be canceled. The increased business offering to the Allegheny County Light Company rendered imperative large improvements and additions to its plant, and the Philadelphia Company advanced to it $135,000, and for that purpose sold an additional $125,000 of first mortgage bonds, making the total issue of first mortgage bonds to date $4,250,000.

TELEPHONE CONSOLIDATION.—A dispatch from Pittsburg says that it is understood that considerable stock of the Pittsburg & Allegheny Telephone Company has been sold to Baltimore capitalists. The buying is said to be the beginning of a deal by which the Federal Telephone Company will acquire the exchanges, lines, franchises and good will of the Pittsburg & Allegheny concern and its allied interests. The properties the Federal Company is supposed to want are the Pittsburg & Allegheny Telephone Company, the West Penn Long Distance Telephone Company, which is still a paper concern; the Allegheny County Telephone Company, of Braddock; the Homestead Telephone Company and the Home Electric & Telephone Company, of Wilkinsburg. As soon as certain matters are arranged, it is probable the Federal Company will acquire control. The sale will end a bitter warfare. Part of the plan will be the prompt connection of service to many places in the vicinity. The Federal Company has already purchased the independent telephone companies in Elizabeth, Carnegie, Latrobe, McKeesport, Washington, Apollo, Beaver Falls, Avonmore, Cecil, Canonsburg, Leechburg, McDonald, Venice, Youngstown (Pa.), Coraopolis and Sewickley. In addition it is building extensively, its greatest activity just now being in Washington County.

AMERICAN TELEGRAPH & TELEPHONE.—President Alex. Cochrane, of the American Telegraph & Telephone Company, has called a special meeting of stockholders of the American Telegraph & Telephone Company to be held at the New York office of the company, 15 Dey Street, on Monday, June 3, for the purpose of voting upon a proposition to increase its capital stock from $100,000,000 to $150,000,000. At the present time there is $94,237,500 stock of the American Telephone & Telegraph Company outstanding, but only $62,127,100 is in the hands of the public, the balance being in the treasury of the company, having been acquired from the American Bell Telephone Company.

AMERICAN RAILWAYS-ELECTRIC COMPANY OF AMERICA.—According to a Philadelphia dispatch the terms and all arrangements for the American Railways-Electric Company of America consolidation have been practically completed. The new company will issue about $12,000,000 4 per cent bonds to take over A. R. C. stock at 55 and E. C. A. at 11½, giving holders also 35 per cent in new common stock, of which there will be about $5,000,000, and there will also be an issue of preferred stock. Two million five hundred thousand dollars in bonds, with substantial bonus in stock, which has been underwritten, will be sold for cash, and offered to the stockholders.

EARNINGS.—The Buffalo Railway Company reports gross earnings for the quarter ended March 31, $426,487, an increase of $61,264 over the same period last year. The increase in net earnings was $50,390. The gross earnings of the Brooklyn Heights Railroad Company during the same period were $2,650,235, an increase of $54,040 over the same quarter last year. The net earnings decreased $42,901.

CONSOLIDATION IN CHICAGO.—The announcement is made that the Northwestern Elevated Railroad, the Lake Street Elevated Railroad, the Union Loop Company and the Metropolitan Elevated Railroad in Chicago are to be consolidated. In about a fortnight the leading interests in those properties will meet in Chicago and arrange the final details of the merger.

CONSOLIDATION.—Stockholders of the New York Gas, Electric Light, Heat & Power Company and the stockholders of the Edison Electric Illuminating Company have voted favorably on the proposition to consolidate with each other, the vote being practically unanimous.

DIVIDENDS.—The General Electric Company has declared a quarterly dividend of 2 per cent on its common stock, payable July 15. The West Chicago Street Railway Company has declared the regular quarterly dividend of 1½ per cent, payable May 15.

MORTGAGE.—The Bay Counties Power Company has filed a mortgage for $750,000 in favor of the Union Trust Company, of San Francisco, on holdings of machinery, lines, rights of way and real estate.

ERIE TELEPHONE.—A Boston dispatch states that the next regular meeting of the directors of the Erie Telephone Company will be held in Boston on Tuesday, June 25. At this meeting the reports of Stone & Webster, physical experts, and the Eastern Audit Company, accountants, will be officially presented to the board. These reports with a statement of the earnings for the five months ending May 31 of this year may be taken as a basis upon which a plan for permanently financing the company can be founded. Many of the stockholders anticipate the paying of semi-annual dividends at the rate of 4 per cent per annum, the first dividend of 2 per cent to be paid in July. The gross earnings for the three months ending March 31 will exceed the same period last year by $300,000, and a larger percentage of increase can be maintained throughout the year. The permanent plan of financing the company will probably provide for the raising of $15,000,000 of money to be called in as required for extensions and to pay the temporary loan of $7,500,000 at maturity Jan. 10, 1902, thereby dissolving the trust.

MORTGAGE.—A mortgage of $2,000,000 on the property of the Seattle & Tacoma Interurban Railway Company, Seattle, Wash., has been filed there. The mortgage bears interest at 5 per cent, payable semi-annually. The entire property of the company is pledged to the Old Colony Trust Company, of Boston, and the money is to be immediately available. It will be used for construction purposes. The instrument is liable to foreclosure in any one of three events: Nonpayment of interest after 60 days' notice has been given, failure to keep the property free from liens resulting from taxation, assessment, water rates and public charges and failure to maintain a proper insurance on property. By another provision a sinking fund is to be created for the final liquidation of the mortgage.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation in trade and industry throughout the country is in a satisfactory condition. There are no changes to record, however, notwithstanding the perceptible increase of the spirit of unrest in labor circles. From the heavy grain-producing sections of the country the general situation and outlook is regarded as very satisfactory. The industries are active. Those in the iron and steel trade are working at high speed to overtake orders already received. Foreign trade continues largely to favor this country. Despite the talk of rate-cutting and of expectations of a smaller movement of goods as spring advances, railway earnings continue exceptionally favorable, some great systems reporting maximum weekly earnings. Net returns also are of a good volume and show that business is being done at a decided profit. The building trades are active all over the country, but there has been some disappointment expressed by Eastern lumber dealers at the volume of business done. The failures for the week, as reported by *Bradstreet's,* aggregated 192, as against 193 the week previous, and 155 the same week last year. In the metal market there has been no change in the copper situation. Producers maintain the same prices, but the market is very dull. Lake is quoted at 17 cents and electrolytic at 16⅝ cents. The exports for the first half of this month amounted to 3962 tons, as against 5696 tons for the corresponding period of last year. The imports for the first half of the month amounted to 1327 tons.

ENGINE AND BOILER CONTRACTS.—The New York Safety Steam Power Company, of New York City, reports receipt of the following engine orders during the last few days: 14 by 12 horizontal automatic engine direct connected to a 60-kw C & C generator for Mitchell, Fletcher & Co., Philadelphia; 8 by 9 vertical automatic engine direct connected to 15-kw Triumph generator for the Triumph Electric Company, Chicago; 9 by 12 horizontal automatic engine direct connected to a 30-kw Lundell generator for Childs Dairy, Philadelphia; 7 by 9 vertical automatic engine direct connected to 12½-kw Bullock generator ordered through the Chicago office; 12 by 12 horizontal automatic engine direct connected to 50-kw Northern electric generator for the Eagle Tannery Company, San Francisco; 13 by 12 vertical automatic engine direct connected to Thresher generator and 10 by 12 vertical automatic engine direct connected to Thresher generator for Fort Hamilton, N. Y.; 8 by 9 vertical automatic engine direct connected to 15-kw Eddy generator for Furst Brothers; 6½ by 7 vertical automatic engine direct connected to Eddy generator for Jamestown & Newport Ferry Company, and 8 by 9 vertical automatic engine direct connected to Eddy generator for M. T. Hudnor, Fall River, Mass. The company's recent contract for Worthington boilers include two 142-hp boilers, being the third order received for installation in the Grand Union Hotel, Forty-second Street and Park Avenue, New York City; one 200-hp boiler for Worcester & Hampshire Street Railway Company, Ware, Mass.; one 70-hp and one 102-hp boiler for Fort Hamilton, New York; one 67-hp boiler for F. D. Cummer & Son Company, Cleveland, Ohio; four 360-hp boilers for Michigan Construction Company, Jackson, Mich.; two 50-hp boilers for Childs Dining Hall Company, Philadelphia, Pa., and one 104-hp, one 152-hp, also one 168-hp boiler for use in Hotel Wellington, New York City.

ELECTRIC TRACTION IN MEXICO.—The prosperous State of Yucatan, Mexico, will soon have two important electric traction systems, which will mark the first introduction of electrical motive power into that region. The city of Merida, capital of the State, in which some 50 miles of mule tramways are at present operated, has granted a concession to Arturo Castillo Rivas, of that city, for the purpose of constructing a network of trolley lines. The existing horse roads are to be done away with. The power house, etc , for the projected road, will, it is estimated, mean an expenditure of some $200,000. H. H. Barnes, of Barnes Brothers, of this city, who has largely financed various industrial enterprises in that part of the world, has been approached with a view to his securing an interest in the enterprise. The other project referred to applies to the flourishing city of Progreso, which is the principal port of Yucatan from where some 500,000 bales of sisal hemp, constituting a cargo for about 200 vessels, were shipped last year to the United States. The wharf facilities are now being largely extended, and the Compania del Ferrocarril Muelle y Almancenes del Comercio de Progreso (the Railroad, Wharf & Warehouse Company, of Progreso) is about to incorporate a subsidiary company for the purpose of converting the present mule road—about 8 miles in length—into electricity, and to considerably extend the lines now in operation. The company also proposes to operate all the machinery on the docks by electricity, and also to light the town. Menalio Martin, manager for Jose Gabriel Escalante, which concern is agent for the Ward line steamships at Progreso, is primarily interested in the scheme. This gentleman is at present in New York, and can be found at the Chelsea, 222 West Twenty-third Street.

TROLLEY IN MANILA.—Negotiations leading up to the conversion of the Manila horse tramways into electric power, to which reference has been recently made in these columns, have now been concluded, and G. B. Hopkins, representing American capitalists, has acquired the franchise of the Manila Street Railway Company. English and German parties are said to have made considerable efforts to complete arrangements with the Manila Company. It is anticipated, according to private advices from Manila, that no time will be lost in drawing up specifications, etc., relative to the conversion of the lines, and that contracts for material equipment, etc., will be given out very shortly. All the contracts will, of course, be placed in the United States.

THE HAVANA ELECTRIC RAILWAY COMPANY, which concern continues to place considerable contracts for material, equipment supplies and so forth, in this market, has just forwarded a miscellaneous order valued at some $35,000, to the Morris Electric Company, of New York City. The order calls for the shipment of a $10,000 lot of leaded case 500,000-cm cable; overhead material including frogs, switches, ears, insulators and span wire; 1500 barrels of cold tar, several hundred barrels of grease oil and a varied lot of general supplies.

PECKHAM TRUCKS FOR SIAM.—The Peckham Truck Company, of Kingston, N. Y., has obtained a contract from the Bangkok Electric Railway Company, of Bangkok, Siam, for the furnishing of 26 single trucks. The domestic business of the company is stated to be in an exceedingly flourishing condition, over 1000 trucks being now under construction. Among the principal contracts is one for 157 single trucks of the Metropolitan special type, which are to be supplied the Pittsburg Consolidated Traction Company. The value of this order is reported to be about $44,000.

COUNTY LIGHTING PLANT.—The Cuyahoga County Commissioners at Cleveland, Ohio, have decided to erect a private lighting plant for lighting the county buildings. Plans and specifications prepared by George S. Ryder, a local engineer, have been approved, and bids on the equipment will be received up to June 5. The plant will cost about $10,000.

PARSONS TURBO-GENERATOR.—Westinghouse, Church, Kerr & Co., of New York City, have secured an order for a Westinghouse-Parsons turbo-generator of 400 kilowatts, which is to be installed in the plant of the Yale & Towne Manufacturing Company, Stamford, Conn.

ENGINES.—The Norfolk Coal & Coke Company, Maybeury, W. Va., has purchased two 450-hp engines from the Ball Engine Company, Erie, Pa.

NEW POWER HOUSE.—Plans for a large power house to be built in Cambridge, Mass., have been prepared by Messrs. Sheaff & Jaastad, of Boston.

THE ALSEN CEMENT COMPANY, West Camp, N. Y., has ordered a 200-hp tandem compound engine, arranged for direct connection to the generator, from the Ball Engine Company, Erie, Pa.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended May 15: Antwerp—1 case electrical machinery, $125; 46 cases electrical material, $6,750. Athens—60 packages electrical material, $5,309. Alicante—18 cases electrical material, $398. Argentine Republic—16 cases electrical material, $871; 5 packages electrical machinery, $1,015. British East Indies—69 packages electrical material, $2,138; 14 packages electrical machinery, $625. British Australia—179 packages electrical material, $8,540; 32 packages electrical machinery, $19,205. Brazil—7 packages electrical machinery, $856; 26 packages electrical material, $1,040. Berlin—1 package electrical material, $20. Barcelona—26 packages electrical material, $594. British West Indies—1 case electrical material, $10. Cuba—61 cases electrical material, $437. Cadiz—14 packages electrical material, $200. Chili—16 packages electrical material, $346. Central America—212 packages electrical material, $744. Dublin—4 cases electrical material, $59. Dutch West Indies—13 packages electrical material, $260. Dutch Guiana—1 case electrical material, $25. Dunkirk—1 case electrical machinery, $125. French West Indies—1 case electrical material, $12. Glasgow—30 packages electrical material, $8,764; 2 cases electrical machinery, $60. Gijon—2 packages electrical material, $117. Havre—19 packages electrical material, $946; 12 packages electrical machinery, $66. Hayti—1 crate bicycles, $18; 2 cases electrical material, $58. Helsingfors—3 packages electrical machinery, $773. Hamburg—$50 packages electrical material, $4,316. Liverpool—289 cases electrical material, $16,848; 159 cases electrical material, $4,747. London—522 packages electrical machinery, $70,658; 149 packages electrical material, $6,366; 85 rolls electric cable, $29,646; 21 motor cars and parts, $4,950. Munich—1 crate electrical machinery, $500. Manchester—8 packages electrical machinery, $1,000; 3 packages electrical material, $173. Marseilles—8 cases electrical material, $262. Mexico—63 cases electrical material, $1,082. Norwich—1 case electrical machinery, $300. Nova Scotia—21 packages electrical material, $273. New Foundland—10 packages electrical material, $251. New Zealand—15 packages electrical material, $832; 3 packages electrical machinery, $372. Newcastle—3 cases electrical machinery, $500. Peru—103 cases electrical material, $9,241; 16 packages electrical machinery, $1,522. Riga—5 packages electrical material, $1,779. Southampton—1 case electrical material, $20. U. S. Colombia—14 packages electrical material, $330; 40 packages electrical machinery, $2,000. Venezuela—35 packages electrical material, $527.

ELECTRIC POWER IN SUGAR FACTORY.—The United Fruit Company's sugar factory at Banes, Cuba, which has just been completed, is equipped with electrical machinery for operating everything in connection with the plant with the exception of the crushers. Charles Buckland, the chief engineer for Hugh Kelly, the well-known sugar expert, who undertook the contract for the entire plant, recently returned from Cuba, and states that the electrical installation is the largest ever utilized in sugar plantations in that part of the world. The electrical future of the contract, which was awarded to Percival R. Moses, E. E., of this city, consists of three simple automatic high-speed horizontal center-crank engines of 160 ihp each. These engines were built by the Ridgway Engine & Dynamo Company, of Ridgway, Pa. The generators of which there are three 100-kw machines, are built as well as all the motors used in the plant by the General Electric Company. They are direct connected to the engines. Following are the various purposes for which the motors are used. The crystallizers, which are on the second floor of the boiler house building, are worked by a motor of 15 horse-power. These crystallizers are 10 in number, 6 ft. 6 inches in diameter by 17 ft. long, and are geared down so as to give one revolution in 12 minutes. The salt-water equipment, supplied by Thomas A. Lewis, of New York City, which has a capacity of 4,000,000 gallons a day, is operated by two 50-hp motors. A 3-hp motor is utilized for driving the apparatus used for cleaning the juice. The motors are connected by wire with the main switchboard, and the electric plant is driven from the general battery consisting of 2400-hp Climax boilers, built by the Clonbrock Boiler Works, Brooklyn. The factory is lighted with 500 incandescent and 25 arc lights, furnished as well as is the wiring by Lowe & Leveridge, of New York City. The working of the electrical equipment is stated to be such a success that contracts for further apparatus required for an extension of the company's operations will be determined on in the near future.

BANNER YEAR FOR EXPORTS.—April's figures, as reported by the Treasury, maintain the expectation held out at the end of the nine-month period of a splendid year for American commerce. Already, at the close of ten months, the excess of exports over imports is $584,212,306. Assuming that the exports will drop a little in May and June, as they did last year, the total of exports for the fiscal year will be about $1,500,000,000, and the imports will scarcely reach $800,000,000, making a total commerce of $2,300,000,000, and an excess of exports over imports of $700,000,000. This will give a lower increase in the total commerce than that reported for several preceding fiscal years, but an excess of exports $85,000,000 greater than the hitherto banner year of 1898. The gain in total commerce from 1897 to 1898 was $21,800,000, in round numbers; from 1898 to 1899, it was $76,539,000; from 1899 to 1900, it was $320,000,000, while the increase from 1900 to 1901, now promises to be about $55,500,000. The gain in exports over last year seems likely to be fully $200,000,000.

THE UNITED STATES ELECTRICAL MANUFACTURING COMPANY has been organized in Butler with ex-Postmaster John W. Brown as president of the corporation; M. A. Berkimer, vice-president; W. H. Miller, secretary, and C. A. Bailey, treasurer. The company is incorporated under the laws of New Jersey and capitalized at $100,000, with authority to increase the capital stock to $500,000. The company will erect a plant in Pittsburg for the manufacture of electrical supplies, and engage in the business of building telephone systems. One of the branches of the business will be the manufacture of an electrical appliance which, it is asserted, will revolutionize the cost of building telephone systems. By its use, the central stations in small towns can be done away with and the cost of wiring reduced to about one-third of the systems in present use. One wire can be made to do duty for 25 telephones, and the mechanism is so arranged that any number on the wire can be called without ringing up the other telephones on the line.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., has found it expedient, in order to take better care of its large southern trade to establish another sales office in the South, this one at Winston-Salem, N. C. Mr. F. A. Barr is district manager. The Stanley Company's other Southern office is at Rock Hill, S. C., in charge of Mr. F. C. Whitner. The Stanley Company has now, besides the two mentioned above, branch sales offices located as follows: 71 Broadway, New York City; Equitable Building, Boston, Mass.; 26 South Fifteenth Street, Philadelphia; 31-33 New Montgomery Street, San Francisco, Calif.; Pioneer Building, Seattle, Washington, and Madison, Wis.

CEDARBURG'S NEW PLANT.—A. M. Patitz, of Milwaukee, Wis., is consulting engineer for an electric lighting plant to be installed at Cedarburg, Wis. Two 60-kw Warren induction type alternators, direct connected to Skinner engines, will constitute the generating machinery. A complete switchboard will distribute power to 35 series alternating-enclosed arc lamps and 1200 incandescent lamps. It is expected to have the plant in operation by July 1 of this year.

J. HOLT GATES & CO., 15 Monadnock Block, Chicago, Ill., are installing for Armour & Co., at New Orleans, La., two Triumph dynamos, 100-kw and 30-kw capacity, direct connected to two medium-speed engines. A fine switchboard will also be furnished in connection with the plant. Armour & Co. do a very large distributing business from New Orleans, and this plant will light and furnish power for the depot there.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee., Wis., will enlarge its power plant. The company has contracted for a new direct-connected generator outfit. This unit will consist of a 400-kw, 250-volt Crocker-Wheeler generator, direct connected to an Allis-Corliss horizontal engine running at 100 r. p. m. This unit will be the first of its type in Milwaukee.

NEW AUTOMOBILE PLANT.—The question of selecting a location for the plant of the Church Automobile & Specialty Company is now under consideration. Mr. W. A. Church, Pittsburg, Pa., is president. New Castle, Pa., and Youngstown, Ohio, are mentioned in connection with the location of the proposed works.

EXTENSION OF WORKS.—The George V. Cresson Company, Philadelphia, Pa., manufacturer of power-transmitting machinery, will build an addition to its stock house. The new structure will be 50 by 344 ft. in dimensions.

DEPARTMENT STORE GENERATORS.—The Milwaukee Electric Company has been awarded the contract for the generators for Kroeger Brothers' department store. One 75-kw generator and one of 40 kilowatts will be direct-connected to Ideal engines.

THE AMERICAN BRIDGE COMPANY will furnish the Atchison, Topeka & Santa Fe Railroad with a red rock cantilever bridge over the Colorado River. It will also furnish two deck plate girder spans for the Nacozari Railroad Company, of Mexico.

THE GENDER & PAESCHKE MANUFACTURING COMPANY, Milwaukee, Wis., will add a 100-kw, direct-current, direct-connected unit to its present electric power plant.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has recently shipped one of its new process noiseless pinions to Germany to be used on the private yacht of Emperor William.

EXTENDING ITS SHOPS.—The Card Electric Company, Mansfield, Ohio, is building an addition to its main shop.

General News.

THE TELEPHONE.

WATERBURY, CONN.—The Waterbury Automatic Telephone Company, which voted to go out of existence because of the new law making it necessary for independent telephone companies to apply to the Superior Court for a charter, held another meeting recently and decided to continue the organization.

ANITA, IA.—The Rural Telephone Company, of Anita, has been incorporated; the capital stock is $10,000. M. N. Baker, C. D. Robinson, L. B. Johnson, C. H. Dewald and Abe Bigg are the incorporators.

YATES CITY, ILL.—The People's Telephone Exchange, of Yates City, has been incorporated; capital stock, $2,000. Incorporators: W. G. Lehman, O. B. West and L. D. Fletcher.

POLO, ILL.—The Independent County Telephone Company, of Polo, has been incorporated; capital stock, $20,000. Incorporators: B. W. McHenry, W. P. Graham and A. B. Sheadle.

CHICAGO, ILL.—The Telephone Auxiliaries Company has been organized in Chicago, capital, $10,000, for the purpose of manufacturing telephones and electrical devices. Incorporators: H. P. Young, Nathan S. Smyser, E. J. Wilber.

MOUNT VERNON, ILL.—At the annual meeting of the stockholders in the Southern Illinois Telephone Company, the old board of directors was re-elected for another year, and the following officers chosen: Albert Watson, president; Walter Watson, secretary; O. M. Waters, treasurer.

INDIANAPOLIS, IND.—Considerable inquiry has recently been made concerning the two telephone companies operating in this city. Each was granted a twenty years' franchise, of which sixteen are yet to run, and each pays the city an annual tax or franchise fee of $6,000.

SPENCER, IND.—Three telephone companies are competing for business in this city. The Spencer Telephone Company has long distance connection with the new company at Indianapolis and the Farmers' Co-operative Company has an exchange. Each of the local companies has about 100 subscribers and there are 600 telephones in the county connected with them. Spencer business houses are using three telephones and the companies are seeking more business at low rates. The Farmers' Company has had a rapid growth in the country districts owing to the cheapness of its service to members. The rivalry between the companies is growing.

CEDAR, IOWA.—The Union Telephone Company, Cedar, has been incorporated. Capital stock, $10,000. Incorporators: C. Bradley, R. E. Halloway, James L. Moore, M. H. Picken, O. W. Moore, Wm. Abegg, J. W. Garvin, A. Jay Fairchild, R. J. Woody.

CYNTHIANA, KY.—Construction has commenced on a telephone line to be built exclusively for the accommodation of farmers here. A separate exchange will be established.

BALTIMORE, MD.—A rate war is on here between the Chesapeake and Potomac, a Bell Company, and the Hane Telephone Company, and the former is placing telephones in stores and residences on consideration of one call a day at five cents. The Hane Company promises something better than this. Each company has solicitors all over the State.

BALTIMORE, MD.—The Atlantic Wireless Telegraph & Telephone Company has been incorporated by Richard P. Simpson, Robert E. Lee Cunningham, Harry B. Cook, Willard F. Taylor, William I. Cook, Charles H. McDonnell and William Byrne. The stated capital stock is $5,000,000. It is said that the promoters have the rights for the Marconi system in Maryland, the Virginias and the Carolinas.

BALTIMORE, MD.—A contract has been signed by which the Maryland Telephone & Telegraph Company will install for the United Railways & Electric Company a private exchange with 93 stations. The same company has the contract to supply a private exchange for the use of the various departments of the city government with 120 stations. The company has just issued a new book of subscribers. The book contains a list of nearly 4000 subscribers.

MEXICAN TELEPHONE COMPANY.—The Mexican Telephone Company reports for March:

	1901.	1900.	Changes.	
Gross earnings	$17,204	$14,632	Inc.	$2,572
Operating expenses	11,127	9.731	Inc.	1,396
Net earnings	$6,077	$4,901	Inc.	$1,176
Subscribers	3,549	3,129	Inc.	420

Subscribers gained since March 1, 48.

ALMA, MICH.—The Union Telephone Company is enlarging its plant here. Fifty new telephones are being added, new and higher poles are being substituted for the old ones, and new switchboards are being put in. The total number of telephones at present is 185.

DETROIT, MICH.—The People's Telephone Company has contracted for $100,000 worth of telephone poles, nearly all Michigan timber. It will require 800 cars to bring the poles to Detroit, or twenty trains of forty cars each.

WABASH, IND.—Dayton Harter, of North Manchester, and Lewis Signs have obtained from the Wabash county commissioners a franchise covering the highways of the entire county for telephone toll lines. They are interested in a new exchange at North Manchester.

PRINCETON, MINN.—The Minnesota Rural Telegraph Company of Princeton, capital stock $50,000, has been incorporated by L. Rust, E. L. Saxon, C. T. Johnson, of Princeton; L. Ericskson and A. E. Westling.

MINNEAPOLIS, MINN.—W. R. Baumbach, of Wadena, is president of the new Iron Range Electric Telephone Company, which has organized with a capital stock of $50,000 to construct or purchase telegraph and telephone lines and exchanges. The headquarters will be at Wadena. The other directors are A. B. Kerlin, Park Rapids; W. J. Power, Hibbing; Clifford W. Baumbach and Albert M. Baumbach, Wadena. The Crookston Telephone Company has transferred its lines and entire system and franchise to the Iron Range Electric Telephone Company.

ALBANY, N. Y.—The Batavia Home Telephone Company has been incorporated, with a capital of $160,000, to operate a telephone line in Genesee County, with Batavia as the central point. The directors are Samuel B. Rawson, Addison B. Lord, of Elyria, O.; Alfred R. Smith, of North Tonawanda, and George C. Frost, of Buffalo.

SARATOGA, N. Y.—The Saratoga Telephone & Telegraph Company, of Saratoga Springs, has been incorporated to operate telephone lines in and between Saratoga Springs, Ballston Spa, Mechanicville, Stillwater, Waterford, Troy, Schuylerville, Glens Falls and Schenectady and other places. The capital is $125,000, and the directors are: Frederick H. Beach, Stephen C. Medbery, Irving W. Wiswall and Herbert C. Westcott, of Ballston, and Charles W. Cool, W. Levis Burk and William F. Bentley, of Glens Falls.

HURON, OHIO.—The Huron County Telephone Company is building a line to Berlin Heights.

NAPOLEON, OHIO.—The Napoleon Telephone Exchange has been succeeded by the Henry County Home Telephone Company.

WESTON, OHIO.—The Weston & Grand Rapids Telephone Company is preparing to build farmers' lines. The local exchange is to be enlarged.

WESTON, OHIO.—The Weston Mutual Telephone Company has been organized to build a local exchange. I. B. Ballmer is president and Edward Guyer, treasurer.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company has amended its charter to enable it to conduct telephone and electric lighting business in towns reached by its road.

CLINTON, OHIO.—The Akron People's Telephone Company will establish an exchange in this place. A good list of subscribers has been secured, and the exchange will start with 100 lines.

ANDOVER, OHIO.—The Andover Telephone Company is building a line to Espeyville, which will give connection with Linesville, Conneautville, Jamestown and other points in Pennsylvania.

CHILLICOTHE, OHIO.—The city council has voted to grant a franchise to the Ohio Telephone & Telegraph Company. The rate is limited to $2 for business houses and $1.50 for private residences per month.

ARCADIA, OHIO.—The Findlay Home Telephone Company has secured a franchise to build an exchange in this place. The Central Union Telephone Company has also secured a franchise, and will build a sub-exchange connecting with the Fostoria exchange.

CLEVELAND, OHIO.—The United States Telephone Company is about to inaugurate a one-minute long-distance service in order to meet the competition of the Bell companies. The rates have been fixed at a trifle more than half what is now charged for three-minute service.

SPRINGFIELD, OHIO.—The Home Telephone Company, of this city, which has been organized by David F. Snyder, of this place; Edward Dun, of Columbus, and Cleveland people, has applied for a franchise for a local exchange. This is one of the few large towns in Ohio which has no independent exchange.

COLUMBUS, OHIO.—Mr. Gustav Hirsch, who has been superintendent of construction for the Columbus Citizens' Telephone Company, has been appointed assistant superintendent and engineer for the Detroit, People's Telephone Company of Detroit. Both companies are controlled by the Federal Telephone Company of Cleveland.

TOLEDO, OHIO.—The Great Lakes Towing Company has opened an office at Huron Harbor. One tug will be on duty there at night and she will have on board a telephone. The line will be attached to the dock, and when the tug is tied up a connection will be made. When the tug goes out to make a tow the telephone line will be cast off with the shore hawser. The same sort of an arrangement has been made at the Soo, at Fairport and at Erie.

MANSFIELD, OHIO.—At the instigation of N. C. Manner and H. T. Manner, stockholders of the company, Judge Wolf has granted a temporary injunction restraining the officers of the Farmer's Co-operative Telephone Company from making an assignment or from disposing of the company's property. The company sold out some time ago to the Star Telephone Company, and the latter in turn sold to the Federal Telephone Company, of Cleveland.

CLEVELAND, OHIO.—General Manager H. E. Presson and Secretary C. C. Deering, of the Trans-Mississippi Telegraph & Telephone Company were in Cleveland recently to secure pointers to assist in the establishment of long-distance telephone lines in Nebraska. It is proposed to build lines from Omaha to Davenport, 300 miles, and from Dubuque to Sioux City. The Trans-Mississippi Company has a nominal capitalization of $100,000, and it is expected that this will soon be increased to $1,000,000.

CADIZ, OHIO.—The Harrison County Telephone Company will open its exchange in this city in the near future. The construction work is being done by the Independent Construction Company, of Archbold, Ohio, and the switchboard and other apparatus is being furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. Connection will be made with a number of branch exchanges in this county, and long-distance service will be given over the lines of the United States Telephone Company. Ralph Cunningham is president of the company and W. W. Wright, secretary.

CLEVELAND, OHIO.—The United States Telephone Company has inaugurated its one-minute long-distance telephone service in this State. Heretofore the rate between Cleveland and Columbus has been 70 cents for three minutes or less, and 15 cents for each additional minute. The new rate is 40 cents for one minute and 15 cents for each additional minute. The company will establish a system of making appointments over its lines. Engagements will be made by the use of what are called order wires, without extra charge. It is expected that this service will prove a great benefit both to the company and the public.

TORONTO, ONT.—Ald. Urquhart, of Toronto, announces that he has a proposition for the establishment of a telephone service in Toronto. The company, which is to be incorporated as the Ontario Telephone Company, is said to be an offshoot of a successful United States company, operating exchanges in Wilkesbarre and Scranton, Pa. Local capital will be interested in the new enterprise. The new concern offers to give an efficient modern service for $36 for business houses and $25 for residences, or $50 for both to the same subscriber.

SHARON, PA.—The Bell Telephone Company has served notice on its subscribers at Sharon, Pa., that the rates will be raised after June 1. The Bell has no opposition in Sharon.

POTTSVILLE, PA.—A deed conveying the lines of the Schuylkill Telephone Company to the United Telephone & Telegraph Company, has been placed on record. The consideration was $218,750.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company, which controls the Allegheny County Telephone Company of Braddock, has decided to rebuild the entire system of the latter company. About $50,000 will be spent. The Braddock system will not be connected with Pittsburg for several months.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company is installing an automatic telephone toll service that promises to be popular, on account of its low prices, 5 cents for a three-minute message to any part of the two cities. A list of additional subscribers issued by the company showed 1,600 new instruments added in less than three months, making a total of 4,800 in the two cities.

GOURDIN, S. C.—The Gourdin Telephone Company has been commissioned with $1,000 capital.

GAINESBORO, TENN.—The Gainesboro Telephone Company, of the Georgia Division, has completed a long distance connection to Tallapoosa, Ga.

RICHARDSON, TEXAS.—The Richardson Telephone Company, of Richardson, has been incorporated. Capital stock, $750. Incorporators: C. H. Blewett, W. N. Stutts, C. C. Buffhines and others.

KEMP, TEXAS.—The Texas Telephone & Telegraph Company, of Kemp, Kaufman County, Texas, has been incorporated; capital stock, $20,000. Incorporators. George Mason, A. J. Still, Jr., J. W. Young, J. G. Crawford and E. O. Jones.

SAN ANTONIO, TEXAS.—The Commercial Telephone Company, of San Antonio, has been incorporated; capital stock, $500,000. Incorporators: Z. B. Campbell, H. M. Aubrey, of San Antonio, J. E. Boynton, Waco; C. M. Haskell, Ottawa, Ohio.

WAXAHACHIE, TEXAS.—A local telephone company to connect the towns of Ray, Howard, Nash, Maloney and Avaton with Waxahachie has been organized here. The name is the Ellis County Telephone Company, and the capital stock is fixed at $2,000.

TYLER, TEXAS.—The Tyler Telephone Company, of Tyler, has been incorporated. Capital stock, $40,000. The incorporators are S. F. Richardson, Z. B. Campbell, of San Antonio; M. D. Shaw, of Wapakoneta, Ohio; J. W. Wright, of Tyler; James S. Brailey, of Wauseon, Ohio, and James King Duffy, of New York City.

NEWPORT NEWS, VA.—The deal by which the Hampton Telephone Company was absorbed by the Long Distance Telephone Company of Virginia has been consummated.

ELECTRIC LIGHT AND POWER.

SELMA, CALIF.—The Selma Light & Water Company has been incorporated, with Selma as the place of business. Directors: E. Dudley, T. B. Matthews, J. Brownstone, C. Batchtold, S. Sewald, W. H. Shafer and D. S. Snodgrass. Capital stock, $100,000; subscribed, $4,000.

VENTURA, CALIF.—It has been officially announced that the Santa Ana Water Company and the Ventura Land & Power Company have been absorbed by the Ventura Water, Light & Power Company, with its principal place of business in Los Angeles. The capital stock of the new company is $500,000. The directors are: James H. Adams, Thomas W. Phillips, Theodore W. Brotherton, John M. Gardiner, Frank E. Trask, Los Angeles; William R. Staats and Jared S. Torrance, Pasadena.

SAN FRANCISCO, CALIF.—The San Joaquin Electric Company has received permission from the General Land Office, Washington, D. C., to resume construction work on its new reservoir in the Sierras in Crane Valley, Madera County, Calif. It is about one year since work was stopped by Federal orders because the site was on Government land. The artificial lake, which will cover an area of 350 acres, is located about 10 miles above the electric power station on the North Fork of the San Joaquin River, and will be used to impound water for the dry season.

SAN FRANCISCO, CALIF.—The Ventura Water, Light & Power Company recently filed an application for a franchise. Under its provisions the company will be allowed to extend its pipe lines to Montaloo, Calif., and the Santa Clara River. The privilege is also asked to construct pole lines for electric light and power purposes, from Ventura to Nordhoff, Montaloo, Oxnard, Hueneme, Saticoy and Santa Paula. It is said that the new company intends to build up an extensive electric light and power system, and that new electric railway lines will also be constructed.

ALBANY, GA.—At a meeting of taxpayers and others in the town of Albany it was decided to call an election on the question of a $25,000 bond issue to be used in installing an electric plant.

ATLANTA, GA.—The Atlanta Railway and Power Company, of Atlanta, is preparing to place underground in conduits its electric light wires within the fire district. Two carloads of conduits have been received.

THOMASTON, GA.—The Bibb Manufacturing Company has contracted to furnish power to the town of Thomaston for its new electric light system to be installed. Water power three miles distant will be developed. The company will also supply power to the Thomaston cotton mills.

ATLANTA, GA.—The Atlanta Board of Electrical Control has decided to recommend to Council that the Atlanta Railway & Power Company be allowed to run wires from its trolley wires to business houses in order to do the lighting until Oct. 9, when all wires, with the exception of trolley wires, must be placed underground.

SPRINGFIELD, ILL.—The Robinson Water, Light & Heat Company, of Robinson, has been incorporated. Capital stock, $70,000. Incorporators, C. S. Jones, Frank Barnes and A. H. Bayston.

FREEMONT, IND.—The town board has taken steps to build an electric light plant.

INDIANAPOLIS, IND.—City Engineer Jeup has completed the specifications for the new electric light contract and will present them to the board of public works, and the same will be open to bids.

BEDFORD, IND.—The Bedford Electric Light & Power Company has completed its organization by electing J. W. Cosner president, and J. R. Voris secretary. The contract price for the plant is $35,000 and is placed with the A. J. Stohl Company, of Laporte, and H. W. Shoct, of Chicago.

MARION, IND.—The appointment of a receiver for the electric light plant at this place until it can be determined to whom the property belongs has been approved by the Supreme Court. The court said that the fact that the plant was solvent and yields an income of $2,000 a month, and that there seems likely to be a fierce and protracted litigation over its ownership justified the lower court in taking it away from both parties until the dispute was settled.

INDIANAPOLIS, IND.—An investigation reveals the fact that the Shelbyville Electric Light Company, capital $225,000; the Crawfordsville Electric Light Company, capital $300,000, and other corporations doing business in Indiana have all incorporated under the laws of the State of Maine. If these corporations file articles in Indiana, as the Secretary of State says they must, the total fees will amount to $616.30. Representatives of foreign corporations threaten to test the new corporation law.

WORCESTER, MASS.—W. H. Burns will install an electric light plant in his new underwear factory building to be erected here.

ALBERT LEA, MINN.—The Albert Lea Electric Light Company has increased its capital stock from $100,000 to $200,000.

ST. LOUIS, MO.—Bids were opened by the Board of Public Improvements May 15 for the installation of a municipal lighting plant for the several stations of the water works at Baden. They were referred to the water commissioner for computation and report. The president of the board also submitted the draft of an ordinance providing for the installation of a lighting plant in the new city hall to cost $47,000.

HELENA, MONT.—Work is now in progress on the extension of the Missouri River Power Company's water-electric plant, sixteen miles from this city. Large additions will be made to the electric equipment. The new plant will include ten generators; now there are only four. Electric energy will be transmitted to Butte. The improvements will cost about $1,000,000.

MILLVILLE, N. J.—The window glass plant which will be established here by Dr. T. C. Wheaton, will be lighted by electricity, and operated by gas. The plant will be 100 by 140 ft. in size, and will contain 30 blowing tanks.

TRENTON, N. J.—The American Falls Water Power Company, Newark, N. J., has been incorporated to generate power for lighting, heating, etc.; capital, $300,000. Incorporators: Edward C. Tracy, Frank A. Bridge, Clarence B. Wisner.

MT. VERNON, OHIO.—The village council has decided to submit to the vote of the citizens a proposition to build a municipal lighting plant.

CINCINNATI, OHIO.—The Union Light, Heat & Power Company, of this city will build an addition to its power house on Madison Avenue.

KENTON, OHIO.—Articles of incorporation for the People's Heat & Light Company have been filed. The company will have a capital stock of $100,000.

CLEVELAND, OHIO.—Mayor Tom L. Johnson, of Cleveland, is having estimates prepared on the cost of a municipal lighting plant to illuminate the entire city.

KENTON, OHIO.—The People's Heat & Light Company has been incorporated by local people with $100,000 to furnish electric light, heat and power. A plant will be built at once.

NILES, OHIO.—The Niles Electric Light Company has been incorporated by Wade A. Taylor, W. H. Pritchard, F. H. Wilson, Jr., Jean Kilpatrick and Robert Weiss. The capital stock is $25,000.

CINCINNATI, OHIO.—Electric contractors in Cincinnati have signed the new scale for an eight-hour day with a $2.50 pay scale for inside men, and a ten-hour day and $2.00 for outside men. The Electrical Union, which presented the agreement, threatened a strike if this scale was not adopted.

WAPAKONETA, OHIO.—The linemen employed by the Chicago Interstate Construction Company, which is building exchanges in this city and adjoining points, have struck for higher wages, and work is at a standstill. The linemen demand an increase from $2.25 to $2.50 per day and the ground men from $1.25 to $1.50.

CINCINNATI, OHIO.—The Lima, Ohio, Electric Light, Heat & Power Company has installed one of the largest engines in Ohio. It weighs seventy tons and is of 600-hp, and was built by the McIntosh & Seymour Company, of Auburn, N. Y. As soon as the machinery is put in place and started, all the arc lighting in the city will be replaced by enclosed arcs of the latest pattern.

CINCINNATI, OHIO.—City Electrician Weisledorer in his annual report says the work of removing the overhead wires and placing them underground involves so much in the way of money outlay and engineering questions as to demand the services of a commission of capable men to prepare plans on a comprehensive scale suited to the needs of the city. The report states that during the year 106 new electric lamps were erected, making 3368 in existence December 31, 1900. The total cost of lighting the city during 1900 was $282,451.90.

GODERICH, ONT.—The Maitland River Power Company has been given a contract by the council for the town of Goderich to furnish electric light and power. The company will expend about $100,000 in building and establishing a power plant.

MONTREAL, QUE.—Tenders are invited by the city council of Montreal, Que., until June 15 for electric street lighting after the expiration of the present lighting contract. Particulars will be given by L. O. David, city clerk.

MONTREAL, QUE.—Messrs. Allan MacDougall, of Three Rivers; John Hyde, Edward Ronayne, and H. J. Harrison, of Montreal; Alex. Falconer, of Westmount, and James Galbraith, of Lachine, are applying to the Quebec government for incorporation as the Provincial Light, Heat & Power Company, with a capital of $500,000; the chief place of business is to be at Three Rivers, Que.

MONTREAL, QUE.—There is a probability of a lively war of rates for lighting in Montreal. The new combination known as the Montreal Light, Heat & Power Company, absorbed the Gas, the Royal Electric and the Chambly Electric companies, but failed to come to terms with the Lachine Rapids Hydraulic & Land Company. The latter company is now considering the advisability of going into the gas business.

MONTREAL, QUE.—The power at the head of Shick's Island dam, at Cornwall, Ont., is being developed by Mr. H. P. Davis, from plans prepared by T. Pringle & Son, of Montreal. The power is to be utilized for operating the canal locks. It is understood that the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, has secured the contract for the building of the first of four three-phase generators to be installed.

MONTREAL, QUEBEC.—Manager Walbank, of the Lachine Rapids Hydraulic & Land Company, Montreal, announces that it is the intention of his company to tender for the contract for lighting the streets of Montreal. This contract is worth $250,000 per annum, at present, but the Lachine Electric Company will tender at a lower figure than ever before attempted in order to secure the contract. The company will shortly commence the erection of a steam power-house in the centre of the city to provide against contingencies and insure current for lighting purposes the year out.

MEXIA, TEXAS.—The Mexia Light & Power Company, of Mexia; capital stock, $16,000; has been incorporated by James R. Cravens, John H. Shelly and T. S. Miller, all of Dallas.

PARIS, TEX.—The Paris Transit Light & Power Company, of Paris, has been incorporated; capital stock, $250,000. Incorporators: W. B. Little, Robert H. Cornell, of St. Louis; W. F. Dulaney, R. W. Wortham and S. B. M. Long of Paris.

THE ELECTRIC RAILWAY.

FORT WAYNE, IND.—A new traction road between this city and Goshen is planned.

INDIANAPOLIS, IND.—The Indianapolis, Lebanon & Frankfort Electric Railway Company has filed bonds for construction and will begin work at once.

INDIANAPOLIS, IND.—The two companies that have announced their intention of building an electric road from here to Martinsville, over the same route, have each begun condemnation proceedings to obtain a private right of way.

BRAZIL, IND.—A company, headed by W. R. Risher, has applied to the county commissioners for a franchise to construct a traction line from this city ten miles north to Caseyville.

NEW CASTLE, IND.—The money for the construction of the electric line from this city to Muncie has been guaranteed and the work will be pushed to completion at once.

INDIANAPOLIS, IND.—The preliminary survey of the proposed electric line between this city and Crawfordsville is completed. The company has been incorporated with a capital of $100,000. The company announces that arrangements have been made to finance the road as soon as the estimates of the cost are completed.

NEW YORK, N. Y.—It is announced that the Broadway cable line of the Metropolitan Street Railway Company will cease to be operated by cable power at midnight on May 25. Electric power will then be substituted for the cable. This is the last cable road in New York. With the change of the Broadway line to electric power all of the great longitudinal roads in the city will be operated by this means. Some of the crosstown lines are also operated by electric power, and others are now being changed and rebuilt for the same purpose.

ALBANY, N. Y.—The strike of the employees of the Union Traction Company, which was noted in last week's issue, was brought to a close last Saturday, after a conference between representatives of the employees and the company. In the settlement concessions were made on both sides. The roads affected are now in regular operation. The old men, excepting those under arrest charged with violence, were reinstated. The relations between the company and its employees now seem to be better understood. During the strike the troops fired upon a crowd, resulting in the death of two prominent citizens, who had nothing to do with the rioting. The total cost of the strike, which lasted twelve days, is estimated at $68,943.03. This includes the losses to the men and the company and the cost of transportation and maintenance of the troops. The troops have all returned to their homes. The company's right to employ non-union as well as union men is recognized, the strikers get the increase in wages asked for, and it is agreed that no strike shall begin until six days after notice to the company. The agreement is binding upon employer and employed for three years.

BROOKLYN, N. Y.—General Manager Brackenridge, of the Brooklyn Rapid Transit Company said recently that a plan was in contemplation to provide a receiving dormitory, with cots, medicines and the best medical attendants, for the immediate aid of persons injured on the lines of the company. The plan is to fit up an unused building at Fifty-second Street and First Avenue, on the same lines as the ordinary emergency hospital and also to follow the idea adopted by the New York Central Railroad at Buffalo. Everything that pertains to a well equipped hospital will be placed in the building and an ambulance service by trolley will be provided.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway has decided to erect a power-house at Grant Quarries on Central Avenue.

MASSILLON, OHIO.—The village of Navarre has granted a 25-year franchise to the Canton-Masillon Electric Railway Company for an extension of the line to Navarre.

CINCINNATI, OHIO.—Chicago capitalists will advance the money necessary to build the Chillicothe-Hillsboro Traction Company's road. Dr. Charles Hoyt is president.

BOWLING GREEN, OHIO.—Robert Muir and John Geghan, of this place, are promoting an electric railway which is to run from Port Clinton to Fremont and Bowling Green.

WADSWORTH, OHIO.—Residents in this vicinity have offered a free right of way to the Northern Ohio Traction Company for a spur to Wadsworth from the new Barberton line.

URBANA, OHIO.—The Dayton, Springfield & Urbana Railway Company has applied to the commissioners of Champaign County for a franchise through the northern part of the county.

CANTON, OHIO.—The Canton-Akron Railway Company has applied for a franchise in Tuscarawas County. It is the intention to extend the line from Canton to Canal Dover and New Philadelphia.

LORAIN, OHIO.—It is stated here that several prominent local people, backed by Cleveland capitalists, are securing right of way for a second line from Cleveland to Lorain. The road will be built over private right of way.

ZANESVILLE, OHIO.—The city council has passed a blanket franchise granting to Col. Boone and associates, representing the Black Diamond Traction Company, the right to use practically all of the available streets of this city.

CLEVELAND, OHIO.—The Cleveland, Ashland & Mansfield Traction Company, of which F. T. Pomeroy, of the Cleveland, Elyria & Western Company is chief promoter, has secured a franchise enabling it to build into Ashland.

CINCINNATI, OHIO.—The Little Miami Traction Company, operating many short systems in southern and central Ohio into Cincinnati, will introduce the third rail system on its proposed line from Yellow Springs, Ohio, to Clifton.

CINCINNATI, OHIO.—Rights of way for the proposed electric railway to connect Cynthiana and Louisville, Ky., have been secured through Harrison, Bourbon, Scott, Franklin and Shelby Counties. The line will be eighty miles in length.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company has placed a contract with P. H. McSpadgen, of McKeesport, for building an extension of its line from the East End loop to Little Beaver Creek. Materials have been ordered.

WARREN, OHIO.—Manager A. A. Anderson, of the Mahoning Valley Railway Company, has asked the county commissioners for a franchise for a line from Warren to Leavittsburg. The Chagrin Falls & Eastern Railway Company, has applied for a similar franchise.

LORAIN, OHIO.—The Lorain & Cleveland Railway Company and the Sandusky & Interurban Railway Company, which are soon to be merged into the Lake Shore Electric Railway Company, have completed arrangements for operating through cars from Cleveland to Sandusky through this place.

CINCINNATI, OHIO.—The Dayton, Lebanon & Cincinnati Railway Company has been purchased by A. E. Appleyard, of Boston, principal owner of the Dayton, Springfield & Urbana Traction Company and other large electric railway interests throughout the State. The price paid was $250,000.

TOLEDO, OHIO.—The Toledo-Bryan Air Line Company has been incorporated with $1,250,000 capital, by Joseph L. Yost, Frederick V. H. Cillins, William C. Brewer, Milton Taylor, Joseph C. Bonner, John Q. Adams, John Schlotherg, George F. Miller and William P. Heston. The company, which was originally organized under another name, proposes to build an air line electric railway from Toledo to Bryan.

CLEVELAND, OHIO.—E. G. Tillotson, of the Cleveland Trust Company, and who is at the head of the local syndicate which has a 30-day option on the properties of the Cleveland & Chagrin Falls Railway, and the Chagrin Falls & Eastern Railway, states that the syndicate has been successful in financing the project, and that the properties will be turned over at once. This means a consolidation of the two roads with the Cleveland & Eastern Railway.

CORNWALL, ONT.—The Electric Street Railway Company has purchased a water power from the Cornwall Milling Company, and proposes utilizing the water power for the operation of its road. New dynamos and water wheels will be installed.

OTTAWA, ONT.—Boston, Mass., and Kingston, Ont., capitalists are interested in a proposed electric railway to radiate east and west from Kingston, and ultimately to cover the territory between Toronto, Cornwall and Ottawa. As soon as the company's organization is completed, the Ontario Government will be asked to grant the company a special act to enable it to get a charter.

OTTAWA, ONT.—One of the difficulties, in connection with the street car service in Havana, says Mr. Wm. M. Doull, the secretary-treasurer of the Cuban Electric Railway, of which Mr. A. F. Gault, of Montreal, is president, is the fact that they have no five-cent pieces to use. This has been overcome, but not satisfactorily. They have the peseta, which is equal to fifteen cents, and for this piece of money three tickets are secured. Mr. Doull was in Havana when the first section of the street railway was opened for traffic, and he states that the success, in the way of traffic, was even better than was ever anticipated. The first start made was on ten miles, and the company had not sufficient cars to accommodate the crowds that wanted to avail themselves of the new system of travel through Havana's streets.

LA CROSSE, WIS.—A strike of street car employees is imminent. They have made a demand for higher wages, and the officials of the company do not look on the demand with very much favor.

JANESVILLE, WIS.—The Janesville Street Railway Company is putting in a return circuit in compliance with an ordinance passed by the common council, as a means of protecting the underground systems of the Janesville Water Company and the electric light, gas and telephone companies, against electrolysis.

THE AUTOMOBILE.

THE WOODS VEHICLE COMPANY, to manufacture automobiles, has been incorporated in New Jersey, with a capital of $1,500,000. The incorporators are Alfred P. Brown, Edward B. Hawkins and Edward T. Mogoffin.

THE HAVERSTRAW AUTO-SERVICE COMPANY has been incorporated to operate a stage route in Rockland County through the towns of Haverstraw, Stony Point and Clarkstown; capital, $10,000. Directors: George P. Hilton and Hershel Roberts, Albany; Charles M. Hilton, Haverstraw.

THE ILLINOIS MOTOR TRANSIT COMPANY has been incorporated at Urbana, Ill., with a capital stock of $50,000. The shareholders are Allen Williams, A. J. Williams, M. L. Williams, John Armstrong and others. The company will establish a line of automobiles in Champaign and Urbana.

NEW INDUSTRIAL COMPANIES.

THE GARL ELECTRIC COMPANY, of Akron, Ohio, has been incorporated with a capital stock of $25,000.

THE ELECTRIC DISPATCH COMPANY, of Detroit, has been incorporated at Wilmington, Del., with a capital of $100,000.

THE ELECTRIC MOTOR AND GENERATOR VENTILATING COMPANY has been incorporated at Wilmington, Del., with a capital stock of $100,000.

THE NATIONAL ELECTRIC CLOCK COMPANY has been incorporated in Maine; capital stock, $300,000. President, Joseph S. Smith, of Bangor; treasurer, William W. Gile, of Boston.

THE M. K. C. ELECTRICAL SEPARATOR COMPANY has been incorporated at Denver, Col. Capital stock, $100,000. Incorporators: F. H. Kirby, J. M. McClave, E. R. Cumbe, William Colley.

THE UNITED ELECTRIC & MANUFACTURING COMPANY, of Cleveland, has been incorporated with $10,000 capital stock by Thomas Shehan, C. J. Estep, Ira Culver, M. F. Parrett and W. L. West.

THE G. & E. ELECTRICAL & CONSTRUCTING COMPANY, of Binghamton, N. Y., has been incorporated; capital, $12,000. Directors: W. H. Gaylord, Fred Eitapenc and E. Isherman, of Binghamton, N. Y.

THE NATIONAL ELECTRIC IMPROVEMENT COMPANY has been incorporated, with home office in Jersey City, N. J. Capital, $2,000. Incorporators: Charles N. King, Stephen C. Smith and Le Grand Bouker.

THE CENTURY ELECTRIC COMPANY was recently incorporated, with San Francisco as the principal place of business. Directors: L. D. Hitzeroth, S. H. Weidenthal, W. J. Nixon, F. H. Bates and W. D. Mackey. Capital stock, $50,000; subscribed, $125.

THE ELECTRIC MOTOR & GENERATOR VENTILATING COMPANY has been incorporated at Wilmington, Del., to manufacture, buy, sell, own and operate ventilating facilities for electric motors, generators and other improved devices. The capital stock is $100,000.

THE HEIL RAIL JOINT WELDING COMPANY has been incorporated at Milwaukee, Wis., by Y. P. Heil, R. J. O'Hara, J. B. Conrad and Charles Abrech. The company will do cast welding and other work pertaining to making a continuous rail. It is capitalized at $25,000.

THE DELAVAL STEAM TURBINE COMPANY, capital $1,000,000, has been incorporated at Trenton, N. J., to manufacture steam turbines, dynamos and other electrical apparatus. The company has exclusive control of a patent for turbine wheels operated by steam and is now building a large plant in Trenton.

THE AKOUPHONE COMPANY, of New York City, has been incorporated to manufacture instruments to enable the deaf to hear and the dumb to speak. Capital, $700,000. Directors: Benjamin H. Adams, Herbert W. Grindal, Henry D. McGowan, Charles W. King and David U. Jennings, New York City. The company's system employs an electric telephone of special construction.

THE THOMAS H. B. VARNEY COMPANY was recently incorporated, with San Francisco as the principal place of business. Automobiles, both electric and steam, will be handled on a large scale. Directors: T. H. B. Varney, L. D. Owens, E. I. Varney, C. C. Hopkins and H. Mortenson, all of San Francisco. Capital stock, $25,000; fully subscribed. The company will carry the agencies for the Waverley and other automobiles.

LEGAL.

DEFECTIVE LIGHTNING ARRESTERS.—The Supreme Court of Vermont has confirmed the judgment of the trial court in a case where a physician was killed by lightning while sitting in his library reading under a telephone. It was contended that the lightning entered the house over the telephone wire, and that the company was negligent in not providing proper lightning arresters. The evidence brought out the fact that there was a lightning arrester connected with the telephone, but that it was inoperative. The Supreme Court affirmed the judgment of the lower court in favor of the heirs of the physician.

SUIT TO RESTRICT PARTY LINES.—In the case brought by Supervisor McCarthy, of San Francisco, against Louis F. Glass, manager of the Pacific States Telephone & Telegraph Company, charged with violating the telephone ordinance by using more than five subscribers on a party line, a dismissal was recently granted on motion of the plaintiff's attorney. The reason for this action of the prosecution was that it had been discovered that, under the law, an individual could not be charged with the offense. A new warrant will be issued charging the corporation with the violation of the ordinance. There are many 10-party lines in use in the city, which have caused complaints.

UNDERGROUND WIRES IN MINNEAPOLIS.—The Supreme Court of Minnesota has sustained the contention of the Northwestern Telephone Company as to the telephone company's right to build overhead wires within the limits prescribed by the city of Minneapolis, Minn., in which wires shall be placed underground. The company ignored the ordinance and proceeded to string wires within the "underground limits." The work was stopped by the police, and the company applied for an injunction to restrain the city from interfering with the work. The injunction was demurred to by the city and the company appealed to the Supreme Court, which reversed the action of the lower court, but a rehearing was secured. The decision makes it necessary for the city to establish new limits for underground wires.

PERSONAL.

MR. C. A. COFFIN, president of the General Electric Company, sailed last week for Europe.

MR. E. C. BOYNTON, for the past five years electrical engineer with the New York, New Haven & Hartford Railroad, has been appointed mechanical engineer of the Chicago Great Western Railroad, with headquarters at St. Paul, Minn.

CLEVELAND ELECTRIC CLUB.—At the last monthly meeting of the Cleveland Electric Club, Professor W. E. Goldsborough, of Purdue University, presented a paper on "The relative desirability and efficiency of direct current and induction motors."

MR. J. GEISEROWICH, secretary and treasurer of the Alden Electric Company and Illinois Insulated Wire Company, of Chicago, was a visitor at our offices last week. He has been making an extensive Eastern trip in the interest of the above concerns.

MR. BAYARD L. KILGOUR, until recently electrical engineer of the Cincinnati Street Railway Company, has been appointed supervising engineer of construction and maintainance and supervisor of contracts of the City & Suburban Telegraph Association, Cincinnati, Ohio.

MR. R. E. DANFORTH has been appointed general manager of the Lake Shore Electric Railway of Cleveland, a consolidation of the Lorain & Cleveland, the Sandusky & Interurban and the Sandusky, Norwalk & Southern. He was formerly assistant superintendent of the International Traction Company of Buffalo. His headquarters are in Cleveland.

MR. F. STUART WILLIAMSON, consulting structural engineer, has entered into a copartnership under the firm name of Charles Henry Davis & Partners, with New York offices in the Broad Exchange Building, 25 Broad Street, New York. The other members are C. H. Davis, J. S. Griggs, T. W. Sprague, E. Vander Horst, E. G. Thomas and C. E. Pearce.

WIRELESS TELEGRAPHY.—Prof. S. M. Kintner, of the Western University of Pennsylvania, on May 3 gave a lecture on "Wireless Telegraphy" at Carnegie Institute, Pittsburg, Pa. Mr. Henry W. Fisher, chief electrical engineer of the Standard Underground Cable Company, Pittsburg, also gave a lecture on "High Frequency Electric Currents." The lectures were delivered under the auspices of the Academy of Science and Art, and were illustrated by experiments.

EDUCATIONAL.

SUMMER COURSES.—The Massachusetts Institute of Technology has issued a pamphlet giving an outline of its courses for the summer of 1901. The supplementary series of courses of study will be given during the months of June and July. These courses are of private undertaking on the part of certain instructors, and they will only be given when a minimum number of students have applied at a fixed date. They have been undertaken primarily for the benefit of two classes of its students, first, those who wish to study in summer in order to gain more time for advanced work in their regular courses, and second, for those who through illness or other causes have deficiencies to make up.

Trade Notes.

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., reports success for its new baby knife switch. The trade in general apparently approves of this new switch as readily as the National Board of Fire Underwriters.

BUSY DAYS.—These are busy days for the shipping force of the Electric Appliance Company, Chicago. While the demand seems to be for everything in the realm of electrical goods, the percentage of increase of sales of Adams-Bagnall arc lamps is leading the company's other specialties.

ELECTRIC FANS.—The Robbins & Myers Company, of Springfield, Ohio, recently made a shipment of a carload of its electric fans to Texas, the largest single shipment it has ever made. This department of the company's business has increased ten-fold since it was started, and a very heavy foreign trade is being worked up.

THE ROCHESTER ELECTRIC MOTOR COMPANY, Rochester, N. Y., in a neatly gotten-up pamphlet give a list of a few Rochester people with whom it does business. The pamphlet contains the names of 50 Rochester firms, representing different lines of trade, to whom the Rochester Motor Company has furnished its apparatus.

THE MONARCH ELECTRIC & WIRE COMPANY is the name of the new company which succeeds Samuel Mankowitz at 125 and 127 South Clinton street, Chicago. It is equipping a factory to manufacture the Monarch brand of weatherproof wire and will also conduct a supply store carrying a complete line of electrical supplies.

THE UNITED STATES WIRE CONDUIT COMPANY, New Kensington, Pa., is just completing its works whereby it is enabled to turn out the "Standard" interior and exterior flexible enameled conduit tubing. There is every evidence that this conduit will secure ready favor and the manufacturer is now desirous of securing agents in various parts of the country.

DIRECT-CURRENT POWER MOTORS.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has issued a card circular giving dimensions, capacities, prices and other information of its direct-current high-speed, shunt-wound power motors. These machines are compact and have square bases, but round or oblong bases can be supplied.

TO REMOVE ITS BUSINESS.—The Dayton Fan & Motor Company, Dayton, Ohio, has received a proposition to remove its business to Ft. Wayne, Ind., and officials of the company are quoted as saying the change will be made within the next few months. The company has been troubled greatly with labor matters in Dayton, and for this reason it is desirous of making a change.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is receiving some nice orders for electric fixtures (chandeliers, brackets and portables). This company can furnish anything desired in this line of material, and is in a position to make prompt shipments. Before making shipments the Central Company is very careful to see that the goods are exactly as the customer ordered—a precaution which will be readily appreciated by purchasers of electric fixtures.

REMOVAL.—The Bordo Valve Company has moved its main office and works from Philadelphia to Coatesville, Pa. The company's new plant is thoroughly equipped with modern machinery and tools, and it is prepared to do strictly first-class work in brass casting and machine work. It carries a large stock of its regular Bordo plug valves and swing joints and can make prompt shipments. The company issues an illustrated descriptive pamphlet of its goods.

MECHANICAL DRAFT.—The B. F. Sturtevant Company, Boston, Mass., has no doubt been many times asked the question, "Who uses mechanical draft?" It undertakes to answer this question with a handsome 34-page pamphlet, in which is given lists of the large plants equipped by the company. The lists take up the entire pamphlet, and although they are only partially complete, they are long ones and include plants all over the civilized world. The title of the pamphlet is the question above quoted.

GRAPHITE BRUSHES.—The Joseph Dixon Crucible Company, Jersey City, N. J., is manufacturing a complete line of graphite brushes for motors, dynamos and generators. The company has issued a price list on the subject, in which it is pointed out that electrical engineers who have seen the commutators on which Dixon graphite brushes have been used for two or three years, have expressed great surprise at the slight wear of brushes and commutators and at the general perfect condition and freedom from burns and sparking.

MESSRS. CHARLES H. BESLY & CO., 10 North Canal Street, Chicago, Ill., report their general business very good. At this season of the year they are making large shipments of their Helmet oil, Bonanza cups and their new "Badger" oil cups, in which Helmet oil is used. At their factory at Beloit, Wis., they are very busy in their tap department, and are running night and day in their oil cup department. Their new 300-page illustrated catalogue is now ready for distribution, and will be mailed free to any address upon application.

SLIGHT FIRE DAMAGE.—The report that the plant of the Standard Telephone & Electric Company, Madison, Wis., was practically destroyed by fire recently was exaggerated. The company informs us that its plant was damaged to a small extent. No part of its machinery was lost and the only interruption was less than two day's duration, which was rendered necessary to enable an adjustment of the losses with the insurance companies. The business has not been interrupted and the fire will in no wise interfere with the work nor delay shipments.

FRICTION COUNTERSHAFTS AND ACCESSORIES constitute the subject of a circular just issued by the Garvin Machine Company, New York. The friction pulleys for these countershafts are lined with Ameledema oilless bearings, that require no oiling whatever, and they do not heat or cut the shaft. The Garvin Company is manufacturing these countershafts in large quantities with special machinery regularly manufactured by it. Illustrations are given of friction pulleys, standard hangers, friction pulley countershafts, a chucking lathe and a pulley polisher.

ELECTRIC SIGNS.—The A. & W. Electric Sign Company, of Cleveland, is building a number of large illuminated signs. One is for the Hershey Chocolate Company, of New York, which will be 76 ft. long and 26 ft. high at a cost of $2,500. It is also building two large signs for the Niagara Gorge Railroad Company at Niagara Falls. Large signs have recently been completed for the Cuyahoga Telephone Company, Scott Dry Goods Company, and other concerns in Cleveland. The A. & W. Electric Sign Company has been in business only a comparatively short time, but it is securing some excellent contracts.

INTERCOMMUNICATING TELEPHONE SYSTEM.—The Clark Automatic Telephone Switchboard Company, Providence, R. I., has issued a neat pamphlet of 24 pages, giving illustrations and brief descriptions of its automatic intercommunicating telephone system and apparatus. This apparatus has been thoroughly tested, and, it is stated, gives perfect service day and night. It is adapted for towns, factories, mills, warehouses, hotels, private residences, steamships and offices. The pamphlet contains a few copies of letters received by the company from users of its apparatus. They all speak in praise of the system.

MR. HENRY D. SEARS, of Boston, formerly for seven years with C. S. Knowles, and earlier with the General Electric Company, has established himself at 45 Arch Street as general sales agent for the Bellevue Porcelain Works, of Schenectady, N. Y. These works have been established for several years, but hitherto have devoted themselves to supplying porcelains to one or two large concerns. Now, however, they are open to orders from the general market, and Mr. Sears will handle their entire output. They make porcelains for electrical purposes only, and make a specialty of special pieces to order from drawings.

TO ENCOURAGE STUDY. Twenty of the leading merchants and business men have agreed to allow any of their employes who become students of the International Correspondence Schools, Scranton, Pa., five evenings a week without reduction of salary in order that they may devote this time to their studies. Employers generally recognize the importance of educating their men, and in a number of the largest industrial plants in this country arrangements have been made for the accommodation of employes who wish to study by mail. On the recommendation of the Franklin Institute, the silver medal and diploma was awarded by the National Export Exposition to the International Correspondence Schools, Scranton, Pa., for a unique, thorough and comprehensive system of technical education by correspondence.

THE LEA ELECTRIC MANUFACTURING COMPANY.—This company's booth at the Pan-American Exposition is attracting attention, which is due largely to the ability and judgment of Mr. William M. Porter, manager of the company. Printed literature about the company's lamps and other products and souvenirs of the Northall lamp cover used by the company on its arc lamps can be obtained at the booth. Mr. Porter is one of the staff of the old Brush Electric Company, of Cleveland, Ohio, and has had 20 years' experience. The success of the Lea Company is due to his excellent management. The company's outlook is decidedly bright, and it is enjoying a large and rapidly growing business. It has outgrown its present facilities in Elwood, Ind., and contemplates moving to a larger city.

COLUMBUS STORAGE BATTERIES.—The Columbus Battery & Specialty Company, 25 N. Scioto Street, Columbus, Ohio, is placing on the market a new storage battery, which is stated to be the result of a long and careful series of experiments covering a period of many years. The plates are, according to the general catalogue of the company, made by an entirely new and superior process which, by chemical action, hardens the active material to the consistency of lime stone, the result of which produces a cell having high efficiency and low internal resistance. It is stated that the plates will not buckle, and that short circuits have no effect upon them whatever. Other important advantages are claimed for the battery. The catalogue just issued by the company gives a description and illustration of the battery.

FRINK REFLECTORS ABROAD.—I. P. Frink, 551 Pearl Street, New York, is not only lighting the finest department stores in this country, but is reaching out after foreign trade as well. Among the latest installations in the show window line are for the J. E. Manix Dry Goods Company, of Nashville, Tenn.; the show windows of the large department store of Senor Tomas Mendirichaga, Monterey, Mexico, who also used a large number of cluster reflectors for lighting the store interior with the most happy results, and also a large order for the show windows of one of the best known houses in Dublin, Ireland. The Frink reflector makes the ideal light for show windows. We might also call attention to the line of cluster reflectors manufactured by this firm for the lighting of store interiors, etc., which give a splendid light, make an exceedingly nice appearance, and are very durable.

IMPORTANT PATENT ON AUTOMATIC SWITCHES.—An important patent, No. 673,274, dated April 30, 1901, has been issued to H. Ward Leonard, which is claimed to cover very broadly all forms of motor starters and circuit breakers in which there are two arms, one of which responds to overload and the other of which responds to underload. These forms of double arm starters are known as "fool proof" starters, because they make it impossible for even the most careless or ignorant operator to cause any damage by improper manipulation of the apparatus. The patent contains twenty-one broad claims, of which we reproduce claim 6, which is a typical one: "In a circuit-controller, the combination of two movable switch members for controlling the same circuit, and two electroresponsive devices for controlling said switch members, each switch and its electroresponsive device operating automatically and independently of the other to affect the same circuit, one when excessive current flows and the other upon failure or abnormal decrease of current."

NEW TELEPHONES.—The telephone department of the Western Electrical Supply Company, of St. Louis, has just issued a number of bulletins covering its new telephones, switchboards, etc. These are bound up in catalogue form, and embrace everything pertaining to the complete equipment, construction or maintenance of a telephone line or exchange. They contain a large number of new devices for the economical operation of lines and exchanges, which have never been shown before. Among the new things noted is the company's loud-ringing extension gongs, developed in response to a demand for an extension bell to be used on telephone lines in noisy places; the adjustable arm, long-distance transmitter, with solid back; and new ideal bridging telephone, which embodies a number of new features. The catalogue also shows a very attractive looking receiver with a covered diaphragm. Any one contemplating installing a new exchange, or making additions and improvements of any kind, would do well to obtain a copy of these bulletins. They are mailed on application.

THE GOULD STORAGE BATTERY COMPANY, which has recently introduced a high-weight efficiency automobile battery, is being overrun with orders for the same. This new acquisition puts this enterprising company in a most advantageous position, for now it is supplying every vehicle requirement, including 40-mile delivery wagon batteries and 50-mile batteries for pleasure vehicles. It is a noteworthy fact that while these batteries are light of weight yet even so they are of the electro-chemical sort, in which the active material is "grown" out of the pure rolled plate after treatment by their ingenious "spinning process." The Gould No. 905 D battery weighs 18½ lbs. per cell, and gives an output of 100 ampere-hours. This is equal to 5½ amperes per pound, which for a 5-plate battery is remarkable, especially since the plates are not posted and are capable of withstanding a 100-ampere rate of discharge without damage to the plates. The Baker Company is using this company's battery in its remarkable runabout, and in Pittsburg the Gould is the only battery said to be capable of doing the "smoky way," which, as we all know, is an uphill job.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 14, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

673,893. COLOR CHANGING AND SIGNALING DEVICE; H. M. Baker, Jr., and A. W. Fox, New York, N. Y. App. filed Aug. 8, 1900. An electro motive device by which the color disks in front of a calcium or similar light can be changed from a distance.

673,900. ELECTRIC BATTERY; D. H. Darling, Jr., New York, N. Y. App. filed Oct. 11, 1899. Details of a sealing device for the jar.

673,903. ELECTRIC CABLE; J. D. Goulf, Brooklyn, N. Y. App. filed April 6, 1898. The current carrying conductor has wound around it a fusible wire, which thereby acts in all parts of the circuit as a thermostat in case of over-heating from any cause.

673,910. CONTROLLER FOR MOTORS; C. W. Kragh, Madison, Wis. App. filed April 14, 1900. A construction by which the contacts can be made large and at the same time occupy a compact space.

673,911. POLYPHASE ALTERNATING-CURRENT MOTOR; B. G. Lamme, Pittsburg, Pa. App. filed Jan. 30, 1899. (See Current News and Notes.)

673,912 and 673,913. SYSTEM OF ELECTRICAL DISTRIBUTION; B. G. Lamme, Pittsburg, Pa. App. filed July 14, 1900. (See Current News and Notes.)

673,935. ELECTRIC LIGHTING SYSTEM; A. J. Wurts, Pittsburg, Pa. App. filed April 21, 1899. (See Current News and Notes.)

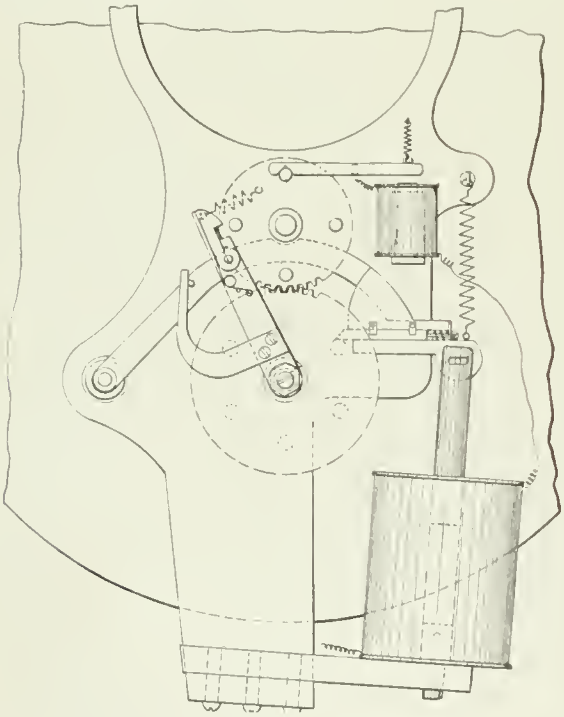
673,936. MAGAZINE GLOWER LAMP; A. J. Wurts, Pittsburg, Pa. App. filed April 25, 1900. (See Current News and Notes.)

673,951. ELECTRIC ARC LAMP; J. Herricht, Cleveland, Ohio. App. filed Dec. 26, 1900. Mechanism by which the entire lamp can be raised and lowered through an opening in a reflector to bring the arc to a central position therein.

673,952. ASYMMETRICAL ELECTRICAL CONDUCTOR; L. W. Hildburgh, New York, N. Y. App. filed Nov. 22, 1897. (See Current News and Notes.)

673,953. ASYMMETRICAL ELECTRICAL CONDUCTOR; L. W. Hildburgh, New York, N. Y. App. filed April 24, 1899. (See Current News and Notes.)

673,980. ELECTROMAGNET MOTOR; L. H. Engelhardt, Everett, Mass. App. filed June 22, 1900. The commutator is so arranged that some of the poles of the field magnet and armature will be attracting each other while others are repelling, at times when their relative positions will result in both forces promoting rotation.



673,893.—Color changing and signalling device.

674,018. ELECTRICAL CONTACT DEVICE; M. Robinson, Newton, Mass. App. filed Jan. 31, 1901. A circuit closer to be stepped on, and consisting of two plates of large dimensions separated at one end by a block of insulating material and free to be pressed together at the opposite end.

674,067. ELECTRIC ARC LAMP; W. H. Northall, Elwood, Ind. App. filed Jan. 18, 1900. The casing for the lamp mechanism is made in three parts, two of which are hinged together on a vertical axis and the third being a cap.

674,076. ELECTRIC SWITCH; Cummings C. Chesney and Herbert W. Smith, of Pittsfield, Mass. App. filed July 23, 1900. Two rods, one hinged on and located in a line considerably out of the vertical have a fuse connected between their extremities, which holds them relatively stationary. The fuse is in a receptacle surrounded by non-conducting powder. Means are provided for releasing one end of the fuse and to retract one of the terminals, thereby permitting the fuse receptacle to fall and laterally displace any arc formed. As the fuse receptacle falls the arc is displaced, both by the movement of the tube and also because the fuse is drawn through the powder contained within the receptacle.

674,097. HOLLOW TILE AND BRICK; O. C. Pixley, Chicago, Ill. App. filed Feb. 23, 1901. A conduit having an opening extending longitudinally thereof at the junction of the partition walls, and adapted to receive a dowel pin to hold the sections of the conduit together.

674,108. ELECTRIC RAILWAY SYSTEM; B. W. Tucker, Newark, N. J. App. filed Jan. 30, 1901. In order to provide for expansion and contraction the conductor is looped or bent into pockets at intervals.

674,109. ELECTRIC RAILWAY SYSTEM; B. W. Tucker, Newark, N. J. App. filed Feb. 9, 1901. The conductor lies in a trough of porcelain and is adapted to be lifted into contact with a metallic cover by a magnet carried by the car.

673,903.—Electric cable.

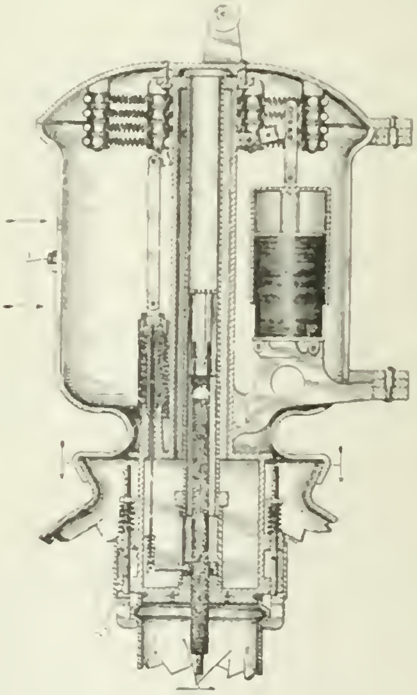
674,110. ELECTRIC RAILWAY SYSTEM; B. W. Tucker, Newark, N. J. App. filed Feb. 7, 1901. A modification of the preceding patent.

674,124. ELECTRIC HEATER; C. Robinson, Baltimore, Md. App. filed April 17, 1899. The heat is supplied by an electric arc in a closed chamber surrounded by heat insulating substances; a chamber is formed in the same structure into which to introduce the article to be heated.

674,130. ELECTRIC ARC LAMP; T. W. Young, Washington, D. C. App. filed Aug. 4, 1900. Details.

674,207. ELECTRIC SWITCH; J. C. DeJanisch, Paris, France. App. filed April 27, 1900. A double switch comprising a sliding switch member and a contact adapted to be engaged thereby, a rocking switch member fulcrumed on said sliding member, contacts adapted to be engaged by the rocking member, and means for operating the switch members.

674,280. ELECTRIC CLOCK WINDING MECHANISM; V. Odquist, Chicago, Ill. App. filed June 2[illegible], 19[illegible]. Details of a circuit closer adapted to close the circuit of the winding magnet at intervals.



674,067. Electric arc lamp.

674,283. ELECTRIC LAMP SOCKET; J. D. Pierce, Philadelphia, Pa. App. filed May 21, 1900. The connections between the wires and the sockets are made in such a way that the lamp can be supported by the wires.

674,338. ELECTRIC ARC LAMP; J. Herricht, Cleveland, Ohio. App. filed Aug. 27, 1900. Improvements in the clutch mechanism designed to obviate the use of a dash pot.

Omitted from list issued April 30, 1901.

673,094. ELECTRICAL BILLIARD CUE CHALKER; J. E. Stoneman, New York, N. Y. App. filed Jan. 11, 1901. A piece of chalk is held in the journal of a motor; the act of placing the cue against the chalk completes the circuit of the motor and the latter in rotating chalks the cue. When the cue is removed the motor stops.

Convention of the National Electric Light Association.

THE twenty-fourth convention of the National Electric Light Association was called to order at 10.45 a. m. Tuesday, May 21, in the meeting hall of the International Hotel, of Niagara Falls, N. Y., by President James Blake Cahoon. After delivering his presidential address, which is reprinted in full elsewhere in this issue, President Cahoon called on Mr. Calvin W. Rice to read his paper entitled, "Distribution of Current at High Potential in New York City." This paper, with the ensuing discussion, is printed elsewhere.

Following the discussion, a letter was read from the manager of the French Gramme Company, announcing the death of its president, Monsieur Z. T. Gramme, which occurred Jan. 20. Resolutions were adopted expressing the deep regret of the association at the loss to electrical invention and discovery of this famous honory member of the association, whose work has done so much to promote the success of the art of modern electric lighting and the economic generation of current. A paper was then read by Mr. L. R. Wallis on the "Foresee (4-C) System of Charging," an abstract of which and the ensuing discussion will be found elsewhere.

Mr. George E. Tripp, of Boston, presented a report as chairman of the committee on uniform accounting, which will be printed in a future issue. In the discussion of the report, Mr. C. F. Hewitt, of Elkhart, Ind., expressed a wish that some means were available whereby the association could obtain from every municipality having its own electric light plant, some reliable data showing the actual costs, in order that comparison may be made between the cost of operation by municipal and private corporations. Mr. F. E. Smith, of Somerville, Mass., criticized the rules laid down by the Gas and Electric Light Commissioners of Massachusetts concerning the reporting of electric light accounts. He thinks that there would be an improvement if the data demanded were such that the companies in preparing the same could not help but know what their costs are. He believes that the great majority of central stations do not know what it is costing them per kilowatt-hour to produce their current. Mr. Charles Price, of New Bedford, Mass., said that if central station men are to make headway against the municipal movement, they must be able to show what they claim their opponents cannot show; that is, the cost of operation; when, however, he has inquired of the managers of different companies as to the cost of their product per kilowatt-hour he found that they had various opinions as to what "costs" meant, some merely giving operating expenses without any allowance for interest, fixed charges and so on. President Cahoon said that from what he understood to have been said by the Massachusetts Commissioners at the last meeting, and some that attended the meeting of the League of American Municipalities, he thinks that if the association would get up a uniform standard, the commissioners would be only too glad to adopt it. Mr. Anthony considers that an account should not be kept on a yearly but on a monthly basis, and that all bookkeeping should be absolutely kept and closed each month by itself. In reply to an inquiry as to what members were keeping monthly accounts, quite a number responded in the affirmative. Mr. R. L. Drum, of Terre Haute, Ind., advocated a form which would enable the companies to keep to themselves, if they so desire, all of the accounts which pertain to the cost of property and things of that nature, and let the association have the cost of supplying the current. Mr. Frederick Nichols said that one cannot possibly keep the correct cost of operation unless the actual cost of the capital end of the business is known. The interest on the capital is just as much the cost of trimming an arc lamp as the wages of the man who does the trimming. A rough-and-ready method of keeping the cost of operation, including the wages of employees, cleaning lamps, breakages, etc., cannot be devised. The thing must be done scientifically from start to finish.

TUESDAY AFTERNOON SESSION.

After calling the meeting to order at 2.45, President Cahoon announced that the first paper to be read would be that of Mr. Francis W. Wilcox on "The Practical Side of the Incandescent Lamp." An abstract of this paper, with the accompanying discussion, is printed elsewhere. After some announcements as to business matters and entertainment, the report of the committee on incandescent lamps, Dr. Bell, chairman, was read by Mr. James I. Ayer, member of the committee. This report is printed elsewhere with the discussion. The meeting adjourned at half-past 4 o'clock, and the delegation in a body visited the power house and plant of the Niagara Falls Power Company.

WEDNESDAY MORNING SESSION.

The meeting was called to order at 10.45 a. m. by President Cahoon.

Mr. James I. Ayer read the report of the committee on "Amendments to Freight Classification of Electrical Apparatus." A petition was presented by the committee to the railroad classification committee on Jan. 4, 1899, and a reply received that the classification committee did not deem it expedient to recommend any change in the freight classification of electrical apparatus. On April 25 notice was received that the committee would not permit oral argument before it in support of an application for change in classification. On Nov. 2, 1899, in reply to another petition, the classification committee said that it was not expedient to make any freight reduction as requested. On Jan. 22, 1900, the case was presented by the Merchants' Association of New York at a conference with the executive committee of the Trunk Line Association, and on Nov. 25 of the same year the secretary of the National Electric Light Association committee wrote the classification committee pointing out the unreasonableness of the attitude which the latter committee had taken. The letter said: "If your committee desires to reconsider their action on our previous application, and desires us orally to represent our side of the case during such reconsideration, we shall be pleased to have a proper representative take up the matter at such time and place as your committee may indicate. Beyond this we decline to take further action, as suggested in your letter, by submitting another set of demands, feeling sure that the committee's efforts can be better employed in other directions looking to the final adjustment of this matter."

In the discussion on the report, Mr. Ayer said the subject of freight classification has been in the hands of the committee for three years past, during which time a large amount of work has been done, but absolutely no tangible results obtained. The Southern Traffic Association representing the Southern railroads, had voluntarily changed the classification of electrical machinery from first class in less than carload lots, to second class; and in carload lots from third class to fifth class, putting it where it belongs in freight classification as comparing with other machinery of like character. This change took effect the first of February last. In order to make a case under the Interstate Commerce law for the courts, it was suggested to ship two castings, each weighing, say, one-half ton, one being a dynamo casting and the other an engine casting, paying the freight rate across two States. In this case one would be classified as first-class and the other as fourth class, and on that showing a case can be made to be taken to the United States Court, with the demand that under the Interstate Commerce laws a proper readjustment be made in classification. Such an obvious case can be arranged and a favorable decision would bring the classification committee to terms. This appears to be the only way to get any action having force behind it through which to obtain recognition on the part of the railroads. There is no objection to paying the same rate of freight per pound for a dynamo that is charged for an engine, but there does not seem to be any reason that the same rate of freight should be charged for a dynamo as for a barrel of glass globes or lamp chimneys, which is about 2½ times the rate per pound charged for other machinery.

Mr. Ayer said that the discrimination against electrical machinery dates back to the early history of shipment of electrical apparatus. At that time damage during shipment to electrical machinery cost the railroad companies many thousands of dollars, and as a consequence this kind of freight was put in the first class, and has never been taken out. Mr. Hoyt suggested that favorable results might be obtained by enlisting the aid of consumers, and he considers that there is not a member of the association that could not by proper looking after the matter, secure the co-operation of a local freight agent, possibly of the local general freight agent or some high official, and through the recommendation of these local officials be enabled to secure results which could not possibly be obtained through the association or through manufacturers coming before the classification committee. Mr. Ayer stated that the committee had applied to every member of the association and every central station manager in any city of 10,000 inhabitants or over, asking that they take the matter up personally, and no results had been achieved.

President Cahoon said that the matter has been thoroughly threshed out, and it is now time for action; that the matter ought either to be brought to a definite point or else dropped, since there is no use of going along from year to year dragging as this matter has dragged. A motion was then carried instructing the committee to bring the necessary suits and take whatever steps are required in their judgment to bring about the desired result.

Mr. H. W. Hillman then read a paper entitled, "Arc Lighting at the Beginning of the Twentieth Century," an abstract of which will appear in a future issue.

After the discussion of Mr. Hillman's paper the following-named gentlemen were elected as officers for the ensuing year:

President: Henry L. Doherty, of Denver, Colo.

Vice-Presidents: Louis A. Ferguson, of Chicago, Ill., and Charles B. Hunt, of London, Ont.

Members of the Executive Committee: Mr. Charles L. Edgar, of Boston, Mass.; Mr. D. P. Robinson, of Seattle, Wash.; Mr. C. C. Howell, of Knoxville, Tenn.; Mr. E. L. Bemis, of New Orleans, La., and Mr. Dudley Farrand, of Newark, N. J.

Mr. Frederick Nichols was elected an honorary member of the association.

WEDNESDAY AFTERNOON SESSION.

After the meeting was called to order the discussion of Mr. Wallis' paper was taken up. This continuation of the discussion follows the abstract of the paper printed elsewhere. The discussion of Professor Matthews' report was next on the programme, an abstract of which follows the report printed elsewhere. The report of the committee on rules for electrical construction and operation, Captain William Brophy chairman, was then adopted. Captain Brophy also reported on the subject of the grounding of the neutral.

THURSDAY MORNING SESSION.

President Cahoon called the meeting to order at 10:30 o'clock, after which the report of the treasurer was read. This showed that the receipts for the past year were \$7,776.56 and the balance in the bank at the beginning of the year \$4,368.55, giving a total of \$12,145.05; the disbursements were \$6,143.41, leaving a balance on Jan. 1, 1901, of \$6,001.64. Mr. C. R. Van Trump, of Wilmington, Del., then read his paper on "The Station Load Diagram," an abstract of which appears elsewhere.

Mr. James I. Ayer made a motion that there be incorporated in the proceedings of the Association a report of the Committee on Lighting of the Board of Legislation of Cincinnati, which contains data of much interest. This report, which has been referred to several times in our columns, is on the street lighting of St. Louis, Chicago, Milwaukee, Pittsburg, Allegheny, Edgewood Borough, Baltimore, Washington, Philadelphia, New York, Hartford and Boston, made by a committee of the city council of Cincinnati appointed to gather information concerning city lighting by gas and electricity, and its conclusions are favorable to electric lighting.

The topic selected for discussion, namely, "Steam Heating from Central Stations," was then taken up by Mr. Chas. R. Maunsell, superintendent of the Edison Electric Illuminating Company, of Topeka, Kan. In Topeka the central station now has connected 52,257 square feet of uncovered radiation, and 8,500 of covered piping, and is expecting soon to increase the radiation connected by about 50,000 feet. The conditions in Topeka are very favorable, the district covered by the pipe line including the very cream of the business obtainable. The promoters of the heating scheme said that the station could earn from \$2500 to \$6000 per year per 100 horse-power exhaust steam, and Mr. Maunsell said that they had managed to get a fair profit, the day load being about 250 horse-power during the fall and winter months. The steam heating is also credited with having obtained considerable of the present motor load. The pressure required on the system is from 2 to 5 pounds at the station; the greatest distance steam is supplied is 2800 feet from the station, and little difficulty has been found in giving perfect service at these pressures. The changes necessary in the station equipment were the substitution of standard steam pipe and fittings for plain exhaust piping, and the installation of a double line to enable any engine to be operated on back pressure or to the atmosphere, as the condition necessitated. The latter point is stated to be very essential to success, particularly on the peak load, for most stations will then have a surplus of exhaust. A live steam connection with reducing valve is also necessary. When the service first commenced the cost of service lines into buildings was paid, but after the first year the consumer has been more than willing to meet this expense; the consumer now pays for all the apparatus in his building except the meter, and maintains it subject to inspection.

The first year of operation the revenue received paid 55 per cent. of the coal used from October to June; the second year, 60 per cent; the third year, 72 per cent., and the year just closed 97 per cent. of the coal bill. On a revenue of \$11,000 all expenses aside from coal were only \$280. Experience has shown that flat rates to small customers, and meters for all large ones, is the best system. Both steam and water meters have been used, but the latter is preferred. In Mr. Maunsell's opinion 5 per cent. per annum will cover depreciation. With this system it is possible to defy competition either from isolated plants or a central station not equipped to give this service. In several cases contracts for power, light and heating were secured where parties would have undertaken to supply their own lighting plant if the whole contract could not have been taken. At present there is not a single isolated plant in the city of Topeka.

Mr. Wells, of Towanda, said that to install the exhaust heating plant in that town required an investment of \$16,000. The first season, owing to a late start, the plant only earned about \$1,800; the next season earnings were a little over \$3,000, which paid for the extra coal and labor, and 6 per cent. on \$16,000; the last three seasons the receipts from heating have been respectively \$4,900, \$5,100 and \$5,400, which paid for every dollar of the coal bill, all extra labor, and 6 per cent. on the investment. The result of the installation of the steam plant has been that a floating debt of \$6,500 has been paid off, a new 120-kw generator purchased, and many modern transformers substituted for old ones; the entire plant is now in good shape to pay dividends this summer.

Mr. Wells dwelt upon the necessity of having house steam piping large enough. The courthouse in his town is so badly piped that at times the steam pressure has to be forced to 10 pounds in order to heat the building properly. At York, Pa., there is a large plant on which the pressure does not exceed 3½ pounds of steam in zero weather. The rate charged for heating is three cents per thousand cubic feet, though a larger price is charged on a small contract and a less price where there is a large area to be heated. Since the lighting plant has no day load, live steam is used almost all the time. The cost of coal is \$1.50 per ton for a poor quality of bituminous.

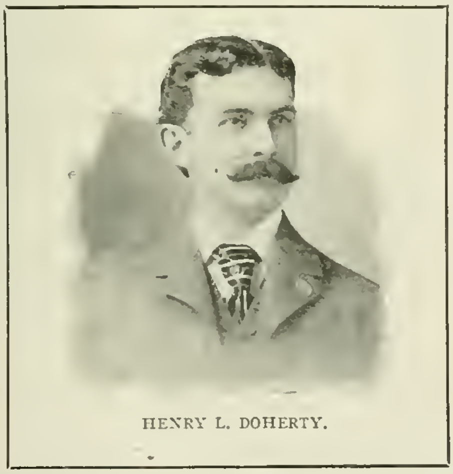
Mr. Maunsell said that in Topeka the city authorities required that cooling coils should be put in in order to prevent hot water from radiators passing to the sewers. The cooling coil is simply an indirect radiator with continuous circulation; that is, a radiator against which a draught of air is directed. Mr. McCabe, of Newcastle, Pa., said that steam heating in his town had not proved a success. Mr. Wells said the reason of the lack of success there was that the plant is a live steam one using small pipes, and that if it were an adjunct to a central station it would pay. Mr. Maunsell said that the proportion of fuel expense for heating was figured in the following manner: The output of the station is taken when there is no steam heating, for example, in the month of September, and the number of pounds of coal determined per kw-hour. This is taken as a basis and during the heating season all the coal in excess of the amount corresponding to this is charged to the heating system, and also the same proportion of station labor. Two dollars and twenty cents per ton is paid for slacked coal, which is claimed to possess 10,000 heat units per pound. Mr. F. N. Jewett, of Chicago, described the Alfred Lea hot water heating system. The water is heated in a surface condenser and circulated through the town at a temperature to suit the weather conditions. In mild weather its temperature is 135 to 140 degrees, and in extremely cold weather 175 to 180 degrees, in the former case the condenser vacuum being 20 inches and in the latter 10 inches. The particular advantage of the hot water system is that the heating can be varied to suit the weather conditions, while in steam heating the temperature cannot be varied. Other advantages are that in the hot water system there is no water loss and a given amount of heating may be supplied by pipes one-half the size of those required in the steam system. Mr. Ernest Woodruff, of Atlanta, Ga., said that his company put in a steam heating plant which commenced operation last November. The experience thus far has been very satisfactory, the receipts having been $10,000 for the first season; the investment was about $100,000. Contracts have already been signed for about $8,000 worth of new business for next season. Mr. Woodruff stated that within a few years the station will be able to use every ounce of exhaust steam. Mr. Elliot, of Atlanta, the chief engineer of the plant referred to, said that in his station compound condensing engines were run in the summer time and non-condensing engines in the winter time, the steam from the latter being used for heating. The additional expense in the station to put in a steam heating system is very small, consisting principally in running a six-inch pipe the length of the station and connections for the same. The idea of regulating the temperature of the water to suit the weather conditions implies that all the buildings are supplied with radiating surface on exactly the same basis; in point of fact, the amount of radiating surface for similar conditions varies widely. Mr. Jewett said that in the hot water heating plant at Red Oak, Ia., the theory that the temperature may be regulated at the station does work out in practice. There is a schedule for the temperature at which the water ought to go out as compared with the temperature of the air, and in actual practice the water is sent out at temperatures varying from 140 to 190 degrees. The fourteen-story factory of the Western Electric Company in New York City is heated by a hot water system. Mr. Dusman, of York, Pa., said that in his city an average of 2½ to 3 pounds of back pressure is used on the steam heating, but sometimes in zero weather this is increased to 5 pounds.

The last paper of the meeting was that of Mr. Augustus Treadwell, Jr., on "Storage Batteries in Central Station Work," which was read by Mr. T. C. Martin. The discussion which followed was participated in by Messrs. E. A. Sperry, Wm. Donaldson, Chas. Blizard and R. Emory. An abstract of the paper and discussion will appear in a following issue.

There being no other business, President Cahoon made an earnest appeal to the members to take an active individual share in increasing the membership, and thanking all who had participated for their share in the work of the convention, declared the meeting adjourned.

President-Elect Henry L. Doherty.

Mr. Henry L. Doherty, president-elect of the National Electric Light Association, was born May 15, 1870, in Indiana, and reared in Columbus, Ohio. Mr. Doherty inherits his engineering bent from his father, who was a hydraulic engineer and inventor. When 12 years of age he entered the employ of Mr. Emerson McMillin, then superintendent of the Columbus, Ohio, gas works, as office boy, and with the exception of a few short periods, has been continuously associated with Mr. McMillin ever since.


HENRY L. DOHERTY.

Mr. Doherty has made himself an authority on all questions affecting the economical equipment and operation of gas and electric plants, and much of his work has been to place on a profitable basis the numerous properties of this kind which Mr. McMillin has acquired throughout the United States. This in some cases has involved the complete modernization of equipment, and in every case the systemization of the administration and operation. He was one of the first in this country to recognize the value of a rate system, whereby consumers' charges are based not only on the current used, but also on his demand on the station capacity. A paper read at last year's meeting of the association dealt with the details of such a system which Mr. Doherty has applied with excellent results to several central stations under his supervision.

In 1896 and for several years following, Mr. Doherty was general manager of the Madison, Wis., gas and electric plants, which he brought to a high state of efficiency, and averted a threatened establishment of a municipal plant. He is now president of the Madison Company. For some months past he has been in Denver in charge of the McMillin interests in that place, but at all times he has acted as engineer and advisor to Mr. McMillin in New York.

Address of President Cahoon.

It becomes my pleasant duty, in the first year of the new century, to greet you at this historic place, now peculiarly of interest to the electrical fraternity by reason of the partial harnessing of the great Falls of Niagara, rendering them useful and subservient to the demands of man. Yet, while we know that thousands of their horse-power are being utilized, which one of us, standing by their side and listening to their mighty roar, can detect this change? They seem to hurl back defiance at the puny attempts of man to control their restless energy. What will be the answer of man at the close of the twentieth century?

We are wont to class Niagara as the greatest water-power in the world, yet it is only as the boy to the man, compared with some others. For instance, the Victoria Falls on the Zambesi River in the Dark Continent have a fall of 391 ft. and a width of 3200, while Niagara has only 177 ft. fall and a width of 1968 ft.

Long-distance transmission of electricity has become a well-established fact, and as high as 60,000 volts have been successfully transmitted, while the distance has been steadily increasing. The Snoqualmie Falls Power Company, of Seattle, Washington, recently operated a motor by means of current transmitted over a circuit 153 miles in length, the results obtained being so satisfactory as to demonstrate fully the feasibility of the plan.

In all parts of the country man is at work utilizing the water powers that nature has provided, which until the advent of electricity were in a great measure unavailable for his work. Those of our association who can recall the early days of central stations, when a few hundred horse-power were sufficient for the demand, may well feel amazed at the wonderful strides that have been made in their development during the closing years of the nineteenth century; but as the mind of man expands and develops, so will his ability to grasp higher and greater problems carry him on into those larger fields in the face of which our present works will appear even more primitive and puny than do now the central stations of the early days. As Shakespeare well says, "We must construe the times to their necessities."

In taking a retrospective glance over the past year we are struck with the fact that but little has been brought out that marks any distinct advance in apparatus. It is as though our associate members in the manufacturing field had taken the good housewife for an example, and had been cleaning here and dusting there—clearing away the cobwebs. I hardly dare say getting the "bugs" out of things, for no good housekeeper would admit that there were such things in her house; nevertheless, technical "bugs" have appeared, and must be gotten rid of before apparatus is perfected, and so, apparently, our manufacturers have been busy setting their house in order preparatory to the next great step in advance.

Turning to the field of invention, we see a few bright rays peeping forth, just enough to nourish the hope, ever latent in our breast, that some better method of illumination is to be given us. Experiments have been carried on with the Nernst lamp with a view to reducing it to a commercial basis, and we may soon look for its appearance in a practical condition for ordinary use.

Ewald Rasch, a German, has brought out an arc lamp, somewhat similar in principle to the Nernst lamp in that the carbon rods are replaced by rods of refractory material, such as the oxides of thorium, zirconium, magnesium, etc. These require heating before they will work, which is, of course, objectionable, but they possess the great advantage that the electrodes are permanent and do not require renewal. The efficiency is claimed to be about double that of the ordinary carbon arc lamps. By changing the material of the rods, the character of the light emitted may be varied.

At the Conversazione of the American Institute of Electrical Engineers, held April 12, 1901, Mr. Peter Cooper Hewitt exhibited a method of lighting by vacuum tubes in which mercury had been placed. Upon current being applied from a 115-volt circuit, the mercury was first vaporized and then the vapor heated up to a point where it emitted a light so powerful, and of such a color, as to make the light from an ordinary enclosed-arc lamp look like that given forth by a common gas jet. This is not in commercial form, as the light is very objectionable on account of its ghastly green effect, but experiments are now being carried on with other vaporized materials, and we may look for a successful issue in the very near future, for we of this day do not question the value of experiments as people did a century ago. In this connection you will all recall an incident of Franklin's career, when he replied to a man that spoke rather contemptuously in his presence of Montgolfier's balloon experiments: "Of what use is a new-born babe?"

When you visit the great Pan-American Exposition, and behold the marked advance that has been made in the arts and sciences, even since the World's Exposition at Chicago, just think for a moment that this could not have taken place except through a series of experiments taxing the brain and the patience of genius, as well as the pocketbook of capital. Both have given freely, and the world has attained a higher degree of civilization by reason thereof.

As you probably have surmised, the reason for departing from our usual custom and holding this meeting here, is that our members and friends may be able to visit the Exposition, and thus combine business with pleasure and with instruction in broader fields than our own. I particularly commend to your attention, as typical of what American citizens can do, this great Exposition. The citizens of Buffalo, out of their own resources, and by their courage, energy and grit, have created this magnificent exhibit, and they may well and proudly say to all the world: "Come, see, we bid you a cordial welcome, and we know you will depart with a higher idea of American skill, of American pluck, and of American civilization, than you could possibly have entertained hitherto." All honor to Buffalo, and to its daring citizens, who have had the courage to bring this to pass!

In a little work entitled "The Thoughts of the Emperor Marcus Aurelius Antoninus," occurs a paragraph that struck me as applying with peculiar force to this association. Antoninus says: "We are all working together to one end—some with knowledge and design, and others without knowing what they do, as men also do when they are asleep." Largely incident to the fact that our officers are not permanent, and cannot well be so, our association has dragged along from year to year with a membership barely sufficient to carry on the routine work of the association and bear the expenses incident thereto without too frequent demands on the members for contributions to carry out some special line of work. During the past year, the matter of increasing the membership has been taken up actively, and every central station in the United States in towns of over 2000 inhabitants has had its attention called to the benefits that would accrue to it through becoming a member of this association. The result has been that new interest has been aroused in the work of the association, and a very substantial addition has been made to our membership. It has really been the inauguration of a campaign of education, and while only a beginning has been made, I feel confident that if my successors will continue the good work, material additions will be made and the association will reach the plane where it should have been long ago.

I doubt if there has been a president of this association up to the present time that has not at one time or another urged the co-operation of the members in this missionary work, and no doubt many a member has left the convention hall with the thought that he would turn over a new leaf and assist in this work, but when he has reached his home and settled down to his accustomed work, the idea has promptly fallen asleep and his good intentions have gone to naught. I cannot appeal to you in better or stronger language than have many of my predecessors. I have purposely avoided uring you unduly to aid me in this work, for the reason that past experience in similar matters showed that the result would be negative. But now that a substantial beginning has been made I feel that I can appeal to you with some degree of assurance that you will join hands with your new president and carry on the good work to a successful issue.

Our committee reports will be presented for your consideration and action. There is not one of them but has a practical bearing upon the work of this association, and I urge that you give them most careful consideration. The papers that have been prepared are by men that speak with authority on the subjects in hand, and I wish to express to the authors my appreciation of the cordial response that they have made to our demands upon their time.

Every combination of circumstances seems to be in favor of this being the best convention this association has ever held, and I hope every one present will depart at its close with the feeling that he has been well repaid for dropping his work temporarily and joining together here with others in a mutual endeavor to give and receive knowledge that will be of benefit to each and all of those interested in the work of this association.

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Papers, Reports and Discussions.

MULTIPLE RATE CHARGING.

Mr. L. R. Wallis, in a paper entitled "The Foresee (4-C) System of Charging," described a method of charging for electric lighting which bears a close resemblance to the Wright maximum demand system. It is stated that the appropriateness of the title given to the system may be readily perceived "from the fact that the plan consists of a 'capacity charge' and a 'current charge,' which you will note is an alliteration consisting of 4 C's, and this may be paraphrased to mean "Foresee," indicating that the plan anticipates the commercial needs of the central station business."

The average fixed charge per 16-cp lamp is obtained by dividing the fixed charges per annum on the unit cost of the plant, by the number of 16-cp lamps per unit, this product being called the average capacity charge. It is stated that while it is perfectly consistent to expect the customer to reimburse the station for all the fixed charges that it has to meet to furnish him with the service he requires, the provision is only to insure the station against loss in carrying capacity for him, and to secure this protection it is not necessary to charge the full amount shown as being the total fixed charges, as the object is accomplished when a large proportion of the fixed charges are guaranteed. The probable fact that all of the consumers will not demand their maximum contracted capacity at the same time should be taken into consideration in establishing the capacity tariff, but not made the basis for individual concessions.

It is difficult to determine from the paper exactly what the system is or how the rates are fixed, but it appears that a variable charge per lamp is made for different capacities based upon costs of meters, cost of transformers, office expenses and meter reading, and transformer core loss. That is to say, the capacity charge for a 50-lamp installation would be less per candle-power than the cost for a 5-lamp installation. It appears also from one of the tables that a different fixed charge is made from October to June than from June to October. The above table gives the rates for a 25-lamp installation.

Hours used per day	K. Watt used per month	Current @ 5c. Capacity charge $3.15 per month	Total charges per K. W. H. cents	Income per lamp per month	Rate per hour per lamp demanded, cents
½	18.75	$4.09	21.8	.16	1.09
1	37.5	5.03	13.4	.20	.67
2	75.	6.90	9.2	.28	.46
3	112.5	8.78	7.8	.35	.39
4	150.	10.65	7.1	.43	.355
5	187.5	12.53	6.68	.50	.334
6	225.	14.40	6.40	.58	.320
7	262.5	16.28	6.20	.65	.310
8	300.	18.15	6.05	.73	.302
9	337.5	20.03	5.93	.80	.296
10	375.	21.90	5.84	.88	.292
12	450.	25.65	5.70	1.03	.285
18	675.	36.90	5.46	1.48	.273
24	900.	48.15	5.35	1.92	.268

President Cahoon expressed the hope that the paper by Mr. Wallis would be thoroughly discussed. Several members expressed a desire to discuss the paper after they had made a study of it, and the matter was, therefore, put over to be taken up at another session.

Mr. E. Slade, of Quebec, opened the discussion Wednesday afternoon on Mr. Wallis' paper. He stated that he had put into effect in Quebec the rate system which formed the subject of a paper read by Mr. Doherty last year. Its acceptance by customers is optional, but it has taken very favorably. In Quebec there is keen competition with a rival company, and in adopting the Doherty rate the customer had to be convinced that it was to his advantage to take it. The whole hitch so far has been to get a maximum demand cut-out which will limit the demand to that contracted for. As to the fixed charge, the first thing to be taken into account is, of course, the capitalization of the plant; this, then, is apportioned to the power service, to the incandescent and to the street lighting services. Mr. Slade considered that you cannot really take the full capitalization of the plant to establish the fixed charge per lamp. In reply to a question, Mr. Wallis said that by his system the fixed charges for incandescent lighting were based only on that portion of the plant which is used for incandescent lighting. Mr. Slade said that another point which affects the rate question is whether the station is a water-power or steam-power plant. The former can be run 24 hours a day much more economically than can a steam plant, and the transformer and meter losses do not have the same weight.

In reply to a question as to what form of maximum demand cut-out he used, Mr. Wallis replied that it is a magnetic device which is adjustable for from 1 to 25 lights. When more current is taken than has been contracted for, the device produces a flickering in the lights, which continues until the excess is turned off, when former conditions are resumed. In answer to an inquiry from Mr. Price as to how the fixed charges are established, Mr. Wallis said that an average is arrived at "by taking the fixed charges on the unit of capacity and arriving at the actual fixed charge per lamp as being the average fixed charge per lamp, and then create a maximum and minimum charge for that so that the average will strike where I find it should, and the charge of $1.25 for five-lamp capacity is plus current at 5 cents per kilowatt-hour. The Wright demand plan with which I compare my plan, carries the same first cost regardless of capacity, while it is my claim that the five lamps have to bear all of the first cost of serving a customer. It is one meter, one transformer, one customer, and the expense that attaches to the customer all the way through, so that the cost per lamp on five lamps is $3, and when we go into the larger capacity with a larger number of lamps, spread that cost over, consequently the secondary costs are reduced." In reply to a question, Mr. Wallis said that a customer's distance from the station is not considered in the rates at all. In reply to a question as to how his customers received the rate system outlined, Mr. Wallis said that at first there was some opposition, but at present he believes that customers are perfectly satisfied, having found that the system is to their advantage. He is opposed to conditional rates; the natural feeling of customers is, he said, expressed: "We are being asked enough under the old plan; we do not know where we will stand if we take another one, and they would not offer it unless it was to their advantage." In reply to a question as to how the maximum demand is fixed for one who averages, for example, an installation of 25 lamps, Mr. Wallis said that the customer selects his own demand—that is, determines the number of lamps he wishes to use simultaneously. If he finds he has selected too few he increases the demand. A device is then installed which is set for the number of lights fixed by the customer; if this is set for 10 lights he can use that number at all times, but he cannot use any more, the automatic device causing the lights to flicker when the number is exceeded. Should a customer wish a larger number for a special occasion, an arrangement is made with the central station whereby the automatic device is changed for that occasion, the charge of a dollar being made. In reply to questions Mr. Wallis said that the cost of the automatic device is $8.00 up to 25 lights, and that the capacity charge is based upon the plant capacity, and not upon the number of lights connected.

Mr. Joseph Sachs described a device, in the manufacture of which he is interested, to be used for the same purpose as that above referred to. This consists of a magazine fuse block; when the customer exceeds his demand the fuse set for that demand is blown, and there is then thrown into circuit a resistance or inductance which cuts down the number of lights.

REPORT OF COMMITTEE ON STANDARD CANDLE-POWER OF INCANDESCENT LAMPS.

During the year elapsed since its last report commercial conditions have changed in a way which has seriously impeded progress towards a uniform standardization. At the last convention, the committee brought in a proposal for methods and apparatus for standardizing lamps which was accepted, and had in preparation both specifications for standard lamp testing and a standard form of photometer which could be readily built and operated for the purpose of effecting such standardization.

During last summer, and before these specifications were completed, there appeared changes in the art which compelled the committee to stay its hand. The changes were briefly as follows, and special attention is called to them as having an important bearing on the economic use of incandescent lamps:

The committee had recommended the standard measurement in the horizontal plane made by revolving the lamp, the forms of filaments in ordinary use at the time having been such as lent themselves readily to useful and fair measurement by this particular means, which has, at all times, the recommendation of simplicity. There has developed, however, among some of the lamp manufacturers a reversion to the long, straight horseshoe filament. The distribution of light from a source having its shape is such as to exaggerate the horizontal candle-power at the expense of the luminosity in other directions.

If one takes a carbon filament of given dimensions, and by passing an electric current through it, heats it to a given temperature, the total luminous radiation emitted therefrom is substantially a fixed quantity, independent of the shape into which that filament is built. If the filament be formed into a long, straight hairpin shape, the horizontal illumination will be exaggerated at the expense of the illumination above and below the lamp.

If, as is the practice in some recent lamps, the filament instead of being so bent is twisted into a number of convolutions, the result is a large increase of the light given towards the tip of the lamp, with a corresponding decrease in the illumination given in other directions. For, since a filament of given dimensions, and at a given temperature will emit a fixed total quantity of light, other things being equal, that filament cannot be so convoluted or bent as to give a very large proportion of such radiation in any particular direction, without a corresponding decrease of the light in some other direction or directions.

The straight, hairpin filament just referred to, facilitates the production of the lamp, having an apparently high efficiency when measured in the horizontal plane. In many, a looped filament gives a correspondingly high apparent efficiency when measured off the tip of the lamp, while in point of fact the two lamps, if provided with the same filament, work at the same temperature, and work absolutely equivalent in efficiency.

Without expressing any opinion for or against any particular form of filament, the committee submits that under the commercial conditions just set forth, a horizontal measurement or a measurement in any other one particular direction, does not and cannot afford a fair basis for the measurement of the lamps having filaments of various forms, hence the committee has suspended action with regard to standard specifications for testing, pending investigation of the present commercial conditions for which it was believed that the testing facilities directed to be provided by your committee would afford a suitable opportunity.

In regard to the establishment of this standardizing bureau for incandescent lamps with which the committee was charged, negotiations were entered into with Professor F. B. Crocker and other officers of Columbia University, with reference to fitting up in that institution a laboratory for the preparation of standards, and such testing as might be desired for the National Electric Light Association. Through the courtesy of these gentlemen it became possible to utilize in a large measure the equipment which that institution already has, and the only expense which would fall upon the association was the addition of a certain amount of special apparatus for work purely of standardization. The president of the association, at the request of the committee, then laid the matter formally before President Low, of Columbia University, and obtained through him a favorable response with respect to the project.

At about the time that the matter was thus far settled, a very courteous invitation was extended by the Testing Bureau of the Edison Association to join forces with it to the extent of having the standards and other testing work of the National Electric Light Association transferred to the laboratory of the Testing Bureau. It also appeared that the National Bureau of Standardization would be probably authorized (as it since has been) by Congress just adjourned.

In this state of affairs the committee was notified by the president through the executive committee that the expenditure of some eight hundred dollars to complete the preparations at the Columbia University, might seem of dubious utility, and the matter was thus referred back to the committee.

After mature deliberation the committee is of the opinion that the National Standardization Bureau, however diligently the work of organization may be pursued, will be unlikely to be in a condition to undertake work of the kind required by the association for a considerable period of time, so that the production of standards cannot be depended upon in the immediate future, or other work necessary to the investigation of the lamp question from other sources.

With respect to the invitation from the Testing Bureau of the Edison companies, the committee feels that while the work of this bureau will undoubtedly be carried out efficiently, it will be of positive advantage to the art to have more than one independent investigation in the matter of developing standards and the correlated questions regarding incandescent lamps which lie within the province of the association to investigate, especially as the president of the association has very earnestly charged upon the committee the consideration of the matter of candle-hours, a subject which of itself requires considerable facilities for investigation.

In the opinion of the committee the original idea of the association should be carried out, and the arrangement completed with Columbia College to do the work as originally outlined in general, subject to such changes and details as are hereinafter referred to, for the reason that in the present state of the art there is no doubt but that it is desirable to have as much investigation of the incandescent lamp from independent sources as may be possible.

A deep interest in this particular branch of electrical development at Columbia University would necessarily be developed by carrying out the committee's plan, and in the way of profitable investigation in the matter of standards of incandescent lamps, be equal to many times the sum of money involved on the part of this association in this transaction.

The committee therefore requests authority to carry out the organization of the Standardizing Bureau under the auspices of the Columbia University as herein suggested, and to incur such expense as may be necessary in the way of additional apparatus for investigations of the candle-hour problem, which were not originally contemplated in the project for the production of standards.

The committee believes that this work carried out as indicated will be very profitable to the association, and particularly in view of some impending changes in the art which may call for the investigation of new types of lamp in the near future. The estimate for this initial cost for apparatus is about $1,000, and authority is requested to expend that amount.

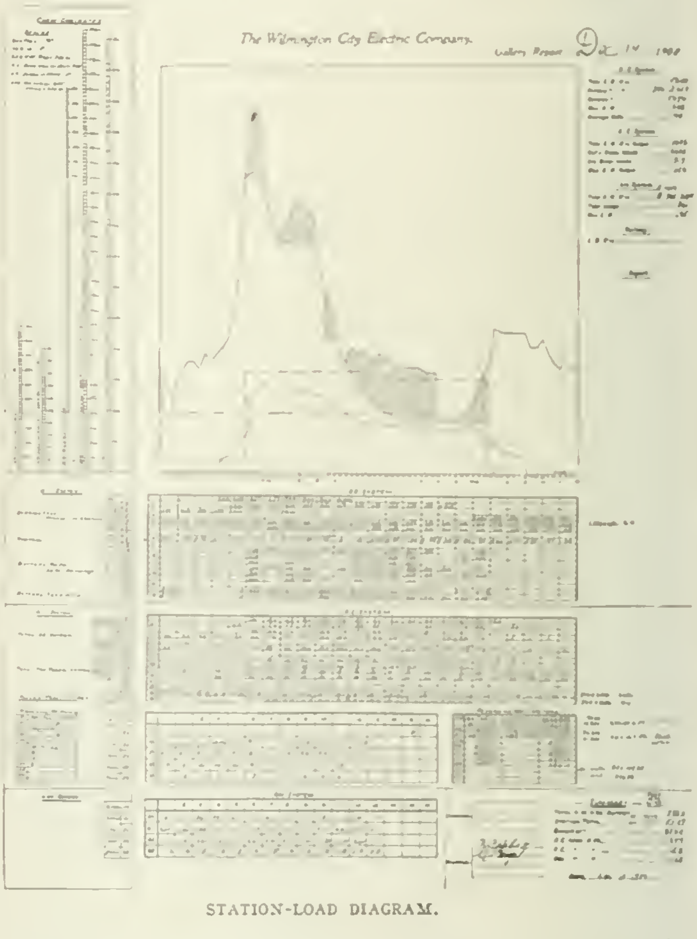
After a reading of the report, President Cahoon said that the matter before the association was, whether it wanted to spend $1,000 to equip Columbia University with additional apparatus so as to enable the association to take advantage of what apparatus they have there for the determination of lamp standards and to carry out any other tests, such as that of the Nernst lamp. Mr. Ayer said that it would be well to mention that Columbia University purposes to return to the association in yearly payments the amount of money expended for special apparatus, and to take over the ownership of the property. President Cahoon said that he did not understand that a definite arrangement had been made to this effect, but that it was suggested by Professor Crocker that Columbia University would, in the course of time, return the money by annual payments, and take over the apparatus for its own use. He said it will probably be at least two years before the National Standardization Bureau gets fully under way, so that it can meet the demands that will be made on it for testing lamps. He considered that if $1,000 were taken out of the treasury at the present time it might cripple the association, and he suggested the levying of an assessment. Mr. Converse D. Marsh asked why it should be necessary for the association to undertake technical work and go to the proposed expense when the United States Government, through the National Standardization Bureau, will soon be ready to do the work. He considered that the association could not come to any scientific determination on many of the points at issue under four or five years, the work being very delicate and technical, and requiring high skill and much time for its accomplishment. Mr. James I. Ayer thought that this objection was in fact a recommendation; the work being delicate, technical and calling for a lot of time and investigation, it follows that the larger the number of workers the better will be the results. He considered that we would be fortunate to get anything from the Government laboratory in five years, and that it is a question whether the proper men will be there to conduct the work, as politics play an important part in such institutions. He advocated the plan recommended by the committee, and said that as to money, that can be arranged for, assuming that the treasury of the association is not empty, which it really is not. Mr. Marsh said that he did not wish to oppose the committee, but that he knew the subject would take many years and many thousand dollars before it could be finished. One thousand dollars would be entirely insufficient.

A motion was finally adopted referring the matter to the executive committee, with power.

Professor C. P. Matthews referred to a method of determining the spherical candle-power of incandescent arc lamps, which involves but one reading. The method is intended to do away with determining the distribution of luminous intensity at different angles and integrating the result. Professor Matthews considers that the mean spherical candle-power is the only true measurement of the true light output of a lamp, and that the candle-power should always be expressed as mean spherical candle-power.

A STATION LOAD DIAGRAM.

In a paper with the above title Mr. C. R. Van Trump described a system which he has in use at the Wilmington, Del., central station for obtaining daily load curves of the plant. The points of the load curve are determined and plotted every 20 minutes by the switchboard attendant, and lines drawn connecting the various points. For this purpose there is a special record form, which is clamped on a board having at the left a series of ordinate scales. A ruler having on its edge divisions corresponding to 20 minutes of time is moved in parallel positions along the sheet. For a given record the ruler is moved along the ordinate scale to the position corresponding to the reading at that time. A point is then made on the record paper corresponding to this ordinate and to the scale of time on the ruler. There are five separate scales of ordinates, corresponding to the total incandescent load, the total direct-current dynamo loads, the alternating load, the arc load and the storage battery output and output. The sheet also contains forms for tabulated data. A reproduction of the sheet is given in the accompanying cut, but owing to the large reduction necessary for our columns, the entries are illegible. The storage battery output is hatched horizontally and the intake vertically.



STATION-LOAD DIAGRAM.

SECOND REPORT OF THE N. E. L. A. COMMITTEE ON THE PHOTOMETRIC VALUE OF ARC LAMPS.

This committee is composed of Henry L. Doherty, chairman; Professor W. E. Goldsborough and J. Q. Brown. As was the case last year the report is one of progress, the various investigations outlined by the committee not being as yet completed. The report opens with an acknowledgment of the uniform courtesy that has been shown by the various manufacturers of arc lamps and carbons in placing at the disposal of the committee the materials needed for the tests.

Practically all American makers of lamps and carbons have assisted the committee by furnishing samples of their output for test. The committee calls attention to the growing importance of the enclosed arc as an artificial illuminant, and the need of an accurate knowledge of its performance.

The tests have been carried out for the committee in the photometric laboratories of Purdue University. The committee expresses its great obligation to the authorities of the University for the use of its laboratories and equipment, and for the power facilities so essential to the conduct of the tests.

The bulk of the report deals with the life and efficiency of commercial brands of enclosed arc carbons, although the questions of steadiness of operation in lamps and the photometric values of series direct and alternating-current enclosed arcs are given some attention.

For the testing of the arc-light carbons a special photometric equipment has been designed and installed by Professor C. P. Mathews. Mr. Paul B. Sawyer has assisted him in the work through the year. Acknowledgment is also made to Messrs. Winter, Hardwicke, Le Fever, McBroom and Watjen, members of the graduating class at Purdue University, for their assistance in various parts of the work. Following is Professor Mathews' report to the committee:

Curves of the distribution of luminous intensity, such as those given in last year's report are obtained by what may be called the step-by-step method. That is to say, the mirrors are moved stepwise about the source until the complete distribution of intensity in a vertical plane has been obtained. In each position of the mirrors it is necessary to take from 15 to 25 settings in order to get a good mean. To secure these settings, to make the subsequent calculations and finally to plot and integrate the necessary curves for a single lamp require the best part of a day. Now, a test upon enclosed arc-light carbons, to be in any degree representative, must be the combined result of measurements made upon a number of samples from each brand. Such measurements should be made at intervals of 10 hours, say, throughout the life of the carbons. It becomes at once evident that to apply the stepwise method to an undertaking of this kind would be a well-night endless task. I therefore set out to develop and install an apparatus which should give at each photometer setting a value of either the mean spherical or mean hemispherical intensity, as might be desired. The difficulties encountered in the perfection of this method were frequent and oftentimes annoying. When finally the sources of error were taken care of, all the constants determined, and the method in successful operation more than half the available time for testing had elapsed. Nothwithstanding this, it is doubtful if the results could have been obtained by the slower method in time for presentation here, and one has the satisfaction of feeling that the apparatus is now in working order for expediting further work on arc-light photometry.

After certain preliminary runs to determine the efficiency of the method employed, preparations were made to test samples of five brands of carbons for enclosed-arc lighting, these brands being well-known and obtainable in the open markets of to-day. The samples represent the product of three American and two European manufacturers.

The carbons were burned in six General Electric, 110-volt, alternating-current lamps provided with opalescent inner globes and shades. Of these lamps, five were fitted with the particular brand of carbons to be tested, the sixth lamp being held in reserve lest accident or poor operation should require a substitution. Experience showed, in one or two cases, the wisdom of this precaution. The lamps were suspended from the radial arms of the wheel shown in the foregoing figure. In this position the lamps ran out the life of one trimming. With few exceptions, the only stops were at the close of the laboratory day. Counting all interruptions, the average run was about eight hours. Not infrequently, a steady run of 12 hours occurred. These conditions are probably somewhat better, and certainly no worse, than the average conditions of practice. The carbon life shown in the following results seems to corroborate this statement, as the life usually claimed for lamps of this type is 80 to 100 hours. It may be well to note just here that the duration of burning in these lamps is limited by the allowable range of descent of the upper carbon holder. This range is a fixed quantity.

A lamp fitted with a shade is, in itself, an intimation that only the downward flux of light is of value. The logical basis of comparison in such cases is the mean hemispherical intensity, or, if desired, the downward *flux* of light which is 2π the mean hemispherical intensity. In the following carbon tests, the mean hemispherical intensity is the quantity determined. In the curves it will be found plotted as an ordinate against time as an abscissa.

In what follows the brands of carbons will be designated by Roman numerals in the order of the tests, while the lamps will be referred to as *A*, *B*, etc. The upper carbon in all the tests was cored, the lower carbon solid.

Carbons I.—The results of the first test were plotted as life curves of the individual lamps in light lines, and the mean performance of the five lamps indicated in a curve derived from these. The trend of the mean curve was, in the main, upward. After 85 hours burning, these carbons show 10 per cent better performance than at the start. Lamp B distanced its companions by showing a life of 114 hours. On the third, fourth, seventh and eighth tests the points are quite close together; on the other tests, there is more or less divergence. Why this difference? The use of an apparatus for recording the changes in the arc length in lamps such as these has convinced me that these differences are due, in a large measure, to changes in the arc length. Now, the time between successive feedings is, in a well-regulated lamp, an interval considerably longer than that required for a test. During this interval between feedings, the arc tends to grow steadily longer. It has been shown by Blondel and by Ayrton that the luminous intensity of an arc at constant current is dependent in a very important way on the arc length. It seems clear then that tests such as those described here might at one time find the arcs of approximately the same length, and at another time differing considerably in length. Lack of homogeneity in either upper or lower carbon might also have an effect. It is evident that any constant difference in the carbons or in the transparency of the inner globes would be made manifest by a permanent separation of the life curves.

While the length of these curves indicates the life of the carbons and the mean ordinate their light value, these quantities alone are not a sufficient measure of the worth of the carbon. The area between the curvs and the X-axis is an important basis of comparison. This area has been found for each test. It is measured in Hefner-unit-hours. For carbons I., this quantity is 20, 200 or 202 *hekto-hefner-hours.* The mean intensity is 202 h. u. and the life on one trimming 100 hours.

Carbons II.—The mean life was practically 99 hours. However, lamp A showed the brief life of 62.5 hours. There must have been some imperfection in the fit of the gas cap on this lamp, although every precaution was taken to secure impartial treatment in this, as in every other respect. If it is justifiable to exclude A, we find a life of 107.9 hours. The Hefner-unit-hours rise in such case to 23,800 The performance of *A* indicates that the life of an enclosed arc may be seriously curtailed by causes not easily detected.

The mean curve in this test rises to a maximum at 60 hours life. Lamp F shows a somewhat remarkable performance, both as regards intensity and life. A mean intensity of 238 h. u. is maintained throughout 111 hours, or a yield of 264 hekto-hefner-hours, which is about double the yield of *A*.

Carbons III.—As regards life, these carbons show a noteworthy performance. The mean life is 115.6 hours, and the maximum life 129 hours. The mean curve does not show the tendency to rise shown in the case of carbons I., although, as a whole, it lies high. By weight the per cent, ash and dust, is about the same. An inspection of the inner globes after the tests showed that the deposit near the base of the globe in case III. was darker; that is, contained more carbon dust than in case I. This is, in my opinion, the cause of the drooping tendency to be seen in the mean curve of carbons III. after 45 hours. In this connection, it is important to note that the number of extinctions in these tests was somewhat greater than in the case of carbons I. and II. The carbon dust is due, in large part, to the pounding or chattering of the carbons at the start. These carbons show a mean performance of 252 hekto-hefner-hours.

Carbons IV.—The contour of the mean curve is smooth and represents, in an excellent manner, the life behavior of a lamp of this type. The arc appears beneath the edge of the shade at about 45 hours, giving a maximum luminous intensity at about 55 hours. The third maximum point at 100 hours was obtained in some of the other cases, and will, no doubt, always be present when the coating at the base of the globe is not too dense.

Carbons V.—The luminous intensity is low, and the life rather brief. The core of the upper carbon seemed to be of high conductivity, but of too loose structure, as it fell out in considerable quantities because of the pounding of the carbons, and collected around the base of the lower carbon. The arc was very long and well centered at the start, but not particularly luminous. The materials in the core are such as to lower the luminous intensity with little, if any, gain in steadiness of operation. The very considerable rise in the intensity curve shows that the ash on the globe was not excessive. The gain in the weights of the globes confirm this conclusion. The mean life is 85.6, the mean luminous intensity is 196, and their product **16,600.**

It is of interest to plot on one sheet the mean curves of these various life histories. Fig. 1 shows the result. We may compare these five brands of carbons in three different ways, viz., on a basis of luminous intensity, on a basis of life and on a basis of intensity of life. Arranging the carbons in order of excellence, the best first, we have:

Intensity.	Life.	Intensity-life.
IV	III	IV
III	II*	III
II	IV	II
I	I*	I
V	V	V

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*If *A* be included in carbons II., the starred values will be interchanged.

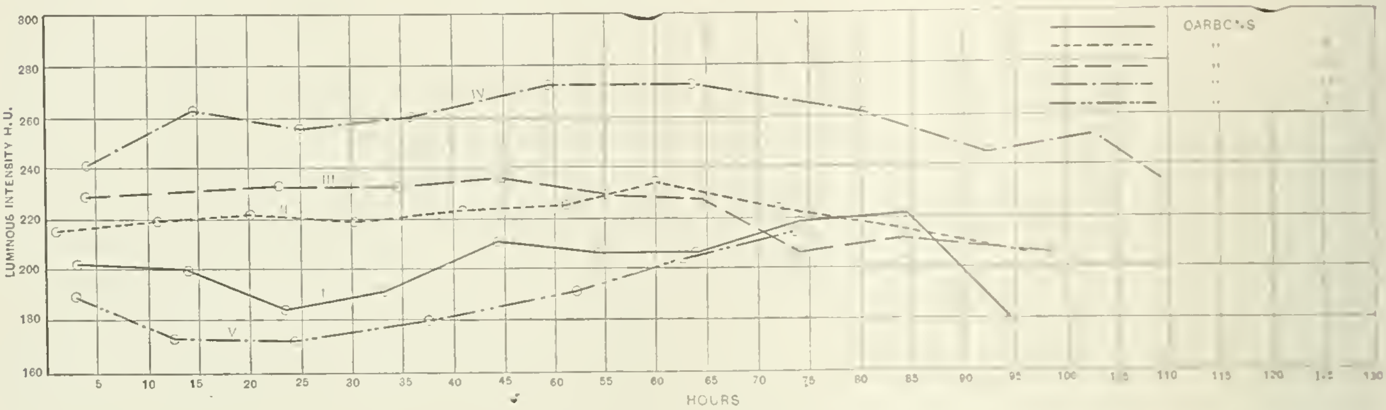


FIG. 1.—MEAN INTENSITY LIFE CURVES.

A partial summary of the results is given in the following table:

TABLE I.

	1	2	3	4	5
Total consumption	6.19	6.3	6.16	6.3	6.32
Consumption ratio ...	10.4%	10.5%	5.1%	8.4%	•
Clearance	.0094	010	.0093	.0079	.0151
Extinctions	11	14	16	14	11
Average run ..	9.3	7.4	7.09	7.3	7.74
Life on one trim	100.1	98.8	115.6	105.2	85.6
Lumin. intensity	202	218	222	259	196
H. U. hours...	20,200	21,500	25,200	27,500	16 600
H. U. hours per inch	3,263	3,540	4,089	4,360	2,609

Owing to the growing importance of series-enclosed arcs, it has seemed desirable to take up their photometric value in these investigations. Fig. 2 shows the distribution of luminous intensity in the case of a direct-current series-enclosed arc, provided with opalescent inner globe and clear outer globe. The data are:

E. M. F.	70	volts.
Current	6.8	amperes
Power	476	watts.
Mean hemispherical intensity......	329	H. U.
Mean spherical intensity..........	266	H. U.

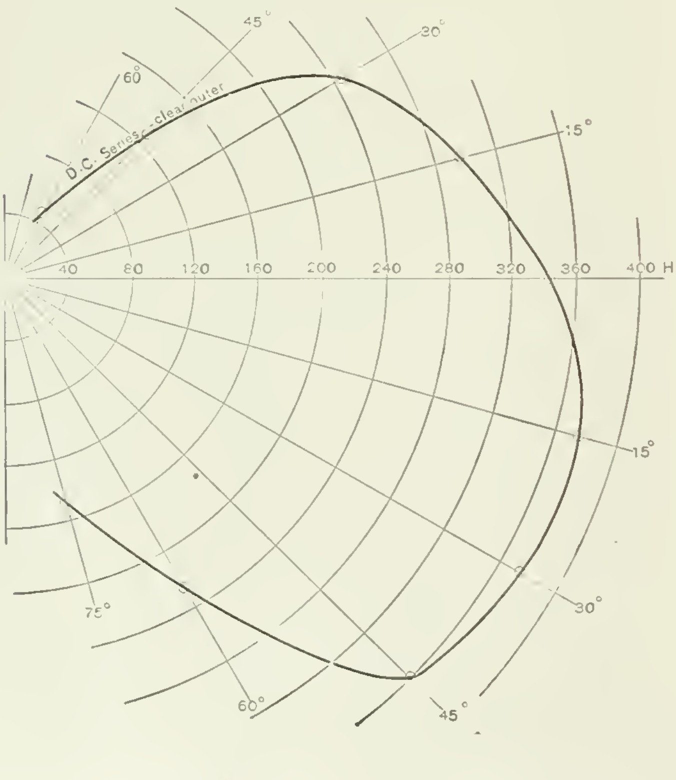


FIG. 2.—DIRECT-CURRENT ARC, OPALESCENT INNER, CLEAR OUTER.

It is of interest to note that, after 75 hours burning, carbons I., II., III. and V. gave approximately the same luminous intensity, and also that the trend of all the curves is, in the main, upward. Carbons IV. maintain a distinct lead throughout their life.

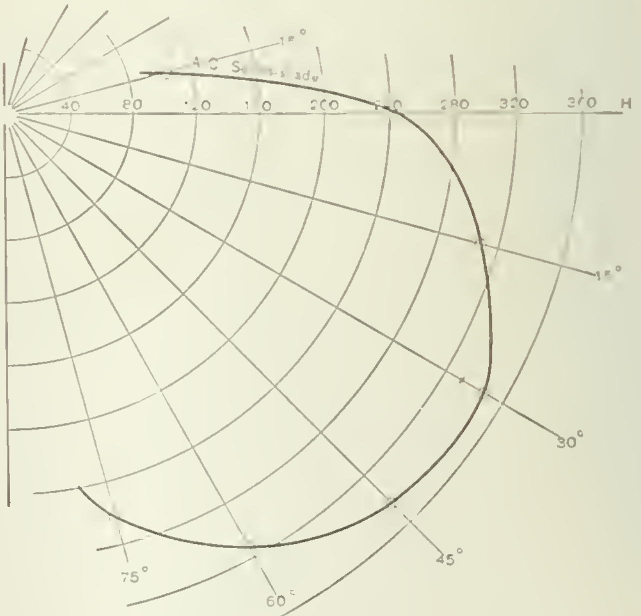


FIG. 3.—ALTERNATING-CURRENT ARC, OPALESCENT INNER, METALLIC SHADE.

Watts per mean spherical.........	1.78
Watts per mean hemispherical.....	1.45

Similarly, Fig. 3 shows the distribution of luminous intensity in the case of an alternating-current series-enclosed arc, fitted with opalescent inner globe and metallic shade. The data are:

E. M. F.	70	volts.
Current	6.6	amperes.
Power, apparent	482	watts.
Power, true	455	watts.
Power factor	.94	
Mean hemispherical intensity	314	H. U.
Watts per mean hemispher. intensity	1.44	

As tests on series arcs are still in progress, discussion of the results are reserved until further data are available.

In reply to a question as to what is a Hefner unit, Prof. Goldsborough said that it is a unit that has been adopted by the American Institute of Electrical Engineers as a better standard of light than the British candle. The ratio .88 between the Hefner unit and the British candle gives a basis of comparison. The Committee has thought it best to introduce the use of the Hefner unit in view of the standing it has received through the action of the American Institute of Electrical Engineers, and also that of the National Electric Light Association.

Prof. Matthews said that one batch of British candles will give one result and another batch an entirely different result, but with a Hefner lamp an accuracy of two per cent. can be attained. He is convinced that there is no standard quite so good as the Hefner lamp. Mr. Converse D. Marsh said that different observers at different times have found a different ratio between the two units, and he said that the Hefner lamp is variable. He believes it would be unwise for the ordinary observer to attempt to use the Hefner unit, and advises the use of an electrical standard which is as unchangeable as anything can be. Mr. Scovil, of Cleveland, made an inquiry as to what candle-power the Welsbach lamps give; Mr. Price says that he assumes that they give 50 candles. It has been said that on damp nights Welsbach lamps give less candle-power than at other times, which statement President Cahoon confirmed. Mr. W. F. White criticised the use of the hemispherical candle-power. By taking the averages of the lower atmosphere a lower average candle-power is produced and a result is thus indicated in street lighting which is not fair. In reply to a question Prof. Matthews said that from the standpoint of life, American carbons were the best, having an average of, say, 115 hours. From the standpoint of intensity, European carbons are the best. Taking the product of life and intensity—that is, candle-power hours—the European carbons give the best results.

THE PRACTICAL SIDE OF THE INCANDESCENT LAMP.

Mr. Francis W. Willcox, in the opening paragraphs of a paper with the above title, calls attention to the fact that the incandescent lamp may be greeted at the first National Electric Light Association of the twentieth century as having attained its majority, and adds that, as pointed out by Mr. John W. Howell, the lamp was practically a perfect invention, since it has to-day the same essential parts, no more and no less, and the same general appearance as when first put in service in lighting Menlo Park 21 years ago.

It is stated that the use of lamps with lower voltages than 100 is rapidly decreasing, and that it is safe to say that such lamps for central station service will be obsolete in a few years. It is recommended that in selection of a voltage the so-called standard voltage of 100, 104, 110 and 115 should be carefully avoided, and some special voltage taken, such as 107, 108, 113, 117, 122, etc. The demand for lamps of the standard voltages is many times the supply, and that producer is wise who fixes his voltage as recommended, thereby securing a close selection and protection against "culls." As to high-voltage lamps ranging from 200 to 250 volts, it is stated that over 500,000 of these are now annually supplied to customers in this country, and their use is being rapidly extended. Heretofore such lamps have been limited to low efficiency, but they can now be had of an initial efficiency of 3.4 watts per candle-power for 16 and 20-cp sizes, and with 3.1 watts per candle for higher candle-power. the lamps giving an average useful life equal to that of the 100-volt, 3.1-watt lamp —that is, between 400 and 500 hours.

The proportion of each of the several types of lamp bases now in use is given as follows: Edison, 60 per cent; Thomson-Houston, 20 per cent; Westinghouse, 15 per cent; all other types, 5 per cent. It is stated that the tendency is strongly toward a still further reduction to one base—the Edison base—which has become the standard of the world. The Thomson-Houston base costs on an average of 1 cent higher than the Edison, and it is besides objectionable by reason of the close proximity of contacts on the bottom of the base and the rending action resultant from screwing the base in too tightly. To the Westinghouse base is ascribed the objection of poor and uncertain contact. Large numbers of plants have changed from Thomson-Houston to Edison bases by the use of adapters, which cost but a few cents and pay for themselves in a year or two.

Referring to the trouble that has been experienced from the use of plaster of Paris in bases, which gathers moisture, it is said that a substitute has been in practical use for over six months, and that a moisture-proof base is now obtainable.

In the past few years there has been a large and constant increase in the use of lamps of 10, 8, 6, 4 and 2 candle-power, caused by the adoption of meters and enforced competition with gas, which is largely used turned down, and also by the general introduction of electric lighting in residences and the great increase in sign and decorative lighting. For the latter service an 8 or 4 or even 2-cp lamp served satisfactorily. The lower the candle-power, however, with the same efficiency, the more delicate becomes the filament, consequently for equal results in useful life low candle-power lamps must necessarily be of lower economy than the 16-cp lamp. As to the use of frosted lamps, it is stated that contrary to the general impression, the amount of light lost through frosting is really very small, averaging only about 3 per cent.

The subject of filaments is discussed with respect to types, and preference is expressed for a filament giving the most uniform distribution with a satisfactory minimum of tip candle-power; the filament should also be one that will not droop against the sides of the bulb, either from the weight of the filament when bent horizontally, or from other causes, and should be able to withstand vibration in the most effective manner and retain a symmetrical position in the center of the bulb. All things considered, the oval form of filament is stated to meet all these requirements most successfully, and can safely be accepted as the standard type. Such a filament is anchored, and in answer to the objections sometimes raised to anchors it can be said that for an anchor placed as it is in the standard oval filament, the advantage gained far outweighs the objections and secures results that are not otherwise possible.

A considerable portion of Mr. Willcox's paper is devoted to a discussion of lamp quality and to candle-power performance, a number of curves accompanying the latter section. One of these is here reproduced as showing the relation of volts, watts per candle-power and lighting due to different candle-powers. As an example of the use of this curve, suppose a lamp at 20 candle-power takes 114 volts, what will be its candle-power at 109 volts? One hundred and nine is 95.6 per cent of 114; 95.6 volts corresponds on the curve to 77 per cent of candle-power; 77 per cent of 20 candle-power is 14.4 candle-power. Suppose a lamp at 115 volts requires 3.25 watts per candle-power, what will be the watts per candle at 117 volts? 3.25 watts per candle corresponds to 99.8 volts; 115 is to 117 as 99.8 is to 100.51; and 100.51 volts corresponds on the curve to 3.04 watts per candle.

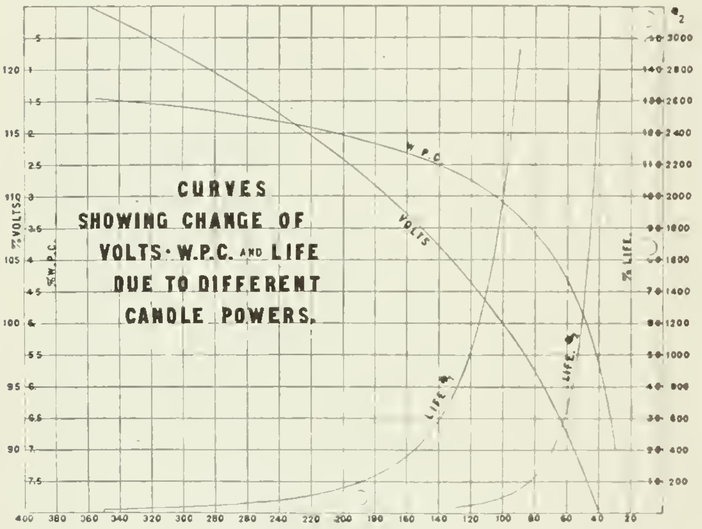
A considerable portion of the paper is devoted to an argument in favor of the adoption of free renewals by central stations, which we reprint below:

The number of incandescent lamps used to-day, although a very large quantity, is not so large as the proper and economical service of lamps demands, and the neglect of the incandescent lamps is one of the greatest drawbacks and evils from which electric lighting suffers to-day in the average central station. We find on the part of many of the large and leading central stations proper appreciation of the correct principles of lamp service and attention to the subject. They correctly consider the lamp a part of the apparatus to be owned and controlled by the lighting company, and if it were possible to get all central station managers to recognize and adopt this principle, it would effect a most marked and immediate improvement, and a signal victory for good lighting. It is difficult to understand why it is so hard to bring home to stations the true function of the incandescent lamp and the necessities of the case. The lamp is designed and used to give light, and lighting companies are in the business of making and selling light—not power. The selling is done, it is true, by the watt-hour, but what the consumer is needing, buying and using, is light. Now, it should be plainly evident that in the production of light, the lamp is practically the sole and chief essential. All the station does is to generate current; the lines deliver it; the converter transforms it; the meter measures it; but it is the lamp that produces the light. In the parlance of the day, "it is up to the lamp."

Now, if it be good practice to provide good and efficient apparatus and lines, transformers and meters to deliver and measure current, is it not much more important to provide and care for the controlling device that produces the substances desired; that is, the light? The manager who thinks he can maintain a well-lighted service without caring for the lamps, is in the same position as the ostrich that thinks itself concealed when its head is hidden in the sand; he has forgotten the most prominent part of the system on view. The great source of trouble lies in the practice of charging customers for the incandescent lamps, and the reason for it is simply this.

Lighting results are directly dependent upon the lamp. All lamps lose in candle-power as they burn—some makes to a much greater extent than others. If lamps are not renewed, therefore, the lighting service must certainly deteriorate just as the lamp does. Extensive experience shows that few if any customers ever renew their lamps when charged therefor, except when they are burnd out. We see, therefore, that as long as the central stations charge for lamps deterioration in lighting service cannot be properly repaired.

The worst case is that where the station does not handle the lamps, and the customers are permitted to buy any and everything. This is the general practice in Europe, and it is directly responsible for the miserably poor lighting service to be found in the continental cities. Not only this, but it is responsible as well for the backward condition of lamp manufacture abroad as the only lamps there are those that cost little and have a long life; that is, cheaply made, low efficiency lamps a low-grade article. This practice, adopted from the gas business, is a most mistaken one when applied to electric lighting, as the conditions affecting the two cases are wholly dissimilar.



CURVES SHOWING CHANGES DUE TO DIFFERENT CANDLE-POWERS.

The case is somewhat better where the central station sells the lamps at a fixed price, particularly if they wisely make the price a low one. Unless, however, the price be made at cost, and preferably less than cost, the consumer is apt to buy all kinds of lamps. This plan is of value, therefore, only so far as it secures the scale of all the lamps used.

To control the type of lamp used, and thus insure the adoption of the best grade and proper efficiency of lamp, is an important essential. This is the first step, but it is only a small part of the battle. As long as the customer has to pay for the lamp, even though it be but five cents, he will generally use it through a dim and useless old age to the breaking point. He will thus always have it in his power to depreciate lighting results, and to checkmate all the endeavors of the station to improve. It seems that we cannot escape the conclusion or avoid the plain facts of the case; viz., that free lamp renewals are a necessity to the best results.

The only objection against free renewals is their cost. Let us see what this amounts to and if it be too great a price to pay for the benefit. When lamps were sold at from 40 to 50 cents apiece, the question of cost might have been a serious one, but at the present low prices we should not find it so. At present prices the cost of free-lamp renewals amounts to from one-third to two-thirds of a cent a kilowatt-hour, depending upon efficiency of lamp used. Stations can be fully reimbursed for this charge by making this increase in their meter rates, or they can advantageously adopt free renewals in place of making reductions in rates. Slightly increased rates ought to be possible for the improved service that free renewals will secure. Whether reimbursed for it or not, however, central stations can and should afford the step.

Taking average conditions, it is safe to say that free and periodic renewals will effect an improvement of 50 per cent in lighting results. Is not half a cent a kilowatt-hour a small price to pay for this? The gains secured by free renewals are:

First.—*Freedom from complaints and necessity for allowances on bills.* The manager of a big Pennsylvania station says: "We have always considered that the best advertisement was a satisfied customer, and a satisfied customer is one that is supplied with a satisfactory light, which means free and liberal renewals."

Second.—*Increased business.* With lamps charged for, the customer persists in the use of dim lamps, and the lighting service acquires a bad reputaion with the public, which does not stop to discriminate as to the cause, but condemns the service and prefers and adopts other illuminants. With the improvement rendered by free renewals, business will increase. The best solicitor and the best advertisement a station can employ is a brilliantly-lighted, well-maintained service. It will secure and hold business.

Third.—*Maintenance of rates.*—As the best goods command the best prices, so superior lighting will maintain the best rates. Electricity is admittedly a superior illuminant, and should command good rates, but the name without the service will not enable it to do so.

Fourth.—*Prevention of "outages."* Where customers buy lamps, burned-out lamps are frequently not renewed for some time, and some not at all, the result being a loss of revenue. This condition has no reason to exist with free renewals.

Fifth.—*Economy and satisfaction to consumers.*—Customers are secured the use of a high-efficiency lamp. With free renewals, the question of the life of the lamp is no factor to the consumer, whereas the cost of current is. The customer is, therefore, secured better light, and at a less cost, than is possible when he buys lamps. Customers are spared the annoyance of supplying the lamps. The customer has only to turn the switch and pay his bill; all other details the station cares for.

A large New York company states that in their efforts to keep out isolated plants they find it a distinct advantage to be able to offer a high-class efficient lamp and service to displace the poor and less efficient lamps that are usually found in isolated plants, or wherever customers purchase their own lamp renewals.

Free renewals, then, is the key to the situation, and gives the station the needed control of lamps to secure results. Now, how should this control be exercised? Shall we leave the results to take care of themselves, or shall we take full care of results and provide for the periodic replacement of lamps? It is just here that many companies fail in performance by neglecting to care for renewals. A systematic method is needed by which lamps may be periodically replaced, instead of the too prevalent custom of waiting until the customer complains or the lamps become dim, dark and disappointing. Some other standard than the limit of a customer's patience should prevail.

A good hotel does not permit its rooms to go uncleaned until the guests complain; rooms are cleaned and kept cleaned as a matter of course. This should be the principle of correct lamp service. The best method for accomplishing these results is that originated by Mr. James English, at Bridgeport and New Haven, Conn., and now adopted by many other stations in the country, at Lowell, Mass.; New Orleans, Louisiana, Atlanta, Ga., and other places. On this system employees regularly visit customers, remove all the lamps in circuit and replace them with good ones. The removing of all the lamps is desirable, as it requires no judgment to be exercised by employees, who can, therefore, be boys at a low rate of wages; it insures the certain removal of every dim lamp and a uniform replacement installation; it permits work in the daytime when a customer is not using his light.

The lamps removed are both good and bad. These are returned to the station and passed through a photometer, and can rapidly be assorted (500 to 600 an hour) into two general classes: Those above and those below any prescribed limit of candle-power taken, say 14. Those above this limit can be replaced in service at the next exchange. Those below the limit can be assorted again into classes: Those above and those below, say, 10 candle-power; the former can be used in various ways, about station, or rented for street illuminations or fetes and special occasions.

At Mr. English's station at New Haven, Conn., the residence lights are, as a rule, not disturbed; but the business sections have their lamps replaced four times during a year Not quite one-half of total lamps connected (representing business circuits) were removed, and over one-half by simple visual examination (passing lamps in front of a piece of white paper) were rejected. This left less than 50 per cent that merited cleaning and photometering, and nearly 90 per cent of those tested out above 15 candle-power, and worthy, therefore, of being returned to the circuit on the next exchange. The actual work, therefore, narrows down to testing but a small fraction of total number of lamps connected.

The work of cleaning is done easily and rapidly by means of a jig. A cloth, some water and a little "Boni Ami," or similar cleaner, effectually clean the globe and base with a few revolutions of the jig. Two men can work at the jig, one at each end. The work of photometering is very rapid, and, as stated above, can be done at the rate of 400 or 500 an hour. For this work at New Haven, one good man and a helper are employed. In addition, these men do a good deal of other work, including testing of all the new lamps received, some meter testing, etc. The company estimate that the work is equivalent to the full time of one man costing, say, $600 a year. On the removal and replacement of lamps, an average of 30 lamps per hour are removed and replaced, including time required in going from one customer to the next. The total cost of lamp renewals and work of renewals, etc., averages per kilowatt-hour, .428 cent, or less than half a cent per kilowatt-hour.

After the conclusion of the paper Mr. McCabe, of Bloomsburg, Pa., asked if it was a good policy to use 3.1-watt lamps by a small alternating-current station with hand regulation and transformers distributing variously in a small city; and if it would not be better to use 3.5-watt lamps and get a longer service with a regulation that is not very good. In reply, Mr. Wilcox said that the question is simply one of regulation; the limit of regulation for a 3.1-watt lamp should be, say, 2 to 3 per cent. It is possible for many alternating stations to use high economy lamps at present owing to improvements both in the station and in lamps, whereas it would have been impossible to do so in former years. He stated that it ought to be the ambition of every central station, alternating or otherwise, to improve the regulation so that they could use 3.1-watt lamps.

THE TRANSMISSION OF CURRENT AT HIGH POTENTIAL IN NEW YORK CITY.

The paper, with the above title, read by Mr. Calvin W. Rice, is reprinted below in full.

In America, the most acceptable system in cities is the low-tension Edison, 220-volt, direct-current, three-wire system. This system is the one best adapted to miscellaneous lighting, power and industrial work. The value of a power business in connection with lighting is recognized by all, and as there are in the market a score or more makes of direct-current motors, each manufacturer is therefore an agent of the light and power company.

The system requires sub-stations at frequent intervals, determined by the relative cost of transmission system loss in same and station equipment. As steam stations they have less economy than central stations, and are sometimes placed where they are somewhat objectionable to residents.

The perfection of the rotary converter has been a great factor in the ability to meet the desire to generate power in a large central station located with advantage to coal and water. With the revolving-field generator came the ability to generate current directly at high potential. It was thus rendered possible to do away with step-up transformers for all ordinary potentials and transmissions. Accompanying this advance was the development of switching and safety devices for high potentials. Thus we have in outline a perfected system, namely, the generation of current in one large station favorably located, its transmission to sub-stations, and local distribution from each such centre.

In New York, the above system is also adopted for pure power, that is, railway work, as well as for combined lighting and power. The East River side of New York has been selected for the sites of the four power stations now building. These are located at Thirty-ninth Street, New York Gas & Electric Light, Heat & Power Company; Seventy-fifth Street, Manhattan Elevated Railroad; Ninety-sixth Street, Metropolitan Street Railway, and at the northern limits of Manhattan Island, near Squyten Duyvil, for the Third Avenue Railroad station.

In all of these stations large direct-connected units are employed, generating the transmission voltage. The generators in all are of the three-phase, revolving-field type, twenty-five cycles, seventy-five revolutions. The Third Avenue station, the Metropolitan, and the New York Gas, generate at 6,600 and the Manhattan at 11,000 volts.

The transmission in each case will be in three-conductor cable laid in subways, three-inch duct in three systems, and three and one-half inch in the case of the Manhattan. In each system, also, the transmissions will be to sub-stations with step-down transformers and rotary converters. The potential of the outers of the Edison three-wire system is 270 volts nominal, and for the railway work 550 to 600 volts.

The frequency of twenty-five cycles admits of satisfactory design in the rotary converter, which is one of the essentials of the system. Low frequency is also preferable, as all the generators are direct-connected to Corliss type engines. On the other hand, it does not admit of successful lighting in either incandescent or arc, with the possible exception of the street series incandescent lighting.

The above shows the points in common to all stations. We will, however, now speak particularly of the largest station, that of the New York Gas Company. Before going to the description of the central station—which, by the way, will have the largest capacity of any in the world, and more than the completed twenty-wheel plant of the Cataract Power Company at Niagara—it is well to state that the whole system now being installed was planned several years ago.

As early as 1896, the Edison Company installed motor generators in a cellar, at the corner of Fifth Avenue and Seventy-second Street. These were 240-kw synchronous two-phase motors, direct-connected at either end to 100-kw, 135-volt Edison bi-polar generators. This was the first step in New York City in the development of the present sub-station employing rotary converters.

In 1898, two-phase, 200-kw rotary converters were installed in the Eighty-third street station, and later, in that same year, three-phase rotary converters were placed in the Duane Street and Thirty-ninth street stations, so that energy could be transferred at 6600 volts alternating between the districts.

The efficiency when transmitting 1000 kilowatts, the full load of a rotary, from the direct-current switchboard at one generating station, including all transformers and line loss, to the direct-current switchboard at the receiving station, is eighty-one per cent. This shows the practical economy of a flexible system.

By this means the Duane street station, which is situated at the southerly end of the island, can follow the load as it moves uptown with the people as they go from business to their homes, and then to the stores and theatres. A very high load factor is thus obtained throughout the year.

The waterside station occupies the block between Thirty-eighth and Thirty-ninth Streets on First Avenue down to the East River. It is situated at nearly the geographical centre of distribution. The area covered measures 272 feet by 197 feet, so that with its ultimate capacity of 125,000 horse-power they will have a horse-power for every 0.43 square foot, and in this respect will have not only the largest station, but also the most economical of space.

The equipment will be sixteen direct-connected units. The engines will be 5,200 horse-power at most economical cut-off, and will have a maximum capacity of 8,000 horse-power. They will be vertical, three-cylinder, compound-condensing, taking steam at from 175 to 200 pounds.

The generators will be 3500 to 4500 kilowatts at 6000 volts, and will have a regulation of eight per cent., and on short circuit will give about three times full-load current. These characteristics of regulation and high self-induction insure smooth running and good synchronizing ability.

Steam will be supplied from fifty-six water-tube boilers, 650-hp each. Each boiler will be equipped with mechanical stokers. The boilers will occupy two floors of the boiler house; the coal bunker, with a storage capacity of approximately 10,000 tons, being located immediately above the boilers. There will be four steel stacks, about 200 feet high and nineteen feet internal diameter. These will be supplemented by fan blowers for forced draught.

Condensing water for the engines will be supplied from East River through a main exterior intake tunnel ten feet in diameter. This tunnel will be divided at the building line into two eight-foot tunnels, which will run under the two rows of engines. The discharge tunnel will be placed just above the intake tunnel.

The switchboard will be distributed in galleries. Single conductor cables will be led out from ducts in the foundations of the generators and will go to electrically-operated oil switches situated on the first gallery. From there cables will go to the selector air switches on the top gallery. These selector switches will be operated by hand and are to be used as a safety in an emergency when the oil switch fails to act.

As there will be sixteen units, so there will be sixteen banks of oil switches. In between each group of three oil switches, one for each phase, will be the transformers for the instruments, voltmeters and ammeters.

On the top gallery the grouping of the switchboards will be such that it will be physically possible for one man to control the entire situation. Of course, two men will be on duty at all times, as a matter of practical operation, but it is interesting to note that the switches will be so grouped with their instruments that one man can handle the situation.

The governing control of each engine will be manipulated also from this point, and one will be able to vary the cut-off from twenty per cent. to forty-five per cent., or the speed two and a half per cent. each way from normal.

The cables for the transmission are lead-covered, three-conductor, 250,000 circular mils. At first only rubber was used, but this last season paper was tried, so that now it is about equally divided, there being about twenty-five miles of each.

In the rubber cable each conductor is insulated with six-thirty-seconds of an inch rubber insulating wall. The three conductors are then laid with jute and made into a cable of circular section and another jacket of rubber put on, four thirty-seconds of an inch in thickness. The rubber compound is thirty per cent. pure Para. The lead is one-eighth inch thick, three per cent. tin, but with no outside coating of tin. This gives a cable two and five-eighth inches outside diameter, and the experience from laying fifty miles of cable would indicate that this is the largest practical cable that can be installed in a commercial three-inch duct.

The insulation resistance required on the rubber cable was 1000 megohms per mile, measured either between conductors or between conductor and lead. The completed cable was tested to 20,000 volts in the ducts.

The paper cable was similar, but with two thirty-seconds inch more insulation in the outer jacket, making twelve thirty-seconds inch insulating wall in all directions. Insulation resistance required on this was 400 megohms per mile.

The paper cable measured two and eleven-sixteenths inches outside diameter, and although it has all been installed, yet it was done with difficulty; and one would not advise attempting it again, as it was a great mechanical strain on the cable. The natural question in the minds of many is, which is better? It is proper to say that satisfaction has been obtained with both.

The number of conductors at present installed is such that at no point in the system is there more than five per cent. actual drop in any feeder. As 40,000 feet is the longest, it happens that the five per cent. limit on drop at that distance is reached at the maximum ampere capacity of the cable, which is about 225 amperes, or a little over 2250-kw. This gives a little over two watts per duct foot, which is also a limit in subway work. Were there a larger number of ducts in one trench, even two watts per duct foot could not be allowed.

Cables are allowed sufficient slack to be carefully racked on the sides of the manholes. The outside of the cables is wrapped with asbestos and steel tape, so that in the event of one cable failing it will not melt the lead and insulation off its neighboring cables. This covering, complete, costs about five dollars per cable per manhole.

At the sub-stations the cables go to marble switchboards, each circuit is provided with safety devices. The switchboard cables lead to the air-blast transformers, which are connected in to give a double delta or six-phase relation on the secondary.

The rotaries are six-phase, as it is agreed that their action is better, less armature heating, and the amperage led into each collector ring is reduced. Between the statics and the rotary are the induction regulators. These regulators have about thirteen per cent. of the capacity of the rotary, as a potential regulation of thirty volts is required either way of normal, which is 270. Only two sizes of rotaries are used, 500 kilowatt and 1000 kilowatt.

An interesting feature of the entire system is that all translating devices are in multiple; that is, all rotaries, in whatever location, are in multiple on the alternating-current side with the generators at the central station and with every other rotary in the sub-station. On the direct-current side every rotary is in multiple with every other rotary, direct-current generator or storage battery. By means of the field rheostat all rotaries are operated at minimum input, which gives a power factor of one to the system.

Floating on the system in almost all of the rotary and sub-stations are storage batteries. The most common unit is one of 150 cells, having a capacity of 2000 amperes discharge for one hour.

The completeness of the system is shown by the uniformity of potential and continuity of service. It is considerably over ten years since there has been an interruption of service.

Upon concluding the reading of his paper, Mr. Rice was asked by Mr. Frederic Nicholls, of Toronto, how long the rotary converter system and the six-phase rotaries have been in service, and to what extent they have been loaded up, and how long they have been loaded up to the full-load capacity. In reply, Mr. Rice said that the beginning of the use of the rotary converter system in New York dates from 1898. At the outset the rotaries were not operated continuously throughout the day, but used as a convenience and not as an essential to the system. He could not give the exact date when the rotaries became essential to the system, but it was probably about 1899. The first rotaries, and even those installed last fall, were run very often at 50 per cent overload, for the reason that the manufacturers could not make deliveries as fast as the demands came upon the system. Often upon notification of the shipment of a rotary from the factory, teams would be ready to take it the minute it reached the city, and it was not unusual to install a 1000-kw rotary and have current on it in 30 hours, and load it up immediately to 50 per cent overload and continue its use every night on the peak.

ATTENDANCE LIST.

The names of those in attendance representing central stations are given below. Other names of the manufacturing and supply trade, visitors, press, etc., will be found duly recorded elsewhere.

Chicago Edison Company.—S. Insull, W. M. Anthony, R. C. P. Holmes.
Cleveland, Ohio, Electrical Illuminating Company.—S. C. D. Johns, S. Scovil, M. E. Turner, G. B. Tripp.
Birmingham, Ala., Consolidated Electric Company.—J. M. Bradley.
Cincinnati Edison Company.—W. F. White.
Pawtucket Electric Company.—H. A. Pierce, Orrin Smith, Jr.
Jacques Cartier Water Power Company, Quebec.—E. Slade.
New Omaha, Neb., Thomson-Houston Company.—W. J. McManigal.
Bristol, Pa., Electric Light & Power Company.—C. E. Scott.
Ottawa, Canada, Electric Company.—John Murphy.
Montreal Lachine Rapids Company.—R. S. Kelsch.
New Bedford, Mass., Gas & Edison Company.—C. R. Price, D. W. Beaman.
New York Edison Company.—C. W. Rice, E. A. Leslie.
Louisville, Ky., Electric Light Company.—G. W. Hubley.
Derby, Conn., Gas Company.—R. E. Wyant.
Bellows Falls, Fall Mountain Electric Light Company.—H. Bottomley.
Westchester Lighting Company, Mount Vernon, N. Y.—J. E. Hodgson.
Fulton County Gas & Electric Company.—C. M. Allen, Gloversville, N. Y.
Toledo, Ohio, Consolidated Electric Company.—E. J. Bechtel.
Lorain, Ohio, Gas Company.—C. A. Schwarm, A. B. Walton.
Lowell, Mass., Electric Light Corporation.—H. T. Edgar, H. A. Wright.
Brockton, Mass., Edison Illuminating Company.—A. W. Leonard.
Somerville, Mass., Electric Light Company.—F. E. Smith.
United Electric Company, of New Jersey.—W. W. Titzell.
Philadelphia, Pa., Brush Electric Company.—A. H. Manwaring.
Bridgeton, N. J., Electric Company.—B. F. Hires.
Woburn, Mass., Light, Heat & Power Company.—L. R. Wallis.
Newton, Mass., and Watertown Gas Company.—W. A. Learned.
Bradford, Conn., Lighting & Power Company.—F. H. Golding.
Westmoreland Electric Company.—Greensburg, Pa.—W. R. Kenney, E. H. Barr.
Johnstown, Pa., Electric Light Company.—A. Weis.
Irwin Electric Light & Power Company., Greensburg, Pa.—W. S. Lane.
Southbridge, Mass., Gas & Electric Company.—A. F. Hall.
Elkhart, Ind., Electric Company.—C. F. Hewitt.
Nashua, N. H., Light, Heat & Power Company.—G. L. Sadler.
Georgia Electric Light Company, Atlanta.—J. G. Rossman.
The Erie Company, Erie, Pa.—M. J. Fogarty.

Savannah, Ga., Edison Company.—G. E. Tripp.
New Castle, Pa., Electric Company.—J. M. Walker, G. Thompson.
Peninsular Electric Light Company, Detroit, Mich.—E. F. Phillips.
Meriden, Conn., Electric Light Company.—H. Minkwitz.
Capital Electric Light, Motor & Gas Company, Boise, Idaho.—F. R. Kerr.
Walla Walla, Wash., Gas & Electric Company.—E. C. Morrow.
Imperial Electric Light & Power Company, St. Louis.—H. A. Lardner, S. B. Way.
Atlanta, Ga., Railway & Power Company—E. Woodruff, T. Elliott.
West Chester, Pa., Edison Company.—J. E. Pyle, H. C. Baldwin.
Boston, Mass., Edison Company.—C. L. Edgar, H. A. Wagner, W. Brophy.
Schenectady, N. Y., Illuminating Company.—J. R. Lovejoy.
B. & O. Railroad Plant, Baltimore.—W. D. McDonald.
Sioux City, Iowa, Electric Company.—C. C. Gartland.
Excelsior Electric Company, Port Huron, Mich.—J. E. Davidson.
Topeka, Kans., Edison Illuminating Company.—C. R. Maunsell, J. P. Griswold.
Seattle, Wash., Electric Company.—D. P. Robinson.
American Electric Light Company, Bloomsburg, Pa.—E. F. McCabe.
Carlisle, Pa., Gas & Water Company.—C. E. Ramsey, J. M. Crider.
Worcester, Mass., Electric Light Company.—H. H. Fairbanks, W. H. Coughlin.
London, Ont., Electric Company.—C. B. Hunt.
Cumberland Electric Light & Power Company, Nashville, Tenn.—R. Emory.
Marlboro, Mass., Electric Company.—F. O. Barnes.
Elmira Light & Railroad Company, N. Y.—A. E. Walden.
Ashtabula, Ohio, Lighting Plant.—E. E. Beam.
Rochester, N. Y., Gas & Electric Company.—G. A. Redman.
Hartford, Conn., Electric Light Company.—R. W. Rollins.
Stamford, Conn., Gas & Electric Company.—R. Crawford.
Norfolk, Va., Railway & Light Company.—P. Wright.
Towanda, Pa., Electric Illuminating Company.—C. P. Wells.
York, Pa., Edison Company.—J. F. Dusman.
Lancaster, Pa., Electric Light, Heat & Power Company.—E. D. Ruth.
Lancaster, Pa., Edison Company.—C. E. Titzell.
Dundee, N. Y., Electric Light Plant.—E. L. Bailey.
Niagara, St. Catherines & Toronto Railway Company, St. Catherines, Ont.—E. F. Seixas.
Buffalo, N. Y., General Electric Company.—C. R. Huntley, G. Urban, Jr.
Catania, Italy, Street Railway Company.—Cesare Pio.
Galion, Ohio, Electric Light Company.—H. C. Dye.
Augusta, Ga., Railway & Electric Company.—W. E. Moore.
Springfield, Ohio, Light & Power Company.—J. H. Miller.
Franklin, Pa., Electric Company.—B. F. Ott.

CONVENTION NOTES.

The convention was in many respects one of the best—large but not the largest; with not many exhibits, but a whole exposition under its lee; several good papers and a steady run of sober, useful discussion. There was a marked infusion of new blood, and the men there for the first time were not long in getting their orientation. If they lacked anything, their good friends, the supply men, were at every elbow. In the discussions, a notable number of central station men took part, as in that on steam heating; and on more than one occasion, the discussion might well have been prolonged. A great many members went over to the Pan-American to study the lighting effects, and the remarkable display of Nernst lamps by the Westinghouse Company in Electricity Building was a universal theme of comment. Mr. Cahoon was congratulated at the close on a very successful year of office, and his expressed desire to see the membership of active lighting companies far more than the present 10 per cent. of the possible was heartily echoed.

Visitors to the Convention not mentioned elsewhere included Dr. E. L. Nichols, of Cornell University; Prof. W. E. Goldsborough, of Purdue University; B. B. Hatch, of the Boston Public Buildings Department; Harold Almert, Lincoln Park Commission, of Chicago; H. H. Humphrey, E. E., St. Louis; H. W. Young and E. Bergtheil, of London, England. T. R. Mercein, secretary Northwestern Electrical Association, of Milwaukee; Prof. C. P. Matthews, of Purdue University; E. A. Deeds, engineer of the Natural Food Company, of Niagara Falls; G. M. Hoag, city electrician, Cleveland, O.; H. W. Buck and P. M. Lincoln, of the Niagara Power Company.

Electrical World and Engineer was represented by President J. M. Wakeman, Messrs. J. V. S. Church, G. W. Elliott and E. T. Walker, of the business department, and Messrs. T. C. Martin and J. R. Cravath, of the editorial staff.

Ladies Present.—Rarely has an N. E. L. A. convention had so many ladies present. The list includes Mesdames S. C. D. Johns, Mabelle Johns, S. Scovil, S. Insull, W. F. White, A. T. Clark, J. M. Hill, J. M. Wakeman, W. K. Beard, C. P. Poole, E. E. Wood, A. E. Clifford, J. L. Wilson, E. L. Decker, F. L. Perry, W. A. Kreidler, C. E. Scott, Helen Scott, T. C. Martin, R. E. Wyant, C. F. Munder, P. S. Tilden, J. W. Godfrey, Pearl Godfrey, W. M. Anthony, J. D. Meister, W. M. Deming, J. R. Baldwin, H. L. Baker, C. W. Baker, J. P. Coghlin, R. Emory, E. A. Leslie, Miss Leslie, W. C. Hubbard, S. M. Young, E. Woodruff, E. W. S. Gray, A. J. Wurts, F. H. Taylor and others whose names were not registered. On Wednesday evening a hop was given at the International, followed by a cakewalk, in which Miss Barnard greatly distinguished herself, her beauty being enhanced by a most graceful carriage in that difficult form of calisthenics.

The Electrical Press was in unusual strength. Beyond the staff of this journal there were also present Messrs. W. T. Hunt, C. W. Price, C. T. Child, W. A. Kreidler, F. L. Perry, S. Goddard, C. P. Poole, W. K. Beard, A. E. Clifford, E. E. Wood, W. E. Keily, F. S. Kenfield, T. E. Crossman, E. B. Biggar, J. D. Meister, J. D. Downer.

Mr. E. F. Seixas, an old-time electrical man in this country, though still in his teens from appearances, has been made manager of the Niagara, St. Catherines & Toronto Railway Company. He did a very graceful thing Thursday in taking off a party of ladies and gentlemen, fifteen in number, on a trip over his road to St. Catherines and then down to Port Dalhousie. The party then returned to lunch at St. Catherines and reached the Falls about 2:30 P. M., having spent a most delightful morning.

Mr. C. R. Huntley, general manager of the Buffalo General Electric Company, one of the earliest and best presidents of the association, was constant in attendance, as soon as released from duties caused by his prominence in the Pan-American directorate. Generous hospitality was extended at his rooms, and on Wednesday evening he gave an informal but delightful banquet in the Ladies' Ordinary to a score of "Old Timers." Several who would have liked to be present were away at the Show, but the roster included Messrs. Huntley, Habirshaw, C. O. Baker, Corey, Shippy, Bailey, Porter, McQuaide, Urban, Garrison, D. Rankine, McLean, Brophy, Page, H. B. Kirkland, C. Holmes, A. Patterson, E. A. Leslie. There were many toasts to the pioneers and to the newer men, and the evening was one unbroken succession of fun and reminiscence, with just the touch of pathos coming from the remembrance of the days that are no more.

The Gorge Route is one of the most spectacular trolley rides in America, and for its close touch to peril may be compared with some of the Swiss electric rack roads like that skirting the Jungfrau. Of late one of the attractions of the Gorge has been the illumination of it by special searchlight, and on Tuesday evening, by invitation of Manager Morgan, on behalf of the trolley company, the convention went en masse down the Gorge to see the searchlight play on the gigantic breakers and their clouds of spray. The evening was clear, with a young moon hanging over the Gorge, and the spectacle was declared thrilling beyond imagination. The searchlight has now been reinforced by some 40 enclosed arcs, grouped in pairs in front of reflectors so that a steady white light can at all times be thrown on the rushing torrent.

Mr. C. O. Baker, Jr., master of transportation, while he had not been called upon this time to furnish a special train from New York, was present as usual, and discharged his voluntary duties as a perambulating information bureau with wonted courtesy and infallibility. On Tuesday he did secure a special for a convention trip to the Pan-American, but it rained so heavily that the excursion had to be reluctantly abandoned, much to his disgust.

Mr. Frederic Nicholls, the mainspring of the Canadian General Electric Company, was heartily welcomed by a host of American friends, many of whom wanted details of his recent big lighting consolidations and the extension of his manufacturing interests. His power transmission enterprises for the benefit of Toronto are likely soon to make a stir in the great world of engineering and finance.

Mr. Luther Stieringer, the consulting electrical engineer of the Exhibition, was kind enough to go down nightly from Niagara as a personal escort and cicerone, to explain the features of the superb lighting effects, especially those of the Howard Tower, which he has made a veritable gateway to the Celestial City itself.

Ex-Presidents were plenty, the list including Messrs. Huntley, Nicholls, Insull and Ayer, to whom Mr. Cahoon was added, as he lay down the gavel at the close of the convention. The new president, Mr. Doherty, is also an ex of the Northwestern Electrical Association. It was much regretted that he was unable to be present, but another year of brisk administration is very confidently expected by all his friends.

The Niagara Power Company received the convention at their splendid power house on Wednesday afternoon. Messrs. Rankine, Buck, Lincoln and others taking a part in exhibiting the apparatus to the visitors. As a new power house is now building on the other side of the canal, facing the old one, the plant could virtually be seen in every stage of construction and operation. The new 20,000-volt circuit to Buffalo has just been thrown on, so that was in evidence also, and its manipulation attraced much attention. Some of the members also took in the big Schoelkopf plant down the Gorge.

Mr. F. E. Barker, of the Massachusetts Gas & Electric Light Commission, was a familiar and welcome figure. The work of the commission came up two or three times in the discussions.

Mr. Cesare Pio, of the Catania (Italy) Street Railway Company, was quite interested in convention methods and in the Niagara power utilization.

EXHIBIT NOTES.

The exhibits this year were very few and far between. It is said that, on the contrary, never before were so many manufacturing concerns represented by their officers, salesmen, etc. In spite of consolidations in various lines the expansive tendency of electricity was never more marked than at present, and the new faces, new lines and new ideas challenging attention and acquaintance were frequently commented on by the Old Timers, who again were far more numerous than of late years. One of the reasons for the few exhibits was the fact that only a few miles away at Buffalo was the show with an Electricity Building and a great variety of electrical exhibits, specialties and attractions. Thither all steps tended, somewhat to the dividing up of the convention, but quite naturally, and giving a unique flavor of interest and novelty to the occasion. As one of the newly married members put it, he had four attractions all going at once—his wife, the Falls, the convention and the show, and he now knew what distraction meant. A series of running notes below mentions those seen in attendance, and if in the hurry one or two names have been overlooked the compiler tenders his apologies in advance. There are easier jobs than taking such a census.

H. W. Johns Manufacturing Company, of Hartford, was represented by Mr. Joseph Sachs, who had an excellent compact exhibit of his Noark switches in the hall, and was most busily occupied in discussing its merits and peculiarities. Mr. A. H. Berry, of the concern, was also there.

Mr. G. F. Porter, the busy secretary, was, of course, spokesman also for the Brixey Kerite Cables. He went direct from the convention to Seattle, bound for Alaska, where he is laying Brixey cables for the Government while the thaw is on. Miss Billings, his assistant secretary, was, as ever, efficient, indefatigable, intelligent, omniscent and sweet-tempered in every emergency.

The Edison Storage Battery was a theme of discussion, and a few advance copies of the Institute paper on it were eagerly snapped up by those lucky enough to get them. The consensus of opinion appeared to be favorable, with the customary phrase, "Time will show."

Phoenix Glass Company was represented by Mr. Alec. Patterson, who has attended so many conventions one's memory hardly runs to the contrary. The development of electricity has brought many corresponding growths in fine glass work as shown in the Phoenix productions.

E. F. Phillips Electrical Works, of Montreal, Canada, were represented by G. H. Olney, 2d.

Standard Chemical Company, of Boston, was represented by Mr. G. B. Davis.

Mr. H. G. Landis came all the way from Wichita, Kan., for the Electric Supply & Construction Company of that city.

Chase-Shawmut Company, of Boston, and all their fuses, etc., were represented by Mr. A. P. Moore.

E. B. Latham Company, of New York, was vouched for by Mr. R. L. Caldwell.

Western Electric Company had in attendance P. M. Fletcher and E. W. Rockafellow.

Chas. A. Schieren Company, of New York, was suggested in connection with belts by Mr. A. W. Harvey.

Bossert Electrical Construction Company, of Utica, N. Y., were represented by Mr. F. G. Scofield, who soon learned that many of the delegates visiting the Pan-American had seen and greatly admired their magnificent switchboard and instrument exhibit in Electricity Building.

Mr. J. L. Hinds, of Syracuse, N. Y., had many an excellent opportunity, promptly availed of, for discussing the work of his company.

John A. Roebling's Sons Company was ably represented by Messrs. H. L. Shippy, G. C. Bailey, F. W. Harrington, H. C. De Camp, G. W. Swan, M. P. Bowman and D. F. Irvins.

Canadian General Electric Company, which is branching out into very heavy general engineering, was represented by Mr. H. G. Nicholls, "a chip of the old block," who is taking a very active and responsible share in the management of that large and progressive concern, the second or third largest electrical manufacturing company under the English flag, and right abreast of anything American. Mr. E. D. McCormack was with him.

Okonite Company, of New York, was represented by Mr. George T. Manson.

Dr. W. M. Habrishaw and J. W. Godfrey were present in behalf of the India Rubber & Gutta Percha Insulating Company.

American Circular Loom Company was represented by Messrs. A. T. Clark, R. B. Corey, T. G. Grier, J. L. Wilson and E. L. Decker.

Westinghouse Electric & Manufacturing Company, of Pittsburg, was represented by the following: Pittsburg—H. P. Davis, H. C. Ebert, J. S Peck, W. M. Probasco, F. H. Taylor, E. M. Tingley, A. J. Wurts, C. F. Scott. New York—E. W. S. Gray, F. B. H. Paine, Calvert Townley. Boston—W. F. Fowler, D. E. Manson, R. L. Warner. Syracuse—Paul T. Brady. Cleveland—N. S. Braden. Detroit—W. C. Armstrong, C. F. Medbury. Buffalo—E. A. Eames, T. C. Frenyear, C. W. Underwood. Niagara Falls—L. E. Imlay. The company had parlors on the first floor, but had no need to make an exhibit, Niagara Falls being full of some of its finest work At the Pan-American Exposition, the delegates were especially interested in the lighting of the interior of the dome of Electricity Building. Under a canopy of light green and lavender draperies, against which the white bulbs shine beautifully, are suspended in festoons 98 Westinghouse-Nernst self-igniting lamps, all of 400 cp each. Where the festoons of lamps converge at the top of the dome hangs a large central Nernst of 2000 candle-power. In each of the 400 lamps are six glowers, which individually are good for 50 candle-power, and in the large central lamp there are no fewer than 30 glowers bunched. At present this striking exhibit is dependent on outside circuits, but it will soon be fed by a fine Westinghouse direct-connected gas engine unit, the engine being supplied with Buffalo natural gas.

Sprague Electric Company was represented by Mr. Alex. Henderson, in charge of its interior conduit interests, and Mr. H. G. Issertel, who represented its dynamos and motors, this being by no means his first convention, but his first in the company's interests. Both gentlemen were active and efficient in their duties.

General C. H. Barney had no trouble in finding ready ears to entertain his account of the virtues of the Monarch Fire Appliance Company's extinction apparatus.

S. B. Condit, Jr., of Boston, represented the firm bearing his name. There were many inquiries about the interesting new double frontboard he has just built for the big new power transmission work of the central station company at Manchester, N. H.

The Electrical Material Company, of Baltimore, was represented by Mr. Arthur L. Bosley.

Mr. James Wolff, western manager for the New York Insulated Wire Company, was on hand furthering his company's interests at convention, with P. H. Hover.

The Bullock Electric Manufacturing Company, of Cincinnati, was well represented in the person of Frank G. Bolles, who distributed a handsome Bullock Pan-American chain medal charm.

Mr. T. H. Lane, of the Warren Electric Specialty Company, of Warren, Ohio, was in attendance. Mr. Elmer W. Gillmer, secretary and treasurer, was also active throughout the convention.

The Phelps Company, State and Rowland Streets, Detroit, Mich., represented by W. J. Phelps, had samples of its Hylo lamps in the hotel lobby. They were favorably commented on by many. In addition to the ordinary filament, there is a small low candle power filament, cut in by slightly turning the lamp in its socket for use when a dim light is desired.

The Standard Paint Company was fully represented, having in attendance Ralph F. Shainwald, president; Walter Cary, vice-president; J. C. Shainwald, western manager, Chicago; F. F. Vanderwater, New York. A handsome paper cutter souvenir was distributed by them.

Mr. J. G. Pomeroy, general western agent of the Adams-Bagnall Company at Chicago, was one of the well known men at the convention.

Mr. Thomas G. Grier, of Chicago, western agent of the American Circular Loom Company, was about renewing acquaintances on his way home from an eastern trip.

Messrs. John T. McRoy and E. F. Kirkpatrick, among the best known men in the trade, were on hand to represent one of the important standard articles of the industry—conduits.

Mr. S. L. Kuehmsted, of the Gregory Electric Company, of Chicago, dealer in second-hand apparatus, was present and found the demand for such machinery larger than ever, owing to the crowded condition of factories and prevailing high prices.

Mr. F. N. Jewett, of the Evans Hot Water Heating Company, Chicago, was among the convention visitors.

Mr. C. W. N. Money, representing the New England Electric Manufacturing Company, of Boston, gave much pleasure to the ladies by distributing large bunches of carnations among them; nearly every gentleman in attendance also wore a carnation by the courtesy of that company.

The Crouse-Tremaine Carbon Company, of Fostoria, Ohio, were represented by J. B. Crouse and H. A. Tremaine.

Mr. Norman McCarty, general sales manager of the United States Carbon Company, was present making friends, as usual. The company is full of orders and pursuing the even tenor of its way.

Mr. Paul H. Brangs, of the New York office of the Heine Safety Boiler Company, represented that company at this convention in his usual able manner. He is one of the very earliest builders of electric lighting dynamos in this country.

The Crescent Manufacturing Company, of Chicago, had Albert Meyer looking after its interests.

Mr. N. C. Cotabish, general sales manager and also a director of the National Carbon Company, of Cleveland, represented the big carbon interests of which he handles the output.

The General Electric Company had parlors on the first floor for the reception of its numerous customers and station managers, etc. The courtesies were extended by Messrs. J. R. Lovejoy, W. Le Roy Emmet, E. E. Gilbert and H. W. Hillman, of the lighting department; A. D. Page and F. W. Willcox, incandescent lamp works; E. A. Carolan, foreign sales department; M. A. Oudin, E. H. Mullin and others, who, with above, were also active as escorts to the fine Pan-American exhibit of the company.

Sawyer-Man Electric Company was represented by C. S. Jennings, from New York; Frank S. Smith, G. A. Nellis, from Pittsburg. Henry Watts, from Buffalo.

Mr. C. F. Munder had in hand the interests of the Munder Electrical Works, Springfield, Mass.

Mr. E. W. Kellogg represented the Frank Ridlon Company, of Boston.

Stanley Electric Manufacturing Company, of Pittsfield, was represented by Messrs. W. B. Jackson, W. L. Fairchild and C. E. Bibber.

Mr. L. R. Wallis, of Woburn, found life too short to explain to all who wanted to know the features of his system of charging for current. The apparatus is now being built for him by the Stanley Instrument Company.

Mr. John H. Dale represented the Dale Manufacturing Company, of New York City. With him was O. J. Bryan.

The Electric Vehicle and **Riker Motor Vehicle Companies** were most assiduously represented by Mr. J. M. Hill, who came down daily from their fine automobile exhibit at the show and whose courtesies in the way of "pick-up" rides in the handy vehicles were most gratefully appreciated by many of the members, to whom the serious lack of transportation facilities at present would otherwise have been a great drawback to their comfort and pleasure.

National Battery Company, of Cleveland, Ohio, were represented by Mr. Elmer A. Sperry. The Sperry battery is playing a prominent part in automobile work, and the company will, it is understood, build a large, new factory in order to be able to fill orders.

Am. Dist. Steam Company, of Lockport, whose exhaust steam heating system is in use by so many members, was represented by Mr. H. J. Babcock and C. R. Bishop.

The Acme Switch Company, of Hartford, Conn., was represented by Mr. G. L. R. Eldredge, who was doing his first N. E. L. A. convention, and rather liked it. The company is introducing a useful time switch, of which a large number are already in use by the Boston Edison Company.

Mr. E. G. Bernard attended for the E. G. Bernard Company, of Troy, N. Y.

Mr. A. A. Thresher, of the Thresher Electric Company, found a great deal of interest and curiosity existing as to the new vertical shaft generators of his concern, built for operation by waterwheels.

Carborundum and **Acheson Graphite Companies**, of Niagara, were represented by Mr. E. G. Acheson, president, and inventor of these new products of Niagara energy. The demand for carborundum, as an abrasive, etc., has already grown to amazing proportions.

The Fort Wayne Electric Works were represented by Mr. J. C. Lott, of New York, and A. E. Dresser, whose energetic efforts in their behalf were unremitting.

The United Electric Company, of New Jersey, was represented by Mr. W. W. Titzell, superintendent of the Jersey City plant, and Mr. John J. Gaffney, of Newark.

The Lea Electric Manufacturing Company, Elwood, Ind., had W. M. Porter, its general sales agent, looking after its interests. They also brought an excellent male quartette of glee singers from their factory.

Mr. Frank H. Clark, of Chicago, the new Helios Upton storage battery sales manager, was around shaking hands in his new capacity.

Mr. C. W. Cobb was in attendance in behalf of the Chicago Mica Company.

President G. A. McKinlock, of the Central Electric Company, of Chicago, renewed many old acquaintances.

The O. C. Little Pulley Coating Company had a model in the hotel lobby showing the relative pulling power of a belt when on a smooth pulley and on one coated with the company's covering. The exhibit demonstrated that the coating doubled the cling of the belt.

The Chicago Boiler Cleaner Company, 321 Dearborn Street, Chicago, exhibited its new Electric Purifier for purifying oils, in charge of G. W. Atterbury. The company distributed free to oil users an inverted oil microscope for testing the purity of oils.

The Gould Storage Battery Company was represented by Mr. W. W. Donaldson. This exhibit occupied a prominent position in the lobby of the International. There were shown plates formed and unformed, both positive and negative, from the smallest to the largest size. Among them were plates which had gone through a series of discharges representing over a year's work in ordinary use, and showing apparently no depreciation. The number of discharges to which they had been subjected was 317, with over 100 at a twenty minute rate, the same number at a half-hour rate, and one, three and eight-hour rates. "Spinning," the special method employed by the Gould Company for sub-dividing the lead and obtaining a large contact surface for the active material, was exemplified by numerous samples, showing a ratio of 20 to 1 and as high as 450 square inches per pound of lead. An automobile type was shown which with 13 pounds of element will give 100 ampere-hours at a four-hour rate, There were also shown different types of plates which had been recently installed at Mr. W. K. Vanderbilt's, Oakdale, L. I.; the Commercial Office Building, New York City; the Edison Station, Canton, Pa.; Lansing, Mich., Street Railway.

Mr. Charles Blizard, general sales agent of the Electric Storage Battery Company, Philadelphia, took care of the interests of his company and participated in the battery discussion. He was assisted by Mr. A. Taylor.

Mr. J. S. Crider represented the Washington Carbon Company of Washington, Pa.

Standard Underground Cable Company was represented by Mr. T. E. Hughes, of Philadelphia; Mr. J. V. Marsh, of Pittsburg, and Mr. Charles J. Marsh, of the New York & New England territory.

Mr. W. D. Packard looked after the interests of the New York & Ohio Company, of Warren, Ohio, and also talked automobile freely.

Mr. J. S. Speer, of the Speer Carbon Company, St. Mary's, Pa., who has recently been married, was accompanied by Mrs. Speer, and received the hearty congratulations of his many friends.

The Pittsburg Transformer Company was well represented by Mr. F. C. Sutter, who reports that the transformer business was never better, and that they are running night and day turns to keep up with orders. This spring's business proved unusually large and the company, although still somewhat behind on shipments, is rapidly completing arrangements whereby stock shipments may be resumed.

American Electrical Works, of Providence, were represented by Mr. F. E. Donohoe and Mr. W. J. Watson.

Safety Ins. Wire & Cable Company was represented as usual by Mr. Avery P. Eckert, whose work in connection with the Electrical Trades Society has given him an unrivaled acquaintance with the trade throughout the country.

Pass & Seymour, the porcelain people of Syracuse, were represented by Messrs. John Brooks. F. M. Hawkins and B. E. Salisbury.

Franklin Electric Manufacturing Company, of Hartford, Conn., was represented by Mr. J. Gain, Jr., and Mr. G. D. Curtis.

Mr. C. I. Hills was not hard of hearing or of identification when the H. T. Paiste Company was mentioned.

Otis Elevator Company sent Mr. A. H. Wright to the convention, and many wondered what had become of Benton.

Manhattan General Construction Company was well represented by Messrs. S. Marsh Young and W. C. Hubbard, on behalf of the New York offices and Newark factory. They were assisted by G. B. Griffin.

The Shelby Company had its efficient and energetic New York representative on hand, Mr. J. C. Wormley, who, if he had invented their lamp could not talk its points better or be more genuinely enthusiastic about it. He distributed a very ingenious card showing lamp measurements at various angles.

Mr. Phil Ackerman responded whenever the name of the Rhode Island Electric Works was mentioned.

Adams-Bagnall Electric Company was represented by Mr. W. V. Orr.

Mr. C. H. Barkelew spoke for the Barkelew Electric Manufacturing Company, Middletown, Ohio.

Mr. A. C. Garrison, of the Columbia Incandescent Lamp Company, of St. Louis, had some very effective badge buttons that were greatly in demand and adorned pretty well every lapel and shirt waist in the convention.

Mr. F. S. Terry was present for Sunbeam lamps. He is credited with carrying a focusing glass to which all other incandescent lamp beams are soon to converge. A "consolidation" of several lamp manufacturers is in the air, and they say Terry will manage it with headquarters in Chicago. If so, his opportunity, long and patiently waited for, to display his marked commercial abilities, has now arrived.

Packard Electric Company, of Canada, was represented by Messrs. R. B. Hamilton and G. A. Powell.

The Shaughnessy Agency was all there in the persons of Mr. M. J. Shaughnessy and Mr. S. L. Coles.

Page Electric Company, of Worcester, Mass., was represented by Mr. J. P. Coghlin and Mr. H. D. Perkey.

American Electric Heating Corpn. was represented by Mr. J. I. Ayer on behalf of the Simplex Company. Mr. Ayer has some exceedingly interesting problems on hand that involve novel uses of heating apparatus on a large scale. He can hardly refrain from talking about them.

"Emerson" Motors, etc., were brought prominently to notice by Mr. H. L. Parker for the Emerson Electric Manufacturing Company, of St. Louis.

Phillips Insulated Wire Company, of Pawtucket, was represented by Mr. H. C. Adams, Jr.

National Conduit—and J. P. McQuaide. Also McLean.

Baker & Co., of Newark, was represented by Messrs. C. W. Baker, L. Le Sicla and C. O. Baker, Jr., who gauge the output of incandescent lamps by the demand for platinum.

American Vitrified Conduit Company, of New York, was present in the person of Mr. A. S. Barnard.

New York Insulated Wire Company was represented by Mr. J. R. Cole, of 'Frisco, who does not get East quite often enough, but renewed many old friendships this time.

Mr. G. E. Davis was present for the Motor & Equipment Company, of Newark, N. J.

The Diehl Manufacturing Company was represented by Mr. B. C. Kenyon.

Mr. Charles H. Austin was present from Nashua, N. H., for the concern bearing his name.

Ansonia Electrical Company was represented by Mr. W. J. Tonkin.

Mr. W. C. Benham represented his company from Columbus, Ohio.

The General Incandescent Lamp Company, of Cleveland, Ohio, was represented by Mr. Joseph Insull. Great regret was expressed that labor troubles in New York detained his brother, Mr. Martin Insull, general manager of all the other "G. I." concerns. The General Incandescent Arc Light Company, of New York, was, however, represented by Mr. H. P. Ball. Mr. Samuel Insull was, as usual, one of the notable convention personalities, but attended as president of the Chicago Edison Company.

Electrical Supply & Manufacturing Company, of Cleveland, was represented by Mr. H. Whitford Jones.

Jandus Electric Company and the Jandus arcs were highly spoken of by Mr. G. W. Pope.

Standard Carbon Company, of Cleveland, and Mr. A. D. Spear became closely identified by the members.

George M. Gest, of Cincinnati, was represented by Mr. T. E. Wood.

Mr. Marcus Nathan came up to study the Pan-American in convention time. He will probably bring it to New York this fall.

Mr. W. Smith Horry, well known from his connection with electric light invention and engineering, is now at Niagara Falls in connection with large carbide production. and is also engaged on work at Sault Ste Marie. He met a great many old friends at the convention

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International Trade Relations.

We publish in this issue one or two articles bearing on the subject of the international relations of American trade. From Germany come suggestions with regard to the methods of cultivating trade with that country, which in business and manufacturing methods has much likeness with our own, and is as ready to buy as it is to sell, provided prices, quality and packing are right. Of German electrical apparatus and supplies, America has always been a purchaser, and similarly there is a good market in Germany for many of our electrical specialties. The article which we present this week on the lighting of the Atlantic liner the "Deutschland," is, in this connection, unusually interesting from the opportunity it affords to study the best German methods of marine electrical engineering.

Another article likely to provoke thought is that wherein the reply of the United States Bureau of Statistics to the inquiries of Mr. Naoroji is set forth, trying to explain the enormous excess of American exports over imports. This is no longer a "debtor" country, having bought back all of its own securities that can be lured from foreign strong-boxes; but the piling up of an apparent balance in our favor goes on, that once could only have been explained on the theory that it went to wipe out interest charges. An explanation for the fact that the excess seems to remain unliquidated in trade fiscal statements is that our people are not only investing the proceeds of their sales in the securities of foreign governments, but are putting them into foreign industrial properties also.

One other article in this issue also throws a curious side light on international relationships, namely, that on the new hotel at Nassau, Bahamas. A description is given of what is perhaps the finest hotel in a British colony, but it happens to be equipped throughout with American apparatus, to have been designed and constructed by American engineers, and to have been paid for outright by an American millionaire, who is spending his money making other folks comfortable—as good an occupation as giving them books to read. This addition to the resources of the British Empire is one that we can all contemplate with complacency.

Exit the Cable.

Last week the famous cable system on Broadway, New York, made its last haul, and on Monday morning of this week electric conduit trolley cars were in successful operation over the same route. The swiftness of the change, when it actually came, was one of the most surprising things this city has seen, and New Yorkers had not expected to find cars running over the road for a week. But the huge transformation was all effected on a Sunday, and a wet Sunday at that, so that public inconvenience was reduced to a minimum, and public praise of the feat was hearty and warm to an unusual degree. President Vreeland and his associates of the Metropolitan staff have indeed deserved well of their fellow citizens, in the skill, energy and zeal with which they substituted electricity for cable on the best known thoroughfare of the New World.

But we cannot refrain from remarking that the change, as a change, has been a long time coming. It is now just about ten years ago, before the Vreeland regime, we noted that the cable was going in, and entered a protest on the ground that it would soon have to come out and be replaced by electricity. The criticism doubtless seemed premature to some persons, as they did not hesitate to say so, but facts have abundantly justified our belief that an electric conduit system could have been put in ten years ago, and all the expenditure on the costly cable plant and its abandonment avoided.

To a certain extent, history is repeating itself in the trials now being made with compressed air cars in this city. They are an older story than the cable, and they are an even worse failure; and it does seem to us a great pity that time and money should be wasted in the effort to substitute them for electricity, which is emphatically the all-conquering, all-sufficient agent of modern traction.

Work of the Smithsonian Institution

Among the notable exhibits at the recent Conversazione of the American Institute of Electrical Engineers were several from the Smithsonian Institution, including a 20-foot map of the solar spectrum constructed in the Astro-Physical laboratory of the Institution. Several bolometers and some aerodrome photographs were also exhibited, and Professor Langley had printed for distribution some hundreds of copies of a description of each exhibit. We learn that this exhibition was made in accordance with a new plan for extending the usefulness of the Smithsonian Institution, which plan was first put into effect at the Institute Conversazione, and that the exhibits shown in New York now form part of a collection that has been sent to the Pan-American Exposition. Professor Langley in thus broadening the scope of the Institution and popularizing its work has made a departure from traditional policy that cannot be too highly commended. While the former policy of the Institution was perhaps the best for the period when it was outlined, the conditions of to-day are such that the scientific world is quite independent of a special agency for the transfusion of knowledge. On the other hand, interest in the higher work of science on the part of others than the savant, is becoming yearly more widespread, and in catering to the popular desire for knowledge of the latest scientific achievements, the Smithsonian Institution will be accomplishing a good work, no small part of which will lie in its tendency toward counteracting the pernicious influence of sensational newspaper science.

Atomic Fragments.

In a letter to the New York *Sun* of May 15, Professor Hall, of Harvard, discusses the recent atomic theory of Professor J. J. Thomson, according to which an atom belies its name and is composed of a great number—perhaps 1000—smaller quantities provisionally called corpuscles. Each corpuscle when separated from the atom to which it belongs carries a definite negative charge, or constitutes a negative ion. It seems that the atom, a hypothetical minimum quantity of matter, was worked too hard, and broke down in the attempt to execute all its duties. According to the new theory, we have room for orbits and a large interplanetary system, all confined within the limits of a single atom; and although the corpuscles of which atoms are composed are all alike, or indistinguishable from one another, the particular mode of aggregation, configuration or orbital motion of these corpuscles differentiates the atoms of one elementary substance from those of another, or differentiates substances. Professor Hall shows that while there is ample room in the new hypothesis for a great variety of new theories of fundamental matter, yet our pristine and erstwhile revered notions concerning the indivisibility of atoms are probably destroyed beyond all chance of repair. Let us hope that the new internal complexity will make amends to our shattered idol for the loss of its prestige as being "one and indivisible."

The Utility of Libraries.

The interesting letter which we publish this week from Dr. Park Benjamin on the subject of the gift by Dr. S. S. Wheeler to the Institute of the Latimer Clark library, suggests one or two lines of thought. We do not understand the writer to decry libraries, he being himself a discriminating and successful collector. Nor does he find it a matter of regret that this collection should be taken out of the stout packing cases in which it has been immured, and is made part of the possessions of the Institute. The contention seems to be that such gifts are not fully appreciated, and that this particular one is little likely to be used.

Dr. Benjamin cites his own experience, when, being in possession of a fine collection of the earliest electrical and philosophical literature, he threw it open to the public, and, then, discovering the absolute indifference of people, generously, with one or two friends, turned it over to the Naval Academy at Annapolis. We cannot see that the books are very happily placed at Annapolis, but they are at least preserved as a valuable collection, even though the students look at them as little as did the public of New York.

The main point about a library is its availability, and we cannot quite agree with Dr. Benjamin that his library was available in the broad sense that the Wheeler gift will be. Very few people care to intrude on a man's privacy to consult his books, and every one going to Dr. Benjamin's office knew they must be disturbing the practice of a busy professional man, to say nothing of being disturbed themselves by hearings and the movement of clients. In the same way, there are private collections of pictures in this city open to the public on very easy terms of admission. Who ever goes to them? How many of our readers, visitors of the Metropolitan Museum, have ever seen the private Vanderbilt collection or that of Mr. Jacob Schiff? The reticence or delicacy of the cultured men and women desirous of studying books and pictures in private collections is the very bar to their doing so. In Europe, there is decidedly less reluctance in inspecting such possessions in a private house, but an American finds it get on his nerves to do so.

In connection with the Wheeler gift, which we are confident will be used very liberally, when installed in this city, there are two points to be made. One of them is that it is not simply a collection of rare books, in which necessarily few are interested as students, but is rich in engineering files and volumes, and is a "working library" of unusual merit. Moreover, it will have annexed to it all the files of the Institute of current publications, already freely used, and, best of all, it will have a most careful and elaborate catalogue, in which each important book will be noted in detail. Every member of the Institute will have a copy of that catalogue, and we shall be greatly surprised if that does not help to stimulate that refined taste for historical-scientific research, which Dr. Benjamin himself has so conspicuously illustrated as a collector and author.

Technical Education.

Our issue of May 11 contains an interesting letter, in which the writer, taking as a text a recent address by Dr. Pritchett, president of the Massachusetts Institute of Technology, discusses the subject of technical education in its general educational aspect—that is, the value of such an education in qualifying a young man not only for merely technical positions, but also to take advantage, with good prospect of success, of opportunities that may offer in the administrative and commercial branches of the industry with which he connects himself. In his address Dr. Pritchett points to the new factors which have entered into modern commercial and industrial life, and concludes that under modern conditions the duties of the manufacturer, the man who directs export trade and the man in railway administration, are rapidly becoming those of a profession and not those of a business. For this profession he considers there is a training to be had in the schools which will not only save time for the individual, but which will develop a broader, a more efficient and a higher type of man—a training which shall not only bring a keener vision, but a wider outlook and a better perspective. Allusion is made to the significant fact that the man who prepares the raw material into the manufactured product is now almost always of college training, but that 40 years ago it was considered just as impossible to train an engineer in the schools, as to-day it is thought impossible to train the man who directs railroads or banks or export trade or manufacture.

Mr. Nostrand in his communication does not disagree entirely with the views of Dr. Pritchett, but confining consideration to the education afforded by the technical schools of to-day, he believes that the methods of many of these will have to be revolutionized before their graduates can be considered to possess the qualifications necessary to success in the broader walks of life to which Dr. Pritchett refers; that many of the present courses conduce to narrowness of vision rather than to the breadth of view which is so necessary in those who have to do with the relations of men to each other. While Mr. Nostrand by no means considers systematic education a bar to eminent success in the business world, yet he makes use of an illustration which usually forms the entire argument of those who sneer at college education, namely, that the most successful men of to-day lack entirely that accomplishment. This much-quoted illustration loses almost all of its force when we consider that the success of these men is rooted in the conditions of 30 or 40 years ago—in a period when a college education had for its object the fitting of young men for the so-called "learned" professions, or imparting to the sons of the wealthy or well-to-do the traditional academic culture having no direct utilitarian object. Through his education out of sympathy with the industrial and commercial spirit, and viewed askance by all men of affairs, had the college man of that period aimed at industrial leadership he would have labored under a handicap much harder to overcome than the lack of education on the part of the man mounting from the foot of the ladder. To-day the conditions are quite different. The value of systematic mental training is now almost universally recognized, and in many of our greatest industrial establishments, the rungs of the ladder leading to higher things are now almost exclusively reserved for the man of college or equivalent education.

It cannot be denied, however, that the criticism of Mr. Nostrand would have considerable force were it admitted that the present organization of technical education is such as to conduce to narrowness rather than breadth of mental vision, thereby tending to limit in after life the opportunities of the graduate to those arising in purely technical departments; and it must be acknowledged that such an admission cannot be avoided in the case of some of our technical schools. Where it does apply, however, we believe the underlying cause is not difficult to discover, and that when revealed it will not be found an evil inseparable from technical education. Were the instruction in technical courses confined to the inculcation of principles, to teaching the various branches of science so that each shall stand out in the mind of the student in its full proportions and in proper perspective and relation to other branches, we believe the reproach that technical education narrows the mind, would lose the greater part of its force. Where, however, technical instruction consists largely in fitting the student so that he may, upon graduation, have an immediate wage-earning capacity, the reproach is apt to hold, particularly if so-called "practical work" is made a prominent feature of the course, which is quite likely in such a case. Indeed, we believe the worst evil of present technical education is that arising from too great stress being laid on practical work. At the present time graduates from technical schools are coming more and more to be considered merely as raw material for engineers, and, as a rule, they can obtain no responsible position with the larger electrical companies until after having served a period in a shop-student course at merely nominal pay. In view of this condition, which, in a sense, may be considered to reflect the opinion of manufacturers as to the value of the so-called practical knowledge imparted in the schools, the inutility is manifest of sacrificing the study of principles—which sacrifice, as a rule, can never be compensated for in after life—to practical work of any kind that does not have an educational value comparable in permanent effect to that obtainable in the lecture and study room.

That the broader technical education here referred to is beginning to be appreciated at its true value is indicated by the trend of thought shown in the recent volumes of *Proceedings* of the Society for the Promotion of Engineering Education, and elsewhere in papers by educators. Whether its thorough establishment would produce a condition obviating all the objections of Mr. Nostrand is doubtful, for these, in part, imply the necessity of instruction in branches which belong to the regular academic college course, and the introduction of which into a technical course would involve sacrifice in the scientific curriculum. None can dispute, however, the value of such supplementary training. Aside from broadening the horizon of the mind—or perhaps as a consequence of this—the graduate would be the better qualified to meet men in all the relations of life on an even footing. The writing of reports and technical correspondence are no mean part of an engineer's work, the proper discharge of which implies a certain training of the literary faculty, not only that a technical case may when necessary be presented so as to be fully understood by the layman, but also so presented as to be most apt to influence favorable decision even when addressed to a master of technics. These considerations point not so much to the advisability of including in a technical course some of the ordinary college studies, as they do to the desirability of an academic college course preceding a technical one. The careers of some of our most successful younger engineers seem unquestionably to indicate that the young man who has followed both courses is much the surest of unqualified success.

Whatever the future may develop, the graduated electrical engineer has at present no cause for complaint as to limited opportunities, at least so far as concerns the industry for which he has been directly educated. In every branch of the electrical industry we find him represented, and if the present tendency continues it will be but a few years when he shall monopolize practically every position of profit in the industry, whether technical, administrative or commercial. It is well that this situation exists, for the disproportion between the number of purely technical positions of profit and the number of graduates is so enormous, that otherwise our technical schools would long ago have been confronted with a crisis. As it is, the present supply of electrical engineer graduates, great though it is, appears to be less than the demand, an indication of which fact is given in a note in another column, wherein it is stated that the graduates of one of our largest electrical engineering courses were last year eagerly bid for two or three times over. While this is most comforting, it is none the less desirable to keep in sight the fundamental considerations apt to govern in after life the success of the coming technical graduate. For the youth who to-day starts his education may, when graduated, encounter conditions less favorable than existing ones with respect to competition from other sources for the prizes that arise in other than the purely technical branches of industrial life—which outnumber perhaps as twenty to one those available to the electrical specialist *per se*.

The International Trade Relations of the United States.

"What has caused so much produce, merchandise and specie of the United States to go out of the country without the ordinary corresponding return?" is a question recently propounded to the Treasury Bureau of Statistics by Mr. Dadabahai Naoroji, an Indian gentleman residing in London. Mr. Naoroji, in his inquiry address to the Bureau of Statistics, quotes the recent figures showing a large excess of exports of merchandise and specie over the net imports of merchandise and specie, and says: "In India a heavy net excess always takes place because the system of government of India compels a heavy tribute, i. e., compels a large drain of the produce of India to England without any material return of merchandise or specie. But America is not under such a draining system of an alien foreign government; and I therefore desire to know the causes, and their extents, of such heavy net excess of exports of America's wealth or produce, and how this large 'balance of trade' is expected to be settled."

The following is an extract from the interesting reply of the Chief of the Bureau of Statistics: During the period immediately following our Civil War great internal development of our railways and manufacturing occurred. Much foreign capital was brought into the United States for use in this development, and during that time and in subsequent years railroad and other securities were largely marketed abroad. The commercial results of this development of railways and manufacturing establishments, including the opening of new field. of production, was an enormous increase in the exportations and a disposition to relatively decrease the importations because the development of manufacturing was making it practicable to produce at home from our own materials much which was formerly brought in from abroad. Thus the great business development of the years 1870 to 1890 had a tendency to stimulate production and exportation, but discouraged importation, and, as a consequence, exports exceeded imports in a constantly increasing ratio. The fact, however, that large sums had been borrowed abroad for the internal developments above alluded to required payments of large sums for the annual interest charges, and thus absorbed a part of the proceeds of the surplus exports. The earnings of foreign capital invested in great enterprises in this country, other than that obtained by the sale of bonds or by direct loans, also require considerable sums for the payment of the dividends and profits of the enterprises in which it was invested. The further fact that internal commerce and investments in internal developments were extremely profitable, reduced and temporarily suspended shipbuilding in the United States, and, as a consequence, the increasing traffic came to be carried more and more in foreign ships, and the payment of the freights thereon, especially the freights upon imports, again absorbed a large additional amount of the proceeds of the excess of exports.

Another factor to be considered is that of the money expended by Americans traveling abroad who usually take their funds in the form of letters of credit, and draw from time to time for such sums as they require, and this, of course, proves an offset to that extent against the balance which would otherwise be returned to the United States in the form of cash.

Until recently these four great factors—(1) the payment of interest on American securities held abroad, (2) the payment of earnings of foreign capital invested in business enterprises in the United States, (3) the payment of foreign freights carried in foreign vessels, especially freights on goods imported into the United States, and (4) the expenditures of Americans traveling abroad—have been considered the chief cause of the fact that the exports of merchandise so much exceeded the combined imports of mechandise, specie and bullion. Within the last two or three years, however, three further factors have apparently been added—(1) the cancelation of American indebtedness abroad, including a return to the United States of the railroad and other securities thus held; (2) the sale of foreign securities in the United States, such as the German, British and Russian securities which were placed upon the markets here during the last year, and in most cases quickly taken to the amount of probably $100,000,000 in the year, and (3) the credits which now stand abroad in favor of our exporters, and which are permitted to so stand because better interest rates could thus be realized than by insisting upon their immediate payment.

The sums of money represented by these various factors which presumably about equal the excess of exports over imports have been variously estimated, and up to the present time no means of obtaining more than estimates have been devised. These estimates usually put the amount paid to foreign vessels as freights on imports at about $50,000,000; interest on, and earnings of foreign capital, $75,000,000 to $100,000,000; money expended abroad by Americans, $75,000,000 to $100,000,000; American funds invested in foreign securities in 1900 about $100,000,000, and credits permitted to stand abroad in 1899 and 1900, each $75,000,000 to $100,000,000, to which must be added the amount of our foreign indebtedness actually canceled by the return of securities for which no definite estimate has, so far as I am aware, been made.

The United States is rapidly increasing her production, especially of the minerals and of manufactures for exportation, while the rapid development of our manufacturing industries steadily reduces the relative importations of manufactured goods, though the raw materials required for our manufacturers, especially those of a tropical and sub-tropical nature which we cannot produce at home, are constantly increasing, as are also the tropical foodstuffs of which we do not produce a suffcient quantity to meet our own requirements. The fact that we are rapidly becoming a creditor instead of a debtor nation will reduce to a minimum and wipe out the annual balance for payment of interest on our securities held abroad, and finally for the liquidation of those securities, and to this extent the absorption of our favorable balance of trade will be rapidly reduced, while the present disposition to encourage the re-establishment of our shipping industry in a sufficient volume to carry our growing commerce seems to justify the expectation that this drain upon our surplus may be at least somewhat reduced in the near future. Our foreign credits, as above alluded to, have increased largely during the last few years, and foreign obligations have been taken by investors in the United States in large sums, but it seems at least probable that two of the factors which absorbed a considerable share of the favorable balance, viz., the payment of interest and indebtedness abroad and payment of freights to foreign vessels, will within a comparatively short time be materially reduced, and thus require a settlement with specie and bullion of a larger proportion of the trade balance than has been the case in former years.

Capital Punishment.

According to a recent special dispatch from Pittsburg, Pa, a measure to change the mode of capital punishment for United States criminals sentenced to death will be introduced at the next session of Congress at the instance of the Allegheny County Medical Society. The bill will prescribe asphyxiation by carbonic acid gas, instead of the hangman's rope and the electric chair. The agitation for a more humane method of execution was taken up by the Allegheny County Medical Society seven years ago, and a committee was appointed. Statistics were gathered to show that the present modes of inflicting the death penalty had a degenerating effect on the inhabitants in communities where the deaths took place. Nervous disorders of extraordinary kind had attacked persons of sensitive temperatment. The Pennsylvania State Medical Society became interested in the investigations and the discussions in that body attracted the notice of other medical societies in this country and in Europe. It is not the object of the bill to make the punishment less terrifying for the criminal's sake.

Wanted the Whole Class.

June *Success* contains an article by President J. G. Schurman, of Cornell University, in which he says: "It is true that there is an increase and, just now, an unusual demand for college-bred men in all walks of life. The prescribed preliminaries to legal and medical education are, step by step, approaching graduation from college, and have reached it, in some instances, while these professional courses themselves have been extended and deepened, till they are now nearly or quite on a par with the old liberal training with which they are co-ordinated in the modern university. As to engineers—15 years ago, the manufacturers of machinery had to be coaxed to take those pioneers, the Cornell men, into their shops and give them a chance. But where one went many followed. Last spring, when the class of 1900 came to graduation, every student in this branch was eagerly bid for two or three times over. One great electrical firm alone asked to be given the entire class. There is observable, too, a gradual increase in the call for college-bred teachers in the public schools, and this demand will grow by what it feeds upon. All this is but the sign and symbol of an increasing complexity and organization in our civilization.

Fig. 1.—The Steamer "Deutschland."

Electric Light and Power Installation on Steamer "Deutschland."

THE fast mail steamer Deutschland, of the Hamburg-American line, can justly be termed a masterpiece of German shipbuilding. All branches of technical industry have been united, and have done their best to attain this splendid result. A prominent share can be claimed by electrical engineering, as the plant for illumination and transmission of power comprises what amounts to a large electric supply station. The entire electrotechnical part was designed and constructed by the Allgemeine Elektricitats - Gesellschaft, Berlin. Two thousand five hundred and fifty incandescent lamps were required for illumination, while 23 electric motors are used for operating the various supplementary machines.

FIG. 2.—SMOKING-ROOM LIGHTS.

Five units are used for generating the required current, each consisting of a vertical compound steam engine of C. Daevel, Kiel, coupled direct to a continuous-current dynamo. The speed of these engines is 250 r. p. m., and the e. m. f. is 110 volts. Three of these steam engines have cylinders 300 and 500 mm. in diameter, with a stroke of 255 mm., while each of the corresponding dynamos gives an output up to 700 amperes. In the remaining two smaller steam dynamos, the diameters of the cylinders are 270 and 450 mm., respectively, and the stroke 200 mm., each of the corresponding dynamos having an output of 400 amperes. The windings of the dynamos are provided with special insulation. The magnet frame is composed of two parts, so as to readily enable the armature to be replaced in the limited space. The commutators are made of a special width and the current is collected by carbon brushes.

Four of the steam dynamos, viz., the two larger and the two smaller ones, are in the dynamo room behind the main engine rooms, between the two propeller shafts (Fig. 5). The fifth dynamo is in a second smaller dynamo room, which is likewise accessible from the main engine room, but situated on the main deck above the water level (Fig. 4). By this arrangement sufficient illumination is given by the upper machine, even if the lower machines are prevented from supplying current. The current is conveyed from the four dynamos through iron-wire armored lead and rubber-covered cables to the main switchboard situated in the same room. The current is also conveyed in a similar manner in the upper engineroom to the smaller switchboard located therein; and from these switchboards to the main circuit. This is composed of three principal parts, viz., the so-called pilot lighting plant, the general lighting plant and the plant for transmission of power.

The pilot lighting system comprises all the lamps which are required for service, and also for the safety of the vessel, passengers and crew, especially for the illumination of the engine and boiler rooms; also the lamps which are required for harbor duty, for cleaning the saloons, and for the cabins of the crew. All the remaining lamps are connected to the circuit for general illumination. The circuits of the pilot lighting plant are fed from the switchboard in the upper dynamo room, while the general lighting and the power circuits are fed from the main switchboard in the lower dynamo room.

Since the dynamos are not worked in parallel, the arrangement is such that by means of four-part two-way switches each of the lower dynamos can be connected up to any circuit of the general lighting or to the bus-bars of the power plant. By a similar switch it is, however, also possible to connect up each dynamo onto the switchboard in the upper engineroom, i. e., to the pilot lighting plant, for which purpose, a trunk main is provided between the upper and lower switchboards. This conductor is in direct connection with a two-way switch, by means of which any one of the lower dynamos or the upper dynamo can deliver its current to the upper switchboard. Consequently, by this system of connection any desired transmission of current can be effected in a simple manner, and an arrangement is provided whereby any one dynamo can be readily substituted for another.

Dead-beat instruments made by the A. E. G. are used as measuring instruments as they work accurately in any position, notwithstanding the rolling movements of the vessel. The main conductors, leading through the boiler and enginerooms and through the bunkers are rubber and lead-covered cables armored with iron wire, secured to the hull of the vessel. Wires provided with a strong seamless rubber insulation and laid in impregnated wood casing serve as main conductors in the remaining compartments. Where the conductors enter water-tight bulkheads, they are fixed in metal stuffing boxes mounted in the bulkhead.

In the engine and boiler-rooms, the conductors are connected as a ring main, to which are attached water-tight boxes for the single lamp circuits. Each box contains eight branch circuits, each for one lamp, with the necessary safety fuses and cut-outs. The cables are made water-tight within the box by means of stuffing boxes, the lid of the latter being likewise made water-tight by means of an india rubber packing and two screws. Each of the conductors leading from these boxes and intended for one lamp, consists of twin iron-wire armored, lead-covered cable with 2 by 1.5 square millimeters sectional area of copper.

FIG. 3.—ILLUMINATION OF MAIN SALOON.

The lights for the engine and boiler rooms are provided with pro-

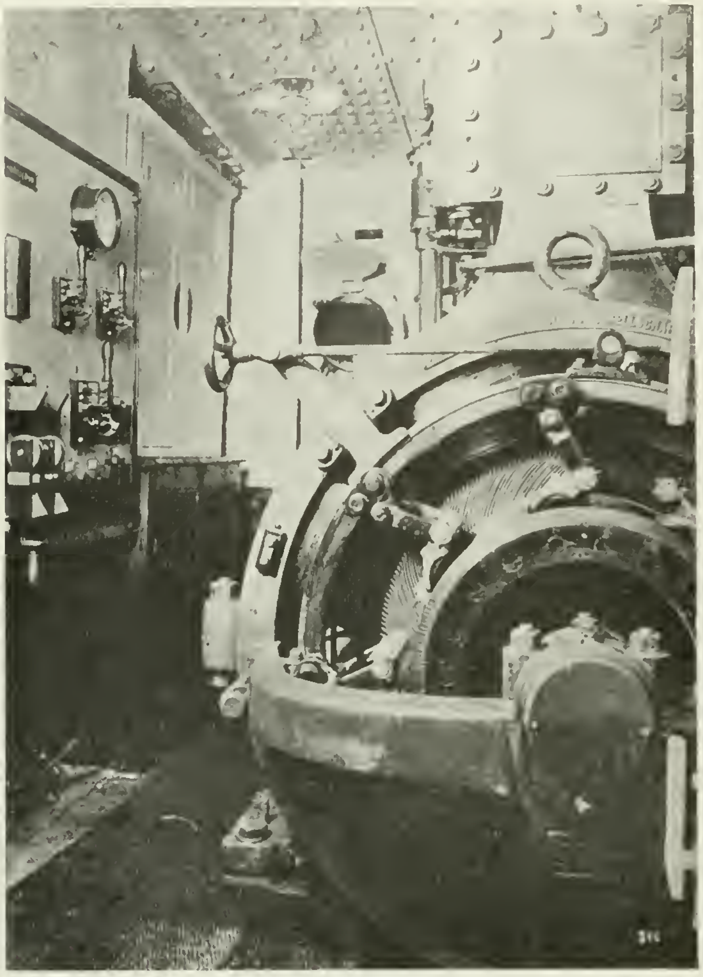


Fig. 4.—Smaller Dynamo Room.

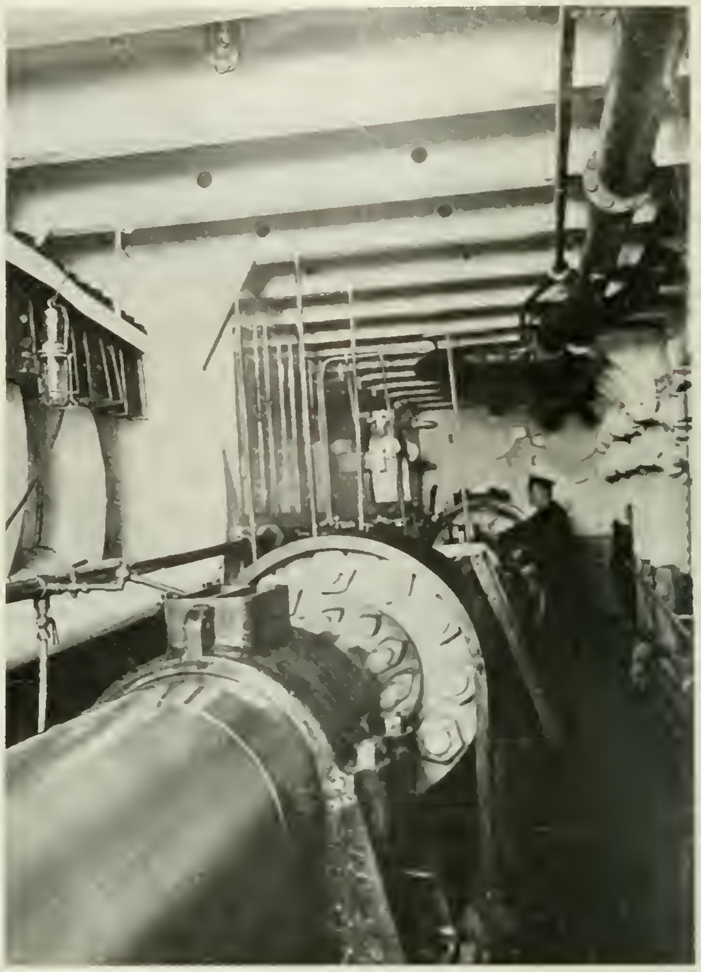


Fig. 6.—Lighting in the Shaft Tunnel.

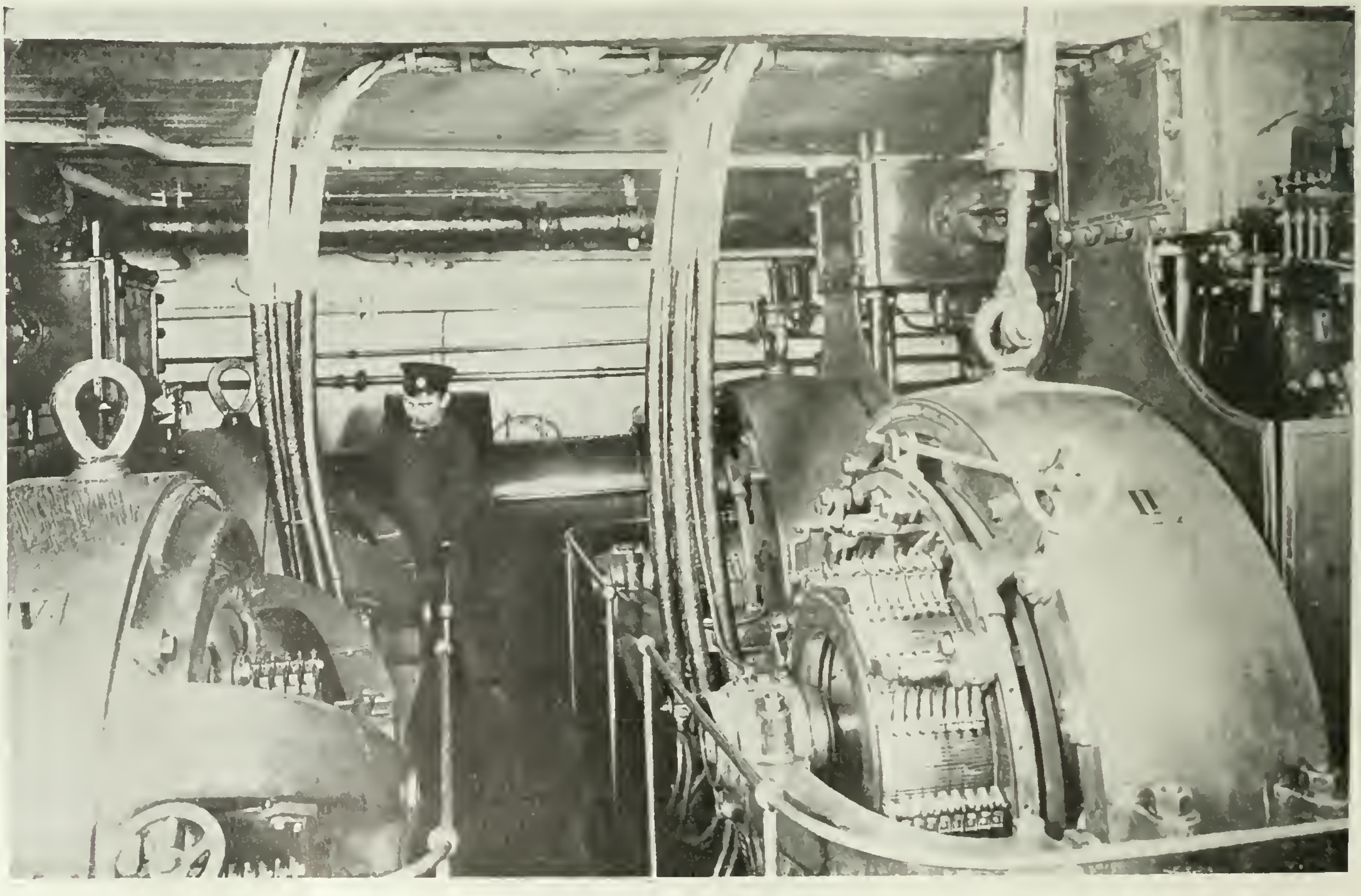


Fig. 5.—Main Dynamo Room.

Electric Light and Power Installation on Steamer "Deutschland."

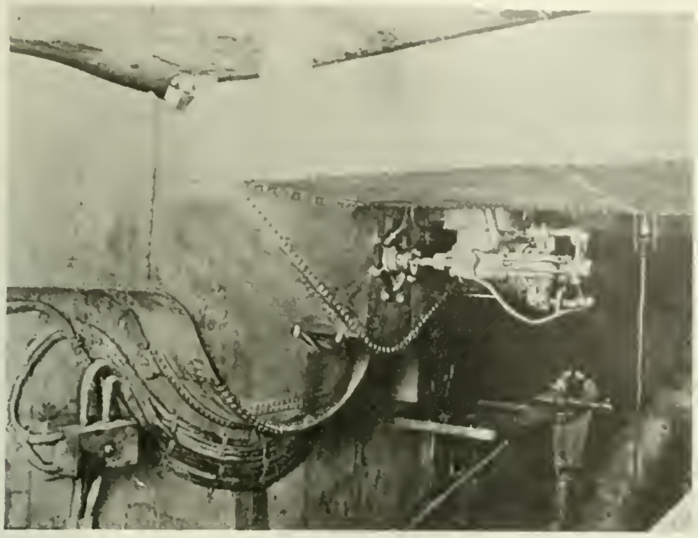


FIG. 7.—A VENTILATING MOTOR.

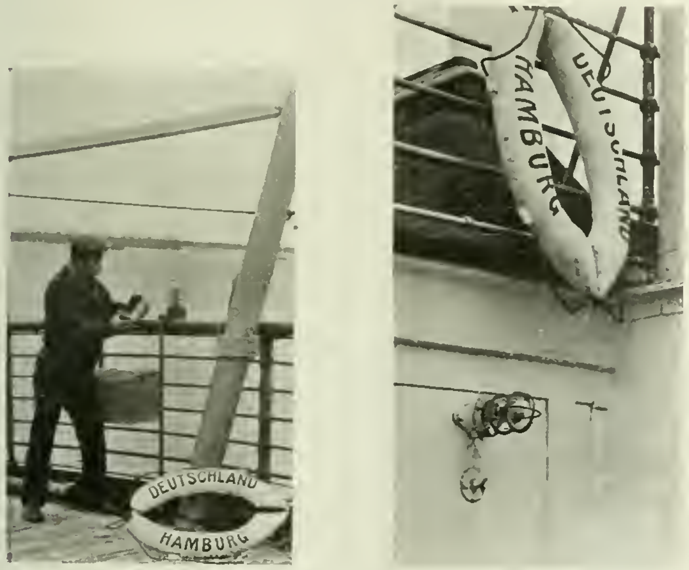


FIG. 8.—BUOY AND SIDE LIGHTS.

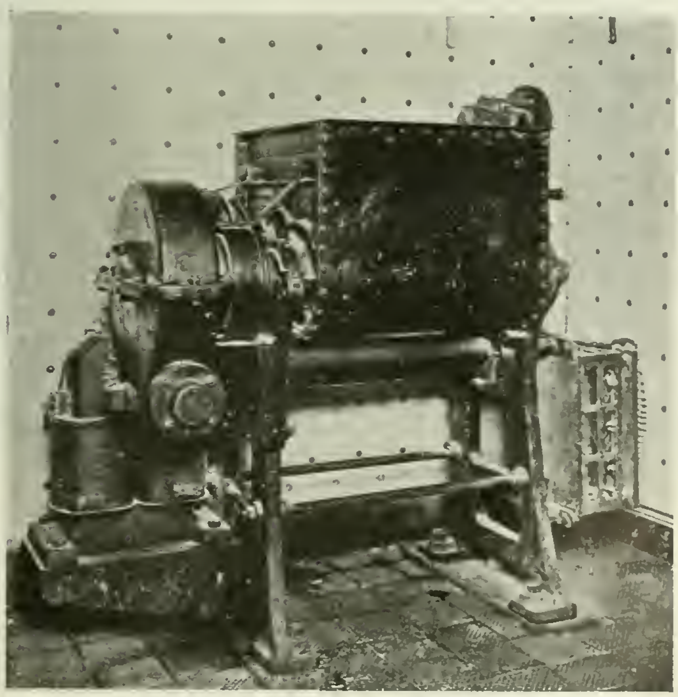


FIG. 9.—KNEADING MOTOR FOR SHIP'S CONFECTIONER.

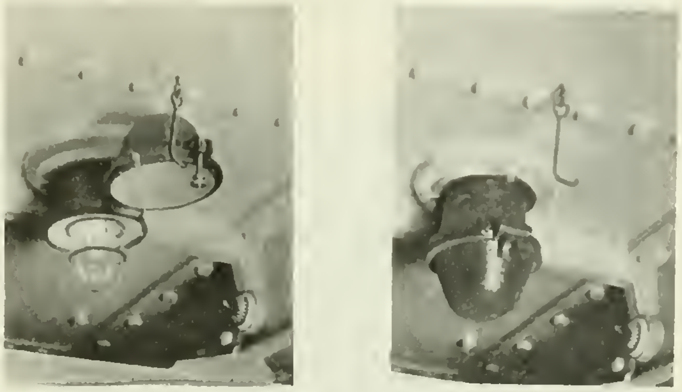


FIG. 10.—LAMPS IN STEERAGE AND STORAGE.

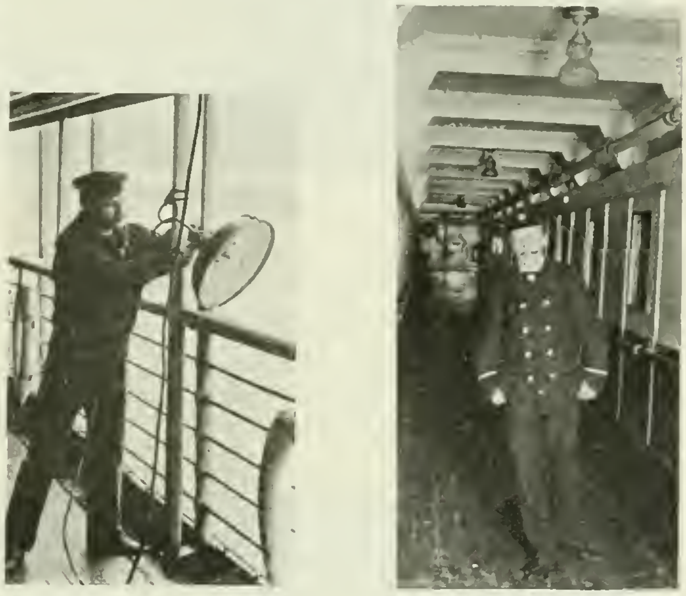


FIG. 11.—PORTABLE DECK CLUSTER REFLECTOR AND CORRIDOR LIGHTS.

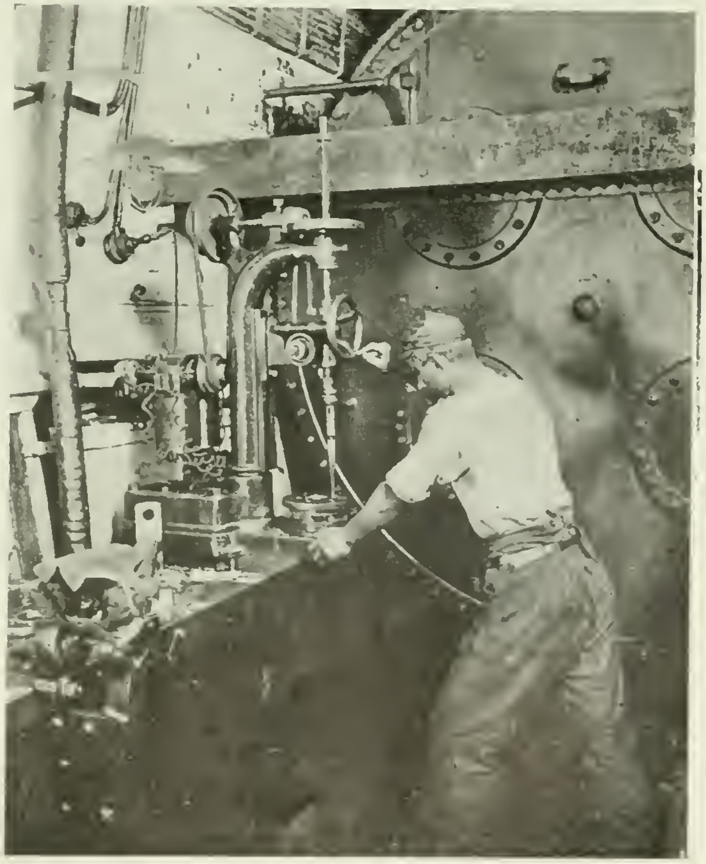


FIG. 12.—MOTOR IN ENGINE-ROOM.

ELECTRIC LIGHT AND POWER INSTALLATION ON STEAMER "DEUTSCHLAND."

tecting glasses and wire baskets. They are secured either directly to the bulkhead, or if situated near the center of the engineroom they are connected to long, bent gas pipes. In every case the cables are inserted water-tight. In addition to the fixed lamps, there are numerous water-tight contact plugs for portable hand lamps. The lighting of the shaft tunnels and of the hold for the cargo is arranged in a similar manner, some of the fittings being provided with reflectors.

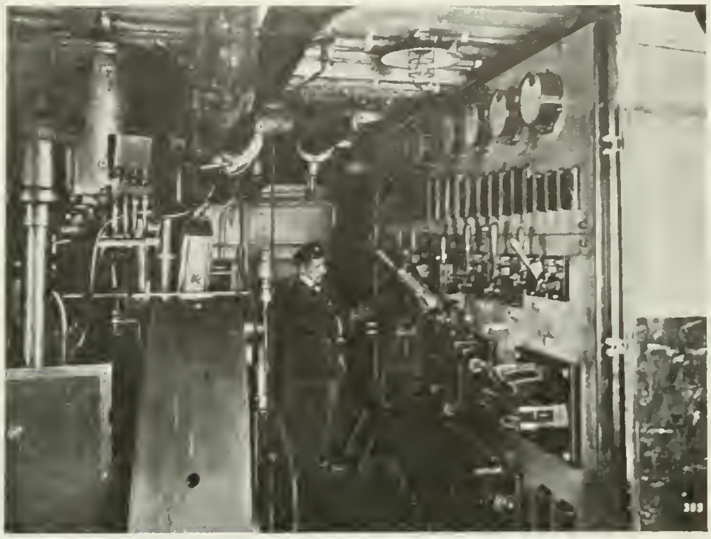


FIG. 13.—MAIN SWITCHBOARD.

As in the branch-circuit boxes in the engine and boiler rooms, there are provided in the remaining parts of the vessel distribution boxes, from which the conductors lead to the lamps. A large number of lamps are, however, always connected up to each single circuit. The boxes are distributed in such a manner that those spaces, which, by their position or their use constitute a group, have always one common distribution box. Each box consists of a marble slab, upon which the necessary switches and safety fuses are provided, and embodies both the pilot lighting and the general lighting plant, for which the back part is provided with separate bars having a separate current supply (Fig. 14).

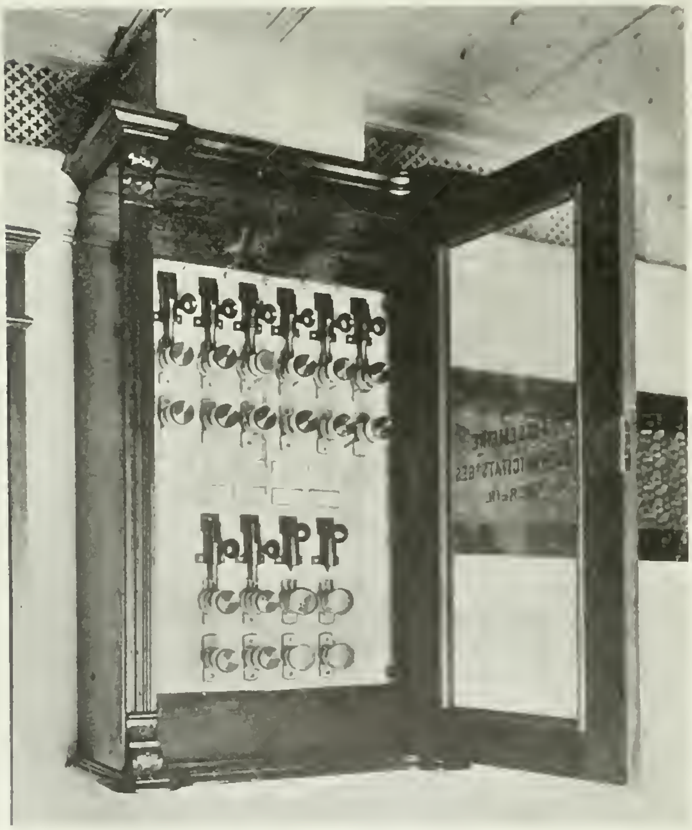


FIG. 14.—A DISTRIBUTION BOX.

The connection of all the conducting wires takes place at the back of the distribution box, from whence the wires are led into the adjoining wood casings. The boxes are made of polished teak wood and have doors with panes of glass. The single switches are provided with small plates, on which the individual circuits are indicated. All circuits are secured by 10-ampere plug fuses.

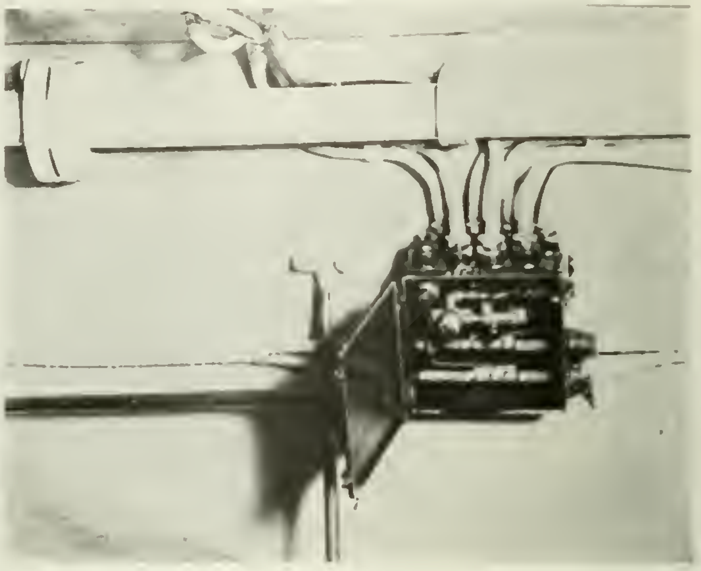


FIG. 15.—WATER-TIGHT BOX, ENGINE AND BOILER ROOM.

The distribution of the circuits is such that, on an average, six incandescent lamps are switched on one circuit, and in the cabins up to six contact boxes are provided. Only in the saloons, where electroliers having several lights are used, do circuits up to 12 lamps come into consideration. Each passenger cabin contains a lamp with two on and off switches, one being provided on the door and the other at the head of the berth. There is also a wall plug for a curling tongs heater or for ventilating fans.

FIG. 16.—LIGHTING ON PROMENADE DECK.

The staterooms are more amply provided with electric light, and the same remark applies to the sitting rooms of the captain, chief engineer, assistant engineer, first mate and physician. The staterooms are also furnished with electric-heating apparatus, stoves being provided in the sitting, sleeping and bathrooms. Those passenger cabins which face the sea and consequently have the benefit of daylight, are also connected to the general lighting plant, while those located towards the interior of the ship and consequently dark in the daytime, are connected to the pilot lighting plant.

The lamps in the rooms for the steerage passengers are provided with water-tight protecting glasses and wire baskets, like the engineroom lights. They have, however, also a cast-iron protecting casing, which is opened when the rooms are occupied by steerage passengers, but can be closed when these rooms are employed for stowing cargo. In the gangways between the cabins are provided more artistic fittings, with dim glass globes (Figs. 10 and 11).

In the numerous rooms which are furnished in gorgeous style for the general use of the first-class passengers, the electroliers are of elegant construction, while all the electric leads are fixed behind the woodwork of the ceiling and walls. Special reference may be made to the first-class saloon in the middle main deck, the large lightshaft of which extends through all the three superposed decks (Fig. 3). The first-class drawingroom and first-class smoking saloon on the promenade deck are also provided with the electric light in a manner suitable to their requirements (Fig. 2).

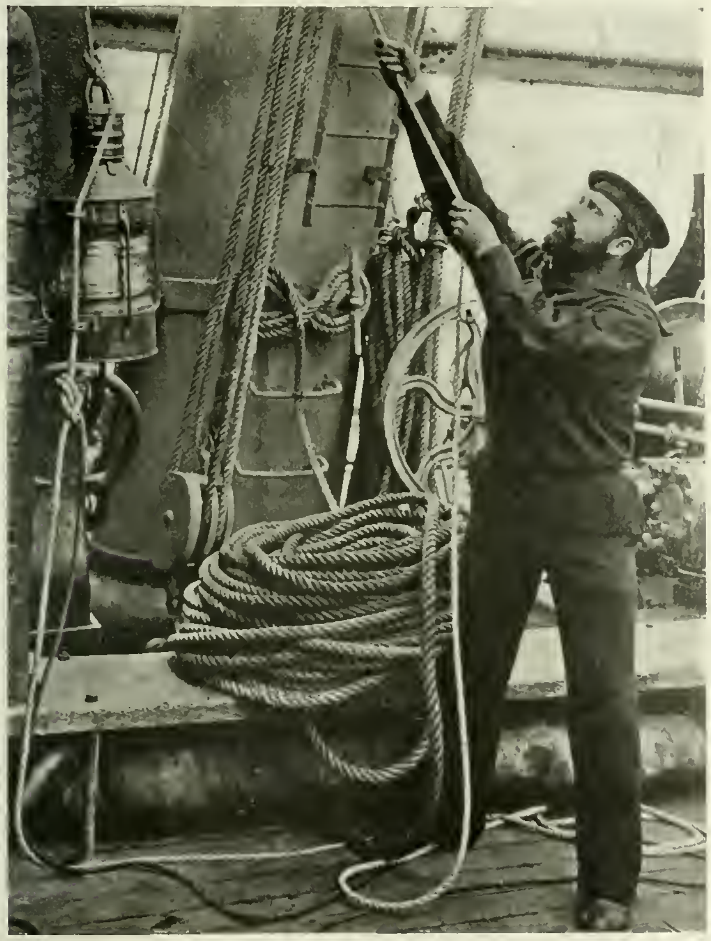


FIG. 17.—HOISTING THE MAIN TOP LIGHT.

The promenade deck which is practically open (Fig. 16), is provided with special flat water-tight fittings. Near the cargo openings, coal doors, likewise suituated on the promenade deck level, are provided water-tight plugs for connecting hand lamps and reflectors, which are employed for illuminating the promenade deck during loading and unloading; when getting coal on board and also on special occasions. All the signal lights are operated with electric lamps, especially the two ship's side-lights and the main top light. The latter is secured to the mast by means of a rope, the current being supplied through a flexible cable (Fig. 17).

In order that the captain or officer on duty may have constant knowledge that these lamps, which are most important for the safety of the ship, are burning properly, they are directly connected to an electromagnetic controlling apparatus, located on the bridge deck. This apparatus has three openings, which are closed by white, red or green panes of glass, and show the same color when the corresponding signal lamps are burning, while that pane of glass is immediately obscured when the circuit of the corresponding signal lantern fails. The poop lantern and some lamps on the fore and quarter decks are constructed like the engineroom lights.

The power transmission plant of the Deutschland comprises 23 motors. More than half of these serve for driving fans for the ventilation of the different lower rooms of the vessel. Two of these ventilators, which are erected on the upper deck provide for the fresh air supply in the cabins of the engine drivers and stokers. Four other larger fans serve for ventilating part of the stoke hold. The motors, the shafts of which are coupled directly to the shafts of the fans, are suspended from the ceiling of the boiler rooms. Nothwithstanding the coal dust, which is, of course, always present, and the unavoidable accumulation of moisture and dirt, the motors run constantly and quite satisfactorily, without special attention or supervision. Besides various elevators for coal, provisions, mail bags and the like, a kneading machine in the confectionery department is operated by a motor, with worm gearing. The starting resistance is situated close to the motor. In the enginerooms there are two electrically-driven drilling machines used for making small repairs during the voyage (Figs. 7, 9 and 12).

For all parts of the electric plant, the necessary spare parts are also on board, and a special set of men attend to the entire electrical apparatus on board under the supervision of two electrical engineers. Since the Deutschland was commissioned for service, the electric apparatus has been working day and night continuously and satisfactorily.

Installing the Electric Conduit System on Broadway, New York.

In a brief seven or eight years the cable has quite outgrown its usefulness on Broadway, New York City, and this week is being replaced by the conduit trolley from the Battery to Central Park. Large numbers of men have been thrown on the work, which President Vreeland is driving with all his wonted energy. The Metropolitan Street Railway Company's officers hope that all the electric cars will be in operation by the middle of the week. Under the surface of Broadway there are between four and five thousand moving parts, all of which were removed before the conductor-bars for electrical traction could be put in place. For instance, on the Tenth Street curve there were 40 wheels; on the Fourteenth Street reverse curve there were 350 wheels between the Morton House and Tiffany's; on the Seventeenth Street curve there were 40 wheels; thre were great terminal wheels, 12 ft. in diameter, at South Ferry, at Houston Street, at Thirty-sixth Street, and at Fifty-ninth Street. As these wheels were built into the road and were set before the track was laid, it was necessary to break them up in the pits into pieces small enough to be removed through the openings.

The 3500 small sheave wheels on which the cable rests along the straight runs of the road also had to be removed through the manholes. About 200 electrical connections had to be made, 8000 plugs removed, and between 36,000 and 40,000 bolts set, before the current was turned on; and none of this work could be done until the cable, which aggregates in length 117,000 ft., and weighs about 3½ lbs. a foot, had been removed. The new material was all ready and waiting.

Yerkes and a London "Rustler."

There are Western "rustlers," but London has them, too. It is reported that one morning not long ago Mr. C. T. Yerkes, who is now engaged in London on underground railway enterprises, received the following letter: "Dear Mr. Yerkes: I have seen by the papers how rich you are, and also I have seen your picture, which looks kind. So I thought I would tell you that my parents are poor, and depriving themselves of many comforts in order to give me a good education. Among my school friends there is a gymnastic club, of which I am a member, and all the girls wear silk skirts; and it gives me the horrors to feel I can't have one, when I hear the fascinating rustle of their petticoats. Would you send me $5 to buy one? Yours, etc."

Mr. Yerkes received the unique epistle from his secretary and, to the latter's astonishment, exclaimed: "Send her the money. It will give more pleasure than if invested in any other way."

The money was sent, and the acknowledgment was as follows: "Dear Mr. Yerkes—Thanks so much for the money. I invested it, and can now rustle with the others."

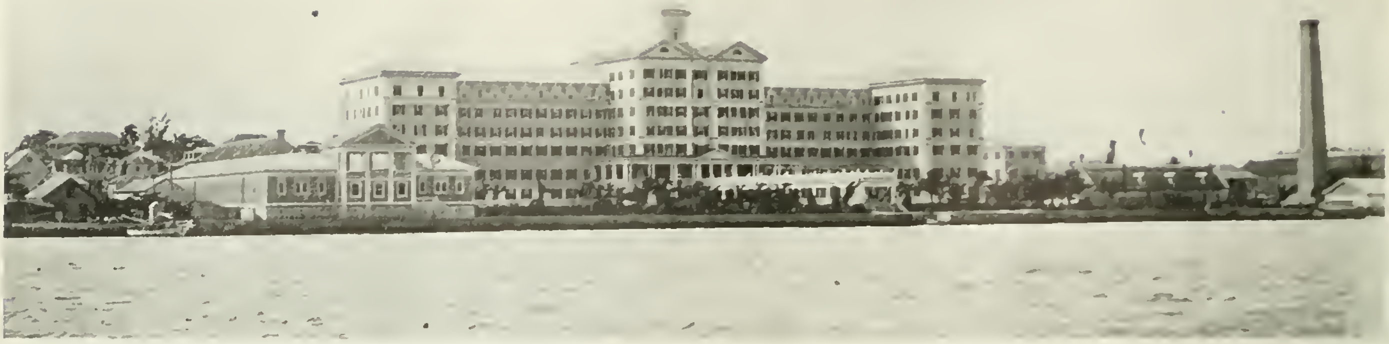


Fig. 1.—Colonial Hotel, Nassau, Bahama Islands.

An Isolated Plant at Nassau, Bahama Islands.

HENRY M. FLAGLER, well-known through his connection with the Standard Oil Company, has probably gained his widest reputation from the many business interests which he has developed in the State of Florida. Mr. Flagler, aside from developing the agricultural conditions of the State and building a railroad running throughout its length, has expended millions of dollars in providing comfortable and luxurious hotels along the 300 miles of the eastern coast of Florida. These hotels are the means of such enjoyment and health to those who winter on the "American Riviera," that Mr. Flagler may be said to have attained the object of the search of the famous historic explorer in Florida, and discovered the Fountain of Youth.

Mr. Flagler's efforts as "host" in the United States have been so much appreciated that he recently determined to extend his hotel system and enter British territory. About two years ago he purchased what is now the Royal Victoria Hotel at Nassau, Bahama Islands. This old hotel was remodeled and immediately proved so attractive a resort that it was found necessary to erect a new, larger and in every respect modern hotel, which was opened a little over a year ago and christened the "Colonial" (Fig. 1). To-day rumor says Mr. Flagler is to further extend his influence and has already entered into a contract with the Mexican Central Railroad to build and operate a number of large hotels in Mexico, and there is also talk of his erecting hotels in Cuba.

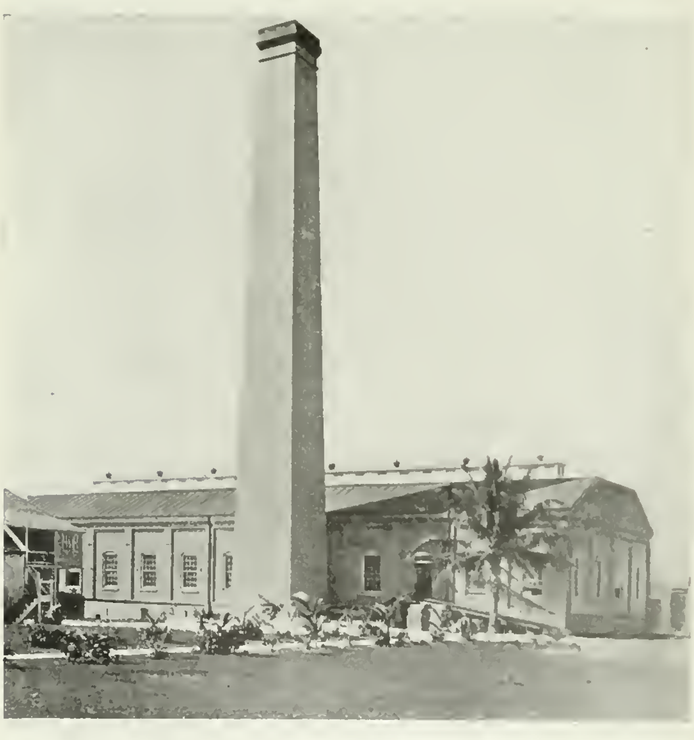


FIG. 2.—EXTERIOR OF POWER HOUSE.

The Royal Victoria Hotel at Nassau, is located on an eminence overlooking the small but beautiful land-locked harbor. It is the same old hostelry, famous in Civil War times as the headquarters of blockade runners carrying cotton out of the Confederate States. The new hotel, the "Colonial," is erected on ground formerly occupied by Fleming's Square and the Government barracks. It is built in the form of a letter E, facing and located directly on the shore of the harbor.

Nassau is not well equipped for providing the many and varied wants of the capricious and exacting winter tourist; consequently, nearly everything that a hotel requires must be imported from the United States or manufactured on the hotel grounds. To supply both the Victoria and the Colonial with light, power, steam and ice, it was decided to erect a large and suitable modern power house, the equipment of which is the subject of this article.

The general exterior appearance of the building is shown in Fig. 2. It will be noticed that ample ventilators in the roof are provided, as the temperature inside, even in winter, with everything open, frequently reaches 110 degs. or 115 degs. The plans of the power house and ice plant are shown in Fig. 3. As seen, the dynamo room is separated from the boiler room by a brick partition extending clear to the roof.

In the boiler room are three 200-hp Babcock & Wilcox water-tube boilers furnishing steam at 150 lbs. pressure. Space has been left for a fourth unit to meet future demands. All the boilers are equipped with Murphy automatic stokers and a special coking furnace designed to consume the garbage received from the hotels. No convenient method for disposing of the hotel garbage was economically available, as it could not be buried, owing to the coral formation of the islands. It was therefore considered necessary to arrange to burn the refuse in order to dispose of it. In practice, however, it has been found that the native islanders are glad to take the garbage for "home consumption," and in consequence the demands on the refuse destroyer are comparatively few.

The power house stack is 125 ft. in height and 5 ft. inside diameter. It is built of brick imported from the United States. The boilers are connected with the stack by an underground brick oval flue.

In the dynamo room are four Ball & Wood 10-inch and 20 by 16-inch tandem compound condensing engines, each direct connected to a 100-kw General Electric two-phase, 60-cycle, 2100-volt alternator, running at 225 r. p. m. The generators are of the revolving field type, with direct-current compounding devices. There are two surface condensers of the Wainwright type, each capable of taking care of two engines. Salt water for condensing is taken direct from the harbor. There are two special horizontal 300-hp heaters for feed water, which are of the even-flow corrugated seamless tube Wainwright type; also one Webster 800-hp combined heater and filter. The condenser pumps, boiler feed pumps and all the pumps for house supply and fire use are of the Deane manufacture. Those used in connection with the ice plant were furnished by the Stilwell-Bierce & Smith-Vaile Company. The high-pressure steam piping is all of extra heavy pattern, and was completely laid out, cut and fitted in New York before shipment. All drips are returned to a partitioned hot-well where the oil is separated and the water again used in the boilers.

On account of the formation of the island, all drinking water and that used for ice-making at Nassau must be accumulated during the rainy season, which is over about the time the hotels open for winter tourists in December, and stored in cisterns. Ocean water is used for condensing and fire purposes. Wells dug on the island yield a brackish water, which, after treatment in purifying apparatus furnished by the We Fu Go Company, is suitable for flushing in the hotels and supplementing the rainwater used in the boilers.

As coal of very ordinary quality costs in the neighborhood of $7 per ton delivered at the power house in Nassau, the question of steam economy was a very important one, and determined the engineers in deciding not only that a condensing plant was necessary, but also that all small power units should be driven by motors rather than by small steam engines. It was found that with the economy guaranteed for the 150-hp direct connected units, less steam per horse-power would be required in operating motor-driven pumps and an ammonia compressor, located even directly alongside of the generators in the dynamo room—taking into consideration the various losses in transformation through the generators, switchboard, transformers and motors—than would be consumed by small steam pumps or a direct-acting compressor of moderate cost. The pumps installed are used for taking the rainwater from the cisterns and distributing it for the various uses throughout the hotel; also for supplying water to the ice-making plant and brine to the refrigerating boxes in the hotel, etc.

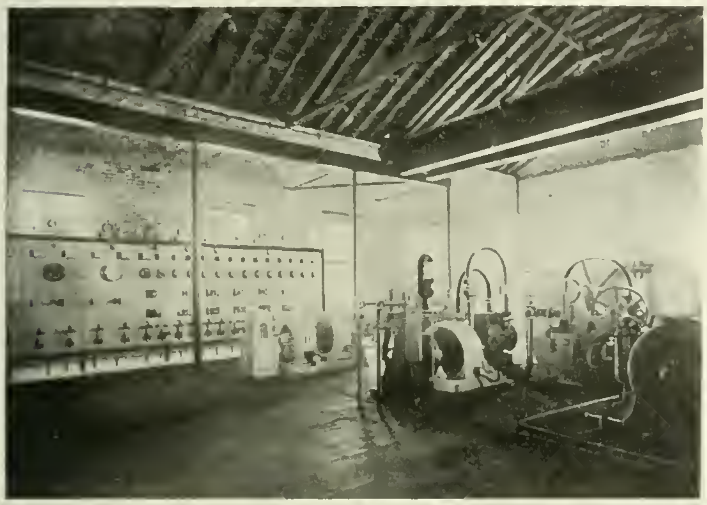


FIG. 3.—ELECTRICALLY-DRIVEN PUMPS.

Because of the poor economy of a small engine, a direct-connected polyphase motor-exciter set was installed, and is used for supplying the field currents to the alternators under the usual conditions of operation. A duplicate exciter, direct-connected to a 7 by 6 Forbes vertical engine is used for furnishing direct current when first starting whenever, for any reason, the plant has been completely shut down. Both of these exciter sets are shown in the foreground of Fig. 3. The exciters and all the motors used in the installation were furnished by the General Electric Company.

On account of the distance of the hotels, particularly the Royal Victoria, from the power house and because of the comparatively large amounts of energy distributed and the further possibility of municipal lighting being undertaken, it was found desirable to use polyphase currents, and the two-phase system was adopted, using 60 cycles and 2100 volts.

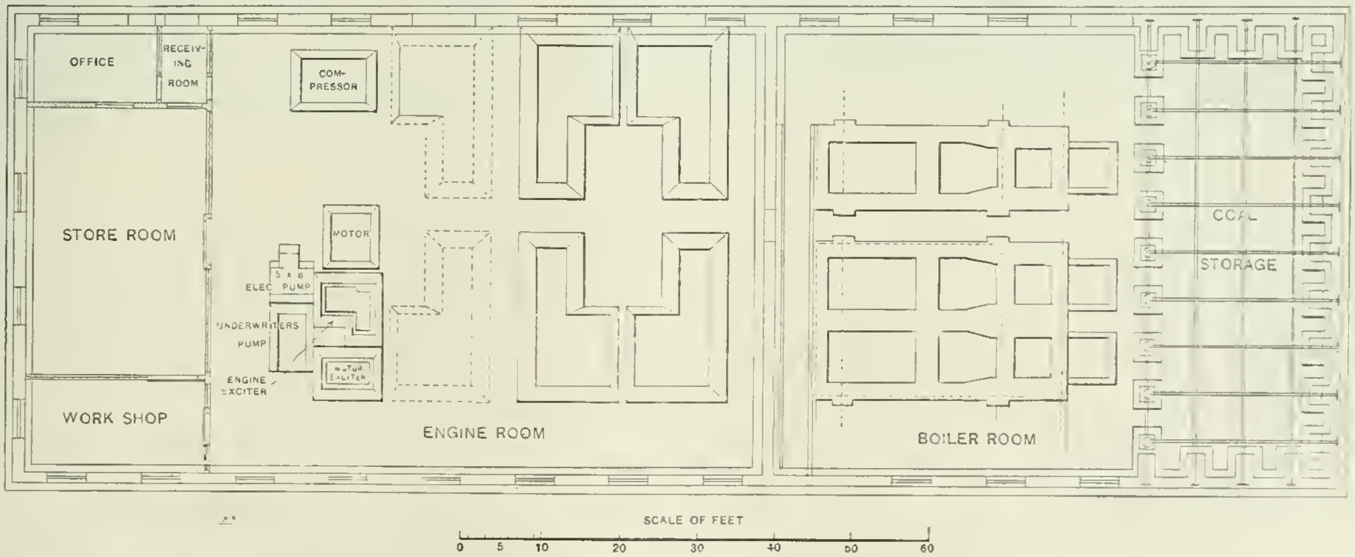


FIG. 4.—PLAN OF ENGINE AND BOILER ROOMS.

Owing to the large number of feeder circuits and the use of polyphase currents, the switchboard is necessarily somewhat elaborate, as it is supplied with every necessary device for controlling, measuring and distributing the current to the various points at which it is used. The board is built of Italian marble mounted in an ornamental bronze frame and consists in all of 20 panels, of which seven are used for single-phase lighting, six for two-phase motor circuits, four for the two-phase generators, one for the exciters and one for power-house lighting, leaving one blank panel for an additional generator. Perhaps the points of special interest with regard to the switchboard are that the feeders are all equipped with circuit-breakers instead of fuses. The two-phase, four-pole high-tension dynamo-changing switches are equipped with double-spade handles of especially compact design gotten up by Mr. Floy, of the firm of consulting engineers for this plant, and the board throughout is provided with two sets of bus-bars, each consisting of four conductors permitting the separation of the motor and lighting loads when desired. Each of the generator and feeder panels is equipped with a recording wattmeter so that the output of the generators and the consumption of energy on the separate lighting or power circuits is accurately recorded. The total length of the board is 54 ft. The board complete was built by the H. Krantz Manufacturing Company, and in view of its complexity and the short time allowed in which to fill the order, much credit is due the manufacturer.

The underground system of distribution is used exclusively, and Fig. 9 shows the relative position of the hotels and power house, and the location of the underground system. Iron pipes connect the power house with the Colonial Hotel, but from the latter to the Hotel Royal Victoria are installed four-duct conduits, manufactured by the American Vitrified Conduit Company, with McGregor manholes.

Oil transformers of large size, 2100 to 112 and 224 volts, manufactured by the Pittsburg Transformer Company are used throughout the installation for both motor and lighting work.

The refrigerating plant was furnished by Messrs. Westinghouse, Church, Kerr & Co. It has a total capacity of 25 tons of refrigeration, of which 20 are for ice-making and 5 tons used in refrigerating boxes in the kitchen, and barroom of the Colonial Hotel. The plate system with brine circulation in both ice-making and refrigerating is employed. The ammonia compressor, which is of the quadruplex single-acting type running at 80 r. p. m., has cylinders 10½ inches in diameter, with 10½-inch stroke. The compressor is provided with a heavy band-wheel and belt-driven from a 50-hp induction motor. On account of the high temperature of the ocean condensing water, the compressor is rather larger than might be necessary under other conditions, but it is so arranged that two of the cylinders may at any time be disconnected and thus operated under half capacity. In the ice-plant building are located the necessary motor-driven pumps for continuously supplying and circulating the water during the freezing process; also for forcing it through a circulating filter which is used to eliminate impurities in the water rejected in the plate system of freezing. The ice-tank is built of and lined with selected yellow pine dressed all over. The ammonia condenser is of the vertical atmospheric type, made up of extra heavy pipe with special cast-steel headers. For separating the ice from the coils steam cutters are used.

A geared traversing hand hoist with overhead ball bearing trolley and rail supported from the roof, permits the easy lifting of the ice from the tanks and transporting it to the cutting-up platform. In one end of the ice-plant building is an ice-storage having a capacity of 75 tons. The ice plant is run continuously 24 hours a day during the hotel season, any excess ice being offered to the townspeople, by whom it is eagerly sought, as there is no other ice-making plant in the Bahama Islands.

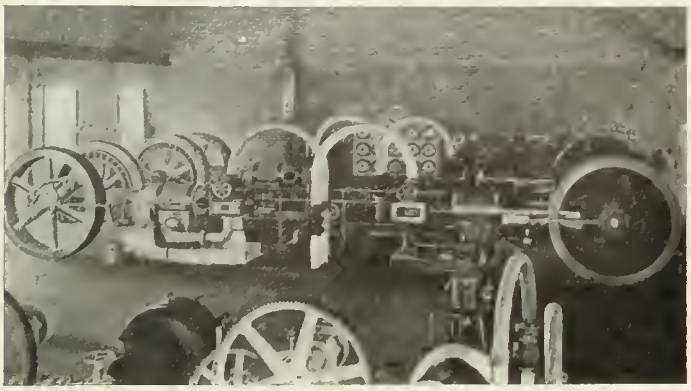


FIG. 5.—VIEW OF ENGINE ROOM.

Close adjoining the power house is a complete machine shop equipped with a lathe, drill-press, planer, etc., all power being furnished by a 10-hp polyphase motor.

The hotels have been furnished and equipped with all the modern improvements, such as electric call bells, electric fire-alarm systems, electric lights, electric elevators, electrically-driven printing presses in the hotel printing office; also electric irons and power in the laundry and live steam for furnishing hot water in the laundry, kitchen and bathrooms and also for cooking in the kitchen. The hotel grounds and piazzas are elaborately lighted by electricity.

The electric elevators in the Hotel Colonial are one passenger, one combined passenger and baggage and one laundry elevator; in the Hotel Royal Victoria, one combined passenger and baggage elevator, all furnished by the Otis Elevator Company and operated from two-phase motors. The passenger and baggage elevators have a speed of 150 ft. per minute, and the laundry elevator 100 ft. per minute. The elevator engines are of the drum, gear type, with a phosphor bronze worm-wheel engaging a solid steel forged screw. The elevators are provided with automatic safety stops for the upper and lower landings, and automatic electric controllers which regulate, independent of the operator, the rapidity with which the cars accelerate. Of course, each car is counterbalanced and equipped with the most approved form of safety appliance. The passenger cars are of ornamental wrought iron and mahogany, equipped with electric lights and annunciators.

For the drawings and illustrations which accompany this article, as well as for the details described, we are indebted to Mr. Henry Floy, of Floy & Carpenter, the consulting engineers, who had charge of both the design and installation of the entire equipment.

Automobile Mail.

Experiments are being made in Chicago by the Government with automobiles for and to mail carriers in delivering the mail. Some of the large buildings and firms in Chicago several blocks from the post office or sub-stations have such a volume of mail that it has become a great burden for the postmen to carry their mail sacks from the post office to the point where they begin to distribute the mail. It is thought that automobile buses for the carriers would improve the service and experiments are being made with a couple of such buses.

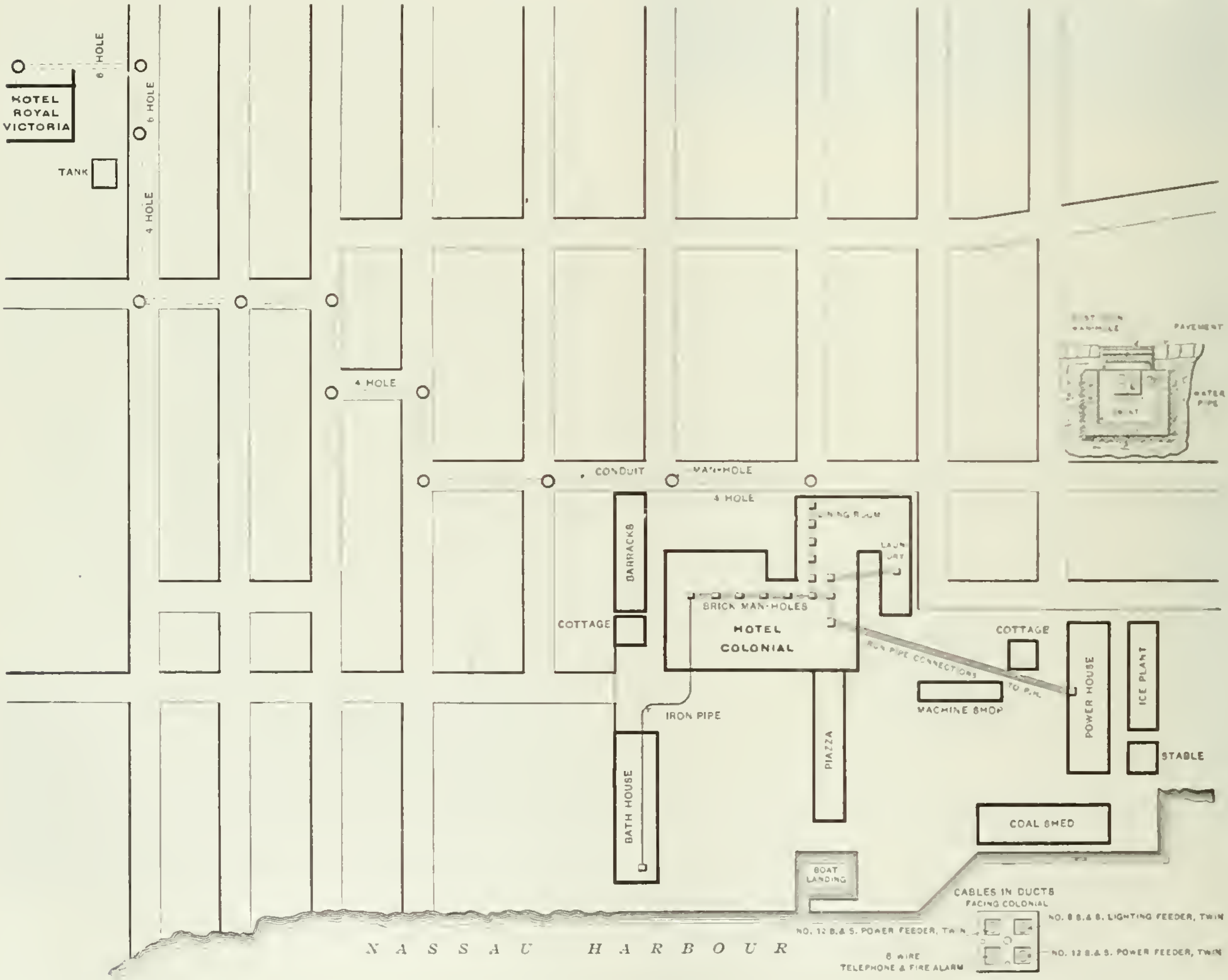


FIG. 6.—DIAGRAM OF WIRING CONNECTIONS OF HOTELS.

The New Trolley System in Glasgow, Scotland.

ONE of the latest and most important trolley systems to be installed in Great Britain is that at Glasgow, the second city in the country. The system is operated by the municipality under the direction of Mr. John Young, who is the general manager. The consulting engineer for the work has been Mr. H. F. Parshall, so well known on both sides of the Atlantic. The power house, at Pinkston, on the Dundas branch of the Forth & Clyde Canal, is built of steel frame supplied by Riter & Conley, of Pittsburg. The building is 244 ft. long by 200 ft. broad, by about 88 ft. high from the basement to the top of the walls. Each of the three rooms extends the whole length of the building, the boiler room being on the east side, with a width of 84 ft. The engine room, in the center, is 75 ft. wide, and the auxiliary plant room, on the west side nearest the canal, has a width of 40 ft. The heights of the various parts of the building vary also, that of the boiler room being 70 ft., that of the engine room 64 ft., and that of the auxiliary room being 52 ft. The two chimney stacks, which are of brick, ornamented with stone, have an internal diameter of 16 ft., lined with firebrick, and are each 263 ft. high. The general design of the whole plant is excellent.

The boiler house contains eight batteries of two boilers each Babcock & Wilcox, in two rows facing each other, with the firing floor between. Each boiler has a total heating surface of 5137 sq. ft., and is constructed for a steady working pressure of 160 lbs. per square inch. The headers are provided with handholes placed opposite the end of each tube to permit of tubes being cleaned or renewed, each handhole being provided with cap fastened with bolt and clamp and cap nut. The sections are connected at each end to two steam and water drums 48 inches in diameter, by means of 4-inch tubes of suitable lengths, and at one end with a mud-drum for receiving any deposit. The boilers are suspended from wrought iron girders resting on columns independent of the brickwork, which allows for free expansion and contraction. Each boiler is fitted with the B. & W. patent steam superheater, and patent mechanical chain grate stokers. The latter are worked by main shafts in the basement, which are operated by 30-hp electric motors. The coal is fed to the boilers from overhead bunkers capable of holding about 2400 tons, these bunkers being filled by two gravity chain bucket conveyors constructed by the Mirrlees, Watson Company, Limited, of Glasgow. Each conveyor can handle 50 tons of coal per hour.

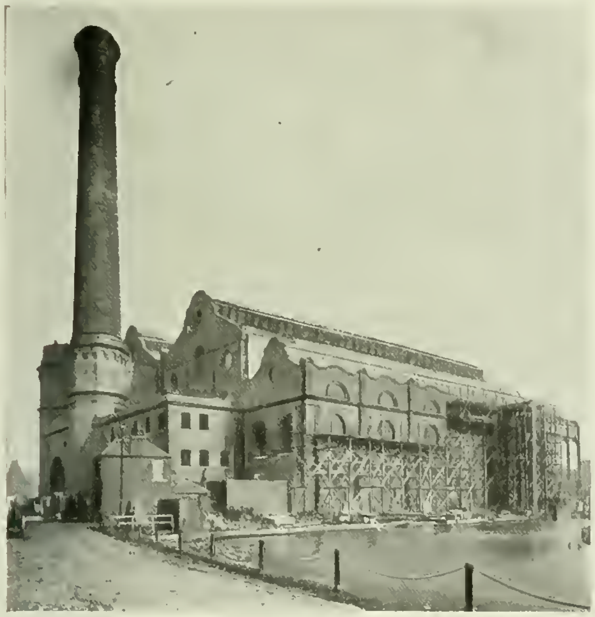


FIG. 1.—SIDE VIEW OF POWER STATION.

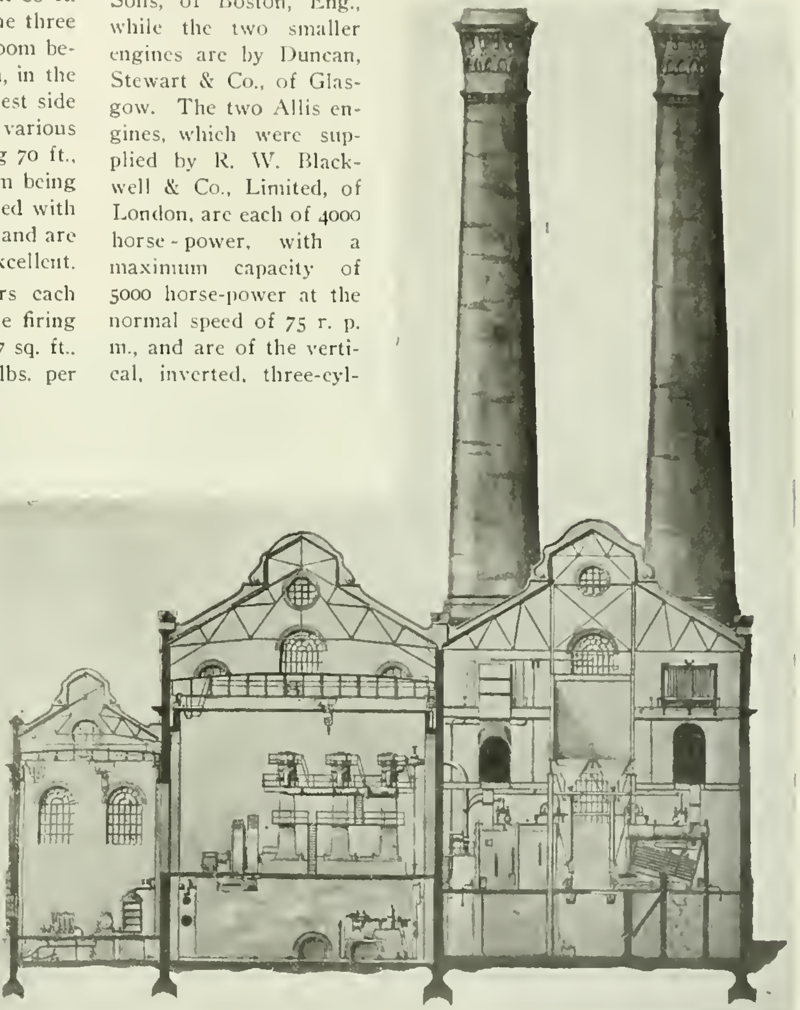


FIG. 2.—CROSS SECTION OF POWER STATION.

The boilers are fed from two large storing tanks situated between the two chimneys, and which are supplied from the ordinary public water service. These tanks, which are 25 by 12 by 10 ft., each contain 18,000 gallons, and the feed-water is forced into the boilers by five electrically-driven feed pumps, made by the Mirrlees, Watson Company, Limited, operated by Bruce Peebles motors, and one steam driven feed pump by G. & J. Weir, Limited, of Glasgow. The former pumps are capable of delivering 8000 gallons per hour, against a boiler pressure of 180 lbs. per square inch, and the Weir pump is capable of delivering 16,000 gallons of water per hour against the same pressure. The fuel economizer scrapers are operated by a 10-hp British Thomson-Houston motor, each economizer heating 12,000 gallons per hour from 90 degs. up to 160 degs. All steam piping is overhead.

In the engine room four large engines and generators are installed, with space for other two, and two smaller engines, which are in line with one another and connected to each other. Two of the large engines were supplied by the E. P. Allis Company, of Milwaukee, and two by Musgrave & Sons, of Boston, Eng., while the two smaller engines are by Duncan, Stewart & Co., of Glasgow. The two Allis engines, which were supplied by R. W. Blackwell & Co., Limited, of London, are each of 4000 horse-power, with a maximum capacity of 5000 horse-power at the normal speed of 75 r. p. m., and are of the vertical, inverted, three-cylinder (one high pressure and two low pressure), compound condensing type. The diameters of the cylinders are 42 in. and 62 in., respectively, with a stroke of 5 ft., and the three cranks are set at angles of 120 degs. to give a more even turning movement. Each crankshaft is of hollow steel, supported by six bearings. The flywheel is 24 ft. in diameter, weighs 98 tons, and is built in segments, bolted together in a special way, the rim measuring 26½ by 26 in. The diameter of the shaft through the flywheel is 36 in., and the complete weight of the engine is about 700 tons. The diameters of the crank pins, beginning with the high-pressure, are 20 inches, 16 inches and 12 inches, respectively. The valve gear is of the Corliss type, and each engine is provided with an automatic control governor, and an emergency governor designed to cut off all steam should the speed increase more than 5 per cent above normal. These governors are intended to prevent the speed from ever varying more than 1½ per cent from normal, and the angular velocity 1-5 per cent during a revolution at any constant load. The engines measure, over all, 43 ft. long, 52 ft. including the generator; 35 ft. high and 24 ft. deep, while each is designed to consume 14 lbs. of steam per brake horse-power per hour.

The Musgrave engines are also of the three-cylinder, vertical, compound condensing type, of 4000 horse-power, with a maximum of 5000 horse-power, and have each one high-pressure cylinder 42 inches diameter, and two low-pressure cylinders 60 inches diameter, all having a stroke of 5 ft.

Corliss valves are provided with Musgrave trip motion, and are double posted, both for steam and exhaust, and at normal load the cut-off will be at four-tenths of the stroke. Two governors are provided, as in the other engines, one acting as an automatic expansion governor and the other as an emergency governor. The flywheel, of semi-steel, is built up in segments, and weighs 98 tons, the whole engine weighing 750 tons.

Each engine is fitted with a reheater or steam receiver, 3 ft. 6 inches diameter by 8 ft. long, containing 1¼-inch tubes, through which high-pressure steam from the boiler passes, reheating the exhaust steam from the high-pressure cylinder before passing into the low-pressure cylinder. A 5-inch pipe passes through the center of the reheater for the purpose of conveying steam direct from the boilers to the low-pressure cylinders, a reducing valve reducing the pressure to 50 lbs. per square inch, for the purpose of starting the engines, should they stop on the high-pressure crank centers.

The four main generators, operated by the four large engines described above, have been supplied by the British Thomson-Houston Company, of London, and are the largest yet installed in Great Britain. They are of the three-phase type, designed to develop 2500 kilowatts at a pressure of 6500 volts when running at their normal speed. They have revolving fields, each 40 poles, so that at 75 r. p. m. the periodicity is 25 cycles per second. The armature is mounted on a sliding base, so that the field coils are readily accessible. The armature core is built up of sheet iron punchings of high permeability and low hysteresis, with rectangular slots in their inner circumference. Ventilating spaces are left in the core to allow a free circulation of air through the core and around the windings. The armature winding consists of separate coils, formed and insulated before assembling, and is star connected, with two circuits per phase, and consists of 120 coils, each coil having 18 turns. The conductor consists of pressed cable, .485 by .275 inch, triple cotton, covered. The coils are held in the slots by wooden wedges, and are protected from mechanical injury by a cast-iron shield, fastened to the frame, which shield also encloses and protects the connections from coil to coil.

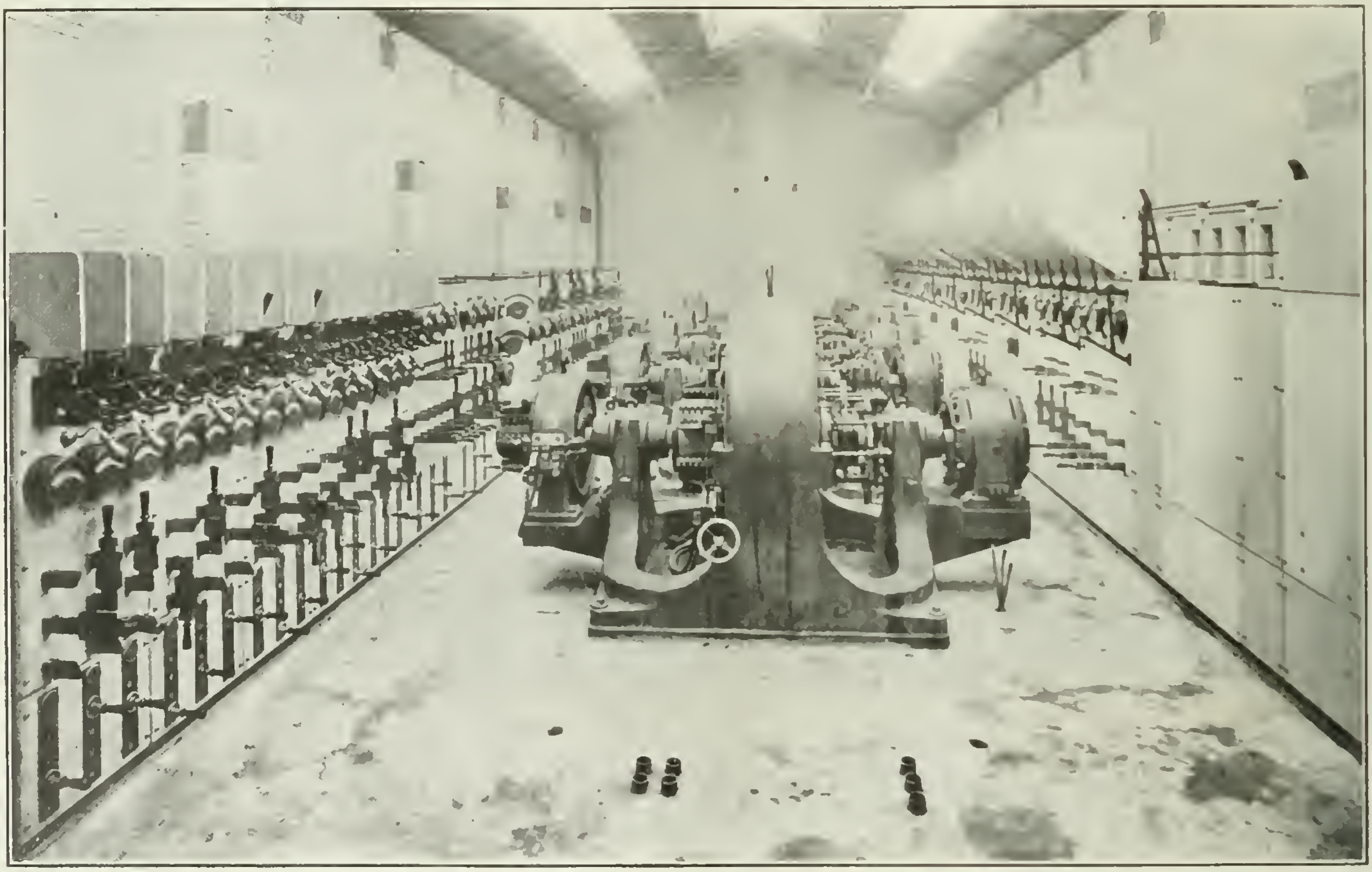


Fig 3.—Interior View of Whitevale Sub-Station, Showing Rotary Converters.

The pole pieces of the revolving field are built up of high permeability sheet iron, securely fastened to the steel ring of the revolving field. The winding consists of 40 coils, connected in series, and designed for an excitation voltage of 100 volts. Each coil has 43 turns of copper strip, 17 by 1⅝ inches, wound on edge. The normal excitation of the field, with full non-inductive load, requires approximately 250 amperes, the excitation current being 100-volt potential. The rise in temperature after a 12 hours' run is not to be greater than 30 degs. C in any part of the generator, when measured by the thermometer, and the machine is capable of carrying an overload of 25 per cent for two hours, or 50 per cent for 15 minutes, without injury. The weight of each generator is 202,000 lbs., or nearly 90 tons, the field weighing nearly 38 tons, and the armature and frame together almost 44 tons. The extreme diameter across the frame of the armature is 21 ft. 6 inches, the diameter of the field frame being 16 ft. 8 inches. In conclusion it should be said that the efficiency of the generators is 96 per cent at full load, 95 per cent at three-quarter load, and 93 per cent at half-load.

The generators for the auxiliary service, already referred to, as direct-connected to the Stewart engines, were also supplied by the British Thomson-Houston Company, and are four in number, and of 600-kw capacity each. Their guaranteed efficiency is 94 per cent, 93.8 per cent and 93 per cent at full load, three-quarter load and half-load, respectively. Each machine has ten poles, runs at 90 r. p. m., and weighs nearly 47 tons. These generators are suitable for operation as shunt machines, at 500 volts, no load, and full load, and as compound machines at 500 volts, no load, and 600 volts full load, and are mounted directly upon the engine shaft. The six exciters are also of B. T.-H. make, each of 50 kilowatts, and driven by a vertical Allen engine.

A special feature of the Pinkston power house is the fine "auxiliary room," with its condensers, one for each main engine, and one for the two supplemental engines; four centrifugal circulating pumps driven by electric motor; four three-throw air pumps, also driven by Bruce Peebles motor, and steam-driven feed pumps for the boilers.

The British Westinghouse Electric Company, of London, built the fine switchboard, which comprises about 1200 sq. ft. of marble, provides for the generators, inter-connecting circuits, feeder circuits, and also the exciter circuits. The generator panels, one to each main generator, each contain a main three-phase high-tension switch, three ammeters, a voltmeter, a field ammeter, two indicating wattmeters, a three-phase integrating wattmeter; a voltmeter plug, and a double-throw field switch with discharge resistance. All the instruments, which are of the Westinghouse standard type, are worked on the transformer system, thus preventing the working parts from being subjected to a high pressure. The feeder panels, of which there are 20, are arranged in five groups in the rear of the generator panels, each group supplying one of the five sub-stations. The inter-connecting panels provide an easy means of operating any of the generators in parallel with the others, or separately, as may be required. The exciter panels are situated between the generator and inter-connector panels, and require no description, their function being quite simple. All the bus-bars and the high-tension connecting bars consist of bare copper tube, supported on porcelain insulators, 10 ft. above the gallery floor level, so that liability to accident is minimized. The switchboard for the auxiliary engines is situated on the main floor of the engine room, immediately in front of the exciters, and underneath the high-tension switchboard gallery. This switchboard deals with the 500-volt circuits from the auxiliary generators, and makes provision for the various lighting and power circuits in the building, and outside low-tension circuits to the various depots and sub-stations. All the wiring in the power house is underground in specially provided ducts, and consists of paper insulated, lead-covered cables supplied by the National Conduit & Cable Company.

The British Westinghouse Electric Company also supplied all the apparatus for the sub-stations to which current is distributed by cables and cement-lined iron pipe furnished by the National Conduit & Cable Company. A description of the sub-station at Whitevale, illustrated, will suffice for all five of them. In this sub-station are five units, each consisting of three transformers and one rotary converter. Each set of three transformers, feeding the rotaries, is completely isolated from the rest of the plant by means of a brick chamber, in which it is set. Each transformer has a capacity of 200 kilowatts, and transforms the 6500-volt current from the main generating station to 310, 330 or of 350 volts on the secondary side, as may be desired. The rotary converters, one to three transformers, are each of 500-kw capacity, and are arranged to over-compound from 500 volts at no-load to 550 volts at full load. They are of the six-pole type, and run at 500 r. p. m., the cycles per second being 25, as in the main generators. The efficiency of the transformers is guaranteed to be 97½ per cent at full load and 97 per cent at half-load, while the rotary converters are guaranteed to have an efficiency of 95 per cent at full load, 94 per cent at three-quarter load and 92½ per cent at half-load. A three-phase induction motor is rigidly connected on the shaft of each rotary converter, for starting up and synchronizing the converter, and, in addition, there is also a continuous-current booster on the other end of the shaft for the usual minimizing of the fall of potential, owing to the resistance of the rails. The switchboards are situated on opposite sides of the room, the high tension on the one side and the continuous-current and feeder panels on the other.

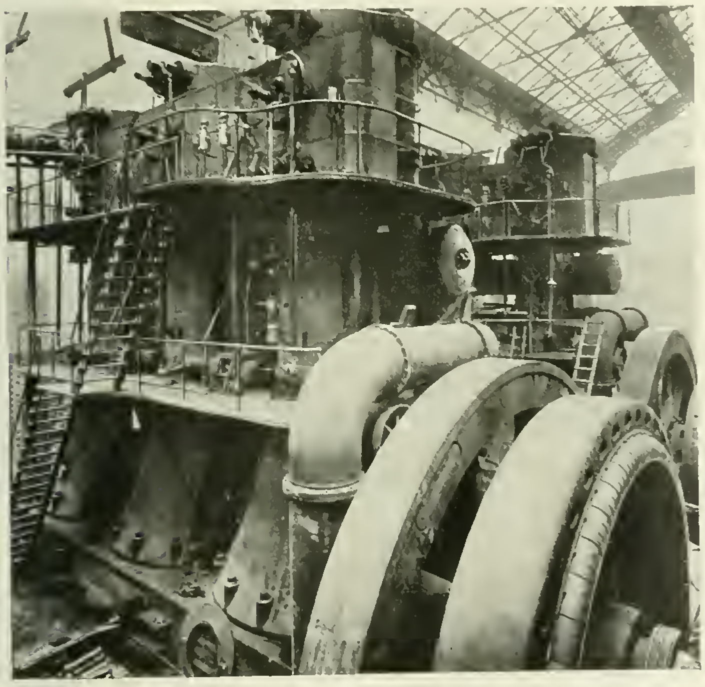


FIG. 4.—GENERATORS AND ALLIS ENGINES AT POWER HOUSE.

The municipality has its own car works, and has built and equipped over 300 cars, all double deckers, besides purchasing some car bodies outside. The trucks are of Brill make. The electrical equipment of the cars is, for the most part, of the Westinghouse type, and consists of two motors wound for 500 volts, two series parallel controllers, resistances, fuse block, main motor, current switch, automatic motor switch and lightning arrester. Each motor is capable of exerting 1000 lbs. horizontal effort at a speed of 7½ miles per hour. There are in all 14 car houses situated in convenient localities throughout the city. The rails weigh 100 lbs. per yard, with a track gauge of 4 ft. 7½ inches. The bonds are No. 0000, supplied by R. W. Blackwell & Co. Nearly all of the trolley wire is supported by span wire and is No. 00 B. & S., with galvanized steel guard wire. Two sizes of steel side pole are in use. The overhead construction was done by Macartney, McElroy & Co., of London and New York.

British Pacific Cable.

A Canadian correspondent states that a deadlock has arisen between the Government of New South Wales and the Dominion Government over the proposed all-British Pacific cable scheme. The Australian colony has granted important concessions to the Eastern Extension Telegraph Company, the competing line. To this Canada strenuously objects, claiming it to be a breach of good faith. The question was referred to the law officers of the crown in Canada, who reported that the action of New South Wales was clearly detrimental to the interests of the Dominion. The British law officers have also reported upon the subject, but in a directly opposite sense, thus causing friction between England and Canada as well. In view of the evident gravity of the situation, and the likelihood of a collapse of the whole cable scheme, Sir Wilfrid Laurier, upon the second reading of the cable bill shortly before the prorogation of Dominion Parliament, reviewed the condition of affairs in respect to the cable project and added a proviso to the cable bill that it shall not go into effect except upon an Order-in-Council. This means that, so far as Canada is concerned, the cable is hung up instead of laid down.

Niagara Falls Power Notes

Penstock No. 3, of the Niagara Falls Hydraulic & Manufacturing Company, was shut off at 8.05 p. m. May 14, 1901, cutting off six dynamos, the object being to prevent the wearing away of the rocks at the outlet of the tail-race into the river. This wearing away had become a serious matter, occurring very near the power house, and retaining walls having crumbled away, as has taken place before in other tail-races.

The device to overcome future destruction consists of a number of pieces of boiler iron, riveted together to form the bottom of the tail-race. There are upright side extensions also of iron to preserve the side walls. At the end toward the river there is a slight upward curve in the iron plate, to throw the water upward and thus prevent further undermining.

Electricity in Nova Scotian Steel Works.

According to the various descriptions given of the great plant of Canada's new iron and steel industries at Sydney, Cape Breton, in the province of Nova Scotia, where the cheapest iron and steel in the world are now being made, electricity plays an important part in the labor-saving operations of this vast industrial undertaking. Electricity, as a motive power, is used in every conceivable way all over the steel plant. In the winter season, when ore and limestone are used from the stock piles, they are gathered up with scoop buckets worked from a trolley traveler, which delivers its load, two or three tons at a lift, into the bins by the furnaces. All the scooping and carrying is done by electric power. Three of the electrically worked travelers serve four blast furnaces, up the sides of which the loaded buckets are hauled to a height of 85 ft., by electric power also, and dumped automatically into the furnaces. Gravitation and electricity are the motive powers, and no men are seen toiling with shovels and wheelbarrows and laboring amid smoke and fumes, and there is no commotion about all this outside work. Nothing in the great plant bears an earlier date than 1900. Much of it will bear the date of 1901. It is typical of the latest and best that experience and practice of the great steel plants of Pennsylvania, Ohio and Illinois have yet evolved, and it is only necessary to spend a couple of hours, it is said, about the first of the Sydney furnaces which have been put into blast, to realize that the design of these modern plants, chiefly by the use of gravitation and electricity, have done away with nearly all of the hard exposing and brutalizing labor, and with much, if not all, of the smoke and fume which an Englishman associates with the making of pig metal at furnaces in Lancashire and Yorkshire.

Determination of the Angular Displacement of Prime Movers.

By LIONEL FLEISCHMANN, PH.D.

IT is a well established fact that in parallel operation of alternators the utmost care must be taken in prescribing the admissible maximum angular displacement. But to my knowledge no accurate method has been developed which permits of its ready calculation from the velocity diagram of the prime mover.

Let us consider Fig. 1 as being the velocity diagram of a steam engine. The method for obtaining this from the torque diagram is well known. Let a represent at any moment the arc traveled by a point of the flywheel at the distance of unity from the center of rotation, ω its instantaneous velocity, the angle 2π corresponding to one complete revolution. If t represents the time counted from the moment of coincidence of the fixed point of the flywheel with a fixed point in space, the following fundamental equation of motion holds good:

$$\omega = \frac{d\,a}{d\,t} \qquad (1)$$

which may also be written:

$$d\,t = \frac{d\,a}{\omega} \qquad (2)$$

If the time of one revolution of the flywheel is T seconds, its mean angular velocity will be $\frac{2\pi}{T}$. Now, assume a point revolving with this mean and constant velocity. While the flywheel rotating with a variable speed describes an angle $d\,a$ in the time dt, the point revolving with this constant angular velocity has passed over an arc,

$$d\,a^1 = \frac{2\pi}{T}\,d\,t; \qquad (3)$$

or substituting from equation (2) the value $\frac{d\,a}{\omega}$ for dt, we arrive at

$$d\,a^1 = \frac{2\pi}{T}\,\frac{d\,a}{\omega}$$

By a simple process of integration we find the total distance a^1 traveled by the point with constant velocity during the time the flywheel has described an angle a to be

$$a^1 = \int_0^a \frac{2\pi}{T}\,\frac{d\,a}{\omega},$$

and the angular displacement is given by the difference

$$\angle\,a = a - a^1 = a - \int_0^a \frac{2\pi}{T}\,\frac{d\,a}{\omega} \qquad (4)$$

It is now left to find for which values of a this expression reaches its maximum or minimum. In order to determine this we have to differentiate $\triangle\,a$ with respect to a:

$$\frac{d\,\triangle\,a}{d\,a} = 1 - \frac{2\pi}{T}\,\frac{1}{\omega}; \qquad (5)$$

equating this to zero gives the value

$$\omega = \frac{2\pi}{T} \qquad (6)$$

This equation shows the angular displacement to reach its maximum or minimum—that is, the point revolving with constant velocity—has its greatest lead or lag in reference to the point moving with variable speed each time when the variable speed equals the mean constant speed.

For the solution of the integral given in equation (4) it is necessary to know ω as a function of a. In the most general case a will be given by a series of Fourier and the calculation would be rather tedious. But there fortunately exists a very simple graphical method for obtaining this value. Let us write the integral $\int \frac{d\,a}{\omega}$ in the form $\int d\,a\,\frac{1}{\omega}$. Then we see at once that it may be regarded as the area of a curve having a as abscissae and $\frac{1}{\omega}$ as ordinates, whence it follows that by simply determining the areas marked in Fig. 2, we also obtain values proportional to the maximum angular displacement.

In order to find the constant with which the areas have to be multiplied we only need to determine the area of the rectangle having 2π as abscissae and $\frac{T}{2\pi}$ as ordinate; calling its area F the constant will be $\frac{2\pi}{F}$.

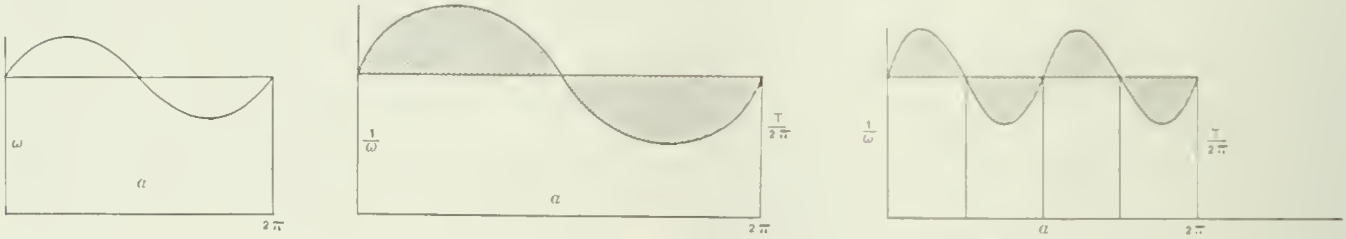
This graphic representation also shows very plainly why generally an engine having a number of impulses (each impulse corresponding to a maximum in the speed curve) is preferable to one with few. Fig. 3 corresponds to a velocity curve having the same maximum, minimum and average speed, but possessing two impulses instead of one.

We see at a glance that the areas representing lag or lead of the flywheel, whether they are above or below the line having $\frac{T}{2\pi}$ as ordinate, are smaller than in Fig. 2. In case the velocity diagram is represented by a saw-toothed line having together n maxima and minima, as shown in Fig. 4, it is possible to calculate the maximum angular displacement.

The velocity ω as a function of a is expressed by

$$\omega = \omega_0 + \frac{\omega_1 - \omega_0}{\frac{2\pi}{n}}\,a \text{ and } 0 \leqq a \leqq \frac{2\pi}{n}$$

$$\omega = \omega_0 + \frac{\omega_1 - \omega_0}{\frac{2\pi}{n}}\left\{\frac{4\pi}{n} - a\right\} \text{ and } \frac{2\pi}{n} \leqq a \leqq \frac{4\pi}{n}$$



FIGS. 1, 2 AND 3.—ANGULAR DISPLACEMENT OF PRIME MOVERS.

inserting these values in the equation for T,

$$T = \int_0^{2\pi} \frac{d\,a}{\omega}$$

$$T = \frac{n}{2}\left\{\int_0^{\frac{2\pi}{n}} \frac{d\,a}{\omega_0 + (\omega_1 - \omega_0)\,\frac{n\,a}{2\pi}} + \int_{\frac{2\pi}{n}}^{\frac{4\pi}{n}} \frac{d\,a}{(2\,\omega_1 - \omega_0) - n\,(\omega_1 - \omega_0)\,\frac{a}{2\pi}}\right\}$$

$$T = \frac{2\pi}{\omega_1 - \omega_0}\,\log\,\frac{\omega_1}{\omega_0}.$$

The average velocity equals $\frac{2\pi}{T}$, and

$$\omega_m = \frac{\omega_1 - \omega_0}{\log\,\frac{\omega_1}{\omega_0}}$$

This is rather a remarkable result, for it has always been the rule to call the expression $\frac{\omega_1 - \omega_0}{2}$ the average speed, but this is only justified in so long as we regard the speed in relation to the position of the flywheel or of the piston stroke. Practically, the numerical values of the two average speeds will be the same. Log $\frac{\omega_1}{\omega_0}$ can be written thus:

$$\log \frac{(\omega_1)}{\omega_0} = 2 \left[\frac{\omega_1 - \omega_0}{\omega_1 + \omega_0} + \frac{1}{3} \left(\frac{\omega_1 - \omega_0}{\omega_1 + \omega_0} \right) \dots\dots \right]$$

$\frac{\omega_1 - \omega_0}{\omega_1 + \omega_0}$ has generally a value lying between $\frac{1}{150}$ and $\frac{1}{300}$, so all higher powers can be neglected, and we may write

$$\omega_m = \frac{\omega_1 - \omega_0}{2(\omega_1 - \omega_0)} \omega_1 + \omega_0 = \frac{\omega_1 + \omega_0}{2}$$

We had to determine ω_m in order to fix the limits of the integral

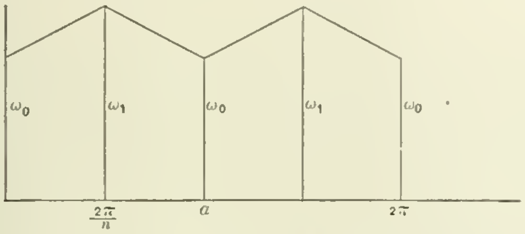


FIG. 4.—ANGULAR DISPLACEMENT OF PRIME MOVERS.

in the expression for $\triangle a$ in equation (4). We will not carry out the intermediate steps, but only give the final result.

$$\triangle a = \pm \frac{2\pi}{n} \left\{ \frac{\omega_m - \omega_0}{\omega_1 - \omega_0} - \frac{\log \omega_m - \log \omega_0}{\log \omega_1 - \log \omega_0} \right\}$$

To express the angular displacement in electrical degrees the value of $\triangle a$ has to be multiplied by $\frac{p\, a\, 180}{\pi}$, where $2p$ is the total number of poles of the alternator.

In conclusion, we arrive at the result that the angular displacement is not only dependent upon the maximum change in speed, but also determined by the general character of the velocity curve.

Central Station Load Curves from Canada.

The accompanying load curves from a large city central station are particularly interesting as showing the result of a policy whereby motor contracts are so made that during the winter months, large blocks of power are dropped out of service at the time of peak lighting load. The extent to which this has so far been accomplished is clearly shown by (Fig. 1) giving the curve for Dec. 28, from which it will be seen that the average percentage of maximum from 7 a. m. to 6 p. m. would have been far below the 85 per cent shown in the curve if it had been required to meet the peak demands of the lighting load at the same time the station was called upon to supply the motor load.

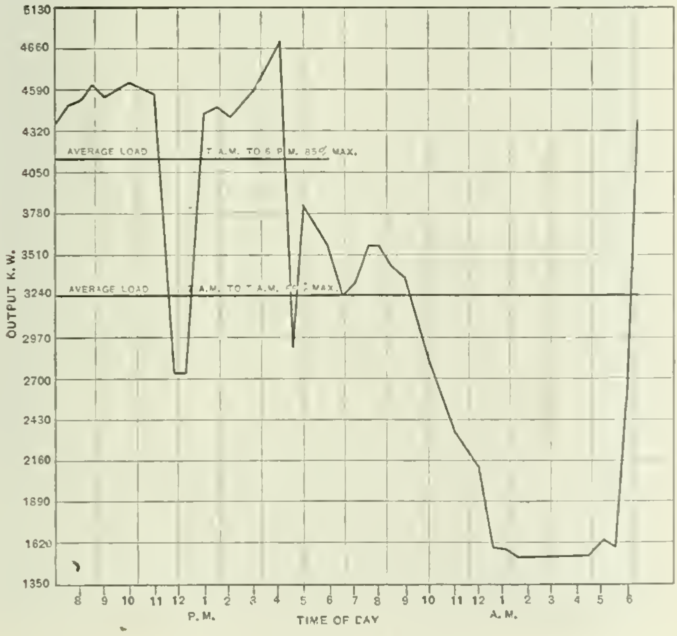


FIG. 1.—OUTPUT CURVE, DEC. 28.

The curve of Fig. 2 is for April 10, and shows the load from the same station for an average spring day with the motor load continuing to be supplied up to 6 p. m. From this curve it will be noted that the high percentage for average load of 94 per cent of the maximum has been reached for the period from 7 a. m. to 6 p. m. This curve, of course, clearly indicates that the lighting demand was of little consequence for that day.

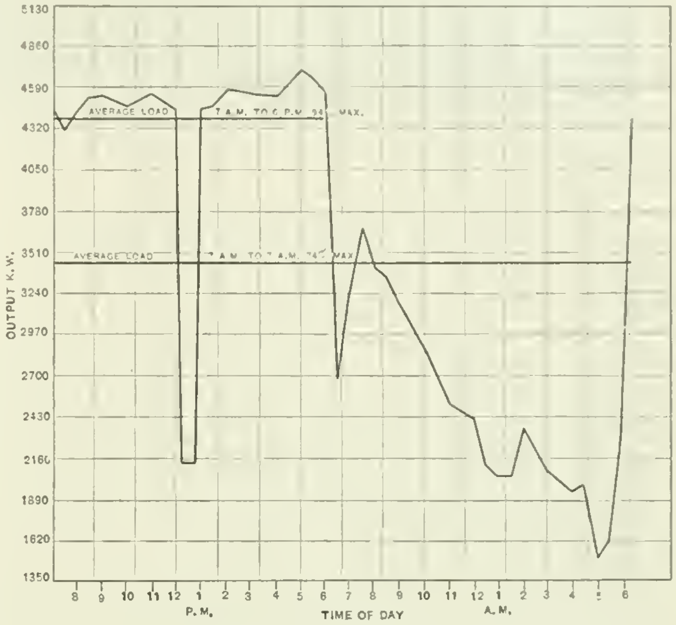


FIG. 2.—OUTPUT CURVE, APRIL 10.

The difference in the curve for the noon hours for Dec. 28 and April 10 is due to a peculiar local condition caused by the different hours of stopping and starting of large mills, the irregularity being the direct result of the early afternoon closing down. The curves are for a combined motor and lighting service from one general system, all generators being operated in parallel.

Independent Telephonists Want Uniform Rates.

It is given out, on good authority, that the independent telephone men of Indiana will be called together at an early day to take action toward establishing a uniform rate for service in the farming districts. The independents assert that they have taken the initiative in this important development of the telephone business in Indiana, and while there is uniformity of rates in the cities and towns, and an understanding relative to long-distance connections, there has been much confusion as to what shall be charged in the country districts. Thousands of farm residences have been connected with the city and town exchanges, and the demand for telephones among the farmers is increasing rapidly. The Hon. Hugh Dougherty, of Bluffton, who has been prominently identified with the organization of the independents and a heavy stockholder says the meeting will be called. The men who have had a hand in shaping the progress of the independent companies have decided that something should be done at once toward bringing about uniform rates. The farmers are anxious to have telephone connection with the cities and towns of their localities, but at this time there is no uniformity among the independents as to what rate shall be charged.

The Central Union Company has recently entered the rural districts in competition with the independents, and in some places, it is said, it is charging only 50 cents a month for each telephone.

Western Union in the New Stock Exchange, N. Y.

The Western Union Telegraph Company has leased accommodations in the new Stock Exchange building for 21 years at $25,000 a year.

Copyright, Oscar A. Simon. *THE PAN-AMERICAN.*

Water Rheostat for a 3,750 k. w.-Circuit at 11,000 Volts at the Pan-American Exposition.

IN an obscure corner of the grounds in a rough shed is one of the most novel and daring electrical engineering features of the Pan-American Exposition. It is the rheostat for bringing gradually up to candle-power the 200,000 8-cp incandescent lamps used in the decorative lighting. Both the apparatus and the results are novelties in the electrical engineering world. Never before has it been attempted to bring up slowly or gradually reduce in candle-power such an immense body of lights simultaneously nor has the control of such a large quantity of energy at such a high voltage ever been attempted by a rheostat.

The big rheostat is located at the western edge of the grounds at the point where the 11,000-volt Niagara transmission line enters. The special Niagara transmission line leaves the main 22,000-volt Niagara-Buffalo transmission line at the sub-station at Ontario Street, where transformers reduce from 22,000 to 11,000 volts. The transmission line supplying the Exposition consists of two three-phase circuits of No. 00 copper on Imperial porcelain insulators. The rheostat house, which is on stilts about 15 ft. high, near the northwest corner of the grounds, is shown in Fig. 1. It contains three tanks of water, one for each leg of the circuit. These tanks are 10 ft. long, 3 ft. wide and 3 ft. deep. They are all mounted on porcelain insulators, such as are used on the line. Into this tank three cast-iron plates operate to vary the resistance in circuit. These plates are approximately the shape shown in Fig. 2. They are of cast iron, 8 ft. long, ¾ inch thick, and are pivoted at the point indicated, so that they describe the arc of a circle while being lowered into the water. When fully in the water the tip strikes a submerged clip or switch jaw, which short circuits the rheostat. The increase of candle-power of the lamps from the dullest red to full brilliancy is very steady, except that there is a sudden rise just before the plate strikes the submerged clip. The plates are lowered simultaneously by an electric motor working on a worm gear. The motor can be controlled from a distance if desired, but is usually started and stopped by a man in the rheostat house. In lighting up the lamps are brought up to full candle-power in 45 seconds. In shutting down 75 seconds is consumed. No accurate tests have been made on the amount of energy consumed by the rheostat. Judging from the appearance of the lamps the voltage at the start is not over 20 per cent of the full voltage. Assuming that the 200,000 25-watt lamps take one-fifth their normal current and voltage at the start the rheostat takes 800 kilowatts. Of course, the current is sufficient to make the water in the tanks boil voilently. The lip at the pivot end of the cast iron rheostat plate is always under water, and the circuit is broken by the main oil switch in the Electricity Building. It was found entirely impracticable to try to break the arc at the rheostat or even to allow the plate to come the least out of the water, as the resultant arc would stream all over the neighborhood. The rheostat is used only for turning on the lights at the grand illumination at 8 p. m. and for turning them off for the night several hours later.

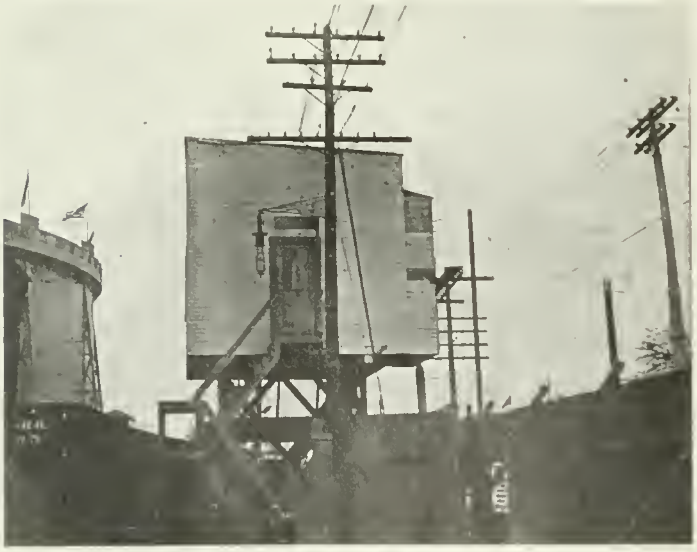


FIG. 1.—HOUSE ON STILTS FOR WATER RHEOSTAT.

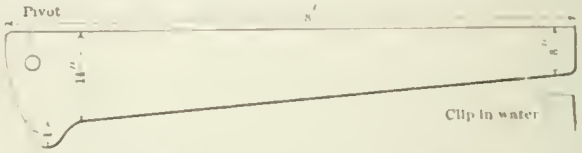


FIG. 2.—CAST IRON PLATE OF RHEOSTAT.

The scenic effect is all that was anticipated and more. The thrill of the spectator who, for the first time, stands in the main area at dusk in the evening and sees that immense mass of illumination rise from a dull red to full brilliancy must be felt to be appreciated. First comes the dull red glow from the lights nearest the observer and the distant points at which the lights are most thickly concentrated. As the lamps increase in candle-power the more scattered lights become visible until the whole is a mass of glow. This effect is best seen

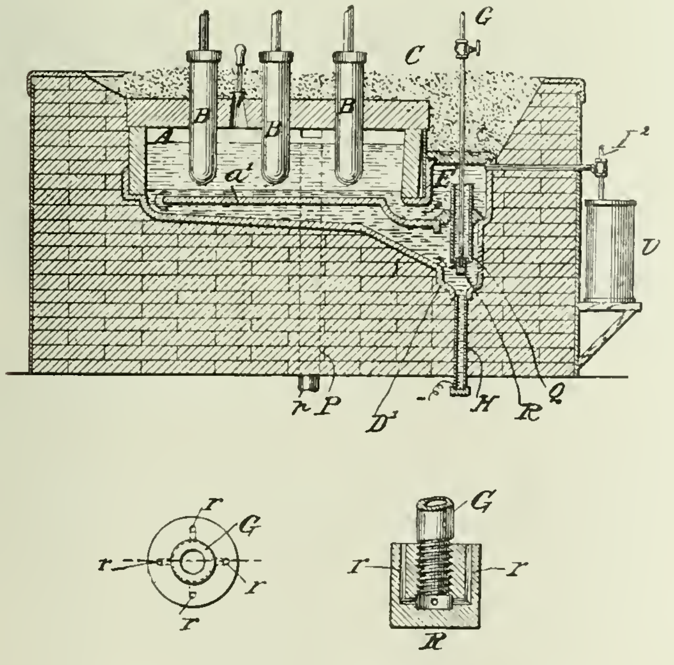
FIG. 3.—"GLOW" EFFECT.

on the sides of the electric tower, where the number of lights is greatest in the middle of circular areas, and gradually diminishes towards the circumferences of these areas. To an observer at a distance the light is seen first at the center and gradually spreads toward the circumferences as the candle-power increases. The aims of Mr. Stieringer to produce a glow effect and have areas rather than points of light have succeeded admirably. Especially is this true at a distance of half a mile from the grounds when the identity of individual lamps almost entirely disappears, and the tower seems to be only a glowing pillar with some prominent parts glowing more brightly than others. The "glow" effect is also shown well by the accompanying bit from the electric tower (Fig. 3).

Caustic Soda from Fused Electrolytes.

The Castner alkali process, employing an aqueous solution of sodium chloride as electrolyte, a circulating cathode of mercury, and water as oxidant for the amalgam, forms the basis of a vast manufacturing industry in this country and abroad. What advantages would follow and what difficulties would arise, if the whole procedure were moved upward one step in respect to temperature, and molten salt substituted for the aqueous electrolyte, fused lead for the mercury cathode, and steam for the oxidant? The suggestion is due to Castner himself, its development to Vautin, Hulin and Borchers, and its industrial perfection to Acker. The results at the Niagara factory of the Acker Process Company, but now beginning operations, will be awaited with interest.

Castner's suggestion never went further than a mental extension of his well-known method: "The same principle may be applied to the electrolysis of fused salts, using a molten metal, such as lead, tin or the like, or an alloy of various metals in place of mercury." Vautin and Hulin encountered the difficulties which arise from the tendency of the separated sodium to collect in the form of globules and reduce the fused salt to a sub-chloride, from the rapid depreciation of the fusion vessels, and from the indiscriminate chemical activity of hot chlorine. Of these difficulties the first and most serious was solved by Hulin by the expedient of electrolyzing, instead of pure fused sodium chloride, a fused mixture of lead and sodium chlorides proportioned to yield a lead-sodium alloy of the richness required, and maintained of the proper composition by shunting a portion of the current through an anode of melted lead. This procedure is open to the objection that it involves the electrolytic deposition of the lead as well as of the sodium, and therefore an additional expenditure of current.



SECTION VIEW OF CELL.

Acker's solution of the first-mentioned difficulty consists in causing the molten lead cathode to flow rapidly and in a thin film beneath the anodes, and the striking ingenuity of the process lies in effecting the circulation by means of a jet of steam, injected into the molten lead, and serving not only to establish a circulation and to conserve the heat of the furnace by the oxidation of sodium within its structure, but also to produce as a result of the oxidation, pure molten caustic which may be tapped off continuously.

The accompanying figure discloses a form of cell employed, consisting of an elongated vessel *A*, having a bottom of steel, side walls of a basic material as magnesia which is resistant to the fused electrolyte, and divided horizontally by a removable steel diaphragm *a'*. The upper and lower compartments so formed communicate at either end, on the left of the figure through a simple slot, and on the right through an upright open-ended tube *Q* of metal, near the bottom of which is the injector *G*, *R*, *r*, for steam, constructed as shown in detail in the smaller figures. Anodes *B* of graphite project through the cover into close proximity to the thin layer of lead which covers the diaphragm. A body of lead fills the entire bottom of the vessel and floods the metal partition, the cathode connection therewith being made through a pipe *H* communicating with the injector-well *D'*. A mass of dry salt *C* heaped over the furnace and around the anodes fulfills the triple function of heat retainer, gas seal, and supply reservoir.

In operation, and as a result of the injection of steam, the tube *Q* becomes filled with an upwardly moving column of mingled lead, caustic and hydrogen. In the chamber *E* these constituents are parted by stratification, the impoverished alloy flowing under an inverted bridge wall to re-enter the electrolytic chamber, and the liquid caustic soda, nearly or quite anhydrous, passing to the drum *U*. Hydrogen escaping at I^2 may be employed as desired; a slight modification in the form of the furnace permits its use, burned with air, for preliminarily melting the salt. Chlorine is drawn off by conduits *P*, *p*, and applied to the manufacture of bleaching powder.

The capabilities of the cell are as yet a matter for conjecture. In general fused bath processes have been found to work with relatively low current efficiency, but by reason of the high current densities which may be employed, to yield an enormous relative output—the return of caustic from a given cathode area often exceeding that from a mercury cell thirtyfold. The new cell will be found not less efficient than its predecessors in the latter respect, and it may be that the rapid movement of the cathode will render it possible to use current densities greatly superior to those heretofore available, and herein lies its hope of successful competition with the earlier types.

Automobilism in the United States.

The Automobile Club of America has decided to organize an annual road race, subject to the approval of the local authorities wherever the course is chosen. The sweepstakes will probably amount to $5,000. It will be an international race, open to competitors from all over the world. The first race will probably be over the Buffalo-Erie course about the middle of September. The following resolution adopted by the Board of Governors May 20 gives particulars:

Resolved, That the Automobile Club of America organize, subject to the consent of the local authorities, an annual road race, to be known as "The Automobile Club of America Sweepstakes," the course to be chosen and the date fixed by the committee on races, to be properly policed and guarded, and to be not over 100 miles nor less than 50 miles in length; that it be open to cars carrying two persons; that the entry fee be $100 for each vehicle, and $50 additional for starters.

Resolved, That the winner receive 80 per cent of the stakes, the second 15 per cent and the third 5 per cent.

Resolved, That the Automobile Club of America subscribe $1,000 toward the sweepstakes.

Resolved, That subscriptions to the above sweepstakes be asked for from members of the club.

THE MILE RECORD.

Resolved, That the Automobile Club of America organize, subject to the consent of the local authorities, an annual race for the mile record, the date and the course to be selected by the committee on races, the course to be properly policed and guarded. Entries to be made for steam, gasoline and electric carriages in separate classes; that the entrance fee be $10; that the club appropriate $600 for the purchase of three cups, one for the winner in each class.

A Fuel Gas Plant for a Model Isolated Hospital in England.

WALTHAMSTOW is a town situated just outside of London to the northeast. It has a population of over 100,000, and its administration is attended to by a district council. The most recently completed scheme carried out by the council has been the providing of a completely equipped modern hospital, where patients suffering from infectious diseases may be isolated, and at the same time receive the best of attention and care. The hospital is situated at Shingford on the borders of the Epping Forest, about 20 acres of land having been purchased there by the council in 1894. Some five and a half acres of this land have been enclosed, and set apart for the present hospital and its extensions, sure to be required at no very distant date, since its present capacity, 46 patients, is only about half of what is usually considered necessary for a population the size of that of Walthamstow, and since this population is increasing at a very rapid rate.

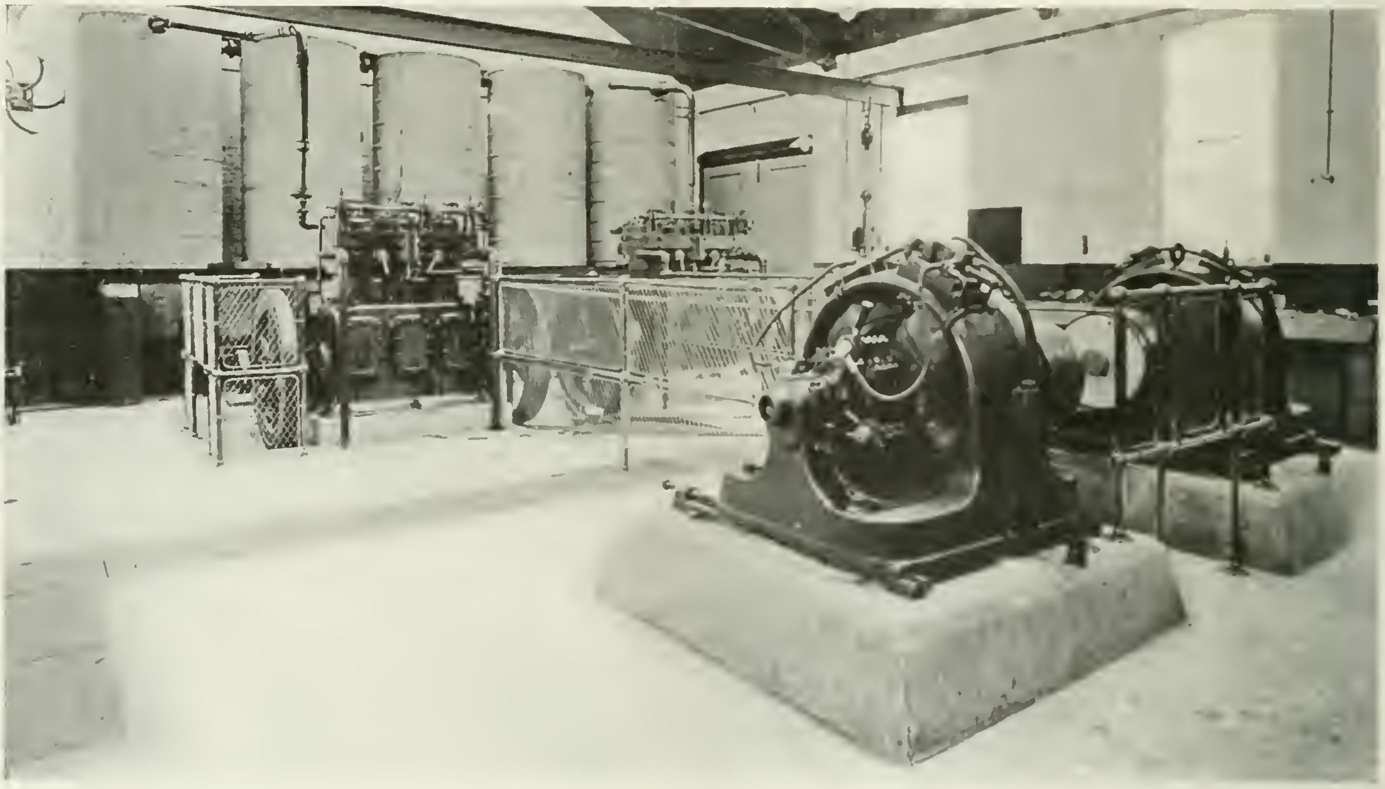


FIG. 1.—GENERAL VIEW OF THE POWER PLANT

The hospital buildings are six in number, and all are one story high, with the exception of the administrative building, which is of two stories. These are four pavilions for the accommodation of patients, three containing 14 beds each, and one containing four beds. The other building comprises the engineroom, laundry, etc. There is also a porter's lodge of picturesque appearance at the entrance gate to the grounds. The buildings are of red brick, the interior walls of the pavilions are finished with cement and all corners and angles are rounded to facilitate perfect cleaning. Partitions and floorings are of polished teak. The two-story administrative building is arranged for the accommodation of the resident medical officer, matron, nurses and domestic staff.

The building set apart for what might be termed the engineering work of the hospital is of special interest. In it is the gas and electrical installation, and there are departments fitted with the most modern machinery for laundry work and for disinfecting. The most interesting feature of this entire plant is that which pertains to the manufacture of gas and the production of power therefrom. The gas producing plant is in duplicate, so that any portion of it may be shut down for repairs or cleaning without interfering with the operation of the hospital. This duplicate feature is not essential in ordinary power plants operating 10 hours a day.

Each gas producing unit consists of one Dowson generator, one small vertical boiler, one hydraulic washer or coke scrubber, and one sawdust scrubber. As is well known, "Dowson Gas" is gas made by the passage of air and steam through a fuel bed. Such gas will vary from 120 to 150 B. T. U. per cu. ft., and it is admirably adapted for use in gas engines.

In this plant anthracite pea coal is used. Crushed coke will also give results equally good. Gas from such material contains little or no volatile matter, and is easily scrubbed and purified. The scrubber is filled with coke and a water spray is provided at the top of the scrubber. As the gas contains practically no tar, the coke does not need to be renewed, except at long intervals. The sawdust scrubber serves to catch entrained dust and fine ash, which might be carried over with the gas. Excelsior serves equally well and is cheap, and easily replaced in the scrubber. Both of these scrubbers are provided with suitable hand-holes and cleaning doors so that the operation in refilling them is a very simple matter. The gas holder is 24 ft. in diameter and 10 ft. deep, having a capacity of 4524 cu. ft. This holder serves to maintain a uniform pressure of gas to the engine and throughout the piping system, regardless of the speed at which the engine may be working

Inasmuch as the gas leaving the producer is of low calorific value it has been found advisable to carburet it for purposes other than the generation of power. No economy would be gained by using the carburetted gas in the gas engine ; in fact, the gas engines operate upon gas of low calorific value fully as well as they do upon gas which has been carburetted. An additional valuable feature about the carburetting of gas is that the gas acquires an unmistakable and characteristic odor. This carburetted gas is piped to each of the buildings above mentioned and is used for heating and domestic purposes.

The culinary arrangements consist of a large roaster whose inside measurements are 4 ft. 6 in. by 2 ft. 9 in. by 2 ft. deep, and a large cooking range containing three ovens. The gas is also used in portable gas furnaces. It will thus be seen that the gas supply is used for practically all power, heating and cooking purposes in connection with the hospital. Exact data as to the efficiency of the plant are not available, but it is obvious that a central station manufacturing gas with the smallest amount of labor and distributing it over the entire plant with all the above-mentioned uses, must possess a decided economy over a system in which coal would be burned direct at various points with the necessary accompaniment of fuel loss, increased labor and the nuisance of ash and smoke.

Two Westinghouse three-cylinder gas engines are supplied from the 4-inch gas-holder main. These engines are of high-speed, and are among the most effective gas engines ever introduced. They are practically noiseless in operation, have a very high running efficiency, and fine speed regulation at widely varying loads. Each of these engines develops 28 b. h. p., and is coupled by belt to a direct-current compound-wound electric generator. The lighting of all the buildings is supplied by these generating sets. A battery of about 50 cells is placed across the supply circuit, and serves as a relay and as a regulator of the supply circuit pressure. With the battery across the mains, the series turns of the generator fields are cut out of circuit.

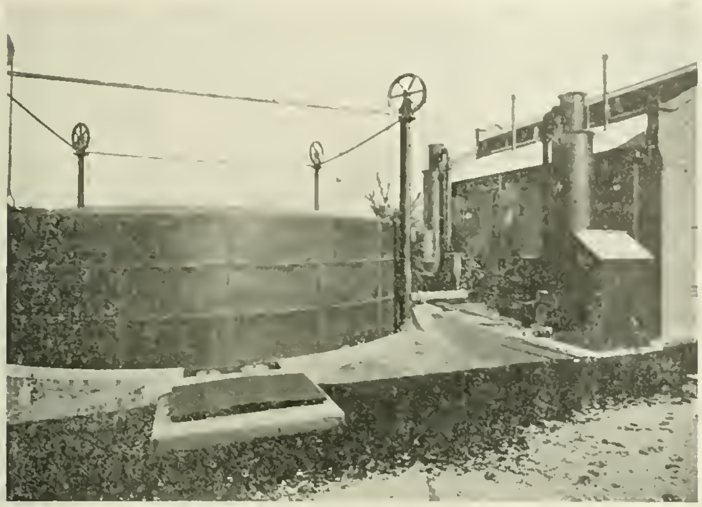


FIG. 2.—GAS HOLDER AND PRODUCER HOUSE.

The electric cables between the buildings are laid underground, being of the lead-covered type drawn into iron pipes. The mains supplying each building are duplicated so as to preserve the supply in the event of a breakdown on one main. Each building is provided with a main distributing board at which the lighting circuits are split up into groups of not more than the equivalent of eight 16-cp lamps per group. Each circuit is, of course, also fitted with the usual switches and fuses placed in convenient positions.

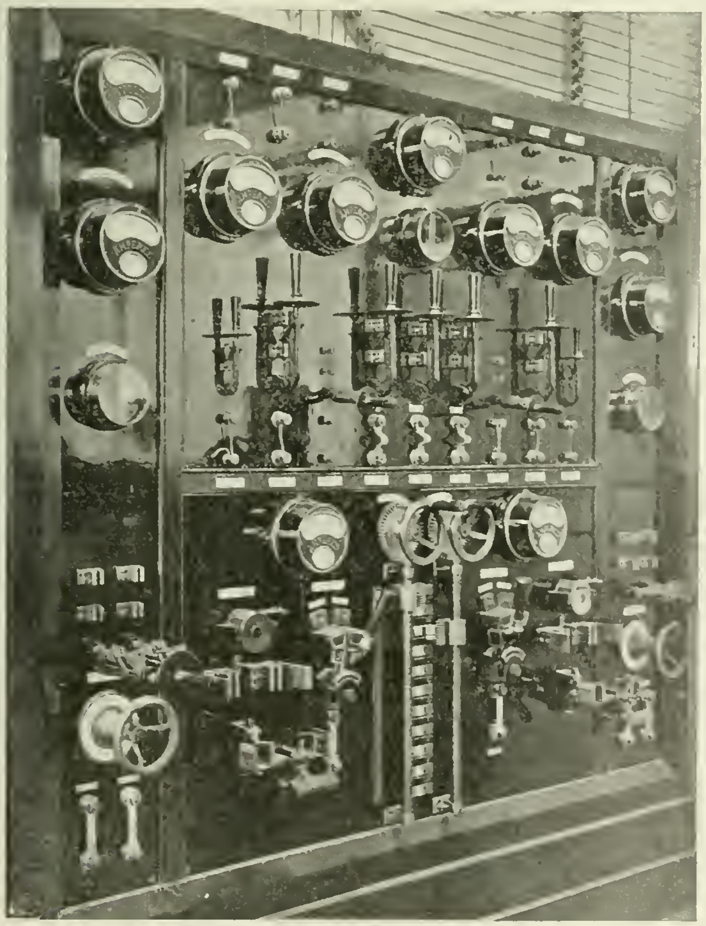


FIG. 3.—SWITCHBOARD.

The laundry machinery, consisting of one hydro-extractor, two washing machines, two mangles, one ironer, one blower and one ventilating fan, is operated by a 6-hp electric motor. The disinfecting chamber attached to the laundry is divided into two parts. A disinfector is placed in the dividing wall so that infected articles pass in at the one room and can be withdrawn from the disinfector in the other room. The disinfector is fitted with a vacuum apparatus. Steam at a pressure of 22 lbs. per square inch is admitted to the chamber and allowed to stand for some time. It is then turned off and the goods dried by the admission of warm air. The cost of this disinfecting plant was $1,000. The cost of the laundry fittings was $2,750. The electric light and telephone fittings cost $2,000. The gas generating plant and cooking apparatus cost $9,000, and the total cost of the hospital when it is entirely complete, will be about $150,000.

A New Use for Calcium Carbide.

Sulphide ores cannot, as a rule, be reduced directly by carbon, but must undergo a preliminary roasting operation to remove the sulphur, the last traces of which are eliminated with extreme difficulty. Accordingly, when Mourlot directed attention some three years ago to the remarkable stability of calcium sulphide at electric furnace temperatures, the observation was sufficient to direct attention to the possibility of reducing sulphide ores directly by calcium carbide. Early in 1900 an account of investigations along this line was published by Geelmuyden, who found that pyrite, tetrahedrite, galena, stibnite and sulphide of magnesium were readily reduced by calcium carbide, the stable monosulphide of calcium remaining in the crucible, the metals of the ore being liberated and, in the cases of compounds of lead, antimony and magnesium, volatilized. Aluminum sulphide alone proved capable of resisting the powerful reducing agent.

M. Louis Michel Bullier, whose claims as original discoverer of crystalline calcium carbide have been recently upheld by the French courts, now describes an interesting extension of the foregoing principle, whereby the metals are recovered directly from mixed sulphide ores and an efficiency of nearly 90 per cent is obtained. If copper sulphide be fused in presence of a suitable flux for which a blast furnace slag melting, according to the patent, at about 1500 degs. C. is found available, and calcium carbide added in theoretical proportions, the reduction occurs readily, the calcium sulphide dissolving in the slag and the copper being recovered as an ingot free from sulphur. If copper pyrites be subjected to the same treatment it is found that the ingot obtained is composed by two sharply separated layers of which the lower is copper and the upper iron saturated with carbon. For ores containing zinc or other metal volatile at the temperature used, a closed retort may be employed and the vapors condensed in the usual manner. The reduction of copper pyrites by this method requires an amount of 80 per cent carbide somewhat exceeding the weight of the ore; for copper sulphide the carbide and ore are used in the ratio 1 : 2.

Introducing the Telegraph in Chili.

It is stated that when the electric telegraph was introduced into Chili strategy was resorted to in order to guard the poles and wires against damage on the part of the natives and to maintain the connection between the strongholds on the frontier. There were at the time between 40 and 50 captive Indians in the Chilian camp. General Pinto, in command of the operations, called them together and, pointing to the telegraph wires, said:

"Do you see those wires?"

"Yes, General."

"I want you to remember not to go near or touch them, for if you do your hands will be held, and you will be unable to get away."

The Indians smiled incredulously. Then the General made them each in succession take hold of the wire at both ends of an electric battery in full operation, after which he exclaimed:

"I command you to let go the wire!"

"I can't. My hands are benumbed!" cried each Indian.

The battery was then stopped. Not long after the General restored them to liberty, giving them strict instructions to keep the secret. This had the desired effect, for, as might be expected, the experience was related in the strictest confidence to every man in the tribe, and the telegraph remained unmolested.

The Tractive Horse Power of Vehicles.

GRADE PER CENTS—TRACTION COEFFICIENTS OF TIRES AND PAVEMENTS—WIND RESISTANCES.

By W. F. D. Crane, M. E.

THE frequent questions regarding the capacities of the motors necessary to propel automobiles of various weights through wide ranges of speed on levels and on grades, render useful for quick and handy reference such a table as is here given for the calculations and comparisons of the horse-power required.

The horse-power per ton weight of the vehicle given in the table are derived from the general formula for the horse-power of traction:

$$HP = \frac{W \times S \times K}{33000} \pm \frac{W \times 2000 \times \sin a}{33000}$$

in which W = total weight of vehicle and its load in tons of 2000 lbs.

S = speed in feet per minute.

a = the angle of the grade.

K = the coefficient of traction or the resistances to the motion of the vehicle in pounds per ton.

In traction calculations, grades are most conveniently stated in per cent, or the decimal relation between the measured length of the grade and its vertical height above a horizontal base line drawn from its foot or base. Thus, if a hill be 100 ft. long and the elevation at the end of that distance be 10 ft. the grade will be 10 per cent.

The coefficient of traction K, or the resistance to the motion of a vehicle, is usually stated as so many pounds per ton weight of the vehicle. It is a variable quantity depending upon the character of the tires, the nature of the road surface, the sizes of the wheels, the speed and weight of the vehicle and includes the friction losses in hub journals; and in the motor-driven vehicle, includes also the friction losses in motor and machinery, when no allowances are made therefor. Other things remaining equal, it should vary inversely as the diameters of the wheels, and on hard roads with iron tires at slow speeds, has been found to increase with the speed, but not in proportion to the velocity. It has also been found that the width of tire has no apparent effect upon the tractive force on hard roads. A knowledge of its value under given conditions is one of the first essentials for comparing the merits of different tires for traction purposes, aside from their resilient and wearing qualities, and for predetermining the capacity of a vehicle motor when working under known or assumed conditions of speed and weight of vehicle; and, vice versa, for ascertaining the performance of a self-propelled vehicle equipped with a motor or engine of definite horse-power.

Under city conditions, unless the machinery be unusually inefficient, the character and conditon of the tires will be usually more influential in determinng the power required to propel the vehicle than the ordinary good and bad conditions of asphalt, block and macadam pavements. This is especially true for pneumatic tires, the most important consideration being whether they are soft or "flat," or are well inflated. Many experiments have been made in various countries to determine the draw-bar pull existing between the horse and the load drawn. The figures thus obtained are instructive as affording comparisons of the effects of different road surfaces upon the traction coefficient, and, in the absence of statements to the contrary, it may be assumed that the tires were of iron or steel, and that the values of K obtained, in addition to the rolling resistance between the wheels and the ground, included the friction in the hub journals; also that there were no other resistances to be recorded. In the motor-driven vehicle of to-day, however, allowances must be made for internal losses in the motors and driving mechanism before similar values of K can be obtained for comparison with the figures obtained with the horse-drawn vehicle. Since, also, the present variable character of the rubber tire has a potent influence upon the amount of power necessary to propel a vehicle, it is desirable that the traction coefficient for each kind of tire be known for the various pavements.

From published figures it is learned that the draw-bar pull or tractive force varies from between 8 and 11½ lbs. on railroad tracks to 448 lbs. per ton for loose sand with metal wagon tires at a speed of 3 miles per hour. Other figures obtained with the road conditions existing abroad for iron tires at 3 miles per hour, quoted for comparison, are:

	Pounds.	Average, About.
Loose gravel road, from	125 to 320	150
Ordinary dirt road, from	89 " 224	150
Cobblestones, from	75 " 140	100
Macadamized surface, from	32 " 112	42
Belgian block, from	26 " 56	38
Asphalt, from	17 " ..	..

More recent figures obtained by the Office of Road Inquiry, probably more nearly corresponding to similar conditons in the United States, are, in pounds per ton:

	Pounds.
Loose sand (experimental)	320
Best of clay roads	98
Cobblestone	54
Best gravel (park road)	51
Poor block pavement	42
Best macadam	38
Poor asphalt	26

In tables I. and II. are published for the first time some values of K obtained from tests of electric automobiles. Two values for K were sought in the calculations. First, the gross value of all the resistances to traction, including the inefficiency of the motors, the friction losses in driving mechanism and hub journals, the rolling friction of the tires, electric losses in the wiring of the vehicles, etc., and, second, the net value of K or the coefficient of traction of the tire *per se* for comparisons with other tires or with the same time on other pavements. It is assumed that the pneumatic tires in the tests were in excellent condition and fully inflated under pressures of about 80 lbs. for the 2½-inch tires, 100 lbs. for the 3-inch and about 120 lbs. for the 4 and 5-inch tires.

TABLE I.

TRACTION TESTS OF TRACTION VEHICLES.

K in lbs. per ton		Vehicle		Sizes and kinds of rubber tires	Sizes of Wheels		City pavements in good condition
Gross values	Values for tires	Weight in lbs.	Speed m. p. h.		Front	Rear	
66	49	1790	14.00	3 in. pneumatic	28	28	Macadam
66	52	1775	13.81	3 " "	28	28	"
55	39	2730	12.45	3 " "	32	36	"
68	52	3140	11.67	3 " "	36	36	"
64	47	1870	15.30	2½" "	28	32	Asphalt
64	46	5380	9.00	4 " "	36	36	"
54	40	4400	11.20	2½" solid	36	36	"
48	35	5425	11.15	2½" "	36	42	"
59	43	7240	7.30	3 " "	38	42	"
58	42	7240	10.00	3 " "	38	42	"
48	36	8480	8.20	4 " "	38	44	"
53	38	4150	11.90	2½" "	36	42	Macadam

TABLE II.

K in lbs. per ton		Vehicle		Sizes and kinds of rubber tires	Sizes of Wheels		City pavements in good condition
Gross values	Values for tires	Weight in lbs.	Speed m. p. h.		Front	Rear	
71	51	4300	10.50	5 in. pneumatic	36	36	Asphalt
52	37.5	5390	12.60	3 in. solid in front 4 in. pneumatic in rear	36	36	"
55	39.5	5390	11.90				
59	42.5	4150	11.15				
48.5	36	5780	9.75	3 inch sectional	36	36	"
38.5	28.5	7900	9.05				

Compared with the usual dynamometric methods the electric vehicle, through the use of the voltmeter and ammeter, affords one of the simplest and most sensitive means for experimenting with traction resistances, but a knowledge of the efficiencies of the motors and gearing at the time is essential for a correct interpretation of the results. It is believed that the figures given in the tables are sufficiently exact to be representative for rubber-tired electric and other vehicles with the tires and city pavements in good condition.

In the vehicles tested the efficiencies of the motors, as determined from their efficiency curves, ranged from 79 to 85 per cent with a general average of about 81 per cent. The friction losses in the gearing was assumed to amount to 8 or 10 per cent, amounts obtained from certain tests of the arrangements of two gears and two pinions common to all the vehicles. An allowance of 2 per cent was made in certain cases to cover the friction losses in hub journals, with plain sleeve bearings, losses in the electric wiring, etc. The efficiency of the combination of a motor at 82 per cent, gearing at 90 per cent, and the other conditions at 98 per cent would, therefore, be about 72 per cent. If the gross *K*, as computed from the results of a test, amounted to 55, the value of net *K*, or the tire coefficient, would be 55 × .72 = 39.6 lbs. per ton. The values of the tire coefficients, as given in the tables, were computed by this method, no allowances having been made for the wind resistance as no records of the force and direction of the wind, if any, were taken at the times of the tests.

The friction losses in the power-transmission gearing in gasoline and steam vehicles may be variously estimated at from 10 to 30 per cent or more of the power delivered by the motor or engine depending upon the nature and condition of the mechanism. The losses through countershafting, bevel gearing, chains, speed-reducing gears, universal joints, etc., will vary greatly with their design, lubrication, condition, etc., and should properly be determined by actual measurements. Losses in hub journals will also vary from practically nothing with suitable ball or roller anti-friction bearings to 2 per cent and more with plain sleeve bearings, according to their design, size and lubrication of the surfaces.

In table I. the average of the results obtained for the six vehicles equipped with pneumatic tires on both macadam and asphalt pavements (the respective figures for which show but slight differences) is a gross value for *K* (for electric vehicles) of 65, and an average tire coefficient of 47 lbs. per ton. Similarly, for the six vehicles with solid tires, the corresponding averages are 53 and 40 lbs. per ton, respectively. In table II. are given some results of tests of vehicles with miscellaneous rubber tires.

It is instructive to compare the tabulated figures for the rubber tire coefficients with those quoted for the iron-tired slow-speed wagons, in view of the fact that iron or steel tires have been contemplated by automobile manufacturers of heavy slow-speed trucks as substitutes for the costly and short-lived rubber tires. It is a noteworthy observation that almost without exception the solid rubber tires which show the lowest traction coefficients (below 40) in the table have suffered the greatest damage to themselves in service and possessed the shortest lives. The results of the tests indicate that from 20 to 25 per cent more power is expended by pneumatic-tired vehicles than those equipped with solid rubber tires on good macadam and asphalt pavements, but it does not follow, from the viewpoint of ultimate economy, that the solid tire will always possess such an apparent advantage over the pneumatic tire.

If we assume that the general efficiency of the gearing in a gasoline or steam vehicle is 75 per cent, and that the tire coefficient is 45 lbs. per ton, the gross value of *K* will be 60 lbs. per ton with a rating of the motor in brake horse-power. This is probably a safe figure for city pavements of asphalt, macadam and Belgian block. On country roads this value of *K* (60 lbs.) can be readily increased two and more times, as is shown by the comparisons offered by the figures quoted for clay, sand and dirt roads.

As it is the desire in the present article to generalize and to produce a table of the horse-power of traction for convenient approximations and comparisons, the value of *K* in table III. has been taken at 60 lbs. per ton as a figure at the present time most likely to approximate its average value for the largest number of vehicles operating under the various conditions of tires, speeds and city pavements.

By substituting in the general formula quoted for the horse-power of traction the speed in miles per hour, instead of in feet per minute, and the grade in per cent for *sin a*, the formula may be simplified to the following expression:

$$H\text{-}P = \frac{W\,S\,K}{375} \pm \frac{W\,S\,G \times 20}{375}$$

in which W = total weight of the vehicle in tons of 2000 lbs.

S = speed in miles per hour.

K = total resistances to motion of vehicle in pounds per ton.

G = per cent of the grade in numerals.

In the table the tractive horse-powers per ton have been calculated for both levels and grades with *K* at 60 lbs. per ton. The results are tabulated in the two parts into which the table naturally divides itself: The horse-power to propel one ton on the level at the speeds given being found in the column headed "H.-P. per ton on level $K = 60$"; and the corresponding *additional* and invariable horse-power per ton on grades, irrespective of whatever power may have been required to propel the vehicle over the surface of the ground, being found (in the lighter figures) in their respective columns headed by the per cents of the grades. The lines of darker figures are the *total* horse-power per ton required to propel the vehicle over the grades with $K = 60$, and were obtained in each case by adding the horse-power on the level to the additional horse-power on the grades for the corresponding speeds.

To illustrate: What horse-power will be required to propel a vehicle weighing 2 tons on a 6 per cent grade at 5 m. p. h.? The tabulated horse-power for one ton on the level, in the column headed $K = 60$, at 5 m. p. h. is .80, which, multiplied by 2 equals 1.6 horse-power. The *additional* horse-power per ton on a grade of 6 per cent at 5 m. p. h. is 1.60, which multiplied by 2 equals 3.2 horse-power., This added to 1.6 horse-power, the horse-power on the level, given a total of 4.8 horse-power, or the same result will be obtained directly by multiplying by 2 the tabulated *total* horse-power for one ton, viz., 2.40, or a total of 4.8 horse-power. If this be an electric vehicle the power demanded of the battery will be 4.8 × 746 = 3580 watts, which at 81 volts will mean a discharge rate of over 44 amperes. If the grade is ascended at 8 m. p. h. what current will be required? Answer: 3.41 × 2 = 6.82 hp × 746 = 5087 watts at 80 volts = 64 amperes.

TABLE III.—THE TRACTIVE HORSE-POWER OF VEHICLES.

Computed by W. F. D. CRANE, M. E.

General formula: $H\text{-}P = \frac{W n}{375}(K \pm 20\ G)$ G = per cent. of grade.

W = weight in tons of 2000 lbs. K = resistance to traction in pounds per ton. n = speed in miles per hour.

Miles per hour	Horse Power per ton on level		HORSE-POWER PER TON ON GRADES The LIGHT figures are the ADDITIONAL and invariable H-P per ton on grades. The HEAVY figures are the TOTAL H-P per ton on grades with K equals 60.											
	$K = 10$	$K = 60$	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	.026		.053	.106	.16	.213	.266	.32	.373	.426	.48	.533	.586	.64
		.16	**.213**	**266**	**.32**	**.373**	**.426**	**.480**	**.533**	**586**	**.64**	**693**	**.746**	**80**
2	.053		.106	.213	.32	.426	.533	.64	.746	.853	.96	1.06	1.173	1.28
		.32	**.426**	**.533**	**64**	**.746**	**853**	**.96**	**1.06**	**1.17**	**1.28**	**1.38**	**1.49**	**1.60**
3	.080		.160	.32	.48	.640	.800	.96	1.12	1.28	1.44	1.60	1.76	1.92
		.48	**640**	**.80**	**.96**	**1.12**	**1.28**	**1.44**	**1.60**	**1.76**	**1.92**	**2.08**	**2.24**	**2.40**
4	.106		.213	.426	64	.853	1.06	1.28	1.49	1.70	1.92	2.13	2.34	2.56
		.64	**.853**	**1.06**	**1.28**	**1.49**	**1.70**	**1.92**	**2.13**	**2.34**	**2.56**	**2.77**	**2.98**	**3.20**
5	.133		.266	.533	80	1.06	1.33	1.60	1.86	2.13	2.40	2.66	2.93	3.20
		80	**1.06**	**1.33**	**1.60**	**1.86**	**2.13**	**2.40**	**2.66**	**2.93**	**3.20**	**3.46**	**3.73**	**4.00**
6	.160		.32	.64	.96	1.28	1.60	1.92	2.24	2.56	2.88	3.20	3.52	3.81
		96	**1.28**	**1.60**	**1.92**	**2.24**	**2.56**	**2.88**	**3.20**	**3.52**	**3.84**	**4.16**	**4.48**	**4.80**
7	.186		.373	.746	1.12	1.49	1.86	2.24	2.61	2.98	3.36	3.73	4.10	4.48
		1.12	**1.49**	**1.86**	**2.24**	**2.61**	**2.98**	**3.36**	**3.73**	**4.10**	**4.48**	**4.85**	**5.22**	**5.60**
8	.213		.426	.853	1.28	1.70	2.13	2.56	2.98	3.41	3.84	4.26	4.69	5.12
		1.28	**1.70**	**2.13**	**2.56**	**2.98**	**3.41**	**3.84**	**4.26**	**4.69**	**5.12**	**5.54**	**5.97**	**6.40**
9	.240		.48	.96	1.44	1.92	2.40	2.88	3.36	3.84	4.32	4.80	5.28	5.76
		1.44	**1.92**	**2.40**	**2.88**	**3.36**	**3.84**	**4.32**	**4.80**	**5.28**	**5.76**	**6.24**	**6.72**	**7.20**
10	.266		533	1.06	1.60	2.13	2.66	3.20	3.73	4.26	4.80	5.33	5.86	6.40
		1.60	**2.13**	**2.66**	**3.20**	**3.73**	**4.26**	**4.80**	**5.33**	**5.86**	**6.40**	**6.93**	**7.46**	**8.00**
11	.293		.586	1.17	1.76	2.34	2.93	3.52	4.10	4.69	5.28	5.86	6.45	7.04
		1.76	**2.34**	**2.93**	**3.52**	**4.10**	**4.69**	**5.28**	**5.86**	**6.45**	**7.04**	**7.62**	**8.21**	**8.80**
12	.320		.64	1.28	1.92	2.56	3.20	3.84	4.48	5.12	5.76	6.40	7.04	7.68
		1.92	**2.56**	**3.20**	**3.84**	**4.48**	**5.12**	**5.76**	**6.40**	**7.04**	**7.68**	**8.32**	**8.96**	**9.60**
13	.346		.693	1.38	2.08	2.77	3.46	4.16	4.85	5.54	6.24	6.93	7.62	8.32
		2.08	**2.77**	**3.46**	**4.16**	**4.85**	**5.54**	**6.24**	**6.93**	**7.62**	**8.32**	**9.01**	**9.70**	**10.40**
14	.373		.746	1.49	2.24	2.98	3.73	4.48	5.22	5.97	6.72	7.46	8.21	8.96
		2.24	**2.98**	**3.73**	**4.48**	**5.22**	**5.97**	**6.72**	**7.46**	**8.21**	**8.96**	**9.70**	**10.45**	**11.20**
15	.400		.800	1.60	2.40	3.20	4.00	4:80	5.60	6.40	7.20			
		2.40	**3.20**	**4.00**	**4.80**	**5.60**	**6.40**	**7.20**	**8.00**	**8.80**	**9.60**			
16	.426		.853	1.70	2.56	3.41	4.26	5.12	5.97	6.82	7.68			
		2.56	**3.41**	**4.26**	**5.12**	**5.97**	**6.82**	**7.68**	**8.53**	**9.38**	**10.24**			
17	.453		.906	1.81	2.72	3.62	4.53	5.44	6.34	7.25	8.16			
		2.72	**3.62**	**4.53**	**5.44**	**6.34**	**7.25**	**8.16**	**9.06**	**9.97**	**10.88**			
18	.480		.960	1.92	2.88	3.84	4.80	5.76	6.72	7.68	8.64			
		2.88	**3.84**	**4.80**	**5.76**	**6.72**	**7.68**	**8.64**	**9.60**	**10.56**	**11.52**			
19	.506		1.01	2.02	3.04	4.05	5.06	6.08	7.09	8.10	9.12			
		3.04	**4.05**	**5.06**	**6.08**	**7.09**	**8.10**	**9.12**	**10.13**	**11.14**	**12.16**			
20	.533		1.06	2.13	3.20	4.26	5.33	6.40	7.40	8.53	9.60			
		3.20	**4.26**	**5.33**	**6.40**	**7.46**	**8.53**	**9.60**	**10.66**	**11.73**	**12.80**			
25	.666		1.33	2.66	4.00	5.33	6.66	8.00	9.33	10.66	12.00			
		4.00	**5.33**	**6.66**	**8.00**	**9.33**	**10.66**	**12.00**	**13.33**	**14.66**	**16.00**			
30	.800		1.60	3.20	4.80	6.40	8.00	9.60	11.20	12.80	14.40			
		4.80	**6.40**	**8.00**	**9.60**	**11.20**	**12.80**	**14.40**	**16.00**	**17.60**	**19.20**			
35	.933		1.86	3.73	5.60	7.46	9.33	11.20	13.06	14.93	16.80			
		5.60	**7.46**	**9.33**	**11.20**	**13.06**	**14.93**	**16.80**	**18.66**	**20.53**	**22.40**			
40	1.066		2.13	4.26	6.40	8.53	10.66	12.80	14.93	17.06	19.20			
		6.40	**8.53**	**10.66**	**12.80**	**14.93**	**17.06**	**19.20**	**21.33**	**23.46**	**25.60**			
45	1.20		2.40	4.80	7.20	9.60	12.00	14.40	16.80	19.20	21.60			
		7.20	**9.60**	**12.00**	**14.40**	**16.80**	**19.20**	**21.60**	**24.00**	**26.40**	**28.80**			
50	1.33		2.66	5.33	8.00	10.66	13.33	16.00	18.66	21.33	24.00			
		8.00	**10.66**	**13.33**	**16.00**	**18.66**	**21.33**	**24.00**	**26.66**	**29.33**	**32.00**			
55	1.46		2.93	5.86	8.80	11.73	14.66	17.60	20,53	23.46	26.40			
		8.80	**11.73**	**14.66**	**17.60**	**20.53**	**23.46**	**26.40**	**29.33**	**32.26**	**35.20**			
60	1.60		3.20	6.40	9.60	12.80	16.00	19.20	22.40	25.60	28.80			
		9.60	**12.80**	**16.00**	**19.20**	**22.40**	**25.60**	**28.80**	**32.00**	**35.20**	**38.40**			

Wind Resistances per sq. foot.

$p = .005\ V^2$

V = miles per hour.

Miles per hour	p = pressure in lbs	Equivalent H-P
5	.125	.0016
10	50	.0133
12½	.687	0229
15	1.125	0452
17½	1.53	0716
20	2.00	1066
25	3.125	.208
30	4.5	.360
35	6.125	.572
40	8.00	853
45	10.125	1.215
50	12.50	1.67
55	15.125	2.22
60	18.00	2.88

What is the steepest grade that a vehicle weighing one ton and equipped with a motor rated at 6 horse-power can ascend at a speed of 10 m. p. h.? By inspecting the table for the total horse-power on grades at 10 m. p. h. we find that 5.86 horse-power is the nearest approximation to 6 horse-power, and that this corresponds to a grade of 8 per cent.

If the limit of a vehicle's speed on the level is 18 m. p. h., at what speed will it ascend a 6 per cent grade, other things being equal? Answer, 6 m. p. h.

If the value of K be known, or assumed, the tabulated figures for the horse-power on the level with $K = 10$ can be increased or decreased proportionately and added to the invariable figures for the additional horse-power on grades to obtain the total horse-power per ton. Since K only enters one term of the formula, manifestly the figures for the total horse-power on grades cannot be altered proportionately, in correspondence with the value of K, on account of the preponderating amount of power required on grades compared to that on levels, as strikingly illustrated by the related figures.

The gross value of K for any vehicle may be found by transposing the formula so that

$$K = \frac{H\text{-}P \times 375}{W \times S} - 20\ G$$

and substituting known values for the horse-power, weight, speed and grade. For example, a solid rubber tired electric vehicle weighing, with passengers, 4400 lbs. (2.2 tons) on a level attained an even speed of 11.2 m. p. h. with 31.5 amperes at 83.5 volts, or 3.5 electrical horse-power. Substituting these quantities in the formula, we have

$$K = \frac{3.5 \times 375}{2.2 \times 11.2} = 53.5 \text{ lbs. per ton.}$$

The efficiency of the motor at the speed and load was 83 per cent and of the gears, etc., 90 per cent, or a combined efficiency of 74.7 per cent, the actual percentage of the power required to overcome the rolling friction of the tires. Hence, $53.5 \times 74.7 = 40$, the net value of K, or the traction coefficient for the tire and pavement under the conditions prevailng at the ime of the test.

In determinations of the tractive horse-power of vehicles at moderate speeds, the resistance of the air is frequently disregarded as of little consequence, but at the higher rates of speed the wind resistance cannot be neglected without seriously underestimating the power required to speed the vehicle. For a vehicle weighing one ton and presenting 10 square feet of surface at a speed of 35 miles per hour, the power required to overcome the resistance of the air due alone to the motion of the vehicle will exceed the power required to propel the vehicle on the level with $K = 60$.

The pressure of the air at right angles to a surface varies as the squares of the speeds and may be found from the formula

$$p = .005\ V^2,$$

in which p is the pressure in pounds per square foot and V the velocity in miles per hour, or from

$$p = .0023\ v^2 = \frac{v^2}{400}$$

in which v is the speed in feet per second.

The wind pressures and equivalent horse-power per square foot of surface at various speeds are given in the table in connection with the table of the horse-power of traction.

Examples.—A buggy-topped runabout presenting 20 square feet of surface to the wind travels in a calm day at the rate of 15 m. p. h. What horse-power is the motor exerting to overcome the wind resistance? The tabulated horse-power at 15 m. p. h. in the table of wind-resistances is .0452 horse-power per square foot. This multiplied by 20 equals .9 horse-power.

What must be the capacity of a motor to drive a racing automobile weighing two tons and presenting 10 square feet of surface at 60 m. p. h. on the level? Horse-power of traction on level equals $9.60 \times 2 = 19.20$. Horse-power due to wind resistance $2.88 \times 10 = 28.80$. Total, 48 horse-power.

Russian Submarine Boat.

Information comes from St. Petersburg that an electrically propelled submarine boat, designed by Lieutenant Kolbasjeffs of the Russian Navy, is being built at Kronstadt by order of the Government.

The United States Signal Corps in Foreign Service.

By F. E. Grain.

In 1899, when I arrived in Iloilo, Isle de Panay, the only lines of wire in service were those employed in connecting the leading cities and towns within a very small radius. No signal corps man could go out far enough from the protected centers to put up lines. All messages had to be transmitted between points by carriers accompanied by guards, and oftentimes these details were fired upon by the insurgents or the ladrones. It was unsafe to put up wires of any sort, for they were at once cut, or the working parties shot. After about one year, when the Americans commenced to occupy the interior towns, it was found necessary to establish lines from point to point, and then the real troubles of the signal corps began. While the operations were confined to Iloilo province, there was not much need for signal corps men, nor was there much danger. As soon as military necessities demanded that the signal corps go into the field the demand for operators and linemen started in and has been maintained ever since. No one can have any idea of the demand for sergeants, corporals and linemen who are privates, as well as native linemen, unless he is on the ground. I know that very many stations were often closed for lack of operators. In many of the larger places where there are many central wires coming in, and where telegraphing is kept up practically all of the time, one operator does the work although the officers know that there ought to be two and even three. The reason is that operators cannot be obtained.

SIGNAL CORPS IN THE PHILIPPINES

The chiefs of the signal corps department are, of course, doing all they possibly can to get trained men into the service and relieve the hardworked men who are at the posts. There are many new men sent to the Philippines by every transport, but the lines are extended so rapidly and so many new offices are being so constantly opened, that it is impossible to keep up with the work. The recruiting officers in America are doing all they can to get good men and plenty of them, and very fair wages are paid, even to the new men, who, as a rule, are enlisted for three years as privates. They are in line for promotion, and in a very short while I observe them recorded as first-class privates, and from this grade it is not long before they are made corporals. When finally appointed first-class sergeants, their future is bright, for the pay is not only good, but the position is suitable. The first-class electrical sergeant in the islands can save about $50 per month from his salary, as he is provided with rations, clothing, quarters, etc., and his chances for spending money are not very great. I saved more money while I was in the service there than I ever saved before in the same time.

The offices of the United States Signal Corps in the islands are usually established in the convents of the cities and towns, and are fitted up with the apparatus usually found in a telegraph station. There are large stone convents in all of the cities and towns, and even in the barrios. The Spanish erected these convents and arranged that portions be separated for church worship. American troops occupying the cities and towns usually make their headquarters at the convents as no other buildings are available. Therefore one will usually find the American flag flying over the convent of a city or town while the soldiers, officers' quarters and Signal Corps station will be established therein. The great, thick walls of the building assure safety against attack from the rebels. In these convent stations one will find not only the telegraph instruments to which wires may center from a dozen different stations, but telephone instruments, and full equipments of signals. I have been in many a station where the busy office is run by one man. Not because the chief signal officer of the district is stinting with his men, but just simply because there are no extra men to use. I know that I have stopped many a night in these convent signal corps stations and relieved men who have been without sleep for hours.

The signal corps man in the Philippines must be a good lineman. For example, we used to get orders to the effect that the wires were down a dozen miles out. The only thing to do is to get a detail of soldiers from the post as a guard, select two or three of the native police to round up about 10 natives, and then the whole force moves out to the point where the rebels had played with the lines by cutting the poles into little bits and snarling the wires into tangled bunches, as well as smashing the crossarms and glass knobs.

I have seen things pretty badly smashed by the insurgents, and often the ingenuity of the telegraph operator is taxed. Sometimes the poles are chopped to pieces, and there are no means of getting poles within a dozen miles. The wires must be put up and the line opened at once because of military necessity, for it is when troubles occur with the wires that the rebels take advantage of the chance to attack isolated stations, knowing well that there will be no means for wiring for aid. I have seen thin bamboo poles wound together with hempen stuff so as to make a substantial pole for holding wires. Sometimes the crossarms have to be of bamboo, and then skill is needed to get a good base. The rebels are up to all sorts of tricks. I have known them loosen the wires in such way that they will drop across the roads and then when troops rush through at night on horseback the soldiers are liable to get swept from their saddles. I have seen many persons with cut faces from this cause. When a signal corps man is alone in a station he has considerable mechanical work to do. There are parts of instruments wearing and breaking, and unless he is a master of his business, he will have trouble. There are no electrical supply stores outside of Manila and Iloilo, and what few hardware stores there are in the islands, do not carry any proper assortments of screws, bolts, nuts and other small mechanical furnishings which would be of great service to the operators. Screws, bolts and the like when wanted, must be laboriously cut from metals, consuming much time and resulting in a poor piece of work.

During the occupation of the islands, large assortments of colored flags, rockets and lights have been put into all of the stations. In rare cases, regular company signal men are stationed, and these men handle the colored flags and lights. But in most instances the display of signals from point to point by colored flags or rockets, is done by the operator; in fact, the poor operator in the tropics is the handy man. He must understand the local code of signals as delivered at night with colored lights, and in the daytime with colored flags. At one station where I was located for several months, we used the church tower as a signal station. White meant country clear, blue, enemy near; red, a probable attack. It was so arranged that by combining colors, the direction of rebel troops could be signaled and also the form of marching, numbers, etc. I know that at times the signal man would hardly finish a message when he would have to climb the ladder to the tower to signal and then rush back to his den, there to hear his station call on the wires and the bells of the telephone ringing his station. The noble fellows in the foreign service deserve much credit. I could give the names of several heroes whom I met in the Philippines, whose names ought to go into history. For instance, one day Lieutenant Wildeman, on Panay Island, rode alone on horseback from Miagoa to Iloilo, through the rebel country to get to Iloilo to appear at an important meeting of officers on military matters. I met with Operator Charles Hart at Oton, when he was so ill with fever that he could hardly stand, and he attended to all of his duties like a hero, sending and receiving messages day and night when he ought to have been in the hospital. His superior officers made all possible efforts to get him relieved by another operator, but emergency of war prevented for several days. Finally an operator came out from Iloilo and relieved him. Operator Syder, of Tigbauan, is another man I remember as being brave and faithful, for he used to go out into the jungle with a very small guard to replace broken wires. Robinson, of Leon, went out with a column once, as signal man, and was under fire, receiving, I believe, special mention.

Arc Lighting at the Beginning of the Twentieth Century.*

The paper of Mr. W. H. Hillman, with this title, was largely devoted to bringing out the merits of the constant-current transformer system of arc lighting. During the past two years it is stated that 50,000 lights capacity of enclosed arcs has been installed for street lighting, of which 30,000 lights capacity is represented by alternating arcs. Enclosed arcs have been adopted by 350 cities, of which 300 have introduced alternating arcs. About 270 cities are operating 6.6 ampere lamps, consuming only 430 watts (average), as compared with about 30 of the 7.5 amperes, consuming 485 watts (average). Attention is particularly called to this latter point, because it shows that as far as volume of light is concerned, the alternating system has fully met the demand; in fact, while the 7.5-ampere, 485-watt lamp has been available since the system was first introduced, 90 per cent of the cities and towns have adopted the lower energy lamps, consuming only 430 watts. If the limiting feature of the system had been in respect to the volume of light from an alternating lamp, surely the 7.5-ampere system would have been adopted exclusively.

Many schemes have been considered in connection with street lighting from the alternating system. Quite frequently the argument is presented that multiple alternating lamps can be used with practically the same degree of economy and convenience, which has favored the series-alternating system. Where the wires from the old arc systems were strung out from the station in pairs, instead of a loop, there would be a greater tendency to consider an installation of the multiple lamp. The question would naturally arise as to whether they would be installed on those constant potential transformers, which were used for commercial and residence lighting. If so, the lamps would have to be controlled individually, necessitating switching them off and on by an attendant, or collectively, by means of some magnetic switch. The first method would be expensive, and lamps would not be lighted simultaneously. The second method would require special additional wiring. At the present writing, street lighting by multiple alternating lamps has simply been considered in isolated cases. The idea does not seem to have special merit.

COST OF MAINTAINING ENCLOSED SERIES ALTERNATING-CURRENT STREET ARC LAMPS, HAMPTON, VA., 1900.

	June.	July.	Aug.	Sept.	Oct.	Nov.
No. of hours burning......	240	248	294	307	372	411
Average life of carbons....	41.50	61.55	80.07	60.00	70.00	75.00
No. of lamps	69	69	69	69	81	81
No. of solid carbons used..	200	145	166	176	215	222
Cost of solid carbons	$4.45	$3.13	$3.70	$3.92	$4.78	$4.94
No. of cored carbons used..	199	146	166	177	215	222
Cost of cored carbons......	$4.73	$3.47	$3.94	$4.41	$5.11	$5.27
Inner globes used	5	5	7	10	5	8
Cost of inner globes........	$0.95	$0.95	$1.05	$1.50	$0.95	$1.20
Outer globes used	6	2	3	1	6	3
Cost of outer globes	$2.70	$0.90	$1.35	$0.45	$2.70	$1.35
Labor trimming, clean., etc.	11.70	11.70	11.70	11.70	13.95	13.95
Total cost of maintenance..	25.53	21.15	21.74	21.98	27.49	26.71
Cost per light	.37	.306	.315	.317	.338	.329

Another method which has been suggested might be illustrated in connection with a 500-light system. A large constant potential transformer installed at the station is arranged with loops brought out on the secondary side to accommodate ten 50-light circuits; each circuit having a reactive coil installed as a regulator for series-alternating lamps. One objection to this arrangement would be that, should any accident happen to this transformer, the entire arc-lighting system is put out of service. If an attempt is made to avoid this point by using two or three smaller size transformers, the system becomes complicated and the attempt to secure high efficiency, together with low cost, is defeated.

During the years of 1895 and 1896, records show that only a few alternating open-arc lamps were in use. Not more than 1000 to 1500 alternating lamps were introduced by central stations during the year 1896. In 1897, the first satisfactory enclosed-alternating lamp was made commercially successful, and in the years 1897 and 1898, between 20,000 and 30,000 lamps were placed in actual service. During 1899 practically 30,000 of these lamps were required to meet the demands of the central stations, while during the year 1900, between 50,000 and 60,000 alternating lamps were installed. As a result, about 125,000 alternating lamps are to-day in actual service. Most of these have been installed during the short period of three years. They have made it possible for stations equipped with alternating generators to establish their commercial arc lighting on a profitable basis, meet competition from Welsbach burners, and contract with their respective cities for the street service, with a commercial system of alternating street arc lighting.

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* Abstract of paper read at the Niagara Falls Convention of the National Electric Light Association, May 23, 1901.

Estimated conservatively, the additional income to the central station business, since the introduction of alternating-arc lamps, has been from $5,000,000 to $8,000,000.

In the past, the attention has been called almost entirely to the *estimated annual* cost of operating enclosed arcs. The table on page 929 shows the actual figures taken from the books of an electric lighting company, and is representative of central station practice. It is of interest to note how closely the figures representing actual practice approximate the estimated figures which have been commonly recognized heretofore.

Exhaustive experiments to date have not as yet been sufficiently successful to warrant the standardization of solid carbons for alternating lamps. On the contrary, the best practice favors one cored carbon for such lamps. It is a fair question to ask, "Why was the alternating lamp designed to take 9½-inch carbons, as against the standard 12-inch length?" Good reasons may be given, namely: in a direct-current lamp the positive carbon burns twice as fast as the lower. A 12-inch carbon is therefore necessary. In an alternating lamp the upper carbon is consumed at the same rate as the lower.

In reply to a question as to what methods may be used to overcome the induction on telephone lines paralleling series alternating arc light lines, Mr. Wagner said that in general it is pretty hard to get rid of the trouble if telephone lines form part of grounded circuits. A case was described wherein it was found that the trouble on a telephone line did not arise from electromagnetic, but from electrostatic induction. Mr. Walton spoke of a serious difficulty with telephone lines at Akron, Ohio, which was entirely obviated by proper transposition of the telephone wires. A special single pole telephone-receiver was wound with two coils having the same number of turns. The telephone lines were transposed in the daytime and at night after the arc lights were on the transposition was opened by means of this receiver to see which end of the line was the strongest; that is, whether the noise from one end of the transposition or the other was the stronger, the idea being to get the transposition in the center of the noise curve. In the course of a month or so, by this means the lines were so regulated as to give rise to no further trouble. Mr. Almert said that if underground lighting cables do not have their lead coverings connected together a condenser effect occurs which will cause trouble on telephone circuits. He referred to the trouble when the West Park, Chicago, lighting plant started up, neighboring telephone circuits being rendered inoperative in hours when the electric light system was in operation. The trouble was entirely eliminated by connecting the lead shields together where they went up into the pole and grounding them every thousand feet. When these connections were left off a considerable disturbance in telephone service at once followed, Mr. Binley said that when the telephone wires are on the same poles with alternating-current wires, the telephone people always prefer to have their circuits come as much above the lighting circuit as is possible, always 18 inches or more. In this case the induced currents between the lighting circuit and the earth do not affect the telephone circuits as much as would otherwise be the case. Mr. Phipps called attention to the fact that the troubles in the Chicago park above referred to were caused by direct currents, and it appears that in some respects the same difficulties may arise from underground direct currents as from alternating currents.

In reply to a question as to whether certain 650-cp alternating-current enclosed arc lamps which were replaced with 2000-cp direct-current open arcs did not, in fact, require from 10 to 15 per cent more current, Mr. Bechtel said that 2000-cp direct-current arc lamps were replaced with 7½-ampere alternating-enclosed arc lamps. At first there was some little trouble on account of poor operation due to mechanical causes, but at the present time the people like the alternating lamp better than the open arc, as it gives better street and general illumination. Mr. Hillman said that of 300 cities which have adopted alternating-current enclosed arc lamps, 270, or practically 90 per cent, use the 6-ampere, 430-watt lamps. At present about 400 constant-current transformers of the air-cooled type are in use; 25, 35 and 50-light sizes are air-cooled, those of larger capacity being oil-cooled.

American Machinery in the German Market.

In the course of a long and interesting communication to the United States Department, Consul-General Frank H. Mason, of Berlin, Germany, writes as follows: "It must be admitted that, except in a few lines, American exporters have been slow in learning the best methods of utilizing the opportunities which are offered in the German market. The makers of machine tools and shoemaking machinery, typewriters, and a few other specialties learned the lesson early and well, and have profited by their knowledge. But, as a class, the American manufacturer—incomparable as such—is still in the primary grade as a merchant in foreign fields. That this should be so is perhaps a natural result of his education and environment. His success at home has been so complete and satisfying, his confidence in American methods so ingrained and assured, that he finds it hard to realize that customers cannot be won in France, Germany and Russia with catalogues and price lists in English; with measurements, weights and values stated in inches, pounds and dollars; and offering to sell his incomparably superior products for "cash at 10 days sight f. o. b. New York, sight draft with bill of lading attached."

The folly of all this has been explained and written threadbare in consular correspondence and published reports. It has been emphasized in the letters of German agents and importers, but still the confident exporter goes on in his efforts to "teach foreign purchasers American methods of business." If he ventures upon a foreign language it is almost invariably Spanish, and Germany has been strewn with Americo-Spanish catalogues and price lists which are twice as bulky and no more comprehensible to Germans than if printed in English alone. By way of making it pleasant and easy for the foreign customer, he often incloses a United States stamped envelope, printed with his own address, to contain the returning order. If he sends a traveling salesman or agent to study the market and make personal propaganda, the chances are that the emissary will be a bright, energetic, capable young American, who knows all about the goods and how to sell them in the United States or England, but is ignorant of every language but English and helpless beyond the realm of his mother tongue. Even with these disadvantages, the imperfectly equipped salesman often renders a valuable service by studying the actual needs and conditions of the foreign market, finding how it can be best reached, and, as one of them sententiously remarked, "geting the facts to convince our firm at home that Germany is not in the United States."

In respect to size, beauty of print and illustration, the trade catalogues issued by American manufacturers are the most elaborate and beautiful, as well as the most expensive, in the world, but for practical purposes they are often defective in several respects, the most essential of which are too many claims to superiority and too little definite and exact information concerning the weight, dimensions and effective capacity of machinery; absence of metric weights and measurements and prices in francs, marks or other foreign equivalents; and translations, when given at all, made by persons who do not understand the goods, and which are often so incorrect and imperfect as to furnish no adequate technical description of the merchandise. As a result of these defects, intending purchasers are frequently obliged to open a correspondence with the exporting manufacturer in order to obtain clear and definite information. This entails a serious waste of time, and often leads to the loss of orders, which are given to manufacturers of other nationalities, who make careful and complete catalogues specially for the German market, or, what is still better, send a capable traveling salesman to exhibit samples or photographs of the goods and make direct contracts in the office of the purchaser.

Writing in a similar strain from Gera, Saxony, Mr. Charles Neuer, United States Consular agent, says: "American manufacturers are often anxious to make large sales at the start, without considering that new articles can be introduced to consumers only by the expenditure of much patience and perseverance. Great fault is found with our terms of credit. While the business in this country is mainly done on terms varying from three to six months' time, our merchants insist in many cases on cash on delivery, and even before delivery, so that receivers are unable to examine goods before payment, and cannot know whether the shipments are in accordance with orders or not. Of course, the demand for cash on receipt is well justified if the purchaser's financial standing is of a questionable nature; but I know of first-class German houses that have been subjected to the same rigid terms, causing a discontinuation of purchases and material losses to our trade.

"Another point one of my informants laid stress on was the packing of our goods; the greatest precaution should be used in this regard. Care should be taken to prevent breakage, and no old or damaged cases should be used. As the customs duties are levied here on the gross weight, less a certain percentage for tare, the advantage of lightness in packing is essential. Manufacturers who ship goods to this country should thoroughly acquaint themselves with the German tariff, and pack their goods in such a manner as to save the purchaser trouble and useless expense. For instance, a much higher duty is charged on nickel-plated iron than on cast-iron stoves. American shippers of stoves will therefore act wisely if they separate the nickel-plated parts and pack them in one case and the heavy iron parts in another, so as not to have the receivers pay the higher duty on the entire weight. The same is true of many other articles."

Underground Wires in Providence, R. I.

The following report has been made by Starkweather & Shepley, the insurance firm of Providence, R. I., on the underground system in that city:

Some two years ago a city ordinance was passed requiring all aerial electric wires in the close fire district to be placed underground, this to be done before February of this year. This has been very generally complied with, and at the present date, fully 95 per cent of all line wires have been placed in conduits in this district, with the exception of the wires of the Union Railroad Company. The work has also been extended very largely in the outside districts, both the Telephone Company and the Lighting Company having run conduits in several cases to the outlying territory. The city of Providence also appointed several men, whose duty it was to go over this district and remove from the buildings and streets all unused wire. This has been completed, and many miles of abandoned wire have been removed.

The Providence Telephone Company commenced laying its underground system on May 9, 1893, and since that time it has built 10¼ miles of conduit. It is its intention to extend the underground work at a rate of five miles per year, until the whole city is supplied with the underground service. It has laid two kinds of conduits, the cement lined wrought iron pipe and the multiple vitrified clay conduit. It uses a lead-covered paper insulated cable. Its method of distribution is to run from the manholes with lead-covered cable to the building or pole, thence making aerial distribution to group of customers. It uses heavy current protectors where the wires enter buildings in every case.

The Narragansett Electric Lighting Company began its conduit work in 1899, and since that time has laid something over 40 miles of multiple conduit containing about 225 miles of cable. It has used throughout the vitrified clay conduit laid in cement. The cables used are lead-covered with rubber insulation. In most cases connections are made direct from manholes to the building served, the wiring not coming out of the ground at all. The whole system is protected with fuses both in the manholes and where the wiring enters the buildings.

The Rhode Island Electric Protective Company has nearly finished placing all its wires in the conduits of the Providence Telephone Company, using the same materials and style of construction.

The Western Union Telegraph Company and the Postal Telegraph Cable Company have not as yet placed their wires underground to any very great extent. They have planned to use the conduits of the Providence Telephone Company, but have as yet been unable to come to terms, although the matter is now about to be amicably settled, and undoubtedly all their wires will be buried very shortly.

The municipal police and fire service is all underground in the close fire district, they also using the conduits of the Telephone Company.

It will be seen from the above that the city is now practically clear of overhead wires, with the few exceptions noted. The telegraph wires are comparatively few. Most of them run in overhead cables, and would cause very little trouble in case of fire. The 500-volt feeders of the Union Railroad Company are the only high-tension wires above ground in the center of the city. These are very heavy covered cables, are run on the trolley poles, and are very few in number. As they do not attach to the buildings and are comparatively low, and for the most part of the same polarity as the trolley wires themselves, they are out of the way of the fire department, and do not add to the danger that already exists from having a bare trolley wire in the street. That the placing underground of both high and low tension wires in the city of Providence has proved very satisfactory is shown by the fact that fewer fires from electric causes have occurred in the last two years than ever before, in spite of the fact that almost the entire close fire district is now using the three-wire 470-volt system for lighting, where formerly the 52 and 104-volt systems were in vogue.

With the exception of New York and Boston, no city has so many feet of duct or miles of underground cable as has the city of Providence and the companies are now carrying out extensions in this work with a view to entirely doing away with aerial wire construction inside the city limits. Before introduction of the underground service the Narragansett Electric Lighting Comuany had been using for lighting purposes a 2000-volt alternating circuit which was reduced by transformers at each building to 52 or 104 volts. They now use, as stated above, a three-wire 470-volt system, the two-wire circuits from which using the current at 235 volts. The introduction of this system necessitated many changes in the existing inside wiring and fittings. To overcome this obstacle the Narragansett Electric Lighting Company at its own expense, and under the careful supervision of the insurance authorities have practically rewired the whole of the close fire district of the city. Work has been done in a very thorough manner, strictly in accordance with the Electrical Code, the electric wiring and apparatus in many of the buildings having been completely renewed.

In addition to the foregoing a very satisfactory system of licensing of electrical contractors has been devised and is in operation, licenses only being granted to those parties who, in the judgment of the inspectors of the Insurance Association and the Electric Lighting Company are found upon due examination to be competent. The Electric Lighting Company has agreed not to supply current to any system of wiring that has not been inspected by the Insurance Association of Providence and certificates of approval issued. With such a large proportion of the wiring underground and with the wiring in all the buildings of the close district in such very excellent condition it would seem that the electric light and power service from an insurance standpoint is all that could be desired, and with the harmonious relations now existing between the various electric companies and the insurance authorities the present high standard will undoubtedly be maintained.

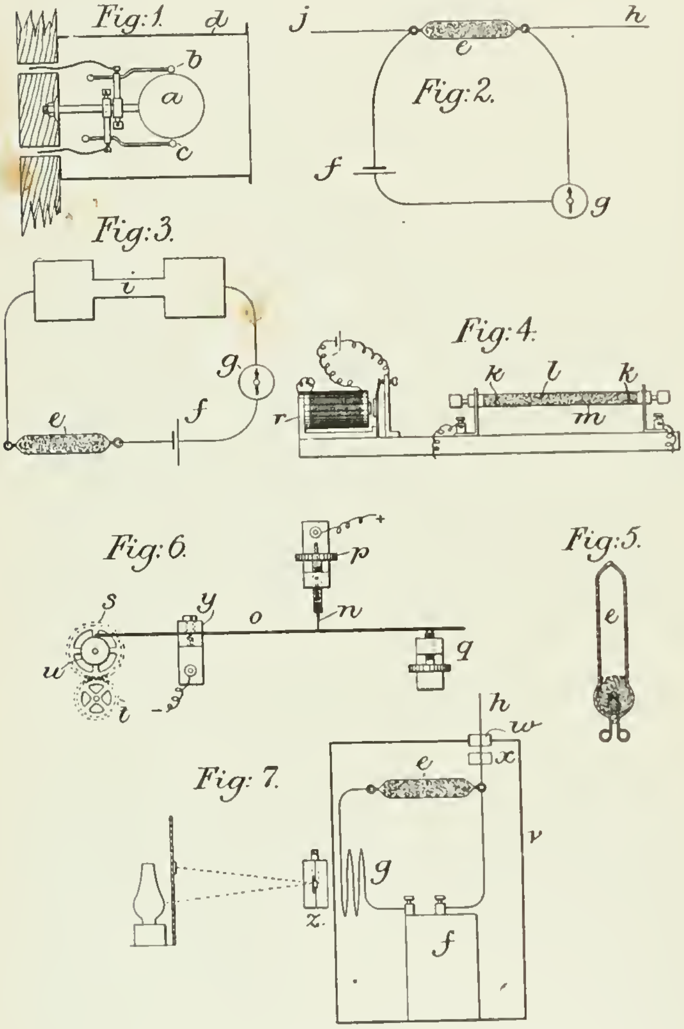
Lodge Wireless Telegraphy Patent.

A patent was issued May 21 to Professor Oliver J. Lodge on a wireless telegraph system, the application for which was filed Dec. 20, 1897. The transmitter is shown in Fig. 1. An electric charge is supplied to a single conductor *a* (shown as a sphere, but which may be of dumb-bell or any other shape) suddenly or disruptively by a couple of positive and negative sparks from knobs *b* and *c*, and there left to oscillate and emit waves. A partial metallic inclosure *d* may be used to diminish waves in undesired directions. Both of these arrangements are stated to be the invention of Dr. Lodge. The more usual plan hitherto has been to charge two conductors by a pair of leading-wires and let them spark into each other.

Referring to Figs. 2 and 3, the receiving circuit consists, essentially, of a coherer *e*, a battery *f* or other suitable source of electrical energy, and a telegraphic receiving instrument *g*, all in electrical connection, as shown. There is added to these latter a collecting wire *h*, of any desired length, as shown in Fig. 2, or else a form of Hertzian resonator, as shown at *i* in Fig. 3, the function of either of which is to collect and to convey to the coherer the Hertzian waves produced at a distance, as aforesaid. In some cases any bare wire or a connection to earth direct or through the system of gas or water pipes, as shown at *j* in Fig. 2, will serve sufficiently well as a collector or as an assistance to the insulated collector.

The coherer consists, essentially, of an organism whose electrical resistance diminishes under the influence of Hertzian waves, but which returns to its former amount when the cohered condition brought about by the electrical influence is broken down by mechanical tremor.

One suitable form of coherer is illustrated in Fig. 4, which was introduced (for other purposes) by Branly previous to the year 1894. This arrangement consists of a pair of metallic points *k*, embedded in metallic grains or powder *l* within a glass tube *m*. Or the filings may be sealed up in vacuum, as indicated in Fig. 5, which increases and prolongs its sensitiveness; or, as illustrated in Fig. 6, a coherer may be used, consisting of a needle-point n, resting lightly on a flat plate or spring o, fixed in a clamp y, the degree of pressure being obtained by the adjustment screws p and q. On the arrival of Hertzian waves more complete contact or cohesion is set up between the particles of powder l or between the point n and spring or other light metallic contact o, and so allows more current from the battery f to flow through the telegraphic receiving instrument (indicated at g, Figs. 2, 3 and 7); but then before the coherer is again in a fit state to receive fresh impulses the said cohesion must be destroyed. According to the invention this is effected by an automatic vibrator. This mechanical vibration may consist of a succession of jars or knocks or taps, which may be produced by electrical means, as in an electric trembling bell (see r in Fig. 4), or by clockwork. (See Fig. 6.) In the last-mentioned figure s and t represent two wheels of a clockwork train. Upon the arbor (or on a disk mounted thereon) of the wheel s is a series of serrations or the like u (shown exaggerated in the drawings), which, as the wheel rotates, effects the vibration of the lever or spring o either directly or indirectly through the stand. Such a tapper as is used in dentistry also serves very well for my purpose.



FIGS. 1 TO 7.—LODGE WIRELESS TELEGRAPHY.

A coherer is sensitive not only to the desired impulse arriving from a distance and conveyed to it by the collectors, but it is also liable to respond to any local sparks or electric surgings in its neighborhood, especially to oscillations in an adjacent emitter. It may be protected from all these by complete inclosure in a flawless metallic box.

For the purpose of protecting the coherer from undesired disturbance, therefore, it is inclosed (sometimes with all coils, wires, batteries and the like connected to it), in a metallic covering or case, as shown at v in Fig. 7, leaving only one or more round holes or short tubes w for the collector terminal or terminals to enter by and for vision or other needful purpose requiring an aperture, for through round holes of moderate size large electric waves do not readily pass, whereas through chinks or long slits, no matter how infinitely narrow, they can pass with ease. They likewise pass in by means of any insulated wire which enters the box; but through any wire which is thoroughly joined to the metal wall of the box where it enters the waves cannot pass.

In the particular arrangement shown in Fig. 7 a single terminal h is employed which is insulated from the casing by tube w and is connected to one terminal only of the coherer. This construction is effective and desirable in certain cases, and it is found that the Hertzian waves pass in as readily through the single wire, affecting the coherer in the same way as in the case of the earthed circuit through j in Fig. 2. Hence it is not absolutely necessary to remove the terminal h from its aperture when it is not being used for the purpose of establishing communication and enabling waves from the collector to enter the box and reach the coherer, for these same terminals h or j may, when they are raised completely, plug with metallic continuity, as shown at x, the small holes through which they can freely afterward be lowered.

The only part of the coherer or detector portion outside the box (shown in Fig. 7) is the index or needle mirror z of the telegraphic receiving instrument employed, which is acted upon and deflected by its coil g inside acting magnetically through the metal wall. When the plan of withdrawing the terminals of the box is adopted, it is sufficient to put the coherer above-mentioned alone in the box.

There are eight claims in the patent, as follows:

1. In a system of Hertzian-wave telegraphy, an emitter consisting of a single conducting body and means for suddenly and disruptively communicating opposite electric charges thereto, whereby oscillations are set up in said body, and waves are emitted; substantially as described.

2. In a system of Hertzian-wave telegraphy an emitter comprising a single conductor supplied with opposite electricities by a pair of knobs connected to the terminals of a high-potential source.

3. In a system of Hertzian-wave telegraphy, the combination with an emitter, of a partial metallic inclosure serving to lessen the emission of Hertzian waves in undesired directions.

4. A coherer comprising a variable electrical contact sealed in vacuum.

5. In a receiver for Hertzian-wave signaling systems, the combination of the following instrumentalities: A coherer, a base or support upon which it is mounted, and a vibrator mounted in proximity to the coherer, and adapted to agitate its elements.

6. In the receiving circuit of a system of Hertzian-wave telegraphy, the combination, with a coherer, of automatic means to successively break down the cohesion caused in said coherer by such Hertzian waves.

7. In combination, in the receiving circuit of a system of Hertzian-wave telegraphy, a coherer, a battery, a telegraphic receiving instrument and automatic means to successively break down the cohesion caused in said coherer by such Hertzian waves.

8. In combination, in the receiving-circuit of a system of Hertzian-wave telegraphy, a coherer, a battery, a telegraphic receiving instrument, automatic means to successively break down the cohesion caused in said coherer by such Hertzian waves, and means serving to collect and convey to the coherer Hertzian waves produced at a distance.

CURRENT NEWS AND NOTES.

WIRELESS TRAIN TELEGRAPHY.—A London dispatch of May 15 states that Signor Marconi has successfully installed his system of wireless telegraphy in a steam motor car, and that he is able thereby to communicate with a base while traveling. The War Office officials are about to witness a demonstration of the apparatus.

TELEGRAPH WIRES LAID ON SNOW.—Consul-General Guenther, of Frankfort, says that, according to experiments conducted by Mr. H. Janssen on Mont Blanc, it is not necessary to erect poles for stringing telephone and telegraph wires in snow-covered countries. If the snow is several inches thick, it serves as a good insulator; the wires can simply be laid down and be ready for transmission of messages. The consul-general adds that similar experiments with equally favorable results were made on Mount Ætna.

ELECTRICITY IN JAPAN.—According to a recent consular report the Japanese investment in electric lighting in 1899 was $3,954,000, an increase of no less than $2,378,000 over 1895.

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society, May 16, the following members were elected: Messrs. David Rousseau, C. J. Spencer and W. C. Gotschall.

THE LIVERPOOL & MANCHESTER ELECTRIC RAILWAY.—According to a cable dispatch from London on May 17, the committee of the House of Lords passed the Mono Railway bill, which authorizes the construction of an electric express railway between Liverpool and Manchester.

UNDERWRITERS' RULES.—The National Board of Fire Underwriters has issued a 42-page pamphlet containing the rules and requirements of the board for the installation of automatic sprinkler equipments, as recommended by the National Fire Protection Association. A section of the pamphlet is devoted to rules and regulations governing wiring for electric alarms.

PARIS-BRUSSELS ELECTRIC LINE.—A Belgian newspaper announces that King Leopold intends to create a network of electric railways, requiring a capital of 1,000,000,000 francs, to be constructed in the following order: Brussels to Antwerp, Brussels to Ostend, and Brussels to Paris. According to the same authority the consent of the French Government has been secured.

RAPID TRANSIT TUNNEL TO BROOKLYN.—Both branches of the New York Municipal Assembly have approved the plans of the Rapid Transit Commission for the tunnel to Brooklyn, and all that is necessary now for the beginning of the construction of the tube is the appropriation of the $8,000,000 by the city to pay the expenses of the work, and the letting of the contract.

WIRELESS TELEGRAPH EQUIPMENT ON STEAMER.—A Liverpool dispatch dated May 21 states that the steamer Lake Champlain, the first British vessel to be equipped with the Marconi system of wireless telegraphy, has sailed from that port for Montreal. She will try to communicate with the shore two days after leaving the Mersey and two days before she reaches Quebec.

ITALIAN SUBMARINE BOAT.—Rear Admiral Micheli, Inspector-General of Italian Naval Engineers, has presented to Vice-Admiral Morin, Minister of Marine, plans for a new submarine war vessel which he says will be vastly superior to anything yet invented. He will undertake to build a vessel of 160 tons displacement and a speed of 12 knots an hour, and capable of remaining under water for a long time.

WIRELESS TELEGRAPHY TESTS.—Recent experiments in wireless telegraphy off the coast of Malta have resulted in the successful transmission of a message 134 miles, according to United States Consul Grout at Malta, in a report to the State Department. The message was received in an unexpected way. While experimenting on a ship in the open sea the operators were surprised to rceive a message in Italian asking as to the position of their ship. It afterward developed that the message came from an Italian war vessel at Syracuse.

A WESTERN SIROCCO.—A heavy windstorm swept over Nevada, Utah, southern Iado and Wyoming last week, the velocity at times reaching 50 miles an hour. The storm has resulted in the complete prostration of telegraph and telephone service in all directions. Reports from outside cities tell of uprooted trees, wrecked outbuildings, interrupted electric service and other damage. The storm was particularly severe through Nevada and Utah, and in places across the desert the blowing sand almost buried the railroad tracks for miles. Around Great Salt Lake a perfect sirocco prevailed.

ROWLAND TELEGRAPH IN GERMANY.—According to a Berlin dispatch experiments have been made between Berlin and Hamburg during the past month, with the system of rapid telegraphy of the late Professor Rowland, of Baltimore. The results are said to have been most satisfactory, the news system easily doing double the amount of work done by the Baudot apparatus. It is understood that the German Postal Department intends to introduce the Rowland system between Berlin, Hamburg, Cologne, Leipsic and Frankfort.

A SOUTH AMERICAN TELEGRAPH.—A Lima telegram states that a proposal has been received in Peru from the Argentine Government, for the construction of a telegraph line from the Argentine Republic across Bolivia and Peru to Ecuador, where it should connect with the line to Central America and the United States. This, it is stated, would obviate the necessity of the South American Republics depending solely upon the English and French cables on both the Atlantic and Pacific coasts for their telegraphic communication with the United States.

TRYING A DIVORCE CASE BY TELEPHONE.—An Indianapolis correspondent calls our attention to the part played by the telephone in a recent divorce case at Noblesville, Ind. A Mrs. Nagle brought suit for divorce. On the day appoitned for the trial her attorney, Mr. Fippen, could not attend, and called up the Noblesville judge and explained the circumstances, suggesting that the case be tried by telephone. The Judge consented, the witnesses were sworn, and in answer to questions asked them by Mr. Fippen, 30 miles away, submitted their testimony to the Judge, after which Mr. Fippen delivered his argument, talking into the Judge's ear by telephone. The divorce was granted.

ELECTRICAL FIRE LOSSES.—The electrical bureau of the National Board of Fire Underwriters reports numerous losses during the last quarter. These aggregate more than $1,361,000, but since the origin of some fires could not be ascertained with accuracy, particulars in all cases are not given. The report cites these incidents: Four fires caused by sparks from motors occasioned loss of $11,714, and in one case a total loss, the amount of which was not recorded. Seven fires are reported of breakdowns in motors. Thirty-three incipient fires and burnouts are reported as due to defective wiring and general breakdown of insulation, mostly on old work. Three fires each, due to sockets and flexible cord, show that the standardization of these articles has not been without effect in reducing the losses occasioned by their use. Eleven cases of grounds on awnings and guilding fronts are recorded. Three losses are on file due to overheating of rheostats and motor-starting boxes. Three losses are noted as caused by the breakage or heating effect of incandescent lamps. Four fires are traceable to defective chandelier switches. Three cases are noted where fires have started by arcing between water and gaspipes, caused by a difference of "potential" between them, produced by breakdowns in Edison underground service wires. Nine burnouts and crosses reported as occurring during wind and sleet storms emphasize the necessity of placing wires underground.

ELECTRICITY AND POPULATION.—In an interesting article in the *Fortnightly Review*, Mr. H. G. Wells notes the centrifugal effects of electric traction as follows, but overlooks the centripetal: We are on the eve of a great development of centrifugal possibilities. And since it has been shown that a city of pedestrians is inexorably limited by a radius of about four miles, and that a horse-using city may grow out to seven or eight, it follows that the available area of a city which can offer a cheap suburban journey of 30 miles an hour is a circle with a radius of 30 miles. And is it too much to expect that the available area for even the common daily toilers of the great city of the year 2000, or earlier, will have a radius very much larger even than that? Now, a circle with a radius of 30 miles gives an area of over 2800 square miles, which is almost a quarter that of Belgium. But 30 miles is only a very moderate estimate of speed, and the reader of the former paper will agree, I think, that the available area for the social equivalent of the favored season-ticket holders of to-day will have a radius of over 100 miles, and be almost equal to the area of Ireland. The radius that will sweep the area available for such as now live in the outer suburbs will include a still vaster area. Indeed, it is not too much to say that the London citizen of the year 2000 A. D. may have a choice of nearly all England and Wales south of Nottingham and east of Exeter as his suburb, and that the vast stretch of country from Washington to Albany will be all of it "available" to the active citizen of New York and Philadelphia before that date.

WIRELESS TELEGRAPHY IN PULPIT.—Rev. C. H. Tyndall, of the Dutch Reformed Church at Mount Vernon, N. Y., a couple of Sundays ago, illustrated his sermon on "Wireless Telegraphy and its Spiritual Similitudes," with a complete operating wireless telegraph equipment. He compared the electric waves to the penetrating but invisible influences of the Diety.

LONG-DISTANCE TELEPHONY.—According to a Boston financial journal, satisfactory tests of the Pupin system of telephony have been made between Chicago and New York, and showed that with this system a line weighing 314 lbs. to the mile gave as good results as an ordinary line weighing 870 lbs. to the mile. The same journal states that a circuit for commercial use will soon be established between New York and New Orleans, which will make conversation practicable between New England and Galveston and all Texas points.

HIGH VOLTAGE IN INDUCTIVE EFFECTS.—A correspondent writes that while in the Western Union office at Reno, Nev., recently he noticed a very pronounced hum above the noise of the instruments. Upon inquiry he was informed that the Blue Lakes Power Company was testing its line and that this inductive effect was the result. It was also stated that the line was at the time being experimentally tested at 85,000 volts, the line being about 170 miles distant from Reno. The noise, which was most disagreeable, would rise to a certain pitch and then fall to a lower pitch as if the generator was racing.

LEHIGH ELECTRICAL THESES.—Among the subjects of theses to be presented by the candidates for degrees from Lehigh University are the following: "Theory and Calculations of the Induction Motor," by P. L. Anderson and L. A. Freudenberger; "Induction Wattmeter Tests," by W. D. Cassin and J. C. Ryan; "Theory and Calculation of Alternating-Current Transmission Lines," by J. H. Flory and C. W. Startsman; "Conductivity Tests of Copper," by E. S. Harrar and G. W. Welch; "Resistance Standards," by A. C. Savidge and J. S. Van Alen; "A Gravity-Driven Electric Power Plant," by F. Donaldson.

MUNICIPAL ELECTRICIANS.—The International Association of Municipal Electricians will meet in the Natural Food Company's convention hall at Niagara Falls, N. Y., on September 2, 3 and 4. Mr. F. C. Mason, of Brooklyn, N. Y., has made special arrangements whereby all delegates and visitors can secure greatly reduced railroad fare, who go via New York City. For full information, address F. C. Mason, superintendent police telegraph, 16 Smith Street, Brooklyn, N. Y., giving the number you will have in your party. Mr. M. J. Donohue, superintendent of fire telegraphs, can be addressed as to local accommodations.

ELECTROLYTIC PURIFICATION OR CRUDE SPIRITS.—In a patent granted May 21 to J. H. Lavollay and G. E. Bourgoin, of Paris, France, a process is described for purifying crude spirits to obtain neutral rectified spirits. The process consists in treating the crude spirits until neutralized with a manganate of an alkaline earth metal in the presence of an electric current. Manganate of calcium or any other insoluble manganate may be employed. The result of the process consists in the elimination of bad flavors, in an improved product, and the reduction of aldehydes by means of electrolytic hydrogen. The quality of the spirits is thus improved, and the yield of resultant spirit increased.

ACETYLENE CONVENTION.—The International Acetylene Association will meet at Buffalo, N. Y., June 20, 21 and 22, when the following programme will be presented: "Purification of Acetylene," G. W. Kuchler, with the Roessler & Hasslacher Chemical Company, New York City, N. Y.; "Acetylene Heaters & Cookers, and Their Application," A. T. Murdock, secretary American Acetylene Stove Company, Minneapolis, Minn.; "Town Lighting," Emory S. Turner, New York City, N. Y.; "The Future of Acetylene Gas," George Landis Wilson, of F. Cortez Wilson & Co., Chicago, Ill.; "Relative Merits of Acetylene & Gas Lighting," William Finkler, of W. Finkler & Co., Chicago; "Results of Practical Experiments with High-Pressure Lighting," Harvey T. Hauer, with Lebanon Fuel Illuminating & Power Company, Lebanon, Pa.; "Acetylene as Applied to Locomotive Headlights," McDonald Elliott, Santa Rosa, Calif.

CLOSE OF N. Y. ELECTRICAL SOCIETY SEASON.—Secretary Guy, 120 Liberty Street, New York, has issued the following notice: The twentieth annual meeting of the New York Electrical Society for the election of officers, will be held at the Cafe Boulevard, Second Avenue and Tenth Street, Thursday, June 6, at 9 p. m., to be preceded at 6.45 p. m. by an informal banquet—tickets $1, without wine. The meeting and dinner will be followed by an entertainment in the place of speeches. An excellent menu has been specially provided, and it is hoped that every member will make an effort to attend, to participate in this pleasant close to a very successful season With the object of studying the convenience of many of the members who are unusually busy at this season of the year, the executive committee requests that members will come straight from their offices and that no evening dress will be worn. Members must give prompt notice on accompanying postal of their intention to be present, as a large attendance is already assured, and it is necessary that the secretary should be fully advised as to how many of the members and their friends must be provided for.

MULTI-SPEED POLYPHASE MOTOR.—A patent granted May 14 to B. G. Lamme relates to means whereby the speed of a polyphase motor may be readily varied. The motor is of the direct-current type—that is, has a commutator armature. The armature is supplied with current from one leg of a two-phase circuit, and the field with current from the other leg, transformers being interposed between the motor circuits and line. The secondary of each transformer is sectional, and means are provided to vary the number of active coils, thereby varying the voltage of either the field or armature, or both. In addition the field circuit contains an adjustable ohmic resistance, and the armature circuit an adjustable inductive resistance. In order to vary the speed of the motor, the e. m. f. supplied to the armature may be varied by cutting in or out secondary coils, or both the field and armature e. m. f.'s may be varied by adjusting the secondaries of both transformers. The speed may also be varied, if desired, by adjusting the phase angle between the currents in the field and armature, this being done by adjusting either the ohmic resistance in the field circuit, or the inductive resistance in the armature circuit, or both. All the adjusting devices above referred to will probably not be used in practice in any one installation.

TECHNICAL EDUCATION.—The April issue of the University of Tennessee *Record* contains an article by Mr. A. C. Lanier on "Technical Education in the South." The growing industries of the South are sketched and the need pointed out for technical courses in the Southern schools to meet the situation. The Georgia Institute of Technology and Clemson Institute in South Carolina have recently instituted courses designed to prepare men for the textile industry, and a plea is made for an increase in the scope of the courses of the University of Tennessee. In discussing the methods of technical education Mr. Lanier points out that specialization should not mean narrowness. The engineer of to-day, he says, requires a broad culture. He has been looked upon as a man of wood and iron, and only with reluctance admitted within the "charmed circle of the learned professions." Of all men the engineer must see "long perspectives and wide horizons"; his whole training should "lift him above bias and prejudices, fit him to balance facts against forms, to eliminate non-essentials, draw up correct conclusions and to seek consequences from premises." Though nature is his workshop, human nature is his most important tool, and studies which will develop the social side of his character should find a prominent place in his education. Recognizing this need many leading educators have recommended that he take a course in literature, history and social economics, together with some mathematics, languages and general science, continuing through two or three years, before entering upon his more specialized work.

LETTERS TO THE EDITORS.

The Wheeler Gift.

To the Editors of Electrical World and Engineer:

Sirs.—The recent gift of the Latimer Clark library to the Institute of Electrical Engineers by Dr. Schuyler S. Wheeler, leads me to ask space for a few words based on my own experience in endeavoring to create a wider knowledge of electrical history among the members of the electrical profession.

At the outset, permit me to differ with you in your statement that now for the first time in this country a historical collection of this sort will be freely open to all interested. I think you overlook the fact that my collection, since given to the United States Naval Academy, was freely open for more than six years. It was placed in a separate room adjacent to my office and provided with a separate entrance. I took every means possible to inform the members of the electrical profession that not only was it open to their use, but that it would afford me great pleasure to have them use it.

The number of people who availed themselves of this offer during the period of six years above mentioned was *just two;* and I don't think that the researches of either extended over more than a few hours. It is true that some individuals—and, of all, the first and foremost was yourself—did manifest a gratifying and, needless to say, intelligent interest; but it is none the less a fact that the great majority of people who looked at the books viewed them with an appreciation apparently no different from that which they would have accorded to any other collection of out-of-the-way objects.

Always excepting the individuals above mentioned, I found by actual experience extending over 12 years that the particular book which happened to bear the earliest date invariably aroused greater interest than others of later epochs, although many of the latter were far more rare, or historically important. If the title pages and pictures of the books were displayed in a public exhibition, as they were here in New York in 1896, they were looked at, but even in this case I failed to discover that the interest they excited in the electrical profession was any greater than that accorded to them by the general public, and in some instances by people in walks of life far removed from any connected with electricity.

At various times I attempted to stimulate the attention of electricians to the beginnings of the science, not merely because of my own interest in it, but because I had found that the actual facts concerning early invention and discovery had been almost constantly misstated, especially in cyclopedias. This was due evidently to two causes. First, the great scarcity of the old original publications, and, second, the tendency to accept the statements of Priestly's history, published in the last part of the eighteenth century, as conclusive concerning all preceding achievement. There never was a more broken reed on which to rely. It was a compilation put together in less than a year, under many distractions mainly arising from theological controversies. and where not based upon the few and easily accessible transactions of learned societies, founded upon a comparatively limited number of original treatises which the author borrowed from Benjamin Franklin. To the inadequacy of his material the author himself was fully alive, for he gives a list of the books which he had consulted, and adds thereto another list of books which he was unable to obtain, thus giving the clearest warning that his field had only been partially winnowed.

It was my good fortune to possess not merely every book which he said he had consulted, but nearly every one which he said he could not get, besides many others which he does not mention at all, and apparently knew nothing of, besides others again in which no one, at that time, even suspected that electrical discoveries were buried; and on that basis I ventured to correct many misconceptions which later writers had assumed as accurate truth. The effort was not successful. The actual words of the original discoverors were, time and again, triumphantly refuted by statements drawn by my erudite critics from cyclopedias sometimes two centuries later in date. Since then the old errors have been no less infrequently reiterated in many a so-called "historical retrospect." Nor have I been able to discover that the labors of others who have attempted to throw open the hitherto closed doors of electrical history have met with any better fate. Dr. Silvanus Thompson's long-promised translation of Gilbert has not appeared. The proposed tercentenary celebration of the advent of Gilbert's great work did not occur in 1900. Most of the copies of Mr. Mottelay's translation of the "De Novo Mundo" still, I think, remain on the shelves of his publisher, and I am informed that the German fac-simile reproductions of Greene and Gilbert have proved far from remunerative.

In brief, if 12 years of study of the subject, coupled with persistent attempts made by others as well as by myself, to popularize it in the electrical profession prove anything, it is that no interest whatever, save in so few instances as to be practically inconsiderable, or at least has hitherto existed among electrical workers concerning electrical history. At the time I was engaged on my own book, one individual remarked to me that the effort would be much better directed to the production of "a practical hand-book on winding dynamos, to sell for 50 cents." I am not sure that he was not right.

The cause of all this is not far to seek. I do not lay it to any general lack of appreciation; still less do I consider it any ground for complaint. The electrical profession is of new growth, and scarcely dates back a quarter of a century. Every one in it has been called to grapple with new ideas and with the endless problems arising from the adaptation of them to immediate practical and commercial uses, and this, in most cases, as a means of livelihood; in fact, there have been comparatively few in the past who probably could give the time to such study. It is no disparagement to these earnest and energetic workers to say that probably also there were many of them whose early education had not implanted in them a full appreciation of its utility.

Perhaps all this is now changing, and to Dr. Wheeler may be due not only the great credit which attaches to his generosity, but the even greater honor of recognizing that a broader spirit of culture is now showing itself among the electricians of this country. If the future use made of his library shall show that he is right, he has conferred a benefit upon his profession which can hardly be overestimated.
PARK BENJAMIN.

NEW YORK CITY.

Electrolytic Rectifiers.

To the Editors of Electrical World and Engineer:

Sirs.—With reference to the discussion of the modus operandi of the Pollak rectifier, may I be permitted to say that the reason of the action is no longer a matter of theory, but was definitely settled by me about four years ago, and the results formed the subject of a paper read before the American Association for the Advancement of Science in, I think, 1898.

I had two of my students, whose names I unfortunately cannot remember at the moment, take curves at various points in such a cell, i. e., between one plate and solution, other plate and solution, different portions of solution, etc. From these curves the phases of the current and voltage in different parts of the cell were computed, and also the instantaneous differences of potential. It was found that a high drop of voltage, 10 to 20 times what could be given by any polarization counter voltage, occurred within a few thousandths of the surface of the aluminum plate, and that the layer was possibly even thinner, this distance being as close as mechanical conditions would permit. It was also found that the current between this point and the aluminum plate was entirely a leading one, when the plate was working efficiently, and that therefore the effect was due to a capacity, in turn due to the formation of a thin insulating layer. With excess of voltage this thin film would break down in points and minute arcs would appear. It was also shown that the decomposition taking place at each period was sufficient to form an insulating layer having a capacity equal to that which the leading current showed and was actually present.

In this connection I would make a suggestion, or, rather an inquiry. The meetings of the scientific associations on this side of the water are very meagerly reported if at all. As regards the purely technical meetings, the exact opposite is the case, as witness the splendid reports made by the ELECTRICAL WORLD AND ENGINEER of the Electric Light and other associations. Could not the same be done with, for example, the electrical papers of the American Association of Science and the Physical Society? The present method of presenting the results of these meetings is entirely insufficient. A few years ago I had the honor of being secretary of the Physical Section of the American Association. I found that the reporting of the proceedings was in the hands so far as I could find out of one man only, and, though however thoroughly qualified he might be, he naturally could attend to only a small percentage of the papers. In a laudable endeavor to accomplish the impossible, he would then come around to the different secretaries and sponge on them for abstracts of all the papers which had been read during his absence. As many of the secretaries were hard worked (to take my own case, I had a number of times to go without my meals), they frequently found it impossible to accommodate him, with the result that he apparently conceived that he had a grievance against them for not doing the work for which he was paid, and work which was entirely aside from the duties of the secretaryship; and he apparently considered the assistance freely given him, often at considerable personal sacrifice, as a right and not as a voluntary contribution.

If some arrangement could be made by the scientific and technical papers, jointly, perhaps, for the full reporting of these meetings, a number of papers containing facts of considerable interest to the engineering professions would be placed in accessible form, whilst at present they are, as a rule, not so placed.

Manteo, N. C. Reginald A. Fessenden.

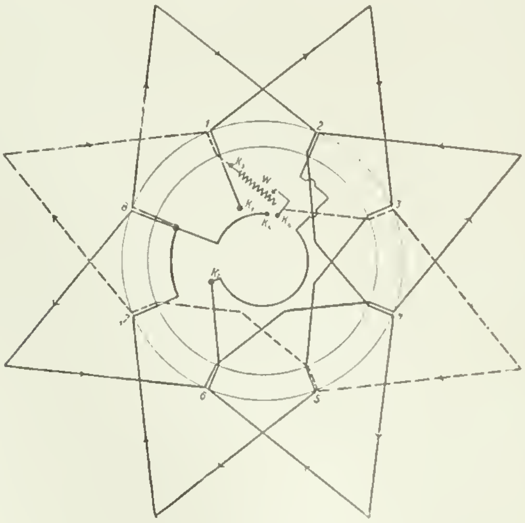
[We have repeatedly referred to the entirely inefficient organization with respect to publicity of the American Association for the Advancement of Science, which defect reduces to a minimum the usefulness of that body in the advancement of science. On occasions when this journal has had a special representative at a meeting, it was found impossible to prepare a satisfactory report, and in at least one instance obstacles were actually interposed. As many of the papers presented at a meeting are only printed in the *Transactions* by title or in brief abstract, the Association with its present press organization might not inaptly be entitled the "American Association for the Suppression of Scientific Knowledge."—Eds.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Alternators.—Giles.—A long, theoretical article on the "Predetermination of the voltage drop in alternators and the action of the so-called amortisseurs." He reaches the following conclusions. All alternators, not provided with a perfect amortisseur, have in the e. m. f. during load, and, hence also in the current, a third harmonic even if the e. m. f. at no-load is strictly sinusoidal. The most important part of the voltage drop is not due to the self-induction of the alternator. The e. m. f. of self-induction, i. e., the e. m. f. due to the flux interlinked with the armature coils without passing through the field spools, is always small and does not exceed 8 to 10 per cent of the normal voltage of the alternator. The total voltage drop consists of two parts: The first is due to the self-induction, while the second is a function of the ampere turns, the reluctances of the air gaps and of the stray circuits of the field, and the internal phase displacement of the alternator. For the operation with a completely wattless current, it is feasible, as Potier has shown, to go from the characteristic curve for no-load over to that for load by displacing all points of the former curve by a constant number of ampere turns and a constant number of volts. These numbers may easily be predetermined. This result cannot be applied to other power factors. In a short-circuited alternator the e. m. f. is not in quadrature with the current. The e. m. f. of self-induction has a value well comparable with that consumed by ohmic resistance. All characteristic curves, plotted for the same output but for different phase differences at the terminals, start from the short-circuit point. The diagram for the operation of an alternator as generator represents also its operation as synchronous motor with constant current, but as it is in general necessary to examine the operation of the synchronous motor at constant voltage and constant excitation, it is necessary to use another diagram. By the application of the amortisseur in alternators the drop of voltage is considerably diminished.—*L'Eclairage Elec.*, April 20, 27.

Starting Single-Phase Induction Motors Under Load.—Osnos.—An article, illustrated by diagrams. He thinks that the methods devised so far for starting single-phase induction motors were wrong in so far as they produce an artificial phase, differing by just 90 degs., which he considers superfluous. As this can be done only in an artificial and complicated manner, the current produced must be small. He suggests the following method of starting, in which he uses only a non-inductive resistance. After the motor has run up to normal speed, the connections are changed over to the normal ones. In the adjoining diagram a four-pole stator winding is shown. k_1 k_2 k_3 k_4 are terminals for making connections, and W is an adjustable non-inductive resistance. The primary circuit is connected to the terminals k_1 and k_2. If k_3 is connected with k_1 and k_4 with k_2, this is an ordinary single-phase winding with two parallel circuits. This corresponds to the connections at normal service. If, however, the connections are made as shown in the figure, the dotted conductors, which form a closed circuit through the non-inductive resistance, are the secondaries of a transformer, the conductors, represented by straight lines and placed in the same grooves, forming the primary windings. At the grooves 1, 3, 5, 7 a combined field is produced which has a certain phase difference against the primary field at the grooves 2, 4, 6, 8. This phase difference can, by regulating the non-inductive resistance, be made 45 degs., which he finds to be the most favorable angle. He compares this motor with an ordinary two-phase induction motor of the same size, and finds that for equal primary e. m. f. the starting torque in his motor is smaller than in the two-phase motor by only 20 per cent. The energy required in his motor is 1.6 times that in the two-phase motor. During starting the primary winding of the artificial field is loaded with double the current of the main field. He has not tested this method experimentally.—*Zeit. f. Elek.*, April 21.



STARTING UNDER LOAD.

Polyphase Working.—Eborall.—An abstract of his second lecture on this subject. He pointed out the influence of the wave-form factor on the e. m. f. of the machine. The calculation by Kapp of the ratio of pole-width to pole-pitch, on which this wave form factor depends, gave too high a figure, as he did not allow for the spreading out of the lines at the pole face, and he assumed the width of the connecting wires between the actual useful winding to be zero. He gave some data, among which were that the ampere-wires round the periphery of the armature per centimeter, should not exceed 200, and that the iron losses in a good machine are generally 40 per cent greater than the copper losses, because of forcing the magnetism in the teeth. He obtained a simple expression for the reactive ampere-turns. Assuming the phases to be exactly at 120 degs. and also a sine wave form, these should be calculable by the formula 1.5 by 1.41 by ampere per phase by turns per phase, but in reality the numerical constant becomes something between 2.2 and 2.4 instead of 2.12. He discussed the method of determining the requisite ampere turns on the field magnets by vector diagrams. The magnet ampere-turns required for compensating the armature reaction are easily ascertained for any particular design of machine by short circuiting it and noting the amperes passing through the field coils, and the circuit of one of the armature phases. The ratio of the observed field ampere-turns to the observed armature-turns, which varies from 2.5 to 3.5 is what is thus obtained. Similarly, a good method of computing the field and armature leakage, and the extra ampere-turns required to make up for them, is to run the machine up to speed and connect choking coils to it until it delivers the full-load current. Then by noting the field current, voltage and output current, and taking the no-load and short-circuit characteristic, a simple graphical construction gives the quantities required, which may be used in designing any other machine with the same ratio of pole-breadth to pole pitch.—Lond. *Elec.*, May 10.

Testing Three-Phase Machines.—BRESLAUER.—An abstract, illustrated by diagrams, of a paper read before the Electrotechnical Society, of Vienna. In the laboratory it is, in general, impossible to make exact tests of three-phase machines for non-inductive loads. It is usual to determine the no-load and the short-circuit curves and to draw therefrom conclusions as to the constancy of the pressure for different loads. He gives an example from the practice, which clearly shows that this method is correct, and that conclusions drawn in such a way agree with the facts. In the special case which he mentions, the voltage drop for full non-inductive load had been found by calculation from the curves to be 40 per cent, and this very great value was also found in the experimental test by means of water resistance. In the central station which was equipped with these generators with that enormous voltage drop, and which furnished power for lighting and power, it had been found to be impossible to maintain a regular satisfactory service, as the voltage variations were extremely troublesome.—*Zeit. f. Elek.*, April 14.

Seefehlner.—An illustrated article on the same subject. He has tested an old machine with bad regulation, and has also found that the measurements agree fully with the theory.—*Zeit. f. Elek.*, April 28.

Alternators in Parallel.—A review of the progress of work of a special committee of the Internat. Soc. of Elec. in Paris, on the connection in parallel of alternators driven individually by steam engines. The coefficient of irregularity of a steam engine is suggested to be defined as the difference of the maximum and minimum speed of the machine, divided by the average speed. Other subjects to be treated are the theoretical and the experimental determination of the coefficient of irregularity of different loads, the maximum value of this coefficient admissible for lighting networks and for power networks, and its variations with the frequency, the influence of this coefficient upon the operation of alternators in parallel, further questions regarding starting, electromagnetic resonance, and sudden changes of load.—*L'Ind. Elec.*, April 25.

REFERENCE.

Induction Motor Diagram.—SUMEC.—An article, illustrated by diagrams, in which he develops the Ossanna diagram for induction motors under consideration of the primary voltage drop, and shows how to find from it the torque, the slip and the efficiency.—*Zeit. f. Elek.*, April 14, 21.

LIGHTS AND LIGHTING.

Nernst Lamp.—An illustrated description of a system patented by the Gen. Elec. Co., of Berlin. As the heating of the filament of the Nernst lamp takes about 15 to 30 seconds, before it is lighted, it is proposed to combine one or more ordinary incandescent lamps with the Nernst lamp, and a device by which the ordinary incandescent lamps are automatically disconnected when the more economical Nernst lamp is lighted up. Several devices based on this principle are described and illustrated in diagrams.—*Zeit. f. Beleucht*, April 30.

Arc Lamp.—An illustrated description of the "Regina" enclosed arc lamp, made by a German company. The life of the carbon is said to be 160 to 180 hours, the temperature of the arc 4500 degs. The carbons are enclosed in a narrow cylindrical glass tube which is enclosed in the lamp globe. This space is in connection with the external atmosphere only by a small perpendicular pipe, extending into the lower part of the lamp. The oxygen of the lamp is quickly consumed and a mixture of carbon monoxide, carbon dioxide and other gases is formed. The hot gases which are formed rise in the lamp on account of their low specific gravity. At the same time the heavier air of the atmosphere is sucked into the lamp very slowly and gradually through the thin pipe. In this way a very regular and continuous, but very slow supply of oxygen to the lamp is said to have been obtained.—*Elek. Rund.*, April 15.

REFERENCE.

Electric Light.—DE FODOR.—A lecture held before the Electrotechnical Society of Vienna, on "The light of the future." He gives a review of recent development in incandescent and arc lighting, and of experiments with vacuum tube lighting.—*Zeit. f. Elek.*, April 7, 14.

Direct and Alternating-Current Systems for Power Distribution in Factories.—GOLDSBOROUGH.—An abstract, illustrated by diagrams, of a lecture held before the Cleveland Electric Club, on "The relative performance and efficiency of direct-current and induction motors." He compares the two systems on the basis of a uniform maximum potential of 500 volts, and on the basis of the same weight of copper being used in the lines. He reaches the following conclusions: In point of construction the direct-current motor and the induction motor are on very equal terms. In point of weight, the alternating-current machine has the advantage. In point of full-load efficiency and equivalent currents taken at full load there is some advantage to be credited to the direct-current machines. In point of efficiency at medium loads, the average performance of standard commercial machines shows that the alternating-current motor has the advantage over direct-current motors. At these loads, however, the equivalent line currents taken by the alternating-current motors are considerably in excess of the currents taken by direct-current motors. In point of starting torque, the direct-current motor is undoubtedly superior to the alternating-current motor for exceptionally heavy duty. Against this advantage of the direct-current motor must be placed the elimination of the commutator in the alternating-current motor, which, in some cases, at least, might make it worth while to install a 20-hp induction motor in order to obtain the required starting torque, where otherwise a 10-hp direct-current motor would suffice. In this comparison no consideration has been taken of the advantage which the alternating-current motor has over the direct-current motor, which is given to it by the possibility of its being operated from high-voltage mains.—*The Eng.*, May 15.

REFERENCES.

Australian Plant.—A brief illustrated article on the power plant of Kalgoorlie, in Western Australia. There are great difficulties, as no fresh water is to be obtained there, all available water being a dense solution of salt and other mineral matter, and even this water is not plentiful. This water can be used in boilers only after distillation, so that in addition to the high-pressure boilers a complete set of low-pressure or evaporating boilers is required with condensers. The electrical apparatus for the plant will be of the three-phase alternating-current type, manufactured by the General Electric Company of this country.—Lond. *Elec. Rev.*, May 3.

Belt-Gearing.—SCHINDLER.—An article on the friction loss with belt-gearing.—*Elek. Anz.*, May 2.

Electric Power on the Stage.—An illustrated description of the electric stage mechanism at the Covent Garden Opera House in London.—Lond. *Elec.*, May 10.

TRACTION.

Electric High-Speed Railroads.—REYMOND-SCHILLER.—The first part of an article in which he speaks in favor of an international European Congress for defining precisely and discussing the question of high-speed long-distance railways through Continental Europe, the speed being assumed at 150 miles per hour. He thinks that the tramway system with single cars cannot be used, but that regular trains should be run, with an electric locomotive and, say, three trailers. In the latter the electric installations (for lighting, heating, signals, etc.) should be such that they can be used as well for direct current as for three-phase current, etc., as different systems may be used in different countries. He therefore suggests keeping the electro-mechanical part of the train entirely separate from the part serving for traffic. He suggests having two classes of trains running, one for long-distance trips, the others for local traffic.—*Zeit. f. Elek.*, April 28.

Electric Boots.—EHNERT.—An article on the commercial practicability of electric boats, compared with steam boats. Electric boats can compete with the latter only for local traffic, with not too extended trips. The Plante type of storage battery, although heavier and more expensive, has proved more satisfactory for electric boats than the Faure type. He compares the annual cost of maintenance of an electric and a steam boat of equal size and equal speed, the duration of the trip being assumed at 1000 hours, and the first cost of the electric and of the steamboat, at $3,500 and $2,500, respectively. The annual cost of operation of the electric boat, including interest and amortisation, is calculated to be $1,096, that of the steamboat is $1,154, so that, if a yearly income of $1,500 from the boat is assumed, the capital invested in the electric and in the steamboat yields an interest of 11 per cent and 13.8 per cent, respectively. Special advantages of the electric boat are its freedom from smoke and vibrations. For special purposes, for instance, for police duties in a harbor, the operation of an electric boat is much cheaper than that of the steamboat. Both boats must always be ready for service, but the steamboat always consumes fuel, while the electric boat does not consume energy as long as it does not run.—*Elek. Anz.*, April 25.

REFERENCE.

Electrolysis from Return Currents.—Jastrow.—A communication in which he shows that the method of the measurements in Krohn's investigation (Digest, May 4) is not correct, and may cause appreciable errors.—*Elek. Zeit.*, May 2.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

High-Tension Alternating-Current Switch.—Bainville.—An illustrated description of a switch, devised by Mornat and Langlois, for breaking high-tension alternating-current circuits. It is said to have proved satisfactory in practice. It is made as double-pole or three-pole switch. The instrument is based upon the breaking of the circuit in a layer of oil. Several types of the switch are shown in diagrams. —*L'Elec., Moy* 4.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Equalization Mains.—Edelstein.—A communication referring to Teichmueller's article (Digest, May 4), and giving some analogous formulas.—*Elek. Zeit.*, May 2.

ELECTRO-PHYSICS AND MAGNETISM.

The Nature of Coherer Action.—Guthe.—A description of the following experiment made to study the coherer action. Two fine wires of the same metal are mounted at right angles to each other and brought into contact. A current was then sent through one of the wires, so as to heat the contact. During the heating a current was sent from one wire to the other. It was found that under otherwise equal conditions the resistances of the contact was the smaller the hotter the contact, and that the resistance returned to its original value on stopping the heating. He believes that the first stage of the coherer effect consists in the heating of the junctions between neighboring particles. But another process must take place as well, since the coherer does not recover its original resistance at once, whereas the wire junction does. If the coherer consists of mixed metals, and bismuth is one of them, the junction between bismuth and the other metal is heated rapidly, since bismuth is a very bad conductor of heat. This effect may sometimes be marked by a Peltier effect, since the heating of the junction between the bismuth and the other metal may give rise to a current opposed to a main current traversing the coherer.—*Ann. der Physik*, No. 4; abstracted in Lond. *Elec.*, May 10.

Resistivity of Pure Metols.—Van Aubel.—A criticism of the various values put forward by Dewar and Fleming for the resistivity of bismuth, nickel and tin. Nickel prepared from nickel carbonyl shows very nearly twice the resistivity found by Fleming for electrolytic nickel. "This discrepancy is so serious that it may well be asked whether the chief conclusion arrived at by the English physicists, viz., that the resistivities of all metals converge upon the absolute zero of temperature and there become zero themselves—can be maintained. In other metals, too, there are divergencies from this supposed rule, for the resistance of platinum, silver, copper and iron would have to disappear at —258, —248.4 and —223 degs., respectively."—*Phys. Zeit.*, March 23; abstracted in Lond. *Elec.*, April 26.

Striated Electric Discharge.—Jeans.—The second part of his theoretical paper. He forms the following conception of the state of things which occur in a vacuum tube. He regards the discharge as a series of small discharges between consecutive "slabs." As the accumulation of ions which occurs in the neighborhood of a point of minimum electric force, must consist of a great number of ions which are not at rest, but are moving equally in all directions, this accumulation of ions may be more accurately described as a "nucleus" than as a "slab." There is not a sudden discontinuity of densities in the middle of such a structure. There is a rapid but continuous change. The number of ions of either kind in a nucleus is being continually increased by arrivals from adjacent nuclei, and also by the dissociation of some of the molecules which pass into it in the course of their motion. The number is at the same time decreased by the ions which are carried away from the nucleus, and also by the recombination of ions inside the nucleus. When the steady state is reached, the losses and gains arising from these four causes exactly balance.—*Phil. Mag.*, May.

Luminous Ring in Rarefied Goses.—Phillips.—A long abstract of a Royal Society paper on "The action of magnetized electrodes upon electrical discharge phenomena in rarefield gases." He discusses the conditions necessary for the production of a luminous ring in rarefied gases under the influence of electrostatic and magnetic forces. The cause of the luminous phenomena is traced to the action of the magnetic field upon electric gaseous particles within the rarefied space, and experimental evidence is given to show that the rate of charge of the magnetic lines is an important factor.—Lond. *Elec.*, April 26.

Double Refraction of Electric Waves.—Pierce.—In a former research he measured the refractive indices for electric waves of a number of doubly-refractive media, namely, various woods. These media were all also doubly-absorptive. In the present note he examines the question as to whether, on Maxwell's theory, the double absorption by these media is sufficient to account for the double refraction; and, indeed, whether both of these properties can be ascribed merely to differences of conductivity of the woods along and across the grain. He finds by analysis a means of testing experimentally such an assumption, but did not have the experimental data at hand. However, without such a test, it is still seen that heterogeneous conductivity plays an important part in the phenomenon of double refraction of electric waves.—*Phil. Mag.*, May.

Action of Radium Rays Upon Selenium.—Bloch.—Perreau has discovered that the Röntgen rays produce upon selenium an effect comparable with that of light. The present author has tested whether radium rays have a similar effect, and has found a slight effect of this kind.—*Comptes Rendus*, April 15; abstracted in Lond. *Elec.*, May 3.

Magnetic Properties of Cast Iron Containing Aluminum.—Schweitzer.—An illustrated account of tests of the magnetic properties of different sorts of cast iron containing aluminum. He found that additions of aluminum cause a decrease of the inductions for equal field intensities, and an increase of the hysteresis loss for equal inductions. The magnetic properties of cast iron therefore become worse by the addition of aluminum.—*Elek. Zeit.*, April 25.

REFERENCE.

Electric Arc.—Bermbach.—The conclusion of his article on the physical properties of the electric arc. He deals with the apparent and real phase difference in the alternating-current arc and describes briefly the acoustic phenomena in the arc.—*Elek. Anz.*, April 21.

ELECTRO-CHEMISTRY AND BATTERIES.

Reducing Action of Calcium Carbide—Von Kuegelgen.—The continuation and conclusion of his article. He deals with the reduction of copper, silver, zinc, mercury, tin, bismuth, chromium, manganese, iron, nickel, potassium, sodium, aluminum. The general result of his investigation is that calcium carbide has strongly reducing properties. The reaction is much greater in the reduction of the chlorides than of the oxides. While for the most chlorides the reaction, after it has been started once, propagates itself sometimes like an explosion, in the reduction of oxides it is nearly always necessary to heat the material, in order to keep up the reduction. A characteristic feature of the reduction of the chlorides is the easy inflammability of the mixture. The reduced metals contain only a small fraction of calcium, if in the reduction the proper quantity of calcium carbide has been used, while by using a large surplus of calcium carbide it is possible to obtain calcium alloys. In the reduction of the oxides the output depends upon the degree to which the oxide can be reduced by carbon. The more difficult it is to reduce the oxide by carbon the less will the latter take part in the reduction and the more calcium carbide is required. He calculated that for one ton of copper, 440 lbs. of carbide are required. This does not seem to be the basis for an economical industrial process. He thinks, however, that for special purposes in metallurgical plants the reducing action of the calcium carbide can be used to advantage.—*Zeit. f. Elektrochemie*, April 18, 25.

Electrolysis of Alkaline Chlorides.—Adolph.—An account of an experimental investigation of the "bell process." (This is so called because a reservoir of the form of a bell open at the lower end is suspended in the electrolytic bath, the anodes are in the bell near the top, while the cathodes are outside of the bell near its lower rim. Fresh electrolyte is continually supplied to the bell from the top.) This process is being introduced now besides the two older ones, namely, the diaphragm process and the mercury process. The experiments of the present author show that alkaline hydrate solutions can be made in much higher concentrations by the bell process, than with the same energy output by the diaphragm process, while the purity of the chlorine in both cases is about the same. His investigation has been made from a scientific point of view. For industrial purposes it would be important to find not only the conditions of the best current output, but also that of the best salt concentration. Instead of the saturated solution with which he worked, more dilute solutions would be better for technical purposes. One of the most important results of his investigations is the proof that the separation of cathode solutions and anode solutions in the bell process is largely due to the free hydrochloric acid which appears in the anode space at carbon electrodes.—*Zeit. f. Elektrochemie,* May 2.

Ferro-Silicium.—GIN.—An article on the production of ferro-silicium in the electric furnace. The physical and chemical properties of ferro-silicium are discussed, the thermochemical data of its production are given and industrial methods of its production are described. He believes that this will become an important branch of electro-metallurgy, especially as many calcium carbide plants, which are now useless on account of the commercial crisis in that industry, may undertake the production of ferro-silicium to advantage.—*L'Ind. Elec.,* April 25.

Primary Cells.—PETERS.—The first parts of an article in which he gives an account of tests of several primary cells. The present installments deal with the "reform cell," the "hydra cell," and the dry cells of the Columbus Electric Company. The feature of the first two cells is the form of their zinc and carbon electrodes. They are so arranged that both electrodes have large surfaces, and that as many parts as possible of the positive electrode are opposite to as many parts of the negative electrode. For that purpose, the carbon electrodes consists of two perpendicular rods, connected together at the top. A zinc ring surrounds both carbon rods, and there is besides a zinc plate between the two carbon rods. In the hydra cell there is "besides the external zinc cylinder which is likewise contained in the reform cell, also an external one."—*Centralb. f. Accum.,* April 15, May 1.

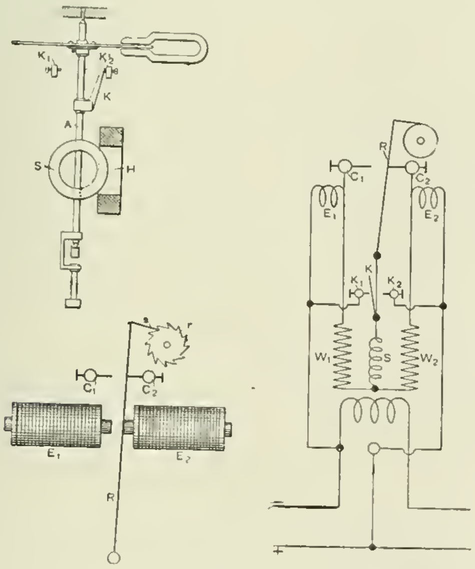
REFERENCES.

Hypo-Chlorite Cell.—J. B. C. KERSHAW.—An illustrated article on the Haas and Oettel hypo-chlorite cell, which was described before in the Digest.—Lond. *Elec.,* May 10.

Aromatic Substances.—ELBS and SILBERMANN.—An account of some experiments regarding the electro-chemical reduction of certain aromatic compounds.—*Zeit. f. Elektrochemie.,* May 2.

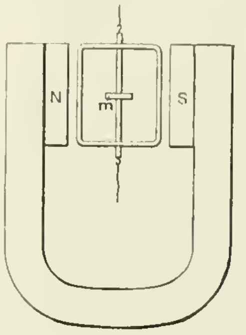
UNITS, MEASUREMENTS AND INSTRUMENTS.

Small Direct-Current Meter.—An illustrated description of a new small meter for direct current, brought out by the Gen. Elec. Co., of Berlin. It is made up of two parts. The first, shown in diagram 1, consists of a fixed coil *H,* through which the main current passes, and a moving shunt coil *S* on a spindle *A.* On this spindle are also fixed the braking disk and a contact arm *K,* which at two positions makes electrical connection with contacts K_1 K_2, respectively. Two fixed resistances W_1 W_2 (diagram 3), are also alternately in parallel with the shunt coil. The second part of the apparatus, shown in diagram 2, is a relay which works the clockwork, and is made up of an armature pendulum *R,* which is alternately attracted to the electro-magnets E_1 E_2, thereby making connection with contacts C_1 C_2, respectively. The action of the meter may be traced from diagram 3. In the position shown, the coil *S* and resistance W_2 are in parallel, and the direction of the current is such that the contact arm *K* is moved to K_2. This short-circuits the electromagnet E_2 and the pendulum is attracted to the magnet E_1, and makes contact with C_1. The coil *S* is now in parallel with the resistance W_1. The current, however, being reversed, the coil moves in the opposite direction, so that the arm *K* makes contact at K_1, and the magnet E_1 is short circuited, and so on. The instrument is made for currents up to 10 amperes and pressures up to 500 volts. The makers guarantee that the meter will not run on no-load, even with a pressure of 20 per cent above the normal, and it will also start at 1 per cent of the maximum. They also claim that only 1.2 watts is lost in the shunt for the 100-volt meters, and 8 watts in the main coil. A small alternating-current meter, brought out by the same company, is also described. It was described in the Digest, Feb. 16.—Lond. *Elec.,* May 10.



FIGS. 1, 2 AND 3.—SMALL DIRECT-CURRENT METER.

Measuring Instruments Having Magnets.—WEISS.—Measuring instruments in which the action of a current upon a magnet is utilized, are liable to change in their sensitiveness, owing to changes in the magnetic moment of the magnet. He compensates these changes in the following manner: In the adjoining diagram *m* is a small needle of soft iron, rigidly connected with the movable coil, and *N S* are the poles of a permanent magnet. When the latter increases in strength, the deflection is increased by the increased action upon the coil and at the same time diminished b ythe increased action upon the needle. If the needle is saturated, the deflection for the same current will be the same as before. In practice he compensates for any lack of saturation by a slight antagonistic couple in the elastic suspension. He constructs ammeters and voltmeters on this plan.—*Comptes Rendus,* April 22; abstracted in Lond. *Elec.,* May 10.



MEASURING INSTRUMENT.

Adjusting the Voltage in Laboratory Tests.—MAREK.—In the calibration and testing of voltmeters, wattmeters and meters, it is often desired to obtain a certain given voltage at the points of connection for the instruments. He describes the following method used in the Austrian Calibration Office. For direct current the arrangement shown in Fig. 1 is used. The terminals of the supply circuit are a_1 and a_2; a_1 a_2 is a bipolar-wound manganine wire, which can stand con-

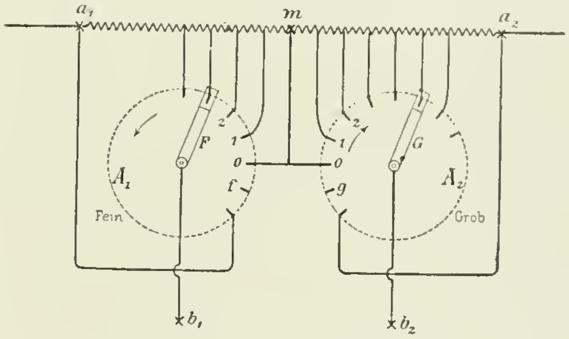


FIG. 1.—ADJUSTING VOLTAGE.

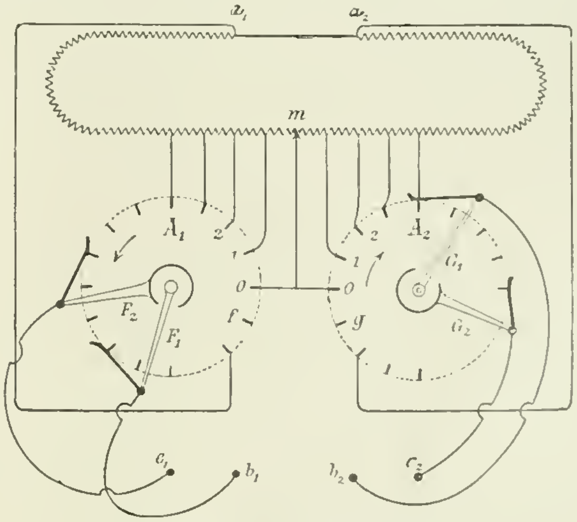


FIG. 2.—ADJUSTING VOLTAGE.

tinually about 1.1 amperes. The resistance is about 160 ohms, and is divided into two main parts, $a_1\ m$ and $m\ a_2$; $m\ a_2$ is divided into 30 equal parts, each one of which is slightly smaller than $a_1\ m$; $a_1\ m$ is also divided into 30 parts. Each point between two parts is connected with a segment of A_1 and A_2, upon which the brushes F and G are sliding; f and g have no connections. The measuring instrument is connected between b_1 and b_2. When the switch is to be used F and G are connected to f and g. This is for determining the zero points of the instruments. G is then connected to O, and F is turned in the direction of the arrow. If the pointers of the instruments are deflected in the right direction, the connections are correct. The desired voltage may then be obtained roughly by adjusting the brush G, and accurately by the brush F. If the voltage of the supply current at $a_1\ a_2$ is slightly more than the voltage wanted at $b_1\ b_2$, the greatest possible error in the adjustment is 0.056 per cent. If the voltage of the supply circuit is higher than that wanted for the instruments, the same arrangement can be also used for alternating current; otherwise, the switch illustrated in Fig. 2 is used to advantage, which explains itself; c_1 and c_2 are the terminals for the supply circuit, b_1 and b_2 those for the connection of the instruments.—*Zeit. f. Elek.*, May 5.

REFERENCES.

Meter for Double Tariff.—Aron.—An illustrated description of an electric meter for double tariff. The kilowatt-hours are registered on two different dials, corresponding to the two different rates.—*Elek. Zeit.*, May 2.

Instruments of Precision.—Haerden.—The continuation and conclusion of his illustrated article. He deals with direct and alternating-current ammeters and voltmeters, measurements and capacities, construction of condensers, and compensation instruments.—*Elek. Anz.*, April 25, 28.

Iron Tests.—Moellinger.—An illustrated description of the methods used by Schuckert & Co. for commercial iron tests regarding hysteresis.—*Elek. Zeit.*, May 2.

MISCELLANEOUS.

Iron from the Electric Furnace.—A short description of a process patented by a French Company for obtaining all qualities of iron and steel directly from the ore. The furnace comprises a crucible with two vertical parallel carbon electrodes, the metal produced being drawn off through the opening below. There are two pouring holes at different elevations, the top one for slag and the lower one for metal. According to the proportion of charcoal in the mixture, and the temperature of the crucible, the different varieties of metal are obtained.—*L'Echo des Min. et Met.*, March 28; abstracted in *Min. and Metall.*, May 1.

Lightning Rods.—A set of rules, regarding the construction of lightning rods, accepted by the Electrotechnical Society of Berlin; also the report by Strecker on the work of the committee which had drafted these rules.—*Elek. Zeit.*, May 2.

Paris Exposition.—Reyval.—A long, well-illustrated description of direct-current and alternating-current machines exhibited by Schneider & Co.—*L'Eclairage Elec.*, April 13, 20, 27, May 4.

Reyval.—An illustrated article on the traveling platform.—*L'Eclairage Elec.*, May 4.

Ruhmer.—An illustrated description of the telegraph and telephone exhibits of Siemens & Halske.—*Phys. Zeit.*, April 27.

New Books.

Primi Nozioni Fondamentali di Elettrochemica.—Di Alfonso Cossa. (Hoepli Manual). Milan: Ulrico Hoepli. 113 pages, 9 illustrations. Price, 1.50 lire.

This is a small text book setting forth briefly and concisely the modern theories involved in the applications of electricity to the productions of chemical change and vice versa.

The Theory of Electrolytic Dissociation and Some of Its Applications. By Harry C. Jones. New York: The Macmillan Company. 289 pages, 9 illustrations. Price, $1.60.

The author has been frequently asked: Where can an account of the power developments in physical chemistry be obtained? And as there existed no English text-book on this subject, he wrote this as an introductory work to meet the demands of a large number of students.

After the 70 pages of the first chapter on "the earlier physical chemistry," the second chapter of 33 pages deals with "the origin of the theory of electrolytic dissociation"; in the third chapter of 67 pages the "evidence bearing upon the theory of electrolytic dissociation" is given; and the fourth and concluding chapter, of 110 pages, is on "some applications of the theory of electrolytic dissociation." He says in the introduction that his book is an attempt to answer in part the questions: What was physical chemistry before the theory of electrolytic dissociation arose? How did the theory arise? Is it true? What is its scientific use?

It must be conceded that the book is a very timely one. There is indeed a great demand for a treatise in the English language which gives a clear survey of the theory connected with the names of Van't Hoff, Arrhenius, Ostwald, Nernst, etc. It is also conceded that Dr. Jones' book is to be recommended as being one which is very easy reading; but it is to be regretted that the smoothness of the exposition of the theory is obtained somewhat at the cost of accuracy. There is often a looseness in the definitions and statements. There is also a lack of originality. The book is in many parts, especially in the fourth chapter, largely a compilation from the larger text books of Ostwald and Nernst.

It is to be pardoned when Arrhenius, Ostwald, Nernst and the other original workers in this theory, sometimes become enthusiastic and fantastic. But in a book like that of Dr. Jones we would like to have seen a little less of this enthusiasm of the originators of the theory, and a little more of the Anglo-Saxon coolness of a compiler; a little less history and a little more of a critical summary. We would like to see in the first line sharp and concise definitions of an "ion," of "electrolytic dissociation," etc. If clear definitions of these fundamental terms were given, many misunderstandings, as they still often occur, would be avoided From a book like that of Dr. Jones, the reader also wants to get a fair knowledge of the terms commonly used in the theory. In the exposition of Hittorf's work on the relative velocity of ions (page 192 to 197) an explanation and definition of the term "transport number" should be given; a few pages later, page 202, it is said: "The unit of resistance most generally used is that of a column of pure mercury 106 cm in length, and 1 square mm in section, at 0 deg. C.; why does he not add, "and is called 1 ohm." This would not be superfluous, especially for his chemical readers, as the book is obviously intended for beginners.

In the last part of the book an unnecessary amount of mathematical calculation seems to be given. It would often have been better to have given less mathematics and more of the physical meaning of the theory. One point which we miss entirely in the book is a reference to the change of an atom into an ion. This is important, as it characterizes the relation between the ionization theory and the principle of the conservation of energy. It has sometimes been said that the dissociation theory is in disagreement with the energy principle. Such statements could, of course, only be made by a misunderstanding of the term "electrolytic dissociation," or by a difference in definition of the term dissociation. All points relating to this question have been cleared up by the theory of the energy of ionization, which therefore should find a place in a book like that of Dr. Jones.

In spite of these objections, the noticeable smoothness and easiness of reading will make the book very acceptable to many of those students who have not the time or do not care to attempt to digest the original voluminous papers.

Electric Lighting. A Practical Exposition of the Art for the use of Engineers, Students and Others Interested in the Installations or Operation of Electrical Plants. By Francis B. Crocker, E. M., Ph.D. Volume II. New York: D. Van Nostrand Company. 505 pages, 391 illustrations. Price, $3.

From the meagre book of du Moncel on "Electric Lighting" to the pretentious two-volume work of Professor Crocker covers a period of 21 years, which is practically the historical life of the subject. Following the first book referred to, came a larger book by Gordon, in which the subject was presented somewhat from an engineering standpoint, and naturally an historical summary of the advancement of the art of electric lighting may be read between the works of Gordon and Crocker. In the present books the subject has been put on an engineering and scientific basis very different from the older works, and as such it is comparable with the literature of any of the older established engineering branches. In these books it is clearly shown that the period of tentative and empirical experimenting, and the flamboyant "patent" is about passed, and that the details of electric lighting have yielded to the approved methods of thorough engineering practice. From the standpoint of time and the perfection of the art, a work of the pretentions of the present volumes must be judged of its fitness to serve as an engineering treastise.

The first volume of the work, published some time since, was devoted to the generating apparatus and accessories, and the present volume is concerned with the distribution system and its auxiliary apparatus and devices. "Both volumes," the author states, "are intended as text books for engineering schools and as hand books for practicing engineers," and then curiously adds, "for these reasons abstruse and detailed matter has been omitted as far as possible." This latter statement is somewhat surprising to read, particularly at the present day, for, beyond students of engineering and practicing engineers, it is very doubtful if others would concern themselves over "abstruse and detailed matter." This stricture on the book would be trivial if it were not at the very root of the selection of matter for such a work, and the extent and manner of its treatment.

Advanced students of electrical engineering and practicing engineers invariably have an indifferent, and, in many cases, even a contemptuous, estimate of the formal literature of electrical engineering and applied electricity. With a few notable exceptions this estimate is only too well founded, and the reasons for it are not far to seek. Authors have been content to fill their books largely with descriptive matter and much catalogue literature. Again, many have tried to humor an unreasonable prejudice against mathematical discussion. An author with a subject such as that of Professor Crocker's comes to no easy task. Upon him devolves the labor of bringing the book up to the grade already established in mechanical and civil engineering, and causing those in these professions to respect the literature of electrical engineering, if he has any devotion to his profession. The only recourse is to present the matter with such clearness, thoroughness and detail, that it may serve as a working basis on the part of the student and the engineer.

The second volume of "Electric Lighting" shows that Professor Crocker has done this to a considerable extent, though we could wish he had been more thoroughgoing in many portions.

The first six chapters deal with the properties of electrical conductors and systems of distribution. The first chapter in particular is treated in a clear and masterly style, and leaves little to be desired. If the entire work had been written in the same spirit it would have heartily commended itself to the profession and have become an authoritative work.

Under the heading of "The Temperature Coefficient of Copper," the theory is fully and clearly stated, and its working application is discussed in a most satisfactory way. Such treatment satisfies at once the student, and leaves the engineer in no doubt in its application. It would be difficult to find a better discussion in all the literature of applied electricity. It is an excellent illustration of the maxim that the practical man is one who has a complete knowledge of the subject, as against one who simply knows a few facts.

The succeeding two chapters state the principles of alternating currents and alternating-polyphase currents. These subjects are fundamentally developed in an unusually clear and terse manner. It is a question if a great deal of this might not have been omitted to advantage, since the matter is so admirably treated in Professor Franklin's "Alternating Currents," and with more detail but much obscurity in a similar work by Professor Jackson. Where the present author is terse, however, he falls into a questionable practice. On page 129 a formula (51) is stated for the self-induction of two parallel copper lines in air. Where such a critical formula is not fully developed and discussed, a reference should be given to its complete discussion.

This instance may serve for calling attention to one of the most serious faults of the work. What a student needs above all else is to be guarded against mere formal statement and description. The practicing engineer, and the student as well, must have some knowledge of the sources where the subject he is working with is fully discussed. It is only in this manner that he can proceed with confidence and assurance in design and calculation. Judged in this spirit many portions of this work will be of no real value to its readers.

On pages 257-61 are given "General Specifications for Ordinary Pole Line Construction." It is somewhat in the nature of a surprise to find in the work of a college professor four pages of punctuated sentences which are minus the verbs. Compared with first-class specifications in general these in particular are in poor style to place before students as a model. Because one aims to be practical and terse it is no excuse for poor English; and if some practice sanctions this it is high time for the good standing of the profession that it is corrected.

One of the poorest chapters is that on meters, which is almost entirely descriptive. As a whole, the work is a commendable effort, but is disappointing. In brief, the author appears to have missed the modern engineering standpoint, and while the work will be found of value to the engineer of the day, its method would have appealed with greater force to the engineering audience of 10 or 15 years ago.

But few errors have been noticed in the matter and proof-reading. The book is well printed, but poorly bound. Another objection is that the book is too heavy for its size, doubtless from the use of paper suitable for half-tone illustration. The line illustrations are excellent in conception and printing, but the numerous half-tones are so miserably printed that they disfigure the work. Many of these are out of place in a book of this character, such as Fig. 309, page 367. They savor too greatly of catalogue literature and popular books on the wonders of electricity and lightning harnessed in the service of man.

Les Phenomena Electriques et Leurs Applications. Etude Historique, Technique et Economique des Transformations de l'Energie Electrique. By Henry Vivarez. Paris: Georges Carre et C. Naud. 376 pages, 225 illustrations. Price 15 frs.

This book is intended for those who have not made a specialty of the subject of electricity, but who, in the course of their work, find it as necessary or desirable to obtain an insight into the subject, as it is to know something about physics and mechanics. It is therefore written in a popular and easily understood style, and begins with the first principles.

The first part is devoted to the early history, the second to the scientific period, and the third and by far the largest, to the industrial or that of the engineers, as he calls it. While this sub-division may have some advantages in a book for the layman, yet in the opinion of the reviewer it is not to be recommended, as it necessitates too much duplication, and scatters the different parts of the same subject over entirely different parts of the book. For instance, complete dynamos are illustrated and described before the general principles of their action are discussed. The descriptions are necessarily brief and perhaps not too much so for the layman, but they do not seem to be well balanced; an itemized table, for instance, of the annual production of copper from each of a number of mines, and for a long period of years, seems somewhat unnecessary and might well have been replaced by more useful information. Many other subjects which are not electrical are also discussed, some of them, like energy in general, being quite in place, but when a number of pages are devoted to the time it took nature to form coal, and to numerous tables on the amounts of coal mined in different countries and during different periods, it seems out of place in such a book.

The chapter on transmission of energy to great distances, is on telegraphy and ends with four verses of poetry. The next chapter is on telephony, but this is not considered to be a case of long distance transmission, like telegraphy. Many of the illustrations are old and have been seen before, and there is a scarcity of those showing the latest developments. There is much information of a useless kind, such as a full page table giving nothing but the voltage, horse-power and kilowatts of one dynamo of each of a large number of companies, chiefly French, leaving to the layman the impression that each of these companies makes only one dynamo of that particular voltage and power. France and French machinery are given special attention throughout the book, which is natural and quite proper for a book intended for the French people. The book concludes with a long index of proper names which are referred to in the book, a bibliographical index, and index of words and technical expressions, a table of contents, and a map of the world showing the cable lines.

The book belongs to the popular treatises of no great depth, and is not among the best of these, although it contains much that will interest those laymen who do not intend to study the subject very thoroughly or carefully, and in this respect it may serve its purpose about as well as most books of its kind.

Lightning Arresters.

By C. C. Chesney.

In considering the subject of protection from lightning from the point of view of the station manager who, as has been recently pointed out, has from year to year had occasion to give the matter more and more attention, I desire to outline certain conditions and defects and some remedies which, while novel, will be found most effective.

As has been pointed out, alternating-current lightning arresters, as a class, while more or less successful in protecting the insulation of the apparatus from damage or destruction by atmospheric electricity, are subject among others to the following criticisms:

First.—In some arresters the width and number of spark-gaps are so great as to require the potential of the lightning charge to be as high as or higher than a potential which would rupture the insulation of the system. In others, in order to reduce this potential the spark-gap is made so small that there is continual annoyance from grounding through the arrester.

Second.—The want of proper insulation in some lightning arresters themselves resulting in the formation of arcs over or through the defective insulation and in temporarily putting out of service one or more parts of the system.

Third.—The lack of robust character in the general design and construction, which are necessary to withstand heavy and frequent lightning discharges without total destruction.

Fourth.—The inability to break the dynamic arc quickly and without an excessive flow of dynamic current, which is apt to follow the slightest atmospheric discharge.

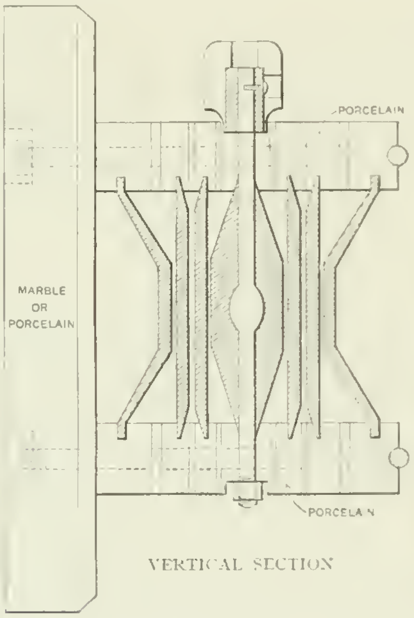


FIG. 1.—VERTICAL SECTION OF LIGHTNING ARRESTER.

Fifth.—The exposing of the line terminals, making possible the formation of arcs by the accumulation of dust, dirt, bugs, etc., and making it extra hazardous to handle the instruments on live lines when this becomes necessary.

Sixth.—Inability to handle heavy discharges, due to either lack of discharging surface or to resistance in series with the gaps, thus, by not taking all the discharge, allowing some to follow the circuit and puncture the insulation of the apparatus.

Referring to Fig. 1 an explanation will be given of the construction and principle of a lightning arrester proper, designed to appeal to those who have experienced trouble from the foregoing faults.

Two nests of concentric cylinders with diverging ends are held in relative position by porcelain caps at top and bottom, these caps in turn being securely fastened to an insulated support of marble or porcelain. To the innermost cylinder the line is connected, to the outer the earth.

Referring to Fig. 2 it will be observed that the porcelain caps are provided with grooves so placed as to make all spark-gaps 1-16 of an inch wide. Between these grooves are sufficient perforations to allow free circulation of air between the cylinders.

In the operation of the arrester the lightning enters from the line to the central cylinder, jumping the gaps in the narrower portions of the arrester and passing from the outer cylinder to the ground connection. If the dynamo current follows the lightning a current of air is at once established through the perforations of the porcelain caps and between the cylinders. This air current blows the arc upward into the spaces between the flaring ends of the cylinders, where the arc is instantly ruptured on account of the increased distance between the conical tops and on account of the increased surface of metal exposed.

Again referring to Fig. 1 it will be seen that between the line terminal and the ground connection there are three spark-gaps, each 1-16 of an inch in width, making a total of 3-16 of an inch air-gap between either line wire and the ground. At the ordinary frequencies now in vogue, 5000 volts or over are required to jump the gaps of the arrester, but at the frequency of a lightning discharge the sparking potential is reduced to less than one-half the above. This rather surprising phenomenon only shows that the relative value of spark gaps cannot be expressed by "short" and "long," and their effectiveness as lightning protection cannot be measured in inches. The importance of this feature can be best understood when it is realized that the spark-gaps of the arrester described are at least double the widths ordinarily used, yet the sparking potential at lightning frequencies is less.

It will also be noticed that the concentric cylinders provide a discharging surface many times that of most arresters. This feature is of great importance, as it enables the arrester to take care of all the heavy discharges, thereby discharging the line completely.

The standard arrester of this type is made double pole (Fig. 3), the outer cylinders being joined by a metal strip to which the ground connection is made. Thus assembled they are intended for 1000-volt circuits; for 2000 volts, two standard arresters are connected in series, the ground connection being made between the two arresters. Fig. 4 illustrates the cast iron case provided for protection from the weather in outdoor work.

In a recent editorial in the Electrical World and Engineer, the availability of reactance in continuous-current systems of sufficient quantity to fairly drive the intruding static discharge to earth, was pointed out. Further on, the difficulty encountered in alternating-current work, precluding similar procedure, was clearly indicated. But suppose we can provide a reactive coil possessing enormous opposition to the passage of lightning to be placed in the circuit between the lightning arresters and the apparatus to be protected, and which at the same time possesses practically no self-induction with alternating currents of ordinary frequency. A reactive coil possessing exactly these features and designed for exactly this service is described in a patent granted to the writer in 1898.

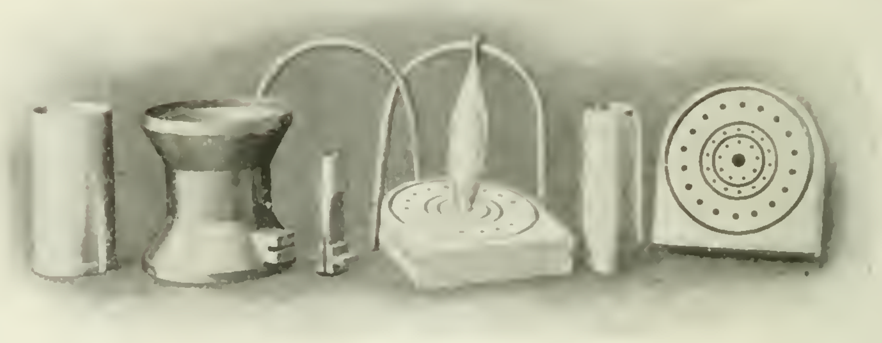


FIG. 2.—DETAILS OF ARRESTER.

This reactive coil consists of parts so disposed relatively to one another that the coefficient of mutual induction is very high. It consists of two parallel coils of insulated copper strips connected in series and wound so that the current flows through them in opposite directions.

These parts are placed near together, side by side, with the result as stated, that the coefficient of mutual induction is very high and, in consequence, with ordinary alternating currents the self-induction of the two coils is nearly zero.

The fact that coils, such as above described, offer practically as great an impedance to lightning discharges as do ordinary coils, is probably due to the fact that with very high frequency discharges the phase of the current in the two parts of the coil is not the same at the same instant, and consequently because wound in opposite directions the currents exercise a reinforcing magnetic effect instead of a mutually destructive one. On the contrary, with alternating currents of the ordinary frequency, the phase is practically the same throughout the whole length of the circuit, so that the resultant self-induction is practically zero. However this may be, the fact remains that the effective impedance of these oppositely-wound coils is very high for lightning discharges, and the self-induction is practically zero for currents of ordinary frequency. In consequence, it is possible in an alternating system to interpose a coil between the lightning arrester and the machine to be protected which will offer no practical disturbing effect either as to magnitude of the output or regulation of the system, and which will at the same time interpose an enormous opposition to the passage of lightning discharges toward the machine to be protected.

For power-transmission circuits of potentials higher than 2000 volts a number of the cylinder lightning arresters connected in series and properly associated with choke coils of the variety described, make up a lightning arrester equipment of remarkable efficiency. The correct number of arresters and choke coils for different potentials has been experimentally determined.

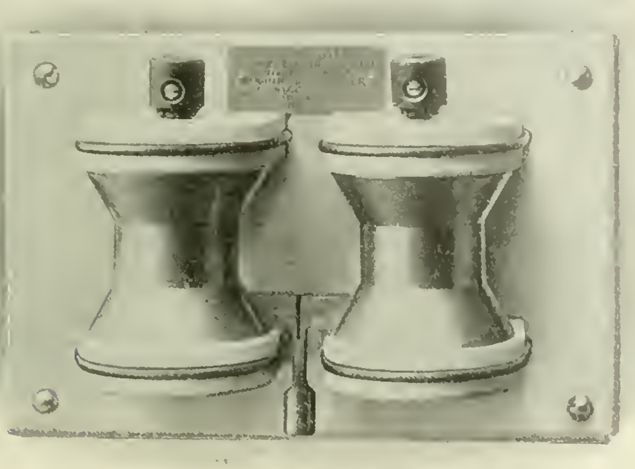


FIG. 3.—DOUBLE-POLE ARRESTER.

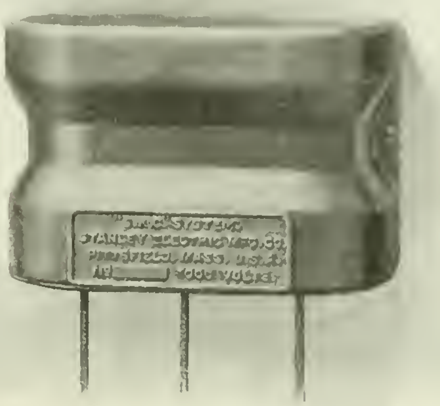


FIG. 4.—VIEW OF PROTECTING CASE.

A large number of these lightning arresters are now in use protecting distribution circuits of ordinary potentials, and are also being used to protect power-transmission lines having a working potential as high as 45,000 volts, with entire satisfaction.

In plants where both "long" and "short" gap arresters are installed on the same circuits it will be noticed that static discharges of low potential and low frequency select as the best path of discharge the short-gap arresters, as the discharges increase in volume and frequency the large gap arresters take the discharge, leaving only a very small portion of the total to go through the short gap arresters. Therefore, neither the long nor the short gap arresters give perfect lightning protection, as the first will not take off small discharges while the second is unable to take all of the heavy discharges. The long gap arresters will give the best protection, as the small discharges might not be able to puncture the insulation of the apparatus, while the heavier discharges would surely do some damage. To remove even the slightest static discharge from the line, an instrument similar to the one illustrated in Fig. 6, called a line discharger, when used with the lightning arrester equipment above described discharges the line completely and provides, I believe, the most perfect protection from lightning yet devised.

The line discharger is a minute air-gap in series with a tube or tubes filled with oxidized metallic particles. A tube, 18 inches long, filled with such metallic particles, has practically an infinite resistance (over 50 megohms), and 2000 volts applied at the terminals would not force any appreciable current through it. The minute air-gap is placed in series with such a tube or tubes only as an extra precaution against grounding the line. The line discharger acts as a selective lightning arrester. It will not allow dynamic currents to go through, yet static discharges of extremely low potential readily pass through the tube and over the minute air-gap to the ground. In using the line discharger in connection with lightning arresters it is connected to the line between the lightning arrester equipment and the generator, as shown in Fig. 5. The number of tubes required is determined by the voltage. As the line discharger will remove even the smallest static charges, it prevents an accumulation of such charges on the line, which might prove dangerous.

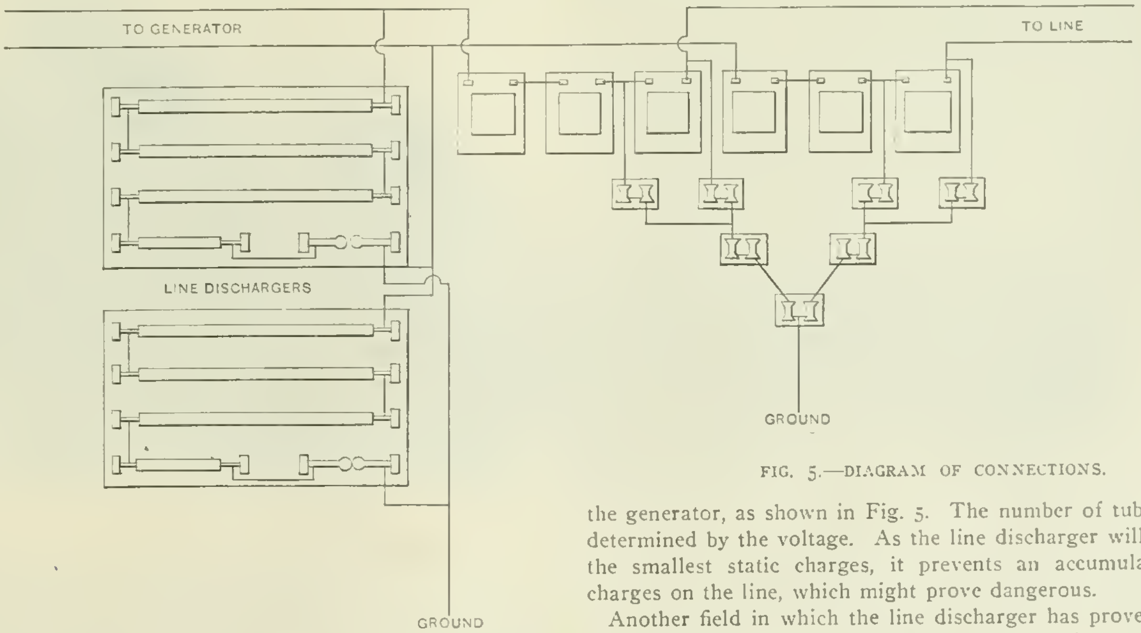


FIG. 5.—DIAGRAM OF CONNECTIONS.

Another field in which the line discharger has proved very useful has been the relieving of underground cables of the extremely high potentials generated when the circuit is suddenly broken. When a large transformer is connected to a lead-covered underground cable, and the circuit is suddenly opened, the combination of the self-induction in the transformer and capacity of the cable tends to set up very violent oscillations in the system and the resultant potential is liable to rupture the insulation of the cable. By the use of line dischargers connecting the cable to the lead covering all danger of the oscillating current puncturing the insulation is removed. Line dischargers can also be used to remove static charges from generators and belts. A modification of the line discharger arranged for use with direct current is particularly valuable for the protection of electric railway circuits.

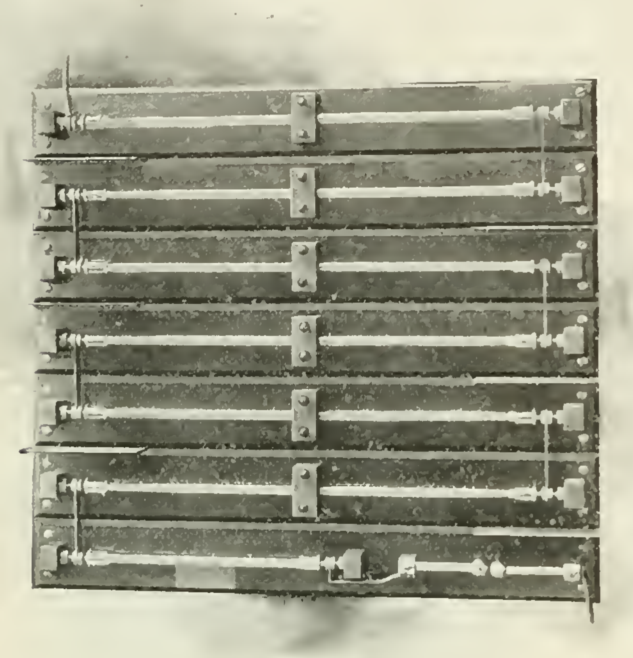


FIG. 6.—LINE DISCHARGER.

Pan-American Exposition Notes.

Mr. W. Jac Marland will have one of the most interesting exhibits in Electricity Building, comprising as it does arc lamps of various types, high and low incandescent lamps, telephones connected up through the switchboard in the booth, electric headlights, portable drills, medical batteries, trolley equipments, carbons, annunciators, portable electric lamps, telesemes, everything in the exhibit being kept "alive." Practical demonstrations will be made such as will attract the attention of the vistors who "want to see wheels go round," just as much as Budge and Toddie ever did.

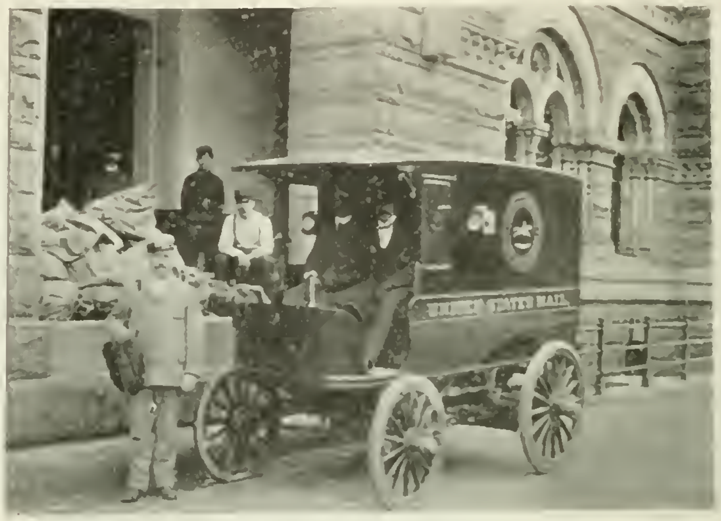
The E. G. Bernard Company, of Troy, N. Y., will occupy a small building at the western edge of the north basin in the southwestern part of the Pan-American Exposition grounds. In this building the company will have offices and two 100-kw motor generators for supplying the big electric fountain in the middle of the north basin. These motor generators are for transforming the 500-volt current received from the power circuit of the Exposition service plant into 110-volt current for the searchlights. The motor-generators and switchboard are furnished free by the E. G. Bernard Company as an exhibit, and will make a very satisfactory and distinctive display for that company.

Pan-American Automobile Mail Service.

Through the courtesy of Mr. D. W. Sowers, superintendent of the Buffalo branch of the New York Electric Vehicle Transportation Company, we illustrate herewith the Electric Vehicle Company's automobile mail wagon, which is employed by the Government to transport the mails between the general post office in Buffalo to the Pan-American post office and to the mail car located at the Pan-American grounds. This vehicle is making an average of 40 to 45 miles per day. The vehicle is one of the parent company's standard delivery wagons. They are using at the present time two of the standard chloride batteries, changing the batteries every two trips. This is, however, oftener than necessary, but it is done to insure a perfect service and for the good of the life of the battery, as the total discharge of the battery is not approached.

The vehicle has been running about three weeks, and has had but one mishap, which was the stripping of a pinion, probably caused by the great amount of mud and slush which the vehicle had to pass through in making the tour of the grounds, which at that time were not in a completed state. The vehicle has carried as great a load as 1400 lbs., but the average load is about 900 lbs.

The schedule of the trips made shows that the vehicle is running on a 30-minute headway, which includes a mile through the crowded Pan-American grounds. Taking this into consideration the time made is remarkable in view of the fact that the vehicle is on duty from 6.15 a. m. until 10.15 p. m. Bridges are crossed with a grade of from 15 to 20 per cent



AUTOMOBILE MAIL WAGON.

Single-Phase Motors for Pumping.

The accompanying illustrations show two electrical pumping arrangements to which single-phase alternating-current motors have been applied by the Wagner Electric Manufacturing Company, of St. Louis, Mo.

Fig. 2 shows a slow-speed single-phase alternating-current motor geared to a triplex pump, and Fig. 1 a centrifugal house pump driven by the same type of motor. This latter arrangement is a particularly neat and serviceable outfit for this class of work, as the pumps have no valves, pistons or sliding surfaces of any kind, except one stuffing box, and are practically noiseless. Among pumping plants recently supplied by this company with single-phase motors is one for city pumping, installed at Whitehall, Ill. The motor drives a pump having a capacity of 15,000 gallons per hour, and is controlled entirely from the power house, situated about one mile from the pumping station. The water is pumped through 6000

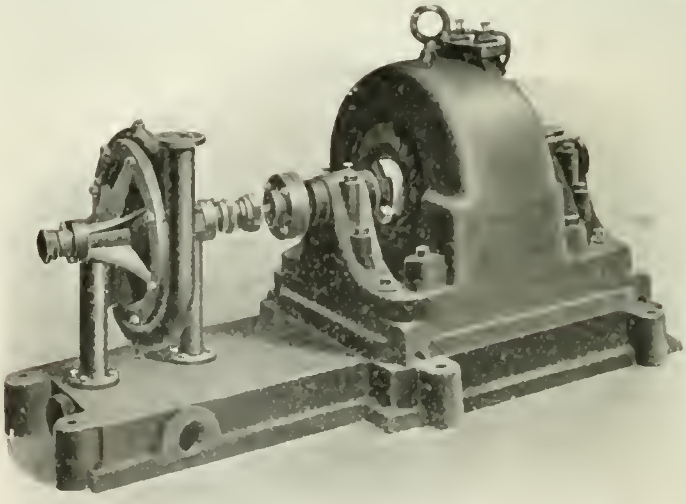


FIG. 1.—ELECTRICALLY-DRIVEN CENTRIFUGAL PUMP.

ft. of pipe line against a head of 156 ft. into a reservoir at the top of the water tower. The pump is started after the heavy part of the commercial lighting load goes off at night, and is operated until morning by the generator which supplies the lighting load.

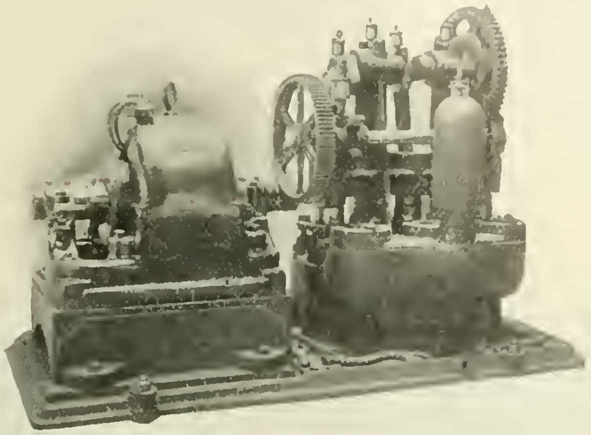


FIG. 2.—ELECTRICALLY-DRIVEN TRIPLEX PUMP.

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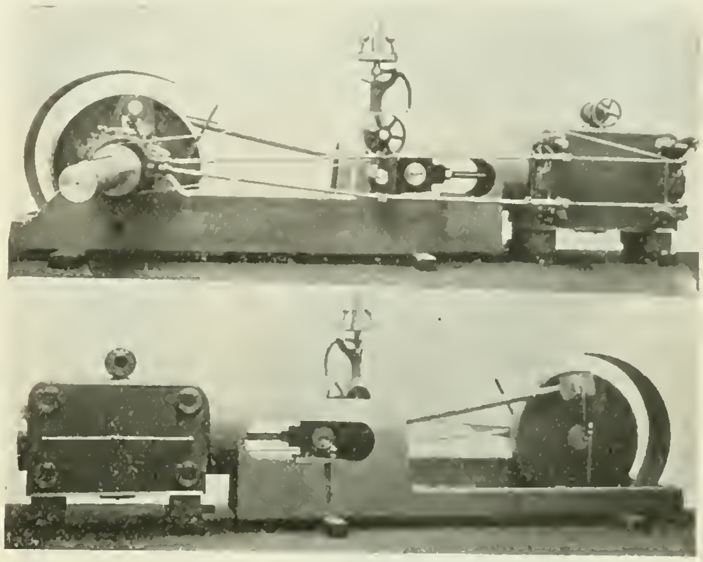
"Twentieth Century" Engines.

The Lane & Bodley Company, of Cincinnati, Ohio, has on exhibition, at the Pan-American at Buffalo, the first of a line of twentieth century engines. The loss of its patterns by fire recently made it necessary to complete a new line of Corliss engine patterns. It took this opportunity to design an engine embodying all of the improvements which its 50 years in the steam engine business showed it to be of value. The requirements which it has designed the engine to fill are that it shall stand 150 lbs. steam pressure, that the ports shall have ample area for a piston speed of 750 ft. per minute and that in case of necessity, the valve gear and other parts of the engine shall work quietly and easily at 125 r. p. m. It does not recommend this speed, but appreciate that there are conditions under which it is desirable.

The engine is of pleasing outline, all ribs and sharp corners having been omitted. The frame is of the heavy duty type, having a bearing on the foundation for the full length and width. The guides are bored to a large radius; the main bearing is made in four sections, wedges being forced downward from the top to permit of the removal of the quarter boxes after removing the cap. The bottom shell can be removed by revolving on the shaft, after raising the shaft less than half an inch, thus making it a very easy operation to inspect this important detail of the engine, and obviating the necessity of removing the eccentrics or governor pulley, to withdraw the wedges from the side.

All oil drips from the guides, cross-head, main bearing, crank pin and eccentrics are collected and carried into a cast iron drip pan under the crank, whence they can be drained and filtered, if desired. The outer bearing is of the floor-stand type, and the bearing proper is made in four sections, the same as the main bearing. The cross-head shoes are removable without disconnecting the connecting rod, which is of the usual solid end type, with babbitted crank pin boxes, and bronze cross-head pin boxes. The cylinder has round corners, with sheet steel lagging and polished angle corners. In the valve gear a most striking innovation has been made. The steam and exhaust valves are each operated by a separate eccentric, the eccentric rods connecting to rocker arms, and from there two parallel rods are attached directly to the steam and exhaust bell cranks. These rods are all light, and the travel being only 3½ inches, the vibration and jar due to excessive inertia strains commonly noted in ordinary Corliss valve gear at high speeds, are entirely obviated. The valves are double ported and of small diameter. The steam lever which operates the steam valve is keyed to the valve stem between the front of the bonnet and the stuffing box, thus supporting it on both sides of the point where the work is applied, and reducing to a minimum the chance of a broken valve stem.

The dash pots are of an improved type of vacuum pot, consisting of a single cylinder and plunger. The rod is attached to the latter by a ball joint, and the location of the dash pots, close up under the steam bonnets, makes the rods short and light, places the dash pots in a convenient place for inspection and adjustment, and removes them from the dust and dirt by which they are usually surrounded when placed on the floor. The lubrication of the plunger is effected by applying oil to the plunger in a groove at the top of the cylinder. The tendency of the vacuum is to draw the oil into the cylinder instead of its being blown out by the air of the compression chamber, as was the case with the old type. The governor is of the company's well-known Hartnell type, running 200 r. p. m., making it very sensitive to slight variations in load.



TWENTIETH CENTURY ENGINE.

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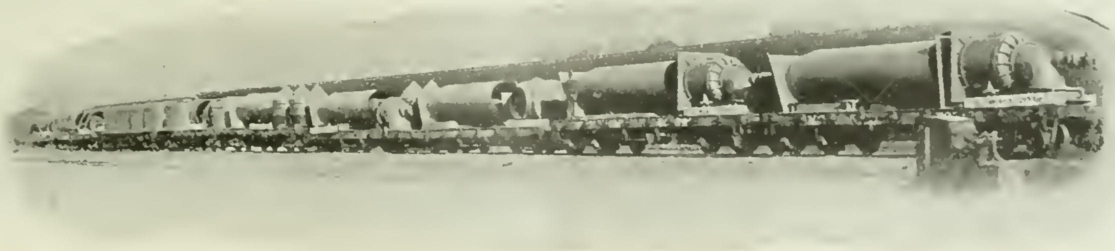
A Large Shipment of Turbines.

The accompanying cut illustrates a shipment recently made to the Remington-Martin Company, of Watertown, N. Y., by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The train consisted of nine carloads of Victor turbines and appurtenances, there being five 39-inch, one 24-inch, two 21-inch machines, and one 18-inch improved cylinder gate Victor turbine, with penstocks, draft tubes, etc.

Each wheel is mounted singly upon a horizontal shaft, and encased in a steel penstock with a heavily ribbed cast-iron head, this head being rounded so as to give the best possible appliance of the water to the wheel. To this head will bolt the cast-iron quarter-turn through which the wheel will discharge into a draft tube about 22 ft. long. On the neck of each quarter turn is provided a self-oiling ring thrust bearing for taking care of the end thrust of the wheel, and outside of this bearing the shaft is fitted with a pair of heavy face couplings for direct connecting with the pulp grinders and electrical machinery. The total power developed by the wheels will be 4375 horse-power under 42 ft. working head of water.

These wheels will be installed in a new pulp and paper mill at Norfolk, N. Y., which is being built by the Remington-Martin Company, of Watertown, N. Y. The water is conveyed from the Raquette



TRAIN LOAD OF TURBINES.

River through a wooden penstock and discharges into an open flume from which the turbines will receive their supply. The wheels will be mounted on concrete arches, with the draft tubes reaching through to the tail water below. The whole, when completed, will make a very compact and model plant.

Wheatstone Bridge and Illumination Photometer of English Make.

Electrical instruments of English design and manufacture always possess more or less interest to American electrical engineers and the trade in general. The two instruments illustrated herewith are manufactured by Messrs. Nalder Brothers & Co., Princess Mews, Great George Street, Westminster, London, England.

The instrument shown in Fig. 1. is a new form of Wheatstone bridge, which, it is stated, retains all the advantages of the old post office pattern and possesses improvements in other points. The plugs are placed wider apart than in the old form, so that they are more easily manipulated, and the size of the blocks are increased, thus diminishing the block error. A new and improved form of coil is used, which reduces the depth of the box. The units, tens, hundreds and thousands are arranged in four separate bars, which are joined underneath so as to give a clear way through between each two. Another advantage claimed for this bridge is the extra pair of ratios, namely, 1, 10, 100 and 1000, instead of 10, 100 and 1000, thus increasing the range of the instrument tenfold each way.

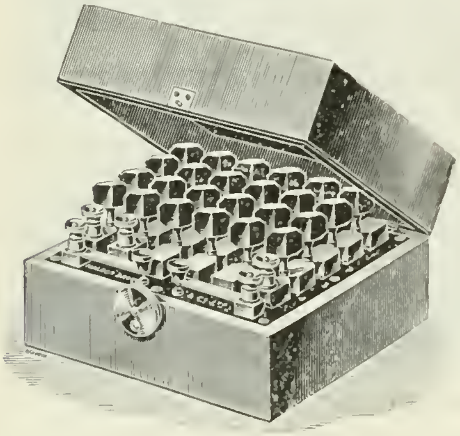


FIG. 1.—WHEATSTONE BRIDGE.

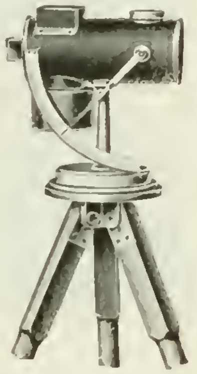


FIG. 2.—PHOTOMETER.

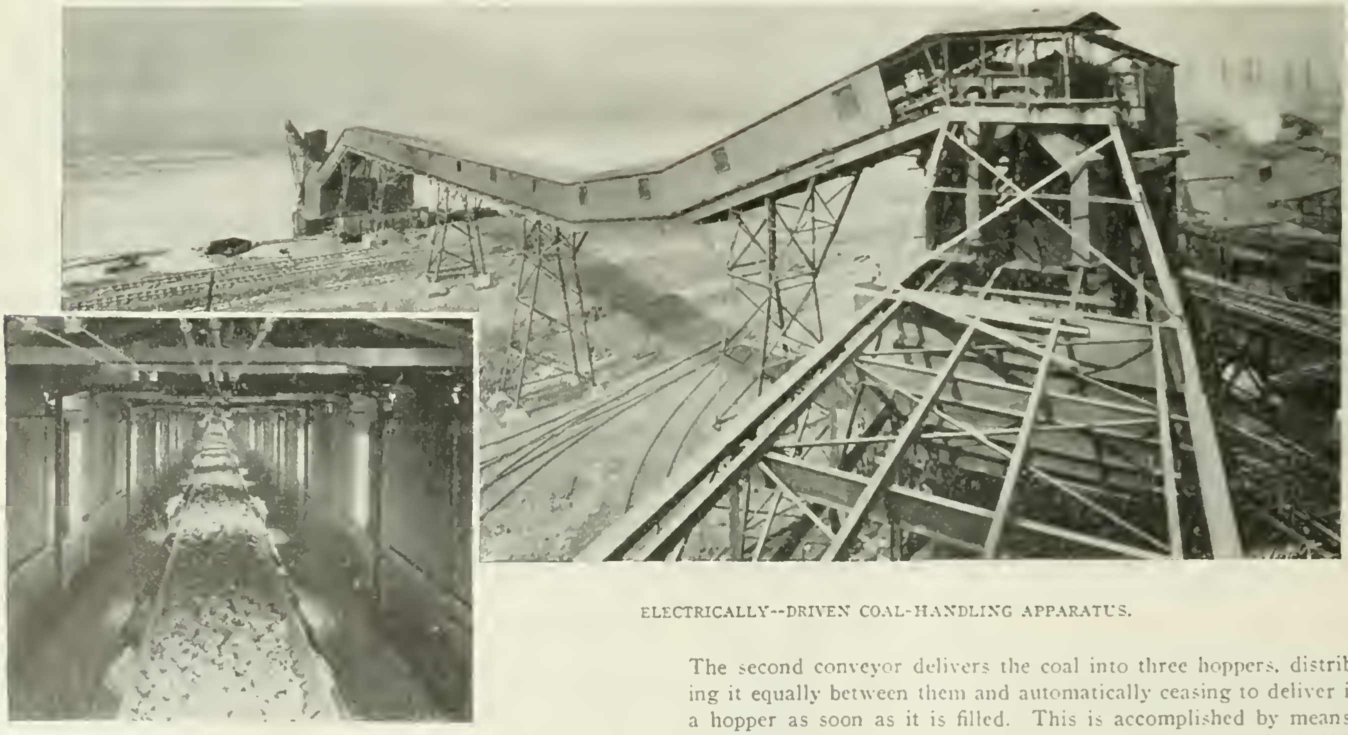
Fig. 2 represents the Preece-Trotter Illumination Photometer of new pattern. Instead of using an incandescent lamp and battery as in former designs, it works with an amyl-acetate standard, which is claimed to be much more reliable and less troublesome. The flame is not affected by a gentle breeze, and on windy nights the instrument can be easily shielded by a piece of cardboard or other similar protection.

A Motor-Driven Coal Handler.

The accompanying illustration shows the coal-handling apparatus recently installed by the Robins Conveying Belt Company, of New York, at the works of Jones & Laughlins, Limited, Pittsburg, to carry coal from the river front to the coke ovens. The amount of coal conveyed daily varies from 2500 to 3000 tons, and as the elevator and conveyor can easily handle 500 tons per hour the daily consumption of the thousand coke ovens dependent on the system can be cared for in a single shift, including the time lost in shifting boats and other similar delays. The enormous quantity of coal handled daily is said to bring the expense to the minimum.

The elevator consists of a double row of steel buckets, each measuring approximately 4 ft. long by 2 ft. wide and 2 ft. deep, and these buckets, 70 in number, are attached to a steel chain. The elevator is supported at its head and foot on a boom which is moved in an inclined plane by an electric motor, and in this way its position can be adjusted to any stage of water. Another motor drives the chain and a third warps the coal barges into position and moves them along under the elevator as fast as the coal is removed. Through these three motors one man operates the entire system, controlling the working of the elevator and shifting the boats with perfect ease. This elevator was designed by Jones & Laughlins, Limited, and built at their works.

At the head end of the elevator, the coal is delivered to a Robins conveyor of the 30-inch size. As shown in the illustration, the conveyor first runs at a somewhat steep incline, the grade being 20 degs. After reaching a sufficient height, the conveyor runs horizontally, crossing several railway tracks, including the main line of the Baltimore & Ohio Railroad, over which it passes at a height of 24 ft. Near its inshore end it takes an upward curve and on reaching a height of 68 ft. delivers its load to another similar conveyor running nearly at right angles to the first. This conveyor is 250 ft. between centers.

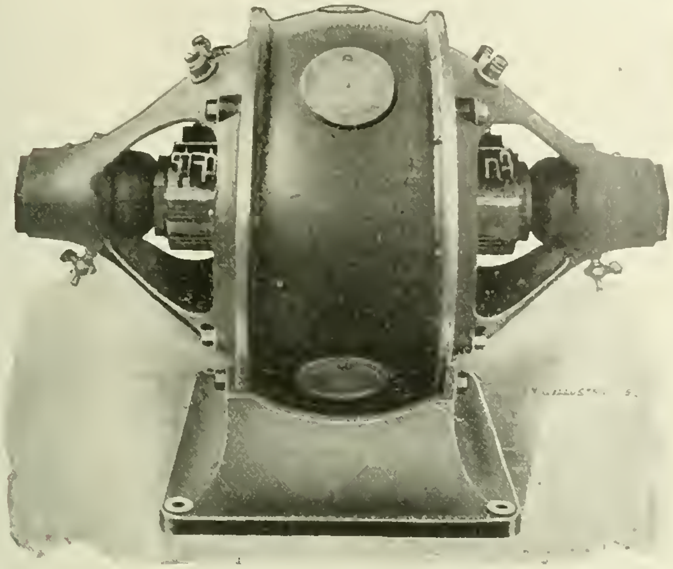


ELECTRICALLY--DRIVEN COAL-HANDLING APPARATUS.

The second conveyor delivers the coal into three hoppers, distributing it equally between them and automatically ceasing to deliver into a hopper as soon as it is filled. This is accomplished by means of "trippers," and an arrangement of chutes designed by the builders. Both conveyors are driven at the end where they receive the load, and not at their head ends, as one would expect. By this arrangement the motor of the long conveyor is located in the house, which also contains the elevator motors, and this concentration of the power plant is of undoubted convenience.

A New Double Commutator Dynamo.

The accompanying cut illustrates a double-commutator machine, built by the Jenney Electric Manufacturing Company, of Indianapolis, Ind. The machine is an equalizer for a three-wire system of distribution in a large printing establishment, where only a 500-volt current was available for driving the presses and other machinery. On account of supposed danger from 500-volt motors, the three-wire system was adopted for motor service, the motors being wound for 250 volts. The equalizer maintains the same voltage on each side of the neutral wire.



DOUBLE COMMUTATOR DYNAMO.

This company builds double commutator machines for other purposes, such as motor generators to transform direct currents from one pressure to another, and also for motor service, where a large variation of speed is desired. These machines for small and moderate capacities are made of the "Universal" motor type, as shown, and the larger capacities are built on the open generator form of frame.

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Rapid Workshop Building.

An excellent example of American enterprise was recently afforded at the works of the B. F. Sturtevant Company, Jamaica Plain, Mass. Early on the morning of Sunday, April 14, fire was discovered on the third floor of the electrical department in the extensive Sturtevant works. Before effective resistance could be presented the flames had spread through the entire engine and electrical departments. They lapped over the intervening spaces, burned off the roof of the engine storage building and worked down through two floors of the office building. But the fire wall around the power plant held them at bay and the fire was eventually confined to the building in which it originated. Some idea of the effects of the fire can be gained from the accompanying illustration.

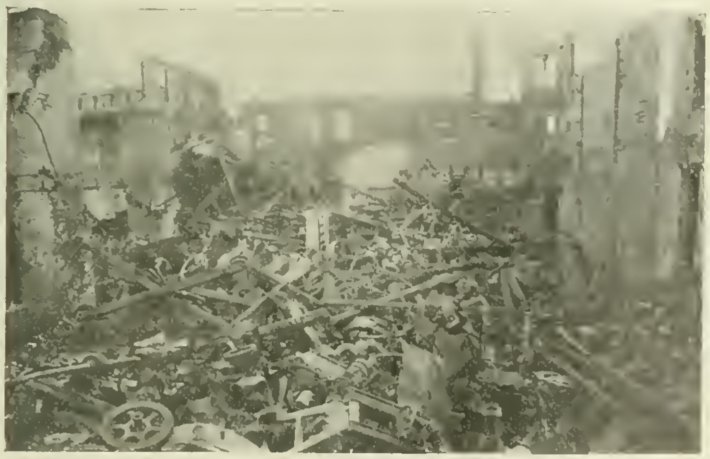

FIG. 1.—RUINS AFTER THE FIRE.

New office and drafting-room quarters were immediately secured in a nearby building, and by Monday noon work was progressing much as usual. The patterns were in a building not reached by the fire. Although the fire had destroyed over an acre of floor space the great extent of the works made it possible by a process of change and compression to provide available space in the remaining three acres of floor area. This was done with the utmost dispatch. A large shipping and storage area on the main floor was immediately transformed into a machine shop for heavy work, the large galvanized iron department gave way to a tool room and machine shop for lighter work, while the electrical department was installed on the vacated floors of another building. The introduction of electric motors at local points simplified the matter of power transmission. Thirty days after the fire these shops were thoroughly established, as evidenced by the accompanying reproduction of a photograph taken on May 14, work was going on as of old and orders for engine and electrical equipments were receiving prompt attention. The two weeks necessarily required for the adjustment of insurance delayed by that amount effective work upon the ruins, but no sooner was the matter settled than order began to appear out of chaos.

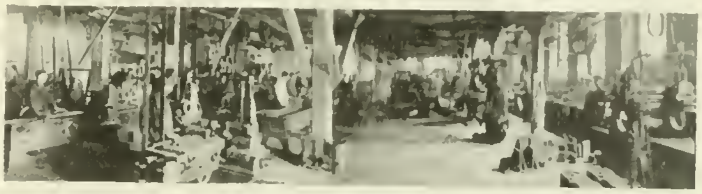

FIG. 2.—THE NEW ELECTRICAL DEPARTMENT.

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Artistic Showroom Arrangement.

The illustration herewith in addition to being a very excellent picture, represents the "talking machine parlors" of the Western Electric Company's Philadelphia branch, being located on the eighth floor of its new building, 931-933 Market Street. The main parlor is a sumptuously furnished apartment 40 by 60 ft., and is a model of beauty and comfort, being fitted up with hardwood floors, Turkish rugs, ferns, etc. In the centre of the room, as in the illustration, is a gold-plated concert phonograph, which is the personal property of Mr. Thomas A. Edison, the inventor. This machine was on exhibition at the Paris Exposition. Having the talking machine parlor on the eighth floor of the building has the advantage of getting away from the din of the street, and enables visitors to hear the phonograms in a room with perfect acoustics and with no disturbing noises. It has been ararnged to give a series of concerts every Wednesday afternoon, and the room has been fitted up with sockets which run along near the floor so that the electric phonographs may be arranged with direct connection on one side of the room, while the audience is seated at a proper distance away. There is an excellent suggestion here for other supply houses.

PHONOGRAPH PARLOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 3, and sixty day loans at 4. In the stock market transactions fell off very decidedly during the week, the public interest being on a limited scale. Liquidation, as a result of the disturbance of three weeks ago, is apparently completed, and large financial interests seem to now give support to their specialties. Manipulation and professional trading, in fact, seem to have supplied the larger part of last week's activity. The traction and electric stocks have, in common with the principal railway securities, relapsed to normal conditions, and no noteworthy features made themselves apparent during the week. Brooklyn Rapid Transit exhibited some weakness, closing with a net loss of 1⅜ points on sales of 39,805 shares. The price fluctuated between 74⅞ and 77, closing at 75⅝. Metropolitan Street Railway closed with a net gain of 1¼ points, the closing figure being 169¼. The highest price reached was 170½ and the lowest 165, the sales aggregating 43,400. General Electric maintained a steady tone, closing at the same quotation as that of the week before last, 223. There was limited trading in this stock, the number of shares sold being 3700. Western Union was weak, losing 1⅜ points net on the week's business. In the outside market the week showed an insignificant volume of sales. Following are the closing quotations:

NEW YORK.

	May 18.	May 25.		May 18.	May 25.
General Electric	223	223	Electric Vehicle	11	11½
Brooklyn Rapid Transit	77	75⅝	Electric Vehicle, pfd	16	18
Metropolitan Street Ry	168	169¼	General Carriage	2	2
American Tel. & Cable	98	99¼	Illinois Elec. Veh. Tran.	⅞	⅞
Western Union Tel	93⅜	92	Hudson River Tel	120	120
American Dist. Tel	—	—	N. E. Elec. Veh. Tran	3½	3
Commercial Cable	—	—	N. Y. Elec. Veh. Tran	1⅛	1⅛
Electric Boat	14	15	Tel. & Tel. Co. of Am	5	5
Electric Boat, pfd	40	40	N. Y. & N. J. Tel	167	169
Electric Lead Reduc'n	2½	3½			

BOSTON.

	May 18.	May 25.		May 18.	May 25.
New England Telephone	—	—	Erie Telephone	*60	58
Mexican Telephone	2⅝	2½	General Electric, pfd	—	—
Westinghouse Electric	—	63	Am. Tel. & Tel	174	180
Westinghouse Elec., pfd	—	—	Boston Electric Light	*240	*240

PHILADELPHIA.

	May 18.	May 25.		May 18.	May 25.
Electric Storage Battery	66	63	Philadelphia Electric	6	5⅞
Elec. Storage Batt'y, pfd.	65	60	Pa. Electric Vehicle	1¼	1¼
Elec. Co. of America	9⅝	9	Pa. Elec. Veh. pfd	1	1
General Electric Auto	—	—	Am. Railways	48¾	45¾

CHICAGO.

	May 18.	May 25.		May 18.	May 25.
Chicago Edison	173	*175	Chicago Telep. Co	260	260
Chicago City Ry	250	255	Union Traction	14¾	16½
National Carbon	15⅜	15⅞	Union Traction, pfd	57	57½
National Carbon, pfd	82	83	Northwest Elev. com	43	49½

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* Asked.

AN EXTENSIVE CONSOLIDATION.—The terms upon which the shares of the Electric Company of America and the shares of the Railways Company, which between them own a large number of central station and trolley properties, are to be purchased have been agreed upon and are stated officially as follows: A new company is to be formed with the following capitalization and bonded indebtedness:

Common stock, 100,000 shares at $50 each	$5,000,000
Preferred stock, 50,000 shares at $50 each	2,500,000
Bonds, 4 per cent	15,000,000

The preferred stock is to be entitled to dividends up to 5 per cent., but the dividends are not to be cumulative. It may be retired at par, and it may subsequently be changed for common stock. Of the $15,000,000 bonds to be issued, $3,500,000 are to remain in the treasury to be sold for cash or used in the acquirement of other properties. $2,500,000 of the bonds, with a stock bonus, are to be sold at par for cash, the stockholders of each of the companies being entitled to subscribe. The issue of $2,500,000 bonds to be sold for cash has been underwritten by Messrs. Ervin & Company, the bankers. It has been agreed that $55 per share shall be paid for the stock of the American Railways Company in 4 per cent bonds, with a bonus of 35 per cent, or $19.25 in the common stock of the new company; and that $11.50 per share shall be paid for the stock of the Electric Company of America in 4 per cent bonds, with a bonus of 35 per cent or $4.025 in the common stock of the new company. The shareholders in each of the existing companies will have the privilege of subscribing to the 4 per cent bonds to be issued for cash to the extent of 20 per cent of the amount of bonds to which they will be entitled for their shares in the respective companies. Subscribers to these bonds will receive for each $1,000 in cash: 4 per cent bonds $1,000; preferred stock $900 and common stock $500.

ERIE TELEPHONE.—The next regular meeting of the directors of the Erie Telephone Company will be held in Boston on Tuesday, June 25. At this meeting the reports of Stone & Webster and the Eastern Audit Company, will be officially presented to the board. These reports, with a statement of the earnings for the five months ending May 31 of this year, may be taken as a basis upon which a plan for permanently financing the company can be founded. Many of the stockholders anticipate the paying of semi-annual dividends at the rate of 4 per cent per annum, the first dividend of 2 per cent to be paid in July. The gross earnings for the three months ending March 31 will exceed the same period last year by $300,000 and a larger percentage of increase can be maintained throughout the year. The permanent plan of financing the company will probably provide for the raising of $15,000,000 of money to be called in as required for extensions and to pay the temporary loan of $7,500,000 at maturity, Jan. 10, 1902, thereby dissolving the trust. A dispatch from Boston states that one of the results of the visit of Philip Dexter, vice-president and chairman of the Executive Committee of the board of directors of the Erie Telephone Company, to the West, will probably be a much more vigorous policy in dealing with the independent companies in that section, where low rates and heavy expenses have prevailed. The new policy with regard to this company will undoubtedly be to raise the rates wherever the Erie Company has a strong foothold, and endeavor to retain subscribers by superior local and long-distance service. The party line system will be extended in this section.

NEW YORK GAS & ELECTRIC LIGHT.—There was filed with the Secretary of State certificate of agreement for the consolidation of the New York Gas & Electric Light, Heat & Power Company and the Edison Electric Illuminating Company of New York, forming the New York Edison Company, to operate in the counties of New York, Kings, Queens, Richmond and Westchester. The Power Company has a capital of $36,000,000 and the Edison Company $9,200,000. The capital of the new company is $45,200,000. The stock of consolidating companies, except 89,265 shares of the stock of the Edison Company held in trust, are to be convertible into stock of the new company on the basis of 1.251 shares of new stock for one share of Power Company stock, and five shares of new stock for one share of Edison Company stock. The directors of the new corporation are Anthony N. Brady, Harrison E. Gawtry, Stephen S. Palmer, Thomas E. Murray, Samuel E. Beardslee, Nicholas F. Brady and Louis B. Gawtry. Mr. A. N. Brady is president.

NEW AMERICAN TELEPHONE STOCK.—A Boston despatch states that the directors of the American Telephone & Telegraph Company expect shortly to offer $22,000,000 of new stock at par to the stockholders on the basis of one share of new stock for three shares of old. This offer is dependent upon the authorization of an increase of capital stock by the stockholders at the meeting in June from $100,000,000 to $150,000,000. At present there is $62,000,000 of stock outstanding.

DIVIDENDS.—The Chicago City Railway Company has declared the regular quarterly dividend of 3 per cent., payable June 29. The National Tube Company has declared the regular dividend of 1¾ per cent on its preferred stock, payable July 1. The American District Telegraph Company of Brooklyn has declared a semi-annual dividend of 3½ per cent, payable June 10.

PHILADELPHIA BELL TELEPHONE.—The Philadelphia Bell Telephone Company stockholders have approved the increase in capital stock from $6,000,000 to $8,000,000. $1,000,000 new stock will be issued at once. Stockholders of record to-day having the right to subscribe to 16⅔ per cent of present holdings at par until June 18.

CHICAGO LIGHTING COMBINATION DENIED.—La Salle Street has the story again that the Chicago Edison Company is to be absorbed by the People's Gas Company. President Insull, of the former Company, declares there is no truth in the report and that it is not probable that any merger of the two companies will be effected just at present.

NEW YORK SUBWAY CAPITAL.—The Empire City Subway Company (Limited) of New York City has filed with the Secretary of State a certificate of increase of its capital stock from $1,750,000 to $2,250,000. The certificate was signed by J. W. Lieb, Jr., and John H. Cahil.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation, as indicated by reports to the mercantile agencies, is largely a favorable one, the primary encouraging feature being the fine outlook for the country's crops. Industrial conditions head the list of disturbing features, but confidence in conservatism and good counsel is widespread, and the effect on general business of the idleness of the large number of men from strikes is apparently minimized. A few railroads show a decrease in earnings as compared with last year's highly favorable returns, but the majority reflect, in progressive gains, the enormous current business of the country. The building trades, except in places affected by strikes, are busily employed, and all materials find ready sale. "All in all," says *Bradstreet's*, "the situation, therefore, may be classed as one of much encouragement, with prospects for legitimate business generally equal to, and in some respects, superior to anything in the past." In the iron and steel trade, the demand for finished products is as heavy as ever, structural materials, bars and plates being in especially good demand, with premiums paid for quick delivery, and a large new business not accepted because of the inability of manufacturers to promise immediate shipments. The strike among machinists for higher wages and a shorter day has been a very general one. It is reported that 40,000 men have been granted their demands and that 30,000 more are unfortunately still idle. Strikes in the building trades in New York City and in other places will, it is estimated, swell the number of idle men to 60,000. The failures for the week, as reported by *Bradstreet's*, aggregated 192, which was the same as those of the week previous. For the corresponding week last year the number was 167. There was no change in copper. The leading producers are still holding to their figures of 17c. for spot and 16⅝c. for electrolytic.

MACHINIST STRIKES.—For the past two weeks there has been much disturbance in labor circles throughout the East and Middle West by strikes and rumors of strikes among machinists and workmen in the metal trades. Many electrical and kindred industries were involved. In some cases the demands of the strikers have been acceded to and in others the men are still holding out. The Cincinnati Milling Machine Company granted the nine-hour day asked for. At the Watsessing works of the Sprague Electric Company fifty machinists, winders, and others struck on May 23 for ten hours' pay for nine hours' work. Among the strikers were twenty young women. The Stillwell-Bierce and Smith-Vaile Company at Dayton started its works on May 21 with non-union men. The Crocker-Wheeler Company's machinists gave trouble and the company last week closed the works and notified the workmen to remove their tools at once and receive the pay due them. Reports of strikes have come from Dunkirk, N. Y., Boston, New London, Conn., Indianapolis, Ind., Baltimore, Cleveland, Cincinnati, Buffalo, Scranton, Pa., and many other places. The General Incandescent Arc Light Company, of New York, writes us: "On May 22, the company as manufacturers of arc lamps, switches, switchboards, power motors, flush switches, etc., arranged with their employees to run their factory fifty-four hours per week, and pay the same wages as were paid when the factory was running on a sixty-hour basis." Matters are improving this week.

THE NATURAL FOOD COMPANY STRING WIRES.—Among the many important additions to the already long list of noted factories at Niagara Falls, N. Y., is that of the Natural Food Company, commonly known there as "The Perky Plant." This company has contracted for 2500 electrical horse-power from the Niagara Falls Power Company. The work of stringing the cables was begun May 15. From the power-house feeder switch cables will be run to marble panels, having the well known General Electric time element relay and circuit breakers. From the panels to the exterior of the power-house, there are four cables of 500,000 c. m. each. From this place, 2 two-phase lines in parallel are strung on poles to the canal of the Hydraulic and Manufacturing Company, where the 350,000 cm cables will be increased to 750,000-cm lead sheathed and continued the rest of the distance underground. The plant of the Natural Food Company is located near the Falls, and in sight of the upper rapids. There will be a grand opening of the plant in June. It was the desire of the company to have completed the plant ere this, but since Mr. Perky promised several months ago to make shredded wheat biscuit in his place by May 15 he secured the necessary apparatus and gave a public demonstration of the processes. Electric heating will be freely used in connection with the Perky plant.

THE ROWLAND TELEGRAPH.—It is stated from Baltimore that the heirs of Prof. Henry Rowland, of Johns Hopkins University and business men in Baltimore who organized the Rowland Company are deeply interested in the reported success of the Rowland multiplex telegraph printing invention in Germany. The Baltimore Company owns the invention. Louis De Goll is president, F. H. Hambleton, Chief Engineer of the Consolidated Gas Company, Vice-President, and Columbus O'Donnel Lee, Secretary. Mr. De Goll is now in Germany looking after the company's interests. A considerable part of the company's stock is owned by Prof. Rowland's estate. Vice-President Hambleton says, in relation to the subject: "Prof. Rowland completed the invention in all its details. What remains to be done is to perfect its commercial shape. This is being done now. All that is needful to guide the company in its work is on record in Prof. Rowland's handwriting. We have a factory in this city where the machines are being made, but they are not as yet for sale. We have competent scientists engaged in the work, and they understand Prof. Rowland's principle thoroughly." The Western Union Telegraph Company is named as a possible purchaser, but that is at present doubtful.

MORE WIRELESS TELEGRAPHY.—The Northwestern Wireless Telephone & Telegraph Company, of which Joseph S. Schwab, 84 Lasalle Street, Chicago, is a chief stockholder, has sprung into existence from its parent company, the American Wireless Telegraph & Telephone Company. Articles of incorporation permitting the new company to operate in Illinois, Wisconsin, Iowa, Minnesota, in the northern part of Michigan and in Arizona were taken out last week at Phœnix, Ariz. The capital stock represented is $5,000,000. The parent company is said to have in successful operation a wireless line extending from Yokohama to Corea, a distance of 500 miles over land and water. It is also stated that the Cleveland and Buffalo steamship line has applied to Mr. Schwab for a line to connect Milwaukee and Grand Haven, to be in operation by June 4.

TELEPHONES FOR CUBA.—A. F. Blundell, manager of the telephone companies in Havana, has been visiting Chicago to buy 2500 telephones. He said: "Telephones there are in greater use than in any American city of the same size. People like to use them, and they have become a necessity. The warm climate and the habits of the people conspire to cause the Havanese to make constant use of the telephone. All that stands in the way of an immediate boom in Cuba is the Foraker resolution, which forbids grants and franchises from the provisional government. Capital in all lines of business is simply waiting."

TRACTION IN PARIS.—There is reported from Paris a fusion of the Paris Omnibus Company, the Thomson-Houston Electric Tramway Company and the Metropolitan Railway. It is proposed to reduce fares and abolish the vexatious "correspondence." If the deal goes through the trust will consolidate the transportation in the French capital. The scheme will require the approval of the municipal council, but the advantages offered are such as to render its consent probable. It is said that a big contract for equipment will go to the Compagnie Francaise Thomson-Houston, of which the head is Mr. Thurnauer, so well known in the United States. Nothing is known of the matter here.

THE GENERAL INCANDESCENT LAMP COMPANY, of Cleveland, has recently received orders for large shipments of lamps to England, Shanghai and Honolulu. During the month of April several thousand lamps were sold to the exhibitors at the Pan-American Exposition for use in illuminating the booths; also a great quantity of special sign lamps for use in electric signs erected at Buffalo and Niagara Falls. This company has also recently closed a contract with an electric sign manufacturer in New York City for 50,000 special sign lamps.

EDISON BATTERY FACTORY.—At the County Clerk's Office, Newark, N. J., papers of incorporation of the Edison Storage Battery Company were filed last week; capital, $1,000,000, the purpose of which is to manufacture the new lightweight storage battery recently perfected by Thomas A. Edison. Herman E. Dick, of Chicago; Walter F. Mallory and W. E. Gilmore, of Orange, N. J., are the incorporators. An immense plant is to be erected by the company at Glen Ridge, N. J., where the battery will be manufactured.

WORK IN NEW JERSEY.—The United Electric Company of Newark has just had a new switchboard built at a cost of $25,000, and has practically completed the work of putting all the electric light and power wires in the latest types of underground conduit. The Prudential Insurance Company of Newark has put a splendid equipment in its office building, the third largest of its kind in the world.

TELPHERAGE.—The United Telpherage Company, 20 Broad Street, New York City, has just made two new installations of its interesting and ingenious system for transporting material along wires by means of a "telpher" or traveling motor. One of these plants is outdoors, in the well known works of the Yale & Towne Manufacturing Company, Stamford, Conn. The other is in glass works at St. Louis.

BOILER CLEANERS.—The Ford Automatic Boiler Cleaner Company, Carleton Building, St. Louis, have just equipped the boilers of the Cumberland Electric Light & Power Company, Nashville, Tenn. They have also sold to the John O'Brien Boiler Works, St. Louis; E. Lilly, Indianapolis, and the Big Four Laundry Company, Columbus, Ohio. They are producing up to the limit of their present facilities.

THE MEXICAN SUGAR REFINING COMPANY, a concern recently organized with New York and New Orleans capital for the purpose of developing over 6000 acres of sugar land located on the Santa Fe estate on the Papaloapam River, in the State of Vera Cruz, Mexico, is to be equipped with an electric plant, which will be utilized for operating all the machinery, with the exception of the mills and crushers. J. B. & J. M. Cornell, of New York City, which firm have secured the contract for the entire sugar plant, valued at nearly $400,000, have just determined on awarding the orders for the electric installation. The Birmingham Foundry & Machine Company, of Birmingham, Ala., is to build two Corliss engines of 200-hp each. The Crocker-Wheeler Company will furnish the generators, consisting of four 100-kw machines. The same company will supply 15 motors, three of 50-hp, two of 30-hp, five of 10-hp, four of 7½-hp and one of 5-hp. These will be utilized for driving the pumps, centrifugals and other machinery, to which they will be direct-connected. The pumps, consisting of vacuum, juice, water and boiler equipments, are to be supplied by the Worthington branch of the International Pump Company. The water pumps, of which there are two, will each have a capacity of 1,250,000 gallons every twenty-four hours. The value of the Worthington contract is said to be about $12,500. The Crocker-Wheeler Company will also furnish 20 arc and 250 incandescent lamps for the lighting of the sugar factory, etc. The boilers, of which there are four of 250-hp each, are to be built by the Sterling Company, of Chicago. There will also be a fair-sized machine shop, which will be installed with a 10-hp engine and boiler, lathes, planers, drill presses, bolt cutters, pipe threading and blacksmith's tools, etc. Orders for these tools, etc., will be let within the next few days. The Cornell contract calls for the completion of the refinery and the entire plant by Feb. 1, 1902. The Mexican Company having options on neighboring property, it is anticipated that further contracts for equipment will be let in the near future.

TRAIN LIGHTING.—The description of the special car recently built for the use of King Edward VII. on his continental journeys, states that it is fitted with the Stone system of electric lighting. This system is one of the so-called "axle-light systems," whereby the power derived from the revolving car axle is utilized for driving the dynamo. Messrs. Vickers, Sons & Maxim, Limited, the great English firm, have arranged with the Consolidated Railway Electric Lighting & Equipment Company, of 100 Broadway, New York, to introduce their system of axle lighting in Great Britain and on the Continent. Satisfactory preliminary tests of this system have been made in England and Germany, and have attracted much attention abroad, and the great house of Vickers will soon be in a position to apply it on the railways of the United Kingdom and of the Continent. The superiority claimed for the American system is its mechanical excellence, and it may be expected that the electric light will displace gas, just as the gas displaced oil and candles by its manifest advantage, its established economy and the perfected efficiency which have been secured for it. Even far-away Japan has the new system under consideration, and measures are in progress to apply it to some of the railways of that country, which has already distinguished itself as among the most modern of nations in its persistent efforts to adopt the most complete and up-to-date methods.

THE MALTBY LUMBER COMPANY, of Bay City, Mich., recently suffered quite a loss in the fire at Detroit, which wiped out the pole yard of the Western Union Telegraph Company. They had some 15,000 poles stored there, and the Telegraph Company had nearly 100,000. The two together made by far the largest stock of poles in one place of any yards in the world. The destruction of this large amount of cedar poles will doubtless have a strong effect on the pole market, as the Telegraph Company has a large amount of construction work under way and will have to purchase at once. The Maltby Lumber Company have numerous other yards, notably at Pinconning, Saganing, and Boyne Falls, Mich., and the loss will not deter them to any large extent in making shipments. In fact, at the present writing, they are loading one of the largest capacity pole boats on the lakes a second time for shipment to the burned yard, and they have chartered her for three more trips. In addition, they are rushing forward all the cars possible, and will soon have as large a stock as ever, and better assorted, as the old stock had run short on a few sizes. The insurance will cover about half the cost of the poles.

ELECTRIC POWER SCHEME.—The Baltimore *Sun* says that a report comes from Philadelphia that a syndicate of Philadelphia and New York capitalists has arranged to acquire control of the project started by Baltimore to utilize the water power of the lower Susquehanna River in Maryland for the generation of electricity on a large scale, and its transmission to Baltimore, Wilmington, Chester and Philadelphia. It is said that this scheme is connected with a plan for a system of electric railways between New York and Washington, with branches to be operated in towns and cities within a distance of 20 or 30 miles from the main line.

AMERICAN APPARATUS IN GERMANY.—Mr. Frank H. Mason, U. S. Consul General at Berlin, in a report says: "So marked has been the German appreciation of American machinery and tools that the imports last year included 4757 tons of machine tools of American origin, against 588 tons from Great Britain and 388 tons from France. Besides this, there was imported from the United States during the same year 20,249 tons of agricultural machinery and implements, 343 tons of electrical machinery, 200 tons of steam engines, 574 tons of blowing machinery, and 331 tons of pumps.

THE HARRISBURG FOUNDRY & MACHINE WORKS have secured an order from the Galveston, Texas, Street Railway Company, calling for a tandem compound Harrisburg standard engine of 200 horse-power, to be direct connected to a 125-kw alternating-current generator, ordered at the same time from the General Electric Company. Two 90-hp Harrisburg standard engines are to be installed in the Wells Building, 18 Broadway, which plant is being replaced. The engines will be direct connected to two 60-kw generators of Fort Wayne make.

THE MORGAN ENGINEERING COMPANY, of Alliance, Ohio, recently received a contract calling for the shipment to Cuba of two electric traveling cranes of six-ton capacity each, which are to be utilized for handling sugar cane in the Banes plantation of the United Fruit Company, further particulars of the electric equipment of which plant appeared in our last issue. The cranes are to be operated by 25-hp motors, supplied by the General Electric Company.

RUSSIAN TRADE.—U. S. Consul General Holloway, of St. Petersburg, reports Russian direct imports from the United States in 1900 as follows: Copper, $342,475; iron and steel wares, $42,230; handicraft instruments, $15,450; machines and apparatus of iron, steel, etc., $220,690; parts of machines, $74,160. The additional figures of the indirect American importations into Russia through Germany, etc., are very difficult to obtain.

BABAMABA BREAD.—The following Associated Press item is interesting, to say the least: "Schenectady.—A representative of the Great American & Oriental Babamaba Bread Manufacturing Company, capital $25,000,000, was in the city yesterday contracting with the General Electric Company for machines to cost about $1,000,000.

FREDERICK PEARCE, New York City, has recently closed a large contract with the Government for wiring, tablet switchboards, etc., for the Immigration Department on Ellis Island, New York Harbor, where so many hundreds of thousands of our European cousins first set foot yearly on American soil. The order amounts to about $25,000.

ADOLPHO OLIVER, of Orizaba, State of Vera Cruz, Mexico, who is at present on a visit to the United States has placed a substantial order with Elmer G. Willyoung, of New York City, for Röntgen ray apparatus, etc. Mr. Oliver is purchasing a considerable lot of scientific instruments, etc., and can be found at the offices of Felipe G. Canton in the Columbia building, 29 Broadway.

JAPAN imported machinery and engines in 1899 to the value of 5,657,000 yen and in 1900 to the value of 8,964,000 yen. The yen is worth 49.8 cents. This shows a marked increase for the period. There was a gain of corresponding magnitude in other iron and steel imports.

STREET CAR BRAKES.—The Westinghouse Air Brake Company has purchased the Standard Air Brake Company. The terms are not given. The Westinghouse Company will enter into manufacturing air brakes for street and interurban railroads on an extensive scale.

CINCINNATI TRACTION CONTRACT.—The North American Construction Company of Chicago has received the contract for building and rebuilding about 34 miles for the Cincinnati Traction Company.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York City, has been awarded a further contract for the supplying of 850,000 feet of conduit for the Charing Cross & Hampstead Underground road, London.

THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY has alloted a contract to the Buckeye Engine Company for the furnishing of two 1800-hp Corliss compound engines for installation in its new shops at Berlin, Conn.

THE WILDWOOD STREET RAILWAY COMPANY, of Wildwood, N. J., has awarded a contract to the Buckeye Engine Company, of Salem, Ohio—New York office, Taylor building, 39-41 Cortlandt Street—for two 200-hp engines for installation in its plant.

THE LIDGERWOOD MANUFACTURING COMPANY, of New York City, has obtained an order, through the Flint-Eddy & American Trading Company, for an electric hoisting equipment to be utilized for mining purposes, in New South Wales, Australia.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, May 18, 1901.

KEW OBSERVATORY AND TROLLEYS.—The service of the London United Tramways Company has at last been put into operation, and all difficulties between the company and the Kew Observatory authorities seem to have been settled. This system of tramways commences at the terminus of the Central London Railway at Shepherd's Bush and extends by various routes in a westerly direction, connecting up many of the important outlying towns forming now the suburbs of London. It is unnecessary to state that immediately upon the tramways being put into service that great crowds took advantage of them, and they have been in popular use ever since.

THE GENERAL ELECTRIC COMPANY, LIMITED, of London, recently acquired an extensive site of forty acres at Witton, near Birmingham, and is now making rapid progress with the erection of factory buildings for the manufacture of electrical machinery, particularly heavy generators, as it already has large factories at Manchester, Birmingham and elsewhere for its electrical supplies and fittings. The framework will be of steel, and the factory will be in every respect modern and up to date. It will include a machine shop 850 feet long by 140 feet wide, and a power station from which all the departments will be operated electrically. In order to accommodate the workmen, who will probably number 3000 by the time the buildings are completed, a supplementary piece of ground 60 acres in extent has been secured in the vicinity, on which will be erected a modern village.

MARCONI IN LONDON.—Mr. Marconi, on his return to England from the United States, lectured on syntonic, or "tuned" wireless telegraphy before a crowded meeting of the Society of Arts. He asserted that the days of "untuned" wireless signalling, by which messages sent from any transmitter could be recorded by any receiver, are numbered. In view of this it is interesting to learn from Mr. Marconi that the Admiralty are about to instal the "tuned" apparatus, which ensures secrecy, forthwith on his Majesty's ships which are already fitted with the Marconi apparatus. Secondly, the inventor announced that he had fitted up an automobile to which is attached wireless signalling apparatus, and from which communication can be maintained with a base while travelling about the country. A practical demonstration of this automobile will be made to the War Office shortly. The "tuned" appliance is also to be fitted on the Belgian cross-channel steamers.

A NEW SIEMENS FACTORY.—For some time Siemens Bros. & Company, Limited, of London, have been looking for a suitable place in which to establish a large and up-to-date factory for the manufacture of generators from small to the very largest sizes in order to allow them to keep pace with the growing demand. Their present facilities at Woolwich were altogether inadequate, and they have recently purchased the "Hough" site, consisting of about fifty acres of level land on the south side of the town of Stafford for the erection of their new electrical engineering work. The site is bounded on one side by the London & Northwestern Railway, from which sidings are to be constructed leading to all parts of the works. The principal buildings will be the machine shop and the erecting shop, which will be of large size. In addition, there will be a foundry, woodworking shops, smithy, etc. All of these will be of the most modern design, and will be equipped with all the necessary appliances, and will be arranged in the best way for the uninterrupted flow of the work through the factory. Building operations will most likely be commenced soon. Messrs. Hird and Dumas, two highly intelligent representatives of the company, visited your side recently and have come back with many pointers. They also propose, it is said, to buy part of their equipment in the States.

MIDLAND POWER TRANSMISSION.—The Midland Electric Corporation for Power Distribution, Limited, whose headquarters are at Wolverhampton, is making rapid progress with its works at Ocker Hill, near Tipton, in the center of the Black Country, and intends to supply power to a radius of about seven miles, although in certain directions the lines will extend eight or nine miles. The following towns are embraced in this territory, which is a very closely settled one, and is comprised almost entirely of manufacturing enterprises: Wednesbury, Bilston, Willenhall, Wednesfield, Heathtown, Tettenhall, Upper Penn, Sedgley, Kingswinford, Wardsley, Brierly Hill, Quarry Bank, Cradley Heath, Lye, Great Barr, Tipton, Coseley, Bentley, and a large number of other towns. The power house, which is approaching completion, is 180 feet long by 73 feet wide, and there are being installed in it at present a 3500-hp Yates & Thom engine which will be coupled direct to a Ferranti generator of that capacity. Two other engines of from 1300-hp to 1500-hp are being supplied by S. Z. de Ferranti, Limited, coupled to Ferranti generators, and all the switch gear in the station will be of the Ferranti type. Eight Babcock & Wilcox boilers are being erected, and a Hunt coal conveyor is being installed in connection with a coal storage of about 1000 tons. The chimney shaft is of steel, 9 feet 6 inches diameter at the top and 180 feet high. Current will be sold to power users at 3 cents per unit, though for lighting purposes its charge is intended to be 9 cents per unit. The generators will develop two-phase current at 8000 volts, which will be distributed by means of underground cables, manufactured by the British Insulated Wire Company, to five sub-stations at the following towns: Bilston, Wednesbury, Tipton, Brierly Hill and Old Hill. In these sub-stations the voltage is reduced to 3000 volts, at which pressure the current passes to street-box transformers, in which it is reduced to 200 volts, at which voltage it is supplied to consumers, still, however, of the two-phase alternating type. Rotary transformers will be installed if necessary for producing direct current for tramway purposes. All of the distributing system will be underground, the cables being of the British Insulated Wire paper insulated type, with two elliptical cores and one concentric strip, which is earthed, the largest cable being of 1000-kw capacity. The same type of cable is used for the 3000-volt distribution, and also for the 200-volt distribution, the sizes and amount of insulation varying according to the amount of current to be carried and the voltage. The telephone and pilot wires will also be underground. It is expected that about $2,500,000 will be spent on the installation before completion. J. Hardy McLean is the manager and engineer of the scheme, and it is expected that the power house will be in operation by August of this year.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—Articles of incorporation of the State Telegraph & Telephone Company of Ashdown, Ark., were filed May 16. The capital stock is $50,000. The incorporators are William Freeman and Frank A. Locke, of Ashdown, and L. A. Byrne, of Texarkana.

SAN FRANCISCO, CALIF.—The Home Telephone Company has been incorporated, with Colusa, Calif., as the principal place of business. Directors: W. H. Buster, O. Robinson, J. Grover, E. Swinford and A. A. Thayer. Capital stock, $5,000; subscribed, $825.

GAINESVILLE, GA.—Long distance lines have been started to connect this city with a number of outside points. John Oliver, of the local lines, has the extensions in charge.

SPRINGFIELD, ILL.—The People's Telephone Company, of Chillicothe, has been incorporated, capital stock, $4,000, to operate a telephone system. Incorporators: E. F. Zinser, Howard L. Pettet and D. Kelly.

INDIANAPOLIS, IND.—Articles of incorporation have been filed by the Wakarusa Telephone Company, of Wakarusa, with a capital stock of $10,000.

LETT'S CORNER, IND.—The Lett's Corner Telephone Company has been incorporated with a capital of $6,750, and will operate telephone lines in Decatur and Bartholomew counties. The officers are: President, J. R. Swope; Secretary, J. G. Evans.

MITCHELL, IND.—The town board of this city has granted a franchise to the Hoosier Telephone Company, of Salem, for the erection of a modern telephone exchange. The board also granted Lewis W. Spencer, of Georgia, the right to build a connecting line with his Georgia and Huron system. This town will then have independent long-distance connection with the outside world.

HARTFORD CITY, IND.—The city council has revoked and rescinded the franchise of the Central Union Telephone Company, which has a long-distance station here and a service to several factories. The franchise held by the company was granted fifteen years ago, and at that time a local service was established. It was afterwards abandoned, and only the long-distance service remained. The company announced its intention to re-established a local service, in competition with the independent company which had invaded the field left vacant by the Central Company. Poles and wires already had been sidetracked here, but the council has taken away the company's authority.

SPRINGFIELD, MASS.—The linemen employed by the New England Telephone & Telegraph Company in the western district and by the United Electric Light Company struck on May 13 for higher wages and shorter hours.

DETROIT, MICH.—Articles of incorporation of the new People's Telephone Company, recently organized here, are ready to be filed at Lansing. The capital stock is $2,500,000, 70 per cent. owned by the Everett Moore syndicate, of Cleveland, and 30 per cent. owned in Detroit. The list of directors includes G. L. Palms, Henry Stephens, Alexander McPherson, J. C. Hutchins, Theodore D. Buhl, of Detroit, and Arthur Pack, of Pontiac, Mich. H. A. Everett and E. W. Moore, principal owners of the Detroit United Railway, are two of the Cleveland directors.

CRAIG, MO.—The Craig Telephone Company, with a capital stock of $1000, has been incorporated by F. K. Allen, E. J. Kellogg, W. S. Thompson and others.

ST. LOUIS, MO.—The St. Louis County Court last week increased the assessment of all the telegraph and telephone lines running through the county.

NEVADA, MO.—Work is being pushed on the new independent telephone system from Nevada to Virgil City and Stockton, including several other towns. The line will be extended at once south to connect with a number of mining camps.

CHARLOTTE, N. C.—The American Telephone & Telegraph Company will complete within a month a direct telephone connection between Charlotte and Atlanta, Ga.

CHARLOTTE, N. C.—At Raleigh, where three rival telephone companies are operating, extensive improvements are being projected. The Bell Company announces that it will erect a 180-mile long-distance line to Greensboro, N. C., and intermediate points. The Interstate Company contemplates several new long-distance lines. It has ordered a new switchboard of 1200-light line capacity.

ALBANY, N. Y.—The Batavia Home Telephone Company has been incorporated, with a capital of $160,000, to operate a telephone line in Genesee with Batavia as the central point. The directors are Samuel B. Rawson, Addison B. Lord of Elyria, O.; Alfred R. Smith, of North Tonawanda, and George C. Frost, of Buffalo.

DAMASCUS, OHIO.—The Damascus Telephone Company will build an exchange at Garfield.

BATAVIA, OHIO.—The Clermont County Telephone Company is extending its lines to Brazier and Olive Branch.

MARION, OHIO.—The newly organized Marion County Telephone Company has applied for a franchise in this city.

GERMANTOWN, OHIO.—The Germantown Independent Telephone Company has asked the council for a 50-year franchise.

PAINESVILLE, OHIO.—The Painesville Telephone Company will erect a new exchange building. E. L. House is manager of the company.

JEWITT, OHIO.—The Harrison County Telephone Company has secured a franchise for a local exchange which is to be connected with the new exchange at Cadiz.

ZANESVILLE, OHIO.—Both the Zanesville Telephone & Telegraph Company and the Farmers' & Merchants' Telephone Company have applied for franchises at Dresden.

GARRETTSVILLE, OHIO.—The Garrettsville Independent Telephone Exchange Company will build a branch exchange at Windham. B. F. Hopkins is manager of the company.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has recently installed 31 private branch exchanges for leading business concerns, and has orders for 14 others.

EATON, OHIO.—The two independent companies in this county which have recently engaged in a territorial war have agreed to submit their difficulties to an arbitration committee.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company has been incorporated with $300,000 by Cleveland, Columbus and local people. A franchise has been asked for.

ARCADIA, OHIO.—The Central Union Telephone Company has secured a franchise in this place. The Findlay Home Telephone Company has secured a franchise to build a line through the town.

MANSFIELD, OHIO.—Mr. E. C. Bickel, who has been acting as manager of the Mansfield Telephone Company, has been appointed manager of the Stark County Telephone Company's new exchange at Canton.

BELMONT, OHIO.—Business men of Colerain are organizing a local telephone company. The exchange will have connection throughout the county over the lines of the Belmont County Telephone Company.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association of Cincinnati will instal in the county court house a branch telephone exchange with twenty-six instruments throughout the building. The rental is $1060 per year.

LONDON, OHIO.—The London Telephone Company of this place and the South Charleston Telephone Company, of South Charleston, have consolidated their interests. The new company will be known as the Madison-Clarke Telephone Company.

WESTON, OHIO.—Prominent farmers of this vicinity have organized the Weston Mutual Telephone Company to build a farmer's system throughout this and neighboring townships. I. B. Ballmer is president and T. W. Smith secretary of the company.

NELSONVILLE, OHIO.—Rev. Father Ross, of Gloucester, priest in charge of the congregation of that town, has purchased the telephone exchange here, and will doff his priestly robes for the less prosaic, but perhaps more profitable, business of running a telephone exchange. He has purchased the majority of stock, and has complete control of the plant.

AKRON, OHIO.—Mr. Fred G. Frese, who has been general manager of the Akron People's Telephone Company since it commenced business, and who has been largely responsible for its remarkable growth, has resigned to devote his entire attention to the interests of the Cleveland Construction Company. Mr. Frese is succeeded by Mr. W. F. Laubach, of Akron.

BELLEVUE, OHIO.—The Huron County Telephone Company now has in operation 600 telephones and 60 miles of toll lines. The company controls exchanges at Chicago Junction, Bellevue, Monroeville, Plymouth and New Washington. It has recently gained control of the Stotts toll line, which embraces 16 miles of toll line and operates from Broughtonville to several small adjoining towns.

MIDDLETOWN, OHIO.—The village council, after carrying to its third and final reading an ordinance granting to the newly organized Citizens' Telephone Company a 25-year franchise, reversed favor and allowed the measure to die. At the same meeting the council granted an extension of 25 years to the franchise of the Miami Telephone Company (Bell) in view of promises made by the company to improve its system and reduce local rates.

OTTAWA, ONT.—The Inverness & Victoria Telephone Company, of Nova Scotia, is about to extend its line from North Sydney to Port Hood, and other points in Cape Breton Island.

OTTAWA, ONT.—Mr. E. F. Clarke, M. P., of Toronto, Ont., has written the City Solicitor of Toronto advising that a suit be entered against the Bell Telephone Company without delay in order to fortify the city against the legislation which the company will again apply for next year. He says that it is absolutely imperative that the public mind be aroused on the telephone question, and that the validity of the claim in the Act of 1892, purporting to place the rates to be charged by the company under Government control, should be determined also.

PITTSBURG, PA.—Twelve years ago an agreement was made between the late C. L. Magee, who was then Fire Commissioner of Pittsburg, and the Central District & Printing Telephone Company that there should be eighteen free telephones placed in the engine houses of this city. The telephone company placed the instruments in the engine houses, but with the understanding that they were never to be replaced by any other free telephones. Owing to the recent negotiations between the city of Pittsburg and the Pittsburg & Allegheny Telephone Company, however, which allow the Pittsburg & Allegheny Company the right of free telephones, the Central District & Printing Company has notified the city officials that the eighteen free telephones that have been in use by the city for so many years will now be removed, and there is every indication that there will be some long drawn out differences between the city and the local Bell Telephone Company.

MILWAUKEE, WIS.—Articles of incorporation have been filed for the Kurtz National Telephone Company. The company will construct and operate telephone lines and manufacture telephones and electrical apparatus. The capital is $25,000. The incorporators are J. W. Murphy, J. M. Clarke and J. P. Schmidt.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—Among the California electric power plants that recently began the use of oil fuel are those of the Salinas City Light & Water Company and the municipality of Alameda. At the latter plant a saving of $13 per night is anticipated.

SAN FRANCISCO, CALIF. The Consumers' Electric Light & Power Company was recently incorporated, with Redding, Calif., as the principal place of business. Directors: J. Fillins, J. P. Eaton, C. Jacobson, J. W. Potts, G. W. Bush, L. Moore and E. S. Watson. Capital stock, $15,000, subscribed, $1,900.

BONNINGTON FALLS, B. C.—The electric plant of the West Kootenay Power & Light Company, at Bonnington Falls, is to be greatly extended, a contract having been let for the machinery necessary to enlarge the plant to 12,000-hp.

AUGUSTA, GA.—A $250,000 electric light plant is announced for this city. The plant will be erected on the first level of the Augusta canal

UNION, N. C.—It is stated by a member of the Union Cotton mills that the mill may be run by electricity, if the electric power gives satisfaction.

TRENTON, N. J.—The Suburban Lighting Company, of Jersey City, N. J., has been incorporated. Capital, $100,000. Incorporators: John I. Holly, William F. Williams and Frank B. Randolph.

NEWARK, N. J.—Electric lighting of the city by a plant owned by the city is being considered by the Board of Works. Newark's contract with the United Electric Company will not expire until September, 1903, but one or two of the members of the board of works already are engaged actively in planning for the building of a municipal plant to do the work now being done by the United Electric Company. A new organization, known as the Essex Electric Company, has applied to the board for permission to lay subways and string wires, preparatory to establishing a plant, and it is possible the city will purchase this new company's interests.

HALIFAX, N.S.—At the recent session of the Nova Scotia legislature, the following acts were passed and have become law in this province: An act to enable the town of Lunenburg to borrow money for water, electric light and sewerage purposes; the town of Annapolis Royal, to borrow money for electric light purposes; the town of Parrsboro', to borrow money to extend its electric light plant; also acts to incorporate the Bedford Electric Company, the Nova Scotia Electric Light Company, the Oxford Electric Company, the Mahone Bay Electric Light & Power Company; the Eastern Telephone Company, the Valley Telephone Company, and an act respecting the Chambers Electric Light & Power Company.

LANCASTER, OHIO.—The Electric Light Company of this place contemplates the inauguration of a fan service in this town.

COLUMBUS, OHIO.—The long, drawn-out litigation over the municipal electric light plant is probably ended. Judge Bigger has issued a peremptory writ of mandamus compelling the city to proceed with the erection of the municipal plant.

CLEVELAND, OHIO.—A Cleveland syndicate, headed by A. C. Hay, has secured an option on the gas and electric lighting plants at Elyria and Oberlin, Ohio, and proposes to combine the plants at a point between the two cities and to furnish light to the surrounding farming district.

NORTH AMHERST, OHIO.—J. C. and B. A. Kendeigh have made a proposition to the village council to erect a lighting plant and furnish 35 arc lights at $4,000 per year, extra lights furnished at $35 each. The village has voted favorably on a proposition to float bonds to the amount of $15,000 for the purpose of building a lighting plant.

PETERBORO, ONT.—The Hydraulic Power Company, of Peterboro, is about to build a dam and develop electric power which is to be supplied to the American Cereal Company and other industrial concerns in the vicinity.

OTTAWA, ONT.—Mr. Edgar Tripp, Canadian commercial agent in Trinidad, reports that Mr. Charles H. Cahan, the representative of the Canadian syndicate backed by Sir William Van Horne, has obtained the legislative authority necessary and has completed his arrangements for the purchase of the electric light and tramway companies of Port of Spain. The capital of the new company is stated to be $1,000,000, of which over $200,000 has been subscribed locally.

OTTAWA, ONT.—The stockholders of the Ottawa Electric Company, which suffered so severely by the disastrous fire in April of last year, have displayed the greatest courage in a further purchase of a new issue of stock of the company, to enable it to reconstruct its power houses and plant in a modern fashion. These, when completed in September next, will be unsurpassed on the continent. The new works will cost about $350,000. The company expends in salaries, wages, etc., in the city of Ottawa, over $120,000 annually, and to the civic treasury it contributes $4,000 a year in taxes. Upon completing the improvements, now under construction, the company will have expended $1,500,000 in the development of the electric lighting system in Ottawa. The Ottawa Electric Company has now in operation over 100,000 lamps of 16-cp each, a number which is more than double that of any other city of equal population on the North American continent and greater per capita, than that of any other city in the world to-day.

MONTREAL, QUE.—The Royal Electric Company's contract for lighting the streets of Montreal expires in December, 1903, and tenders are now being called for on a new contract. Specifications are now out, and tenders are to be in by June 15 next. The new steam plant which the Lachine Rapids Hydraulic Company will erect in connection with the city lighting contract will be of about 2500-hp.

RICHMOND, VA.—The Atlantic Light & Water Company has been chartered to establish sewerage, electric and gas light and water plants at Virginia Beach, Va. Thos. R. Heller is president. The minimum capital is $25,000.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The leading street car lines of Mobile have been purchased by Atlanta parties who, it is said, will thus control the principal lines of this city, Dr. A. W. Calhoun, Judge Henry B. Tompkins and others having closed a deal to the above effect.

SYDNEY, C. B.—An electric street railway will shortly be built here. At a meeting of the Cape Breton Electric Company sufficient capital was subscribed to ensure the building of the road within a year.

MARION, ILL.—The Coal City Electric Railway Company, of Marion, has been incorporated; capital, $100,000. Incorporators: P. M. Johnston, Frank P. Read and C. M. Atterbury.

GALESBURG, ILL.—The People's Traction Company, of Galesburg, has been incorporated; capital stock, $10,000. Incorporators: Frank W. Latimer, Lake W. Sanborn and Eugene B. Hardy.

INDIANAPOLIS, IND.—It is proposed to prohibit by ordinance the use of arc head lights on interurban cars in this city.

MUNCIE, IND.—The final transfer of the right-of-way for the trolley line running from this city north of Ft. Wayne took place at a meeting held here on May 17. F. G. Brownell, owner of the right of way, formally transferred to Messrs. Hexter, Scheuer & Lewenthal, Cleveland capitalists, and others, the road that he has been at work upon for years. A stock company with $1,500,000 is being formed. Three-quarters of a million dollars will be in the name of two Cleveland capitalists. Work of construction will begin soon.

HEMPSTEAD, L. I.—The Mineola, Hempstead & Freeport Traction Company has obtained a franchise to build a trolley road through the village to connect with the proposed line to Queens.

CONWAY, MASS.—The Conway electric street railway company voted to increase the capital stock $15,000.

BOSTON, MASS.—A syndicate has been formed among Boston capitalists to build an electric railway in Washington, between Seattle and Tacoma, a distance of thirty-three miles, the contract for which calls for all the details of construction of a first class steam railway. Lee, Higginson & Company, Kidder, Peabody & Company and Stone & Webster are members of the syndicate.

WESTMINSTER, MD.—Mr. Charles E. Fink, of Westminster, Md., and two others have been granted a franchise for the use of the streets of Littlestown, Pa., for an electric railway for 40 years. The property is to be exempt from taxation for 10 years.

ST. JOSEPH, MO.—A mortgage for $1,500,000 has been filed Tuesday by the Kansas City & St. Joseph Electric Railroad Company to cover bonds of that sum issued by the company which is building the electric line between St. Joseph and Kansas City.

TRENTON, N. J.—The Harvey Lake Miniature Electrical Railway & Light Company, Riverside, N. J., has been incorporated; capital, $100,000. Incorporators: Edward Schwabenaldn, Paul Morris and James Orr.

ALBANY, N. Y.—The Warren County Railway has received the approval of the State Board of Railroad Commissioners for an increase of its capital stock from $200,000 to $500,000 and for the issuance of a first mortgage for $600,000. The new capital will be put into new construction. The Warren County Railway is the line running from Glens Falls to Caldwell and Warrensburgh.

BUCYRUS, OHIO.—The Buckeye Traction Company proposes to build a line from Bucyrus to Norwalk.

DAYTON, OHIO.—The Dayton & Western Traction Company is securing right of way for an extension to Richmond, Ind.

MEDINA, OHIO.—The Medina County Commissioners have granted a 25 year franchise to the Northern Ohio Traction Company for its proposed line from Barberton to Wadsworth.

GALION, OHIO.—The Ohio Central Traction Company has decided to build a local line on several streets of this place, in connection with its line to be built from Crestline to Galion.

JEFFERSON, OHIO.—The Jefferson County Commissioners have granted a franchise to the Pennsylvania & Ohio Railway Company for an extension of its line from Conneaut to the State line.

NEW PHILADELPHIA, OHIO.—The Commissioners of Tuscarawas County have granted a franchise to the Canton-Akron Railway Company to extend its line to Canal Dover and New Philadelphia.

TIFFIN, OHIO.—Stockholders of the Tiffin & Southwestern Railway Company have organized, electing H. P. Price president. The capital stock of the company will be increased from $50,000 to $2,000,000.

CLEVELAND, OHIO.—The Columbus, Delaware & Marion Railway Company has been financed by the Western Reserve Trust Company of this city. Jay E. Latimer, of Cleveland, is in charge of the construction work.

CLEVELAND, OHIO.—The permanent organization of the Canton, Massillon & Akron Railway Company has been effected and the capital stock has been increased from $1,000 to $1,000,000. E. W. Moore has been elected president and C. F. Moore secretary.

DAYTON, OHIO.—The syndicate headed by A. E. Appleyard, of Boston, and H. A. Fisher, of this city, has purchased the Dayton, Lebanon & Cincinnati, a steam road running from this city to Lebanon. The new acquisition will be changed to electric power at once.

PORT CLINTON, OHIO.—The latest company to promote a line through Ottawa County is the Toledo & Port Clinton Interurban Railway, which proposes to build a line following the Lake Shore from Toledo to Port Clinton. G. W. Acker, C. Dedean, L. Galshall and W. B. Geroe are the promoters.

TOLEDO, OHIO.—The stockholders of the Toledo & Bryan Air Line Railway Company have elected officers as follows: Milton Taylor, president; J. C. Bonner, first vice-president; R. G. Kerlin, second vice-president; F. V. H. Collins, secretary; John Q. Adams, treasurer; William C. Brewer, general manager.

CLEVELAND, OHIO.—The G. C. Kuhlman Company, which has succeeded to the business of C. G. Kuhlman has elected officers as follows: Fayette Brown, president; T. P. Howell, vice-president; C. A. Ricks, secretary and treasurer, and G. C. Kuhlman, general manager. The company has decided on a building site at Collinwood. Work on a large plant will start at once.

CLEVELAND, OHIO.—The Everett-Moore syndicate, the Pomeroy Brothers, M. J. Mandelbaum & Co., and other prominent local capitalists have quietly succeeded in securing control of the Miami & Erie Canal & Transportation Company, which was recently financed by W. H. Lamprecht for $2,000,000. The franchise which was secured by T. M. Fordyce provides for the electric propulsion of canalboats, but there is nothing in the agreement to prevent the operation of cars on the tracks.

WEST SUPERIOR, WIS.—The West Superior Street Car Company is making active preparations for great improvements in its system. The extent of the work will require several hundred thousand dollars expenditure.

THE AUTOMOBILE.

THE OBSERVATION AUTOMOBILE COMPANY, of Washington, has been incorporated at Wilmington, Del., with a capital of $100,000.

MEMBERS OF CABINET IN AUTOMOBILE RIDE.—The California Automobile Club recently took the members of the cabinet on a tour of the principal points of interest in San Francisco.

AUTOMOBILE CLUB RUNS.—The board of governors of the Automobile Club of America has passed the following resolution: "That all future club runs shall be paced by a pacemaker, to be selected by the Runs and Tours Committee; that the pacemaker shall set a pace which shall not exceed the speed allowed by law; that should any pacemaker or his automobile become disabled he shall appoint the driver of a following automobile as pacemaker, and he in turn if his automobile becomes disabled shall appoint the driver of a following automobile as pacemaker, and so on. Any pacemaker appointed by the pacemaker selected by the Runs and Tours Committee, or by his successor, shall have the same authority as the pacemaker appointed by the committee; that the pacemaker shall be distinguished by means of a red band worn on his left arm; that should any member of the club pass the pacemaker he shall be suspended, and on a second offence he shall be expelled from the club.

LEGAL.

TELEPHONE RATES IN WASHINGTON.—The Court of Appeals of the District of Columbia has affirmed the constitutionality of the Act of Congress of 1898, reducing by about 40 per cent. telephone rates in the city of Washington, thus reversing the judgment of Justice Barnard of the Supreme Court of the District of Columbia. The telephone company refused to reduce its charges to the rates fixed by the act, alleging it unconstitutional for the reason that it interfered with chartered rights and the service could not be performed at the prices fixed. Justice Barnard held the act unconstitutional and the case was carried to the Court of Appeals, which has reversed that judgment and directed the granting of the injunctions. An appeal will probably be taken to the Supreme Court of the United States.

PERSONAL.

MR. C. L. ROSSITER, formerly president of the Brooklyn trolley system, has become president of a new $500,000 trust company in Brooklyn.

MR. C. DOMAR KOUBITZKI, representing the *Electricien* of Paris, is now in this country, and has been visiting the Pan-American Exhibition at Buffalo.

MR. ALFRED HARMSWORTH, of the London *Daily Mail*, has given $50,000 to the Royal Hospital for an electrical plant, enabling the electric light to be used as a cure for lupus.

MR. A. L. DICKINSON, M. A. Cam., chartered accountant and fellow of the Institute of Actuaries, has joined the firm of Price, Waterhouse & Co. and Jones, Cæsar & Co., accountants, of New York and Chicago.

POPE—RUSSELL.—The marriage is announced of Mr. F. J. Pope, son of the late Franklin L. Pope, to Miss Mary E. Russell, daughter of Mr. and Mrs. P. A. Russell, at the Great Barrington, Mass., Congregational Church, on June 12.

MR. JOHN CROSBY NEELY, of the Kellogg Switchboard & Supply Company, of Chicago, was a visitor at our New York office this week. He has been visiting some of the numerous Kellogg independent telephone exchanges.

MR. GEORGE GRAY WARD, of the Commercial Cable, and Mr. C. A. Schieren are among those who have been invited to represent the New York Chamber of Commerce at the dinner of the London Chamber of Commerce on June 5.

MR. C. T. YERKES.—It is said that Mr. Charles T. Yerkes has disposed of all his street and elevated railroad interests in Chicago, getting $8,000,000 cash for the securities. It is said the purchasing syndicate paid $125 a share for Union Loop.

MR. GASTON SENCIER is publishing in France a book on Electric Automobiles, with the assistance of Mr. A. Delasalle and a preface by the pioneer, Charles Jeantand. This ought to make a very interesting volume. It is issued by the Dunod firm.

MR. JAMES W. DUNBAR, superintendent of the New Albany, Ind., Electric Light Company, was re-elected secretary and treasurer of the Western Gas & Light Association, which held an annual session in Louisville recently. Mr. Dunbar has held the office since 1893.

MR. WILLIAM S. TURNER, who is well known in connection with electrical engineering in this country, is sailing for Auckland, New Zealand, to represent J. G. White & Company, Limited. For that firm he is to construct an extensive street railway system in Auckland.

Mr. A. S. CLIFT, of the engineering staff of the Crocker-Wheeler Company, sailed for Europe on Saturday last by Cunarder for a vacation trip.

MR. S. G. DE COURSEY will, it is said, be president of the company consolidating the American Railways Company and Electric Company of America.

MR. T. A. EDISON and other residents of Orange, N. J., have been greatly annoyed by threats of kidnapping their children. The neighborhood is alert with watchers, however, and the villain who tries the Edison house itself will find it one of the warmest places that ever struck him.

MR. W. F. WARNER, the inventor and patentee of the Warner pole changer for ringing telephones, has perfected an electrical piano playing attachment. He has organized a company for its manufacture, which will commence operations about July 1. The factory will be located in Muncie, Ind.

MR. C. T. MALCOLMSON on his return from work as electrical engineer for the U. S. Commission at the Paris Exposition, has become chief engineer for the South Carolina Interstate and West Indian Exposition Company at Charleston, and is now hard at work there laying out plans, etc.

MR. MALCOLM W. FORD, secretary of the Automobile Club of America, has joined the editorial staff of the *Automobile Magazine*. As a trained journalist of great ability, and one of the foremost athletes in this country, Mr. Ford is a welcome and useful addition to any editorial staff.

DR. FLEISCHMANN, one of the chief engineers of the Union Elektricitaets Gesellschaft, of Berlin, is now visiting this country on a trip of study and inspection, including a stay at Schenectady. The Doctor is familiar with American work, having spent some two years here at an earlier period.

MR. A. G. WANIER, secretary and treasurer of the Barschall Impregnating Company, has been laid up for the past week or two with a severely sprained and broken ankle—Pott's fracture and it is to be feared that some little time must elapse before he can again circulate freely among his many friends.

MR. CHARLES J. SEIBERT has resigned his position as contracting engineer for the Reno Inclined Elevator Company and sailed for Brazil to become engineer of the Empreza Ventiladores Electricos, a concern operating in Barra do Rio Negro. Mr. Seibert has many old friends in the Sprague and C & C companies who will wish him success in the great South American Republic.

MR. EVELYN E. PORTER, M. I. E. E., of the electrical firm of E. E. Porter & Company, Shanghai, China, passed through New York this week en route for England. He describes Chinese conditions as naturally depressed after the recent troubles, but hopes that China will be opened up now. If not mended, she must be ended, and either way there lies hope of improvement.

MR. F. E. DRAKE, the active and efficient Director of Electricity and Machinery for the United States at the Paris Exposition, has now become associated with the management of the Union Elektricitaets Gesellschaft of Germany, which may be spoken of as the German end of the General Electric Company, and is a very large and important manufacturing concern, one of the most progressive in Europe.

MR. E. H. COX, who for some years past has been with the De la Vergne Refrigerating Company and made a great success of their Hornsby-Ackroyd oil engine in this country, has now joined the forces of the Electric Vehicle Company, and will have charge of an important part of their gasoline automobile sales. He is well known among electrical men, and is expected by them to repeat earlier successes in his new field.

MISS ISABEL FARADAY, a kinswoman of the immortal Michael Faraday, has made over to the Browning Settlement a ten-roomed house in East Dulwich, to be known as the Michael Faraday Home, and to be used as a rest resort for the poor of that parish, in which the great physicist was born. Funds are needed for fitting, say $750 and $500 per year for maintenance. Subscriptions can be sent to the Warden, Robert Browning Settlement, Walworth, London, S. E.

MR. C. M. JARVIS, vice-president in charge of the operating department of the American Bridge Company, will withdraw from the United States Steel Corporation rather than go to Pittsburg. He prefers his New England home and environment at Berlin, Conn., where he scored his great success in steel construction, and he wants a rest. In an interview in the Berlin *News* he expresses his conviction that the fine plant he built up at East Berlin will long continue in operation.

CAPTAIN G. O. SQUIER writes to a friend from the U. S. cableship Burnside, in the Sulu Archipelago that they have laid practically all the cable they had on board, and that it is working very successfully. The last link connected up our "feudatory," the Sultan of Jolo. Time is furnished now from the observatory at Manila to all important points throughout the islands as far south as Jolo, and a press bulletin goes free daily to every garrison. The resultant unification is rapid and significant.

JOHNSON-STOCKLY.—Mr. Owen McMahon Johnson, of New York City, and Miss Mary Galt Stockly, were married in the Presbyterian Church at Lakewood, N. J., on May 23. The bride is the daughter of Mr. and Mrs. George W. Stockly, while the bridegroom, who is the author of "The Arrows of the Almighty," is a son of Robert Underwood Johnson, of the *Century Magazine*. The marriage ceremony was conducted by the Rev. C. H. McClellan, assisted by the Rev. C. P. Butler. Afterward a wedding breakfast was served at the Stockly residence. Mr. and Mrs. Johnson expect to sail for Europe in July. They will make their home for the next two years in Paris.

MESSRS. EDWARD BERGTHEIL and A. WILSON YOUNG, of London, England, were visitors at the National Electric Light Convention. These gentlemen are members of the firm of Bergtheil & Young, who represent the Bullock Electrical Manufacturing Company, H. W. Johns Manufacturing Company and several other manufacturers, in England. They have recently opened a new establishment in Manchester, where they intend to carry a full line of street railway and electric lighting supplies. They have done quite an extensive business in Europe with the Bullock teaser equipment, having put it in practically every important English newspaper plant. Messrs. Bergtheil & Young have been spending six weeks in America and return on the Lucania June 1.

MR. H. DE STEESE, for many years prominently connected with the electrical supply trade, has taken a position with the Morris Electric Company, of New York. Mr. De Steese will travel for it most of the time, the growing business of the firm necessitating keeping a man on the road permanently. For a year or more Mr. De Steese has been connected with a London firm, where he went after four years' employment in the Western Electric Company. His many friends in this country will be glad to learn that Mr. De Steese has decided to return to his former work, and the Morris Electric Company is to be congratulated on having secured the services of so able a man to promote its interests.

MR. T. H. MACK.—The New York Telephone Company loses a very valuable official in Mr. Thomas H. Mack, who has resigned his position as contract agent to avoid a complete breakdown in his health. He has been adding subscribers lately to the company's system at the rate of over 15,000 a year. Mr. Mack, who was formerly in the banking business in Boston, has been in New York for eight years and has made an excellent record for himself, as during that period the number of telephone subscribers in the city has been increased from 10,000 to over 60,000. At the time that Mr. Mack began this work the management of most telephone companies rather neglected any efforts to make friends of their customers, or to attract new business. In choosing Mr. Mack to carry out a different policy the New York Telephone Company made an excellent selection, as by his tactful methods and extreme courtesy he has made friends for his company in every direction. It may be hoped that he will not be lost to the telephone field.

PROFESSOR R. B. OWENS, of the electrical department of McGill University, Montreal, and Mr. J. B. Ingersoll, E. E., chief inspector of rolling stock for the Montreal electric street railway, have just completed some interesting experiments with a new roller bearing, the Wright roller bearing journal, designed for all kinds of vehicles, from railway coaches to vehicles for ordinary street traffic. Two street cars on a certain route in the city of Montreal were used, and the object was to show how much electric power could be saved by the new device when contrasted with the journals at present in use in the street railway cars. These cars are at present equipped with the standard journal bearing, and the journey of 10 6-10 miles, covered with a large number of street corner stops, consumed 15,00[illegible]-kw, or 20.37 hp, while the Wright roller bearing journal consumed 10,120-kw, or 13.43 hp The two cars were alike and were loaded to represent forty-two passengers. The testing instruments used were Thomson-Houston recording wattmeters.

EDUCATIONAL.

UNIVERSITY OF TENNESSEE.—The annual scientific number of the *University of Tennessee Record* is just out. The leading article is entitled, "Technical Education in the South," and was written by A. C. Lanier, of the class of 1900. Other articles are: "The Electrical Current in Chemical Analysis," by E. F. Kern, of the class of '07, "Polar Planimeter," by Prof. W. W. Carson; "Welding of Copper," by Prof. J. R. McColl, "Tests on a Thirty-Kilowatt Dynamo," by Prof. C. A. Perkins

Trade Notes.

THE AMERICAN BRIDGE COMPANY will furnish the steel work for the Rogers Hotel to be erected at the corner of Seventh Avenue and Fifty-fifth Street, New York City.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, has just published a book cataloging in a most complete manner its new hotel, telephone, intercommunicating telephone and annunciator systems.

THE BAYLIS COMPANY has removed its office and factory from 99 Cedar Street to 140 Washington Street, New York In its new quarters the company has largely increased manufacturing facilities.

THE WILLIAMS ELECTRIC COMPANY, of Cleveland, Ohio, report largely increased sales for their new high power, long-distance bridging telephones. They also report an increase in export sales.

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., has just published a booklet entitled "Peru Mains and Branches," and "Reasons for Their Existence." This booklet is something new and novel. It is sent free.

THE HANDLAN-BUCK MANUFACTURING COMPANY has acquired all the assets of the M. M. Buck Manufacturing Company, of St. Louis, and will hereafter conduct the business in railway supplies formerly carried on by the old concern.

BANKRUPTED BY SICKNESS.—The Southern Electric Company, of Charlotte, N. C., has gone into voluntary bankruptcy. The long-continued illness of the president, J. J. Gormley, is the reason assigned for the failure.

JANDUS ENCLOSED ARC LAMPS.—The Jandus Electric Company, Cleveland, Ohio, has just issued a neat little pamphlet describing the Jandus enclosed arc lamp, and pointing out its advantages. The mechanism and the various styles of the lamp are illustrated.

NEW WORKS OPENED.—The Sawyer-Man Electric Company announces the opening of its new works in New York City at 510 to 530 West Twenty-third Street, where in future the greater part of its product will be manufactured. The principal office of the company will be at the works after June 1.

THE LANE & BODLEY COMPANY, of Cincinnati, have addressed a letter to engine exhibitors at the Pan-American asking them to co-operate in a movement for improving the physical conditions of the installation of steam engines in the "pit" of Machinery Hall. A change for the better is very much to be desired.

THE MONARCH ELECTRIC AND WIRE COMPANY, of 125-127 South Clinton Street, Chicago, is the concern formerly known as Samuel Mankowitz, manufacturers of the Monarch Brand of weatherproof wire, and dealers in electrical supplies and material. They are active and progressive and propose pushing the brand vigorously.

THE CENTRAL ELECTRICAL COMPANY, of Chicago, has issued a new price list and discount sheet, dated May 1, applying to its general catalogue.

These have been distributed to all its customers who are in possession of a general catalogue, and any who did not receive a copy should let the Central know in order that it may be traced.

UNITED STATES CARBON COMPANY, Cleveland, Ohio, of which Mr. N. D. Sayle is receiver, reports activity in business as usual. A number of prominent parties are taking a hand in its reorganization, as the patented processes are valuable, and the products have already won a very high reputation. The president, Mr. Norman McCarty, was in active attendance at the recent N. E. L. A. convention at Niagara Falls.

SELECTIVE SIGNAL TELEPHONES is the subject of the latest publication of the Sterling Electric Company of Lafayette, Indiana. It is an attractive four-leaf booklet describing the styles and uses of its four station non-interfering party line telephones. It reports that it is always behind on orders and is increasing its force as fast as possible.

THE BUCKEYE ELECTRIC COMPANY reports an excellent demand from electric street railways for its Buckeye railway lamp. The filament used is the cellulose type, manufactured from the raw material by the Buckeye Electric Company. Special care is taken in the selection of the railway filament as to wattage, voltage and candle power. The company carries these lamps in stock at its Chicago office, No. 1537 Monadnock Building.

"A STEP FORWARD."—In a neat brochure under the title, "A Step Forward," the Bullock Electric Manufacturing Company, Cincinnati, Ohio, announces the consolidation of its sales department with that of the Wagner Electric Manufacturing Company of St. Louis, Mo., and adds a few brief remarks concerning the two companies. As already announced in these columns, the newly consolidated departments are under the management of Mr. E. H. Abadie.

THE CROUSE HINDS ELECTRIC COMPANY, of Syracuse, N. Y., was recently in receipt of the following from the Pacific Coast Borax Company: The switchboard is now installed, and we consider it a very handsome piece of work. Assuring you that we appreciate the efforts that you and your New York agent have made to fill our requirements in your line, and that whenever we are in the market for goods handled by you, it will afford us pleasure to see you obtain the order, we are, etc."

MESSRS. E. M. VAN DUZEE, JR., & COMPANY, Fifth and Jackson Streets, St. Paul, Minn.—Minneapolis office 830 Guaranty Building—announce that they have recently completed arrangements with the Haines & Noyes Company, manufacturers of guaranteed telephone apparatus to represent it exclusively as its agent for the State of Minnesota. They inform us that they will be in a position to sell to the trade as well as to the consumer, and that the prices will be identical with those of the Haines & Noyes Company.

BORDEN & SELLECK COMPANY, Engineers, of Chicago, Ill., reports active business in its conveying machinery department. Orders are on hand from the C. Reiss Coal Company, Sheboygan, Wis., for conveyors, elevators, screens, car pullers, for equiping a dock recently destroyed by fire; from Breen Bros., Utica, N. Y., for coal conveyors, elevators, etc., for newly equipping their yard; from the Sheboygan Coal Company, Sheboygan, Wis., for coal handling machinery, conveyors, screens, etc., and from the Cook & Brown Lime Company, Oshkosh, Wis., for conveyors and screens.

FEEDER POLE LINE.—George F. Rohn, Milwaukee, Wis., has been awarded the contract for a feeder pole line for the new pumping station of the Wisconsin Central Railway Company's plant at Fond du Lac. The pole line is approximately 4500 feet long and the feeder will be No. 4/0 waterproof wire. The contract also covers extension of the power switch board and equipping the pumping stations with self-starting equipment for direct-connected motor pump equipment. Mr. Rohn has just completed installing a 1000-ft. 1,000,000 c. m. cable feeder for the A. F. Gallun & Sons' electric power plant in Milwaukee.

MULTI-SPEED MOTORS.—The Stow Manufacturing Company, Binghamton, N. Y., has issued a handsome pamphlet descriptive of its slow multi-speed motor. A number of excellent half-tone illustrations show different forms of this motor and also a cross-sectional view, from which the principles of its operations can be observed at a glance. As is well known, the variation in the speed of this motor is obtained by varying the strength of the field, which is done by varying the reluctance of the magnetic circuit. This change of reluctance is effected by changing the position of an adjustable plunger, which forms the core of the field magnet.

THE STURTEVANT COMPANY'S PLANT.—Some idea of the magnitude of the works of the B. F. Sturtevant Company, of Boston, can be gathered from the fact that the engine and electrical departments, covering over an acre of floor space, which were recently damaged by fire, represented only about one-quarter of the total floor area of the plant. It was therefore possible by a process of compression in the blower and heater departments to provide within these walls sufficient space to re-establish the damaged departments. This has now been done, the offices are again occupying their old quarters and work is progressing much as before the fire.

STORAGE BATTERIES IN RAILWAY WORK.—The value of a battery of chloride accumulators as a reserve power in case of emergency was forcibly illustrated on the evening of May 11, at Philadelphia during the severe electrical storm which visited the city at that time. A portion of the generating machinery at the Union Traction Company's Ogontz sub-station was disabled by lightning, and the battery station at Erie and Germantown Avenues carried this section of the load for almost a half hour, while connections with the Beach Street power house were being made. Without the battery this section of the road would have been forced to suspend operation for a considerable time.

FIBRE INSULATION.—The American Hard Fibre Company, of Newark, Del., is manufacturing an insulating material resembling hard or vulcanized fibre somewhat, but made by a different process. This material, called "insulite," is tough, hard, dense and strong and possesses high insulating qualities. It is made in thicknesses of one sixty-fourth of an inch and less. Its freedom from wrinkles and imperfections and its high insulating qualities render it particularly adapted for use in the winding of armatures as well as in lamp sockets and other electrical appliances where a thin reliable insulator is desired. The American Company manufactures, in addition, both hard and flexible fibre for electrical purposes.

ERICSSON TELEPHONE APPARATUS.—The Ericsson Telephone Company, 296 Broadway, New York City, has issued fac similes of a postal card from India inquiring as to its apparatus, bulletins, etc. It is also sending out a handsome quarto card embracing views of its two factories, one in Stockholm, Sweden, and one in St. Petersburg, Russia; the Copenhagen, Denmark, exchange, and the first portion of the switchboard installed at Shanghai, China, particularly interesting because of the Chinese operators shown. The switchboard in use there at the present time is only 600 numbers, but the ultimate capacity is 5000, and other sections are already on the way. Copies of this pretty card can be obtained on request.

THE AMERICAN ELECTRIC FUSE COMPANY, of New York, Chicago, and San Francisco, has removed its factory to Adrian, Mich., where larger and better facilities for turning out work are afforded. The company states that it is now employing over one hundred people, and the demand for its goods has been so unprecedented that it has been for some time considerably behind on its orders. The company has just made new arrangements, which will more than double its former capacity, for supplying porcelain, and has now on hand a large stock of its standard lines. There will, therefore, be no further delay in filling orders. It has recently closed contracts with several of the largest telephone companies of the United States for the furnishing of its standard lines of protectors, connectors, fuses, etc. The company is also doing a very large jobbing trade, as wholesalers, throughout the country. It expects very soon to place on the market an entire new line of illustrations and printed matter. This line, it is said, will be a distinct novelty.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the agency for the Lowatt incandescent lamp. It states that the success of this lamp has been instantaneous. This lamp has a complete metal reflector entirely within the bulb, directly behind a multi-coiled, carbon filament, both in proper relation to each other, and utilizing all the reflecting surfaces in a scientific manner. It is made in three different types, with concave reflector, convex reflector, or side reflector. This lamp is not to be confounded with lamps silvered on the outside of the bulb, the entire centre being entirely without reflecting power. The company states that an 8-cp Lowatt lamp, consuming 32 watts, givs a more effective light and will easily replace a 16 or 25-cp lamp consuming 60 to 90 watts, and in many instances a 32-cp consuming 110 watts. It claims that the Lowatt lamp in the concave type has a measured candle-power at the tip of from four to eight times its rated candle-power. Catalogues, descriptive matter and prices on the lamps will be mailed on application.

RUBEROID shows very conspicuously at the Pan-American Exposition, where it is used on the Government and other public buildings, both as a roofing and a flooring. At Paris the Standard Paint Company's exhibit was a novel one. It consisted of a building constructed entirely of Ruberoid, inside and outside, handsomely decorated. The walls, the ceilings, the roofs and the floors were all covered with Ruberoid. At the Pan-American the company has an equally neat exhibit. At the Omaha Exposition Ruberoid was used to cover the United States Government buildings and most of the other buildings there. It is adaptable to all climates, hot and cold. The barracks sheltering the United States and German troops in China are roofed with Ruberoid, which is also in use in the De Beers mines in South Africa. A large lot went to the Klondike fields in Alaska, a few months ago. Ruberoid is also largely used in Australia, Scandinavia, Russia, Germany, Spain, Austria, Italy, Egypt, West Indies, Philippine and Hawaiian Islands—in fact, in practically all parts of the world.

DE DION BOUTON MOTORETTE COMPANY, Brooklyn, N. Y., reports as follows: "The sale of Motorettes has far exceeded our most sanguine expectations. About one hundred Motorettes have been already delivered, and we are now turning out completed Motorettes at the rate of two a day, while we shall soon be enabled to do even better, owing to a further increase of our facilities, now in contemplation. One agent alone has sold thirty-five Motorettes, twenty of which are delivered to him, and in the hands of his customers. With the exception of the motors, which are imported from France, and the rough Motorette bodies, the entire vehicles are built by our own men in our own works. The business is at present so active that the works are in operation day and night. The plant includes machine shops, blacksmith and forge departments, a carpenter shop, brazing room, nickel-plating department and enameling, painting and unholstered departments, all of which are in full daily operation. Owing to the fact that so many Motorettes are in the hands of satisfied customers, and to our extensive advertising, the business is increasing very rapidly."

A NEW SPECIALTY COMPANY.—The International Specialty Company, of Adrian, Mich., has just begun business with the best facilities for turning out the highest grades for special work in wood and metal, both for electrical and mechanical purposes. The company does not manufacture any standard line of specialties, but is well prepared and equipped to fill any orders for a special kind of work. It believes this idea to be unique in the history of manufacturing. The company now employs over 200 people, who are engaged in the filling of orders for various kinds of special wood and metal work, its business ranges from the manufacture of all kinds of cabinet work, telephone work, tables, and furniture, to the making of all kinds of telephone parts, coils, stampings, formings, plating, screw machine work, etc. It claims to have the largest and best equipment in the United States devoted solely to this kind of business. The company especially solicits business in large quantities. It calls attention to its unequalled ability to turn out small box work. Correspondence may be addressed either to its Chicago sales office at 100c Monadnock Block, of which Mr. G. Hallett Johnson is manager, or to the factory at Adrian, Mich.

CORRESPONDENCE INSTRUCTION.—The idea has been prevalent among the public that the system of education by correspondence was a more or less doubtful expedient, developed on money making rather than educational lines. As a matter of fact, this is far from being true, and more than one college president has come out in the most outspoken manner in praise of education by correspondence. It is stated that not only is correspondence teaching an effective substitute for regular school methods, but that in many cases it is far more efficacious, as a college course always presupposes a considerable amount of training on the part of the student, and the correspondence system is developed with the understanding that the student who takes it up has had no preliminary training, while all unnecessary and theoretical technical matter is eliminated. Technical training is, therefore, brought within the scope of thousands of practical working men who could not hope to derive any benefit from the regular college courses, even if they could afford to attend such. Cornell University is stated to have over 15,000 students enrolled in her correspondence work in agriculture. Chicago University is heartily advocating correspondence methods, and the State University of Wisconsin has nearly 150 instructors devoted to the work of instruction by mail. Besides the older universities which are devoting a portion of their resources to correspondence instruction, a number of schools have, within the last few years, come to the front which are exclusively devoted to correspondence teaching. A conspicuous example is the American School of Correspondence in Boston, which is exclusively an engineering school. This school has already an enrollment greatly in excess of that of any of the residence colleges, although it has been founded within the last decade. Its instruction is intended solely for practical working men, who require a working knowledge of the mechanical sciences, and its success along these lines has been so marked as to place the system of engineering instruction by mail beyond challenge. This method of teaching has not only attained great importance in the educational world, but is undoubtedly destined to have a much greater advance in the future. Certainly no such opportunity has ever before come to the workingman to obtain a practical education along the special lines of his work.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 21, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

674,363. LIGHTING APPARATUS FOR VEHICLES; A. Brady, Galveston, Tex. App. filed July 26, 1900. A belt tension device.

674,398. PUSH BUTTON; S. Bower, Brooklyn, N. Y. App. filed Nov. 26, 1900. The button is loosely connected with the spring contact.

674,401. CAR LIGHTING; R. M. Dixon, East Orange, N. J. App. filed Nov. 20, 1900. The dynamo is driven by compressed air which is stored by means of a pump driven from the axle.

674,402. TELEPHONE SWITCHBOARD; H. A. Douglas, Grand Rapids, Mich. App. filed Nov. 2, 1898. Details.

674,427. APPARATUS FOR COLLECTING ATMOSPHERIC ELECTRICITY; A. Palencsar, Buda-Pesth, Austria-Hungary. App. filed July 10, 1900. An apparatus for collecting atmospheric electricity comprising a collecting body adapted to be kept in motion, heating means for said body, and a rheostatic machine and a converter connected with the said body electrically.

674,458. CLOSED CONDUIT SYSTEM OF ELECTRIC RAILWAYS; F. C. Esmond, Brooklyn, N. Y. App. filed Nov. 21, 1895. The collectors are mounted so that they can be thrown backward or forward mechanically a slight distance to prevent short-circuiting due to bridging the adjacent ends of sectional conductors.

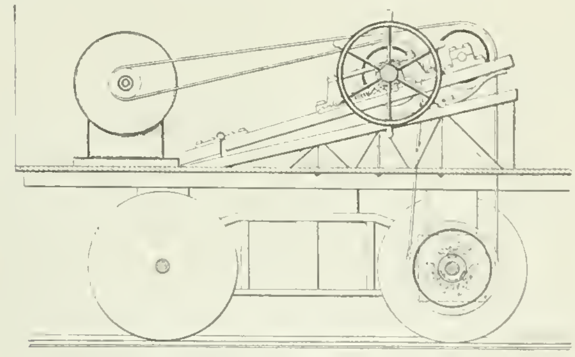
674,467. LINE CONDUCTOR FOR ELECTRIC RAILWAYS; A. Palmros, Fairmont, W. Va. App. filed Jan. 12, 1901. For low trolley wires sections are made removable to allow vehicles to pass on a cross road without interrupting the switches.

674,469. SYSTEM OF TYPEWRITING TELEGRAPHS; F. D. Pearne, Grand Island, Neb. App. filed Dec. 11, 1900. Details of the keyboard and switching mechanism.

674,501. STORAGE BATTERY; W. Gardiner, Chicago, Ill. App. filed Aug. 8, 1900. Details.

674,505. ARMATURE CORE; H. E. Heath, Windsor, Conn. App. filed Oct. 4, 1900. An armature core consisting of a frame, undercut ribs extending along the outer surface of the rim parallel with and adjustable toward and from the axis of the frame, means for adjusting the ribs radially of the frame, and annular sectional laminae fitting the rim of the frame and having mortises receiving the undercut ribs.

674,515. CALLING APPARATUS FOR PARTY TELEPHONE LINES; J. J. O'Connell, Chicago, Ill. App. filed Dec. 26, 1899. A condenser is provided at each subscriber's station in a grounded circuit or branch from the limb of the telephone line over which ringing current is directed, and relay mechanism is included in circuit with said condenser for closing a branch circuit with which the call bell is associated, whereby the call bell may be operated by current in the circuit which is controlled by the switch contacts of the relay, thus securing the protection to the telephone line circuit which is afforded by the condensers at the subscribers' stations, while permitting the bell to be rung as freely as if the condenser were absent.



674,363.—Lighting Apparatus for Vehicles.

674,523. AUTOMATIC SIGNAL FOR ELECTRIC RAILWAYS; C. H. Storm, Waterloo, Iowa. App. filed Aug. 28, 1900. Details.

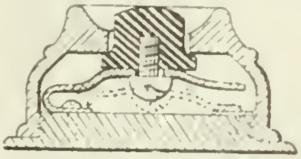
674,540. RELAY; F. D. Pearne, Grand Island, Neb. App. filed Dec. 11, 1900. The armature is held delicately poised above the actuating magnet, so that it will return to its normal position without the use of springs.

674,541. PROTECTOR FOR TELEPHONE OR TELEGRAPH INSTRUMENTS; J. Piel, Schoneberg, Germany. App. filed Nov. 2, 1900. A tell tale device to give notice when a circuit has been interrupted.

674,552. SELF-PLAYING MUSICAL INSTRUMENT; G. H. Davis, New York, N. Y. App. filed Nov. 30, 1897. The key of the piano is moved by causing a shoe to be carried into contact with a rotating drum, by an electro-magnet.

674,560. OUTLET BOX, H. Ill, Newark, N. J. App. filed Feb. 20, 1901. Details of a box in which the openings are closed by covering disks.

674,589. TROLLEY; J. Trickel, Reading, Pa. App. filed Nov. 10, 1900. Details.



674,398.- Push Button.

674,617. TROLLEY WIRE CLIP; J. W. Perry, Philadelphia, Pa. App. filed April 6, 1901. The clip is provided with thickened parts through which solder is poured to engage with the abutting surfaces of the wire and the clip.

674,642. ELECTRIC ARC LAMP; R. E. Ball, New York, N. Y. App. filed April 11, 1900. A prominent feature of this invention is a guide for the carbon rod consisting of a disk mounted to be freely tipped in any direction.

674,656. HANGER FOR TROLLEY WIRES, G. H. Ricke, Cincinnati, Ohio. App. filed Dec. 28, 1900. Details.

674,657. TROLLEY WIRE SUPPORTING AND CONNECTING DEVICE; G. H. Ricke, Cincinnati, Ohio. App. filed March 21, 1901. The wire is held in the loop of a U-shaped clip, the arms of which are prevented from spreading by a ring passing over them.

674,660. ELECTRIC SIGNALING DEVICE; C. F. Wilder, Chicago, Ill. App. filed Nov. 7, 1900. The signal is applied to draw bridges to give notice at a distance of the condition of the bridge.

674,670. WIRE COVERING MACHINE; E. Chamberlin, G. C. Murray, Brooklyn, N. Y. App. filed April 3, 1901. A machine adapted to remove the old covering, then scrape and polish the surface of the wire, and then recover it.

674,691. APPARATUS FOR THE PROTECTION OF CAUSTIC ALKALI AND HALOGEN GAS; C. E. Acker, Niagara Falls, N. Y. App. filed April 24, 1900. (See page 923.)

674,740. TROLLEY; A. Palmros, Columbus, Ohio. App. filed Oct. 6, 1899. A reversible frame each end of which carries an elongated roller for contact with the wire.

674,754. MANUFACTURE OF ELECTRIC GLOW LAMPS; F. Blau, Vienna, Austria. App. filed Jan. 2, 1901. The process of manufacturing self-regenerating incandescent lamps, which consists in permanently placing in the bulbs of said lamps a compound, which will evolve a carbon-containing gas or vapor.

674,770. ELECTRIC LAMP; C. B. Hull, Chicago, Ill. App. filed Jan. 30, 1901. A combined lamp and reflector adapted to be carried in the hand.

674,780. ELECTROLYTIC PROCESS OF PURIFYING CRUDE SPIRITS; J. H. Lavollay and G. E. Bourgoin, Paris, France. App. filed June 8, 1900. (See Current News and Notes.)

674,807. TELEPHONE SYSTEM; E. E. Yaxley, Chicago, Ill. App. filed Dec. 16, 1899. Details of construction whereby compactness of the multiple board is obtained.

674,825. APPARATUS FOR ACCUMULATING AND STORING ENERGY; A. De Castro, New York, N. Y. App. filed April 10, 1900. A fly wheel provided with polarizing coils; a source of electricity for exciting the fly-wheel; means for imparting rotary movement to said wheel; an armature encircling said wheel; and means for opening and closing the armature circuit, whereby the wheel is enabled to run free within the armature and without load during the operation of speeding it to a predetermined velocity, and is therefore caused to co-operate with the armature in the generation of an electric circuit.

674,840. CIRCUIT CONTROLLER; C. Hoffmann, Charlottenburg, Germany. App. filed March 10, 1900. A circuit controller is operated by a bellows in communication with the storage tank.

674,846. ELECTRIC TELEGRAPHY; O. J. Lodge, Liverpool, Eng. App. filed Dec. 20, 1897. (See page 931.)

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THE HALL OF FAME

It cannot be denied that considerable interest attached to the opening of the Hall of Fame at the University of New York last week on Decoration Day. The building is the gift of Miss Gould, and may therefore be fairly said to represent in a measure the profits secured by her father from his connection with telegraphy. It is thus one of the very few public benefactions that can be traced to electricity, and is comparable with the creation of Cornell, although Cornell is infinitely the more useful gift of the two. Yet it is only fit and proper to commend highly the generous impulse to which Miss Gould yielded, and to express pleasure that her broad liberality has found once again so worthy an object. We do not believe that such institutions as Halls of Fame can be set going "ready made," so to speak, but the beautiful building at University Heights will doubtless illustrate slow and healthy growth. It starts well, to say the least. Every name on its tablets is a worthy one, and that, of course, is more than can be said of the "immortals" distinguished in Westminster Abbey or the Pantheon in Paris, in St. Paul's Cathedral or at Versailles. One is glad to hail Morse there, but it grates to see the names of Morse and Whitney listed as those of "scientists," and to find the great name of Henry omitted. But there will be many changes even in the first hundred years. There are only 29 names now on the bronze tablets; and, all in all, they serve to mark this soil of the New World as a fertile breeding ground of great men. Incidentally, it is satisfactory to note the prominence of the American Institute of Electrical Engineers, and of the New York Electrical Society in the proceedings.

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INDEPENDENT TELEPHONY.

The vigorous manner in which the independent telephone movement is being pushed is well indicated by our issue this week. The careful and thorough equipment of independent exchanges with modern, standard apparatus is illustrated by such a plant as that at the Scranton exchange, while the general conditions throughout the country are treated most interestingly in the interview accorded by Judge Thomas to our Cleveland correspondent. The data of progress presented by Judge Thomas will surprise many people, but it cannot be gainsaid or pushed aside. It will be seen that no expectation is entertained in such influential quarters of closer co-operation with the Bell system; in fact, we are promised the continued existence of two actively opposed systems. If this is to be the case, the advance of telephony during the next ten years will be made at a tremendous pace, while so great is the demand to be met, it by no means follows that the service to the public will be done at a loss, as it has been in telegraphy when rates have been cut to secure a business which even serious reductions did little to increase in volume. With telephony it is certainly different, and the lowering of rates has been marked by striking gains in volume. On this point, a well-known European expert, Mr. G. de la Touanne, contributes to our pages this week a valuable analysis of the Bell figures, being the only ones fully available for the United States. It will be interesting to note how these figures and the conclusions now fairly derivable from them are modified by "independent" influences during the next five years.

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THE INDUCTION MOTOR.

Elsewhere we print an article by Mr. Ralph D. Mershon, which forms an interesting and very timely contribution to the literature of the induction motor. It is agreeable to note that while the object of the article is to bring into relief the merits of the induction motor for general power service, and to correct a number of misconceptions concerning it which exist, the writer in his comparisons with the direct-current motor does not manifest the partisan spirit toward the latter which is usually in evidence when the claims for its modern competitor are being set forth. As to the misunderstandings concerning the induction motor—and these are surprisingly numerous—most appear to be due to an entire lack of knowledge of its principles or to a mistaken idea that this piece of apparatus—unlike all other electrical apparatus—admits of little flexibility of design.

One of the fallacies with respect to the induction motor which, happily, is becoming generally recognized as a fallacy, is that it is inefficient in starting torque. In point of fact, the starting torque of this type of motor may be designed for any value within reason, and, as pointed out by Mr. Mershon, it is usually several times the full-load torque. As to disturbing effect in starting up, this is also shown to be largely imaginary. When a sudden demand is made upon any energy supply system, a temporary disturbance is necessarily created corresponding to the extent of the momentary demand; but this fact has not influenced the installation of direct-current motors, and can also be dismissed in relation to the induction motor. Another widespread fallacy is that the power factor of the induction motor is necessarily low, whereas this factor can be controlled by the designer within wide limits. Recent requirements of a power factor of .92 have been met by the manufacturers, and a power factor as high as .96 has been realized. As in the case of any other machine, attaining an ideal piece of apparatus is largely a commercial question; that is to say, if one is willing to pay for refinements he can obtain them, either in the direct-current or in the induction motor—at a price. We commend to the reader Mr. Mershon's discussion of the power factor in its bearing on operation. This side of the subject has been particularly clouded, but, as pointed out by Mr. Mershon, the consumer can dismiss the matter as one in which he has little or no concern, the problem being one for the plant engineer, who can always find the necessary solution.

The power factor bugbear has doubtless led to the advocacy of the synchronous motor for use in cases where otherwise it would not be considered. While this type of motor has its field—and an important one—Mr. Mershon gives very cogent reasons why it is not suitable for general power service. While it is true that the synchronous motor will serve as a regulator on polyphase circuits, to utilize this property requires close attention during operation. Should the field excitation not be kept at exactly the right point, this type of motor will introduce a disturbing influence which can greatly aggravate the evil which it has been installed to overcome, through giving rise to the equivalent of a power factor. In addition, the synchronous motor may possess the equivalent of a power factor in another respect unless its curve of e. m. f. coincides exactly with that of the supply circuit; for should this not be the case, there will be an exchange of idle current between the motor and the line. Moreover, should the synchronous motor have an e. m. f. curve corresponding to that of the line at one excitation, this correspondence may not exist at higher or at lower excitations. We have merely touched upon a few points brought out in Mr. Mershon's admirable article, the careful reading of which will abundantly repay those at all interested in the subject.

STANDARDIZING ENGINE TESTS.

At the recent Milwaukee meeting of the American Society of Mechanical Engineers a preliminary report of the committee appointed to codify and standardize the methods of making engine tests was presented, which contains a great deal of interesting material for the guidance of those who measure the performance of steam, gas and oil engines. In reading these directions one is struck by the fact that the determination of the losses and wastes of power in a heat engine, say, of the ordinary multi-cylinder steam engine type, is much more difficult and liable to error than the determination of the losses of power in the dynamo-electric machine, say of the ordinary alternator type. In other words, steam engineers have a much harder task to determine the efficiency of the steam engine than has the electrical engineer to determine the efficiency of a dynamo, assuming corresponding facilities offered for making observations in the two cases.

Although the paper is thoroughly practical, yet we think there is certainly room for improvement in a few matters of terminology. For example, it is stated that the standard efficiency of an engine is recommended to be defined as the number of British thermal units consumed by the engine, either per indicated or per brake horse-power hour. The "thermal efficiency ratio" is then defined as the proportion which the heat equivalent of the power developed bears to the total amount of heat actually consumed. The latter definition is a logical one—except that the word "ratio" is obviously superfluous—and is in conformity with all modern terminology in electrical engineering, since it is a ratio of power output to power input, and is a numerical fraction which increases as the engine improves. But it is both illogical and misleading to designate the heat units consumed per indicated or brake horse-power-hour, as a standard of efficiency. On the contrary, it is a standard of inefficiency; it is a ratio of energy input expressed as heat, to energy output expressed as mechanical activity, and, consequently, it is essentially of the nature of the reciprocal of thermal efficiency.. Consequently, to call an inefficiency a standard of efficiency is not only misleading, but as the engine is improved and becomes more efficient, the thermal units consumed per horse-power hour diminish and the standard of efficiency, as thus expressed numerically, diminishes instead of increasing.

Of course, there can be no dispute as to the facts of the case, or as to the desirability of having a standard of comparison between engines based upon the consumption of heat per ihp-hour. Our criticism is solely directed to the name of this standard, which should not be called an efficiency, or classed as an efficiency, when it is really of the nature of an inefficiency We think that what the report calls the "thermal efficiency ratio" should be altered to "thermal efficiency" simply, and that this "standard efficiency," or "standard efficiency result," of British thermal units per horse-power-hour, should be called a standard heat consumption, or some term independent of the term "efficiency." The British Society avoided in their report of 1898 the errors referred to. A similar anomaly and misuse of terms is met with in the common expression "efficiency of an incandescent lamp," defined as the ratio of the power it consumes to the luminous intensity it produces. This definition, which is illogical, gives rise to the ridiculous result that the greater the numerical efficiency of a lamp, the less efficient the lamp becomes.

The report contains many useful and significant items of practical information. For example, it is stated that if a single indicator be employed for taking diagrams in succession upon the front and rear ends of a steam cylinder by means of a three-way cock, instead of using an indicator at each end of the cylinder, an error may be produced which has been found to range between 3 per cent and 7 per cent. This error is due to the drop of pressure in the short lengths of pipe connecting the indicator cylinder with the two ends of the working cylinder under test, and it is stated ordinarily to have the effect of unduly enlarging the area of the diagram and, therefore, of unduly increasing the indicated power of the engine. Standard test sheet forms are appended for itemizing the various measured quantities.

THE VELOCITY OF VISIBLE LIGHT AND THE VELOCITY OF ELECTRO-MAGNETIC WAVES.

In the report of the International Physical Congress of 1900 in Paris, there appear two papers in immediate succession, the first of which, by M. Cornu, discusses the most reliable measurements of the velocity of light in vacuo, and the second, by M. Abraham, discusses the most reliable measurements of the electromagnetic velocity v, which is the ratio involved between the magnitudes of electrostatic and electromagnetic units. The two quantities are essentially distinct, although, of course, they are fundamentally in close connection. The one deals with the speed at which beams of light, visible to the eye, advance in air, as measured by purely optical apparatus, while the other deals with a physical ratio quantity deducible from accurate measurements of the same physical quantity, such as the capacity of a condenser, in both electrostatic and electromagnetic measure. It was Clerk Maxwell who first recognized that the latter ratio meant a velocity, and that this velocity was nothing else than a light-velocity. At first the interest was solely confined to proving experimentally that the ratio v was within observational limits of error, the same as the velocity of light. Later, however, a new interest has arisen in seeing how closely both v and the light-velocity in free space approach to the round number of 300,000 kilometers per second.

Two methods of measuring the light speed in air are well known, one being that of the displacement of an image produced by a rapidly revolving mirror, and the other that of interception of a far journeying beam of reflected light, by the teeth of a revolving toothed wheel. The former Michelson found to give a light speed, in vacuo, of a little less than three 10-meters, or 299,860 kilometers per second, while the latter gave a speed a little more than three 10-meters, or 300,400 kilometers per second. Although the probable error of observation assigned to the latter is 10 times larger than that of the former, yet M. Cornu, after an elaborate discussion of the causes and liabilities to error in the two cases, takes the simple mean as the most probable result, namely, 300,130 kilometers per second as the velocity of light in vacuo, with a probable error of 270, or less than one-tenth of one per cent.

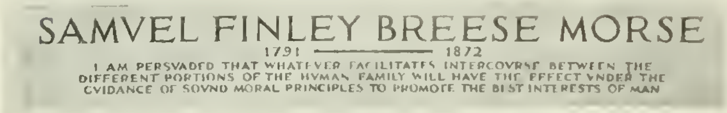
Turning now to the electromagnetic measurements of v, about 25 different sets of results are considered, as obtained by different observers, and the most promising of these are selected, leading to a mean result, which, corrected for the presence of the air, as the medium in which the measurements were made, and reduced to vacuum or free space, gives a speed ratio v of 300,100 kilometers per second. This result, therefore, agrees with the mean reduced speed of visible light, according to Cornu, within 30 kilometers per second, or considerably less than the probable error of either set of determinations. In view of the magnitude of this probable error, it is still too early to decide whether the light speed and v-speed are greater or less than three 10-meters per second. Expressing the same idea in different language, it is not yet certain whether the electrostatic unit of e. m. f. is less or more than 300 volts, or whether the electrostatic unit of resistance is less or more than 900,000 megohms, but the real values cannot be far from these, either one way or the other.

A paper by M. Blondot in the same volume, discusses and compares the results obtained upon the speed of propagation of electromagnetic waves running along wires. These measurements are intermediate in character between the purely optical measurements of visible light waves, and the purely electrical measurements of the v-speed ratio. They involve high-tension currents of brief duration along metallic wires with spark gaps set at definite points thereon, and observations either of nodal distances, or of the time elapsing between sparks at successive gaps, with the aid of a rapidly revolving mirror. The mean of five sets of measurements by different observers is 2,992,000 kilometers per second, as the speed of the waves referred to vacuo, or corrected for the retardation of air, i. e., a little less than three 10-meters per second.

Several remarkable conclusions are deducible from these interesting papers. In the first place, it would seem that whatever refinements and corrections future determinations may effect in the results, it is safe to say that the speed of light is, for all practical purposes three 10-meters per second. In other words, we may consider that the international kilometer may be regarded either as very nearly the ten-thousandth part of the quadrant of the earth measured along the Paris meridian or as very nearly the 1-300,000 part of the distance through which light runs in free space in a mean solar second of time, which means that by a curious coincidence light has a speed of very nearly 30 earth quadrants, or 7½ earth circumferences per second. Secondly, that the speed of transmission of electromagnetic waves in free space must be the same, within a very minute amount, for waves having a length of many kilometers on the one hand, or of a fraction of a micron on the other. In other words, the speed must be independent of the frequency, or wave length, within at all events extremely small limits. Thirdly, that the speed of transmission of electromagnetic waves in free space must be the same within a very minute amount for waves of large amplitude and waves of small amplitude. In other words, the speed of transmission appears to be unaffected either by the amplitude or by the energy of the electromagnetic waves. Fourthly, the mechanism by which electric currents flow along wires is a purely optical one, consisting in the traveling of electric waves along the surface of the wire, the wave front having the form of a sheet to which the wire is very nearly perpendicular. In other words, and conversely, the optical transmission of beams of light through space is a purely electromagnetic process of electric wave-transmission, in the absence of electric guiding conductors, as was first announced by Maxwell. Fifthly, the speed of transmission of electric disturbances over wires is nothing less than the speed of light through the dielectric medium surrounding and enveloping those wires, and is always something less than three 10-meters per second, which would be the speed of transmission in free space. The speed of transmission of signals or impulses over wires in the telegraphic sense is, however, much less than the light-speed, by reason of the absorption or reflection of the impulses and of their energy in the dielectric due to electrostatic and electromagentic inertia. Sixthly, electric currents are electric wave-trains having their seat in the medium surrounding the conductor, which is a mere guide-hole in the dielectric over which they run, and the only place where no electric current, in this sense, really exists. The energy of the advancing waves is slowly expended in the conductor, owing to its imperfect conducting power, whereby after a given wave has traveled around an electric circuit a certain number of times, it disappears, having become completely absorbed, and dissipated as heat. Seventhly, that Ohm's law is a remarkable summation law, dealing with and embracing the total quantity of waves that emerge from the source and remain in existence at any one instant of time over the conductor, after attaining the steady state, and in all stages of strength between initial full power and final disappearance by exhaustion.

Opening of the Hall of Fame.

As a great many of our readers are probably aware, New York University, at University Heights, has had added to it, largely through the generosity of Miss Helen Gould, a Hall of Fame. This structure is a splendid colonnade 500 ft. in length and surrounding circularly the beautiful library building of the University. The Hall of Fame is intended to contain memorial tablets and busts of great Americans, and the selections are made by vote, the electors being themselves a chosen few, leaders in every department of intellectual activity. The cost of the Hall of Fame is said to be about $100,000. Each of the tablets within it is about 10 ft. long and 1 ft. high, of bronze. The name is carved in large letters, and under each name are a few words of tribute. At the present time the electors have chosen 29 names, and there are, therefore, 29 tablets, which were unveiled on Decoration Day, May 30. Chancellor MacCracken states that the electors will continue to serve, and that according to the terms of the gift, 150 names are to be honored by tablets by the year 2000. The names are divided into seven groups, one of which is called that of scientists, and in this are included the names of Fulton, Morse and Whitney. At the ceremonies on Thursday last the Morse tablet was unveiled by Mr. Gano S. Dunn, assisted by Mr. Francis W. Jones, to represent the American Institute of Electrical Engineers, on the nomination of the president of the Institute. The New York Electrical Society was represented by President T. C. Martin and Secretary G. H. Guy, and it is an interesting coincidence that Mr. Jones was the first president of the Electrical Society and Mr. Dunn the president in 1899-1900, so that the society was remarkably well in evidence on this interesting occasion.



SAMVEL FINLEY BREESE MORSE
1791 —— 1872
I AM PERSVADED THAT WHATEVER FACILITATES INTERCOVRSE BETWEEN THE DIFFERENT PORTIONS OF THE HVMAN FAMILY WILL HAVE THE EFFECT VNDER THE GVIDANCE OF SOVND MORAL PRINCIPLES TO PROMOTE THE BEST INTERESTS OF MAN

MORSE TABLET.

The inaugural oration was made by Senator Depew, who, in the course of an admirable address, said: "If the Viking could come from his Valhalla, the Areopagite from beneath the temples at Athens, the arbiter elegantiae from the ruins of Rome, the mediaeval knight from his armor, Frederick from Potsdam, or Napoleon from the Invalides, to view these our heroes, they would have only contempt for this development of democracy. The inventor of the application of steam to navigation, of the electric telegraph and of the cotton gin, the artisans who were in their time and to their world the herd or mass born to bear the burdens and work for the luxuries of their masters, are here crowned with the fadeless laurels which encircle the brows of the conquerors and rulers of the world. Eli Whitney transformed half a continent from a wilderness to one of the most productive of territories; Fulton made possible transportation by water and land, which has given to our country its prosperous population and vigorous States, and the leadership in the industrial competition of nations, and Morse added new strength to our Union by discoveries in electrical power, which, from his initiative, have enormously developed the resources of his country, and given opportunity and employment to his countrymen."

He added: "We have now no Tennysons, nor Longfellows, nor Hawthornes, nor Emersons. Perhaps it is because our Michael Angelos are planning tunnels under rivers and through mountains for the connection of vast systems of railways, and our Raphaels are devising some novel method for the utilization of electrical power; our Shakespeares are forming gigantic combinations of corporate bodies, our Tennysons are giving rein to fancy and imagination in wild speculations in stocks, and our Hawthornes and Emersons have abandoned the communings with and revelations of the spirit and soul which lift their readers to a vision of the higher life and the joy of its inspiration, to exploit mines and factories. When this period of evolution is over, and nations and communities have become adjusted to normal conditions, the fever and the passion of the race for quick wealth and enormous riches will be over. Then the grove, the academy and the study will again become tenanted with philosophers, poets, historians and interpreters of God in man. Unless this shall happen, then let the luxuries and opportunities, evanescent earthly pleasures, and the disappearance after death which come from leadership in business be the rewards of the successful; but reserve the Temple of Fame for those only whose deeds and thoughts are the inheritance, education, inspiration and aspiration of endless generations."

A great many electrical people were among the invited guests on this interesting occasion, and it is interesting to note that a prominent place was given to Mr. E. L. Morse, of Washington, D. C., son of Professor Morse.

The Independent Telephone Convention.

The Independent Telephone Association of the United States of America will hold its fifth annual convention at Buffalo on June 11, 12 and 13, with headquarters at the Hotel Iroquois. The programme is given below:

TUESDAY MORNING.

Reception of delegates, distribution of badges, tickets, etc. at headquarters, Iroquois Hotel.

MORNING SESSION—NOON.

Opening of the convention, in the banquet room of the city Convention Hall, corner Virginia Street and Elmwood Avenue.

Address of welcome, Hon. Conrad Diehl, Mayor of Buffalo; response by James M. Thomas, of Cleveland, president Independent Telephone Association of the United States; annual address by the president of the association, Hon James M Thomas.

AFTERNOON.

Inspection of exhibits made by manufacturers, in connection with headquarters at Iroquois Hotel

WEDNESDAY.

Morning session, 10 a. m., at Convention Hall.

Paper by Hon. S. P. Sheerin, new Long Distance Telephone Company, of Indianapolis. Subject, "Village Exchanges and Farmers' Lines." Discussion by J. B. Ware, of People's Telephone Company, Detroit, Mich., and T. J. Fricker, of Ashtabula Telephone Company, Ashtabula, Ohio. Paper by Chas. E. Wilson, of Keystone Telephone Company, Philadelphia Subject, "Independent Telephone Development East of the Alleghanies." Discussion by C. E. Stinson, Rochester Telephone Company, Rochester, N. Y., and Senator C. W. Kline, of Hazelton, Pa., president Interstate Telephone & Telegraph Company, of Pennsylvania. Paper by L. W. Stanton, Cleveland, Ohio. Subject, "Exchange Service." Discussion by convention-at-large. Reports from various States and other business.

AFTERNOON.

Inspection of exhibits by manufacturers, in connection with headquarters at Iroquois Hotel Pan-American Exhibition and Niagara Falls.

THURSDAY.

Morning session, 10 a. m., at Convention Hall.

Reading of paper by H. D. Critchfield, general counsel, Cuyahoga and United States Telephone companies, Cleveland, Ohio. Subject, "Legislation and Litigation." Discussion by Ed. Kibler, of Newark Telephone Company, Newark, Ohio, and C. S. Bash, Home Telephone Company, Ft. Wayne, Ind. Reading of paper by E. B. Fisher, of Citizens' Telephone Company, Grand Rapids, Mich. Subject, "Bell Methods." Discussion by George W. Beers, of National Telephone & Telegraph Company, Ft. Wayne, Ind., and W. A. Bisbee, of Georgia Telephone & Telegraph Company, Savannah, Ga. Election of officers and unfinished business.

Popular Lectures.

At the annual dinner which was recently given to the lecturers of the New York Board of Education, Dr. Henry Leipziger, the efficient supervisor of the lecture system, stated that the work was now 12 years old. The attendance in the past year was 533,000 in Manhattan and Bronx. During the season from October to May, 1963 lectures were given. Among the lectures on electricity, etc., we may add were W. W. Ker, Max Loewenthal, T. I. Jones, W. J. Clark and S. D. Benoliel. Mr. Ker gave no fewer than 47 excellent lectures, and of these 17 were in one course, the average attendance being nearly 300, showing a sustained interest. We know of no better educational work being done in New York City than that which Dr. Leipziger conducts.

A European Study of American Telephone Statistics.

By G. De La Touanne.

EVERY one knows the care with which, almost since the beginning, the American Bell Telephone Company (now the American Telephone & Telegraph Company), has collected the different data from the telephone systems worked by its licensees; but few realize what profit can be derived from such statistics even under unfavorable circumstances.

The following is a summary of some of said data since Jan. 1, 1884:

Jan., 1st Year.	Total Stations. I.	Mean number of stations. II.	Total of exchange connections per year in the U.S. III.	Miles of Wires, Jan. 1. On poles and Underground Buildings and submarine. IV.	V.	Extra-territorial and toll lines. VI.
1884	123,625	129,236	215,280,000	85,896	......	29,359
1885	134,847	136,298	251,268,000	100,367	1,225	35,631
1886	137,750	142,404	272,479,000	110,375	3,671	41,745
1887	147,068	152,890	312,606,000	121,936	6,295	43,767
1888	158,712	165,083	369,204,000	138,064	8,374	56,179
1889	171,454	178,228	383,822,000	152,897	17,574	73,293
1890	185,003	193,967	400,000,000	165,493	27,720	86,728
1891	202,931	209,474	450,000,000	184,943	55,469	91,230
1892	216,017	224,028	500,000,000	195,093	71,363	115,088
1893	232,140	234,663	600,000,000	210,239	91,552	133,002
1894	237,186	240,309	600,000,000	231,168	122,212	154,106
1895	243,432	262,563	670,000,000	246,533	150,131	180,557
1896	281,695	303,469	757,000,000	273,185	186,543	215,687
1897	325,244	354,737	847,000,000	299,226	237,619	268,866
1898	384,230	424,705	998,000,000	341,091	285,309	324,883
1899	465,180	549,063	1,231,000,000	411,832	360,157	385,911
1900	632,946	716,913	1,825,000,000	524,123	492,654	501,832
1901	800,830	......	....	644,730	709,472	607,599

From the above figures it would be hard to get any conclusions, and curves drawn from them will make the comparisons easier. Those on diagram No. 1 correspond with the figures in the columns similarly numbered in the above table. The general appearance of these curves would make one think that there is some simple law from which the growth of the business in the next one or two years can be rather exactly foreseen. That would be a hasty and incorrect conclusion, for the rate of increase for any of the curves seems to grow from year to year, and it is absurd to suppose that such a law can stand indefinitely. It is evident that at some time the rate of increase must stop growing, become uniform and perhaps decrease; for instance, it is obvious that, above a certain value, the number of subscribers could not increase faster than the population.[1] But as the absolute form of the curve results from the choice of the unit length for each of the co-ordinates, it is safer to examine separately the rate of increase, i. e., such quotients as $\frac{134{,}847-123{,}625}{123{,}625} = 0.09$. For instance, the yearly percentage of increase for the number of stations reads as follows:

1884	9 0	1893	2.1
1885	2.1	1894	2.6
1886	6.7	1895	15.
1887	7.9	1896	15.
1888	8.	1897	18.
1889	7.8	1898	21.
1890	9.6	1899	36.
1891	6 4	1900	26.
1892	7 4		

These figures show that it was necesary to ascertain if the annual rate of increase were responsive to some law, and that, unfortunately, there is no such law. If the data were those of a special exchange, it would be interesting, and it would be profitable, to examine if there is some relation between the variations in the rate of increase and the variations in the system of tariff, but that is not the case, and notwithstanding that uncertainty we are entitled to state:

First.—That, as to the development in the number of subscribers, the tariff system of to-day seems to be a right one, and,

Second, that when there is some real estate to buy, some new building to erect, some cable system to arrange; in other words, some permanent and lasting installation to make, it is better to provide for a coming increase of the business several times larger than ought to be expected as judged from the average increase in recent years. We shall possibly reach a time of telephone expansion, where every one will use telephones to the same extent as steam heaters, electric light and street cars.

Similar warning is given by the figures concerning the increase in mileage of overhead wires.

Mileage of Wires on Poles and on Buildings.

Year	Increase Absolute.	Increase Per Cent.	Year.	Increase Absolute	Increase Per Cent.
1884	14,471	16	1893	14,929	7
1885	10,008	9	1894	15,365	6
1886	11,561	10	1895	26,652	10
1887	16,128	13	1896	26,041	9
1888	14,833	10	1897	41,865	13
1889	12,596	8	1898	70,741	21
1890	19,450	11	1899	112,291	27
1891	10,150	5	1900	120,607	23
1892	21,146	10			

It is very necessary to watch the next possibilities, as it has happened that even telephone experts have been deceived by the sudden growth of the exchanges.

Diagram No. 1 teaches yet another thing, that is the growing importance of underground (and underwater, but that is negligible) wires compared with overhead wires. Amounting to no miles against 85,896 miles of overhead wires on Jan. 1, 1884, the underground wires represented in 1889 0.11 of the total mileage of exchange conductors, 0.34 in 1894, 0.46 in 1899 and 0.52 in 1901. It is proper to take note of the fact, as one might have expected, that the influence of the underground work was limited to the business portion of the very large cities, and partially veiled by the influence of the outside and residence parts of the same cities, as well as by the less important and almost exclusively overhead systems.

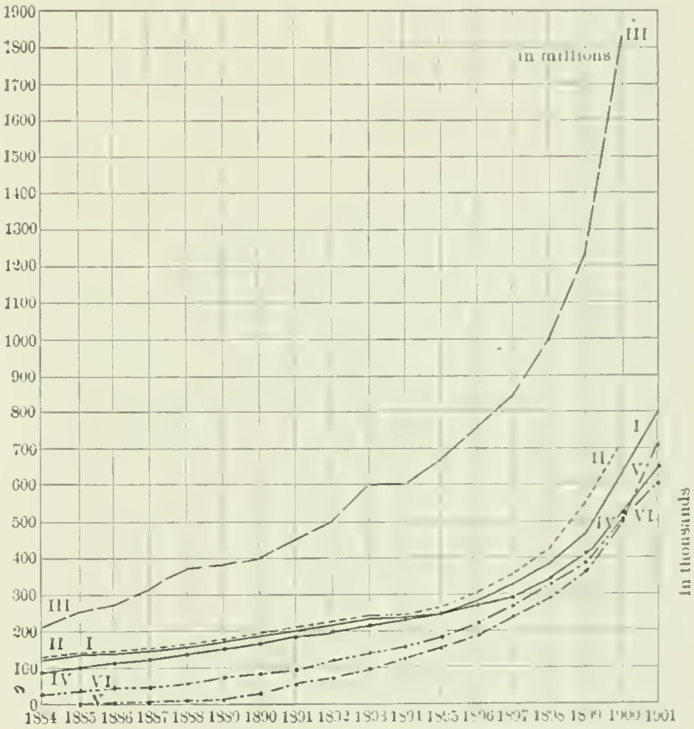


FIG. 1.

I.—Number of stations on January 1st.
II.—Mean number of stations per year.
III.—Total exchange connections per year.
IV.—Miles of wires, January 1st, on poles or buildings.
V.—Miles of wires, January 1st, underground or elsewhere.
VI.—Miles of wires, January 1st, on extraterritorial or toll lines.

Finally, we have plotted on diagram No. 1 the curve of the mean number of stations for every year. The reason for so doing is that in several instances, especially in regard to the tariff question, what matters is not the absolute mileage of wire, the absolute number of exchange connections, etc., but to compare these absolute figures with what may be called the subscriber unit. For instance, one wants to know the number of connections per subscriber. The process by which the result is obtained is generally the following: The number of connections during the whole year is divided by the number of subscribers on Jan. 1 or on Dec. 31 of the said year. Well, this does not seem justified, as the result of the calculation may be perfectly misleading. We ought to divide the number of connections by the arithmetical mean of the number of subscribers during the year; that is to say, the number of subscribers who are supposed to have used the telephone all the year round, would, as a total, have enjoyed the use of their station as many days as did the subscribers who have had a station for 12, 6, 3 months, and so on. In order to fix the idea, let us say that in a certain exchange there have been 20,000 subscribers during 100 days, 25,000 during 140 days and 30,000 during 125 days, then during the year there have been 20,000 × 100 + 25,000 × 140 + 30,000 × 125 = 9,250,000 days of service delivered to the subscribers, or there have been what can be called 9,250,000 subscriber-days, i. e., the equivalent of $\frac{9,250,000}{365} = 25,342$ subscriber-years; and the number of connections correspond to this very number, and not to 20,000 nor to 30,000, which is entirely different. Then, to find the number *n* of connections per subscriber and per year, one must divide the total number *N* of connections by 25,342.

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[1] The highest percentage of increase for the population of the United States has been registered at the 1810 census, where it was 36.38 per cent since 1800; for the 1900 census it was 21 per cent on the figures of 1890.

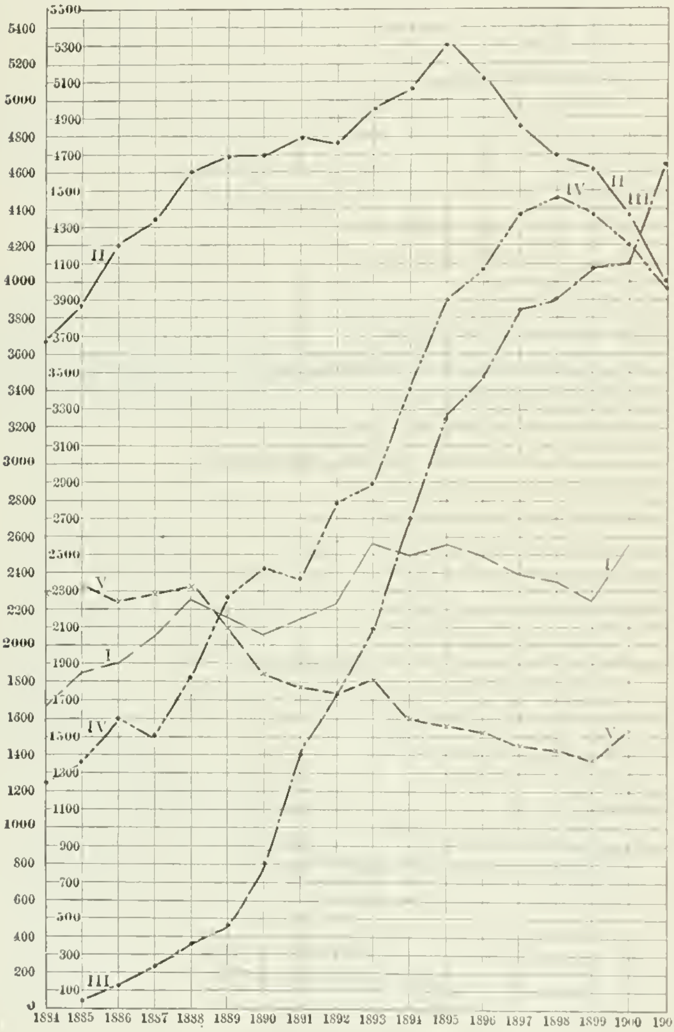

FIG. 2.

I.—Number of exchange connections per subscriber and per year, from the total number of exchange connections and from the mean number of stations per year.

II.—Length in feet of overhead wires per exchange subscriber on January 1st.

III.—Length in feet of underground and submarine wires per exchange subscriber on January 1st.

IV.—Length in feet of wires on extraterritorial and toll lines per exchange subscriber on January 1st.

V.—The number of exchange connections per year and per mile of exchange wires on poles, on buildings, underground and submarine.

The exchange manager alone is able to make such precise calculations, and we can in the present case only get a better approximation than usual by using the arithmetical mean between the numbers of stations at the beginning and at the end of the year. A simple glance at the curves I. and II. shows (and it could be understood *a priori*), that if there is only a slight difference between the two curves when the development is a slow one, the case is not at all alike when the speed of growth is fast.

It is by using these arithmetical means that we have obtained the curve I. in diagram No. 2. For each year the average number of connections per station has been got by the division of the total number of connections during the year by the arithmetical mean of stations for the same year. The curve shows that in spite of the belief so often expressed, the number of connections per subscriber and per year does not increase indefinitely as the number of subscribers increase. In the Bell companies of the United States this average number has reached a maximum (1893, 1894, 1895) of 2500 to 2600, and has decreased up to the last year. That is of practical value in various regards. Among other things it leads to the remark that, when ordering a multiple switchboard, it would be a wrong plan to lessen the number of answering jacks per operator, and therefore becomes obliged in any case to increase the number of the sections and lower the operative power of a given room. On the other hand, one would make a mistake if he should conclude, from the diminution in the number of connections per station and per year, that the subscriber suffers from the system of tariff. Should the drawback exist, the enormous amount of subscription contracts which flow increasingly to the exchanges would be a mere dream and not a thing of daily experience. Thanks to the modern system of rates and to the improved service, residence people and other subordinate consumers come to the telephone who formerly abstained from telephoning and let the great firms, wealthy bankers, etc., use the service every minute of the day. It looks really as if there was in the present system of exchange operation some social improvement for the moderately fortunate class of citizens. That the benefit of such a change in affairs is doubtful for the companies or governments which conduct the telephone business may be understood from the curves II. and III. of diagram No. 2, which evidence the increasing mileage of wires per subscriber. If there is but little change in this mean length of overhead wires (3675 ft. in 1884 against 4002 in 1901), with 5314 as a maximum in 1895, the more costly underground conductors show a regular increase from nothing to 4659 ft. If he has not been in close touch with telephone people and telephone business, one can hardly realize what skillfulness has been displayed by hundreds and hundreds to make a success of the industry brought into existence all over the world by Professor Graham Bell's marvelous discovery.

Now we shall direct our attention to curve IV., from which one could conclude that, after a maximum of 4461 ft. the length of interurban wires per subscriber is decreasing without any chance of reaching the said value in the future. This, we feel, would be an erroneous statement, and is at least a too hasty one. Interurban telephony is very likely only at the beginning, and there is not far off a sudden development similar to the one already initiated in urban telephony. The consequence is that, in order to subserve more and more imperative wants, the companies may presently be induced to multiply the interurban lines and increase their relative length per exchange subscriber.

In the same line of study, and in connection with the diminution of the number of connections per subscriber, accompanied by an increase of the mileage of wire, the curve V. is also well worthy of notice. It demonstrates that, since 1888, the operative power of the mile of subscriber's line has been nearly constantly decreasing.[1] The reason is very probably the same as above, that is, the extension of the telephone service to customers who want fewer connections than those of the early times, and whose stations are located further from the business centers of the cities. That will be perhaps partly compensated in the future by a gradual increase in the use of their station by the subscribers as they will grow more accustomed to the telephone. But we think that the conclusion is a rather unexpected one, which deserves a careful consideration when a system of rates is prepared.

Pres. Loubet Praises Submarine Boats.

In his speech to the committee of the Olympic Games President Loubet made an interesting digression on the subject of submarine boats, of which he spoke enthusiastically. He described his trip in a submarine vessel at the time of the Toulon fêtes, dilating on the apparent ease and security with which she was manœuvred. He declared he was convinced that the submarine boat was one of the greatest inventions of modern times, and would prove a powerful factor in naval warfare of the future.

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[1] Of course, the mileage of wires used for calculating the data of this curve has been, for similar reasons to those given above, the average arithmetical mean between the mileage at the beginning and the mileage at the end of each considered year.

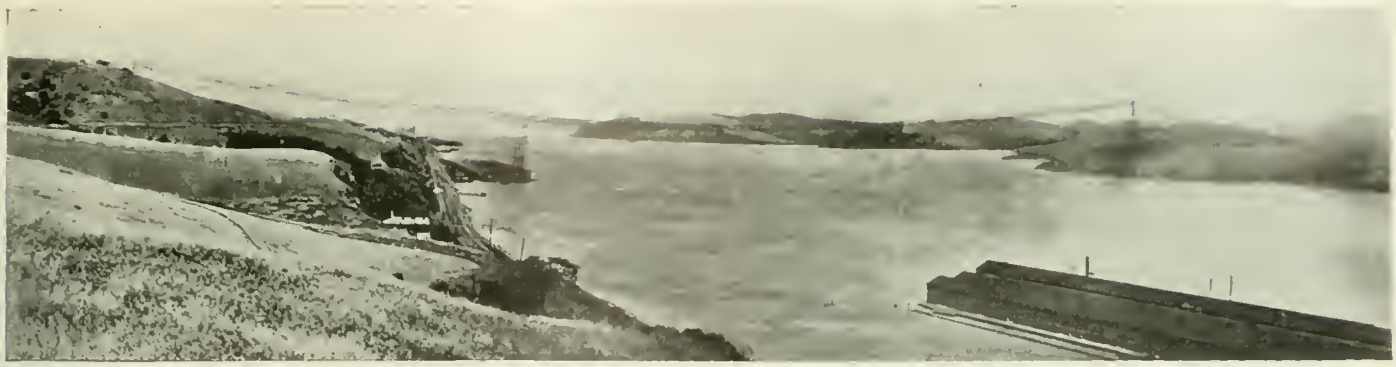


Fig. 1.—High-Potential Transmission Line Spanning Carquinez Straits.

Spanning Carquinez Straits with a High-Potential Transmission Line.

By R. H. Sterling.

When the Bay Counties Power Company, of California, decided to extend its line from its power houses on the two branches of the Yuba River in the Sierra Nevada Mountains to find a market for its power along the shores of San Francisco Bay and in the city of Oakland, the fact was not lost sight of that such an undertaking would necessitate some features in engineering and line construction that had never before been encountered in long-distance transmission. The extensive market in sight, however, overcame any dread at the thought that there would be 140 miles to cover and miles of mountainous country and long stretches of swamp lands through which the lines would have to be built, and finally, that within 20 miles of Oakland the Straits of Carquinez intercepted the route.

This channel is a deep, swiftly-moving waterway about 3200 ft. wide at its narrowest point, and to cross this was the first serious question for thought. Two methods were available for making this crossing, either to transform from the line voltage of 60,000 that it had been decided to adopt, down to a safe pressure for a submarine cable, and then up again to the initial voltage, or to make an aerial crossing. When the loss in these two transformations was considered it was decided to adopt the latter method, and it is the purpose of this article to describe this feature of the work in the spanning of Carquinez Straits.

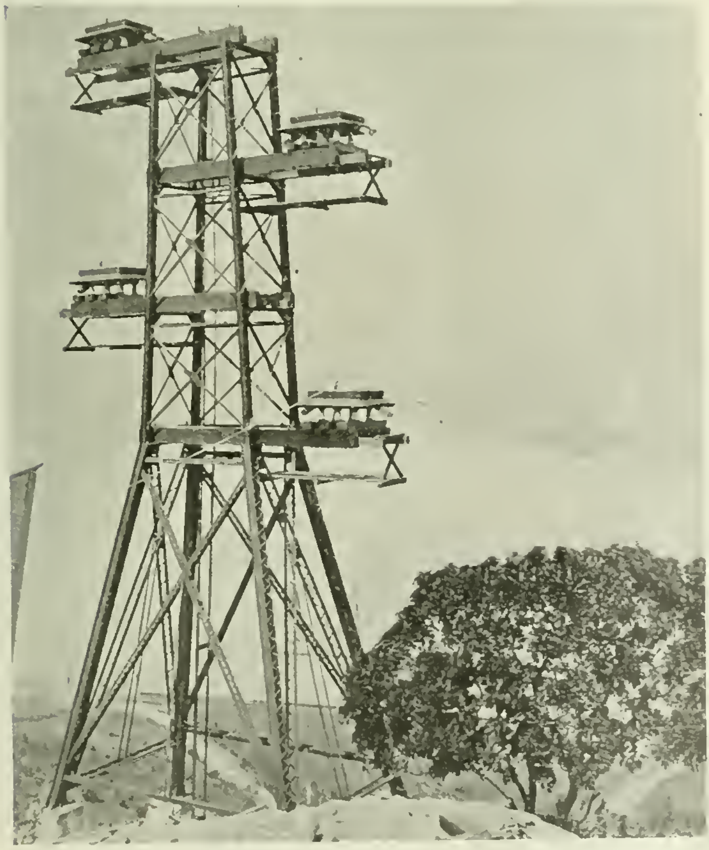


FIG. 2.—SOUTH TOWER, 65 FT. HIGH.

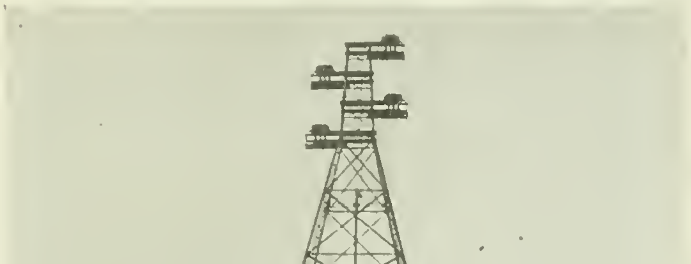


FIG. 3.—NORTH TOWER, 225 FT. HIGH.

Government requirements called for a clearance of 200 ft. above high water, so that the masts of the tallest vessels could pass safely underneath. An occasional wind velocity of 75 miles an hour occurs at times at this point, so that the features of suspension bridge construction were adopted, and the engineering details were turned over to the Pacific Construction Company, of San Francisco, which has most successfully carried out this undertaking.

Points were located on opposite sides of the Straits where the greatest elevation of land combined with the shortest span was available, and steel towers erected. On the north side a point of land that stood 160 ft. above the water's edge was selected, and owing to the height required from the water at the center of the span and the sag necessary in the suspension to give the required factor of safety in the cable, a tower 225 ft. in height was built. On the south side, to save in height of tower, a point further back and higher up the hill was selected, that only called for a tower 65 ft in height. This made the span from tower to tower 4427 ft., undoubtedly the longest span of the kind in the world, and when it is considered that the span of the Brooklyn bridge is but 1600 ft. between towers, some comparison can be had. The total distance from one anchorage to the other is 6200 ft.

One of the most important factors in this crossing is the cable, it serving at the same time the purpose of electrical conductor and suspension cable. It is made up of 19 strands of galvanized plow steel wires, forming a cable seven-eighths of an inch in diameter and having the electrical conductivity of a No. 2 copper wire. Four of these cables were stretched so as to have one in reserve for the three-phase system in use. The breaking strain of each cable is guaranteed at 98,000 lbs., and the total weight of each span is 7080 lbs.; with a sag of 100 ft. there remains a factor of safety of 4. The cables, as in suspension bridge construction, are not fastened rigidly to the towers, but pass over them on grooved rollers and thence on to the anchorage at each end, where a strain of 12 tons is exerted for each cable, the bearing down strain on the saddles at the towers being 7000 lbs. for each. The anchorages are composed of heavy concrete blocks embedded deeply in the earth with anchor bolts running through them.

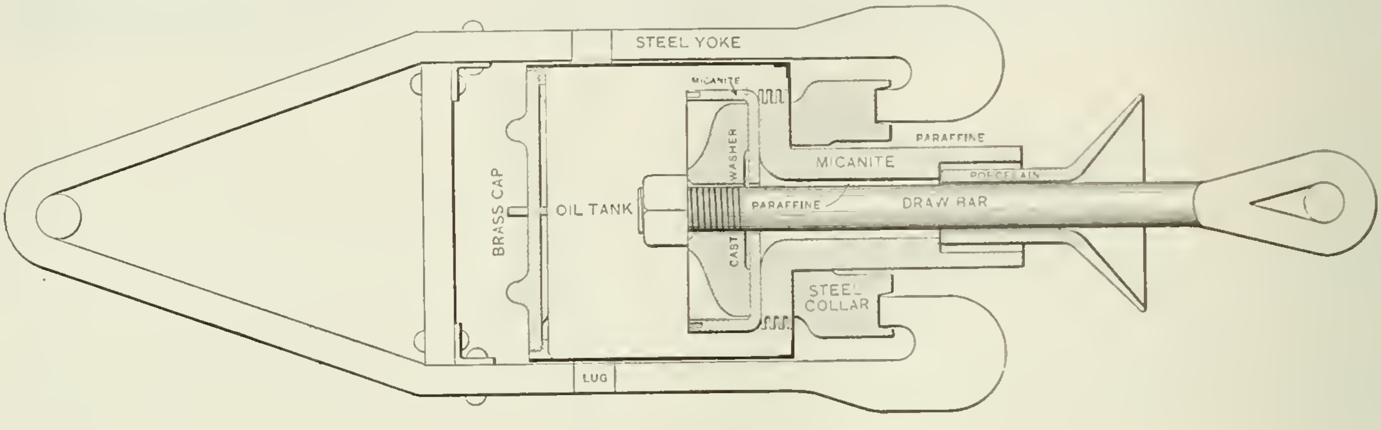


Fig. 4.—Detail of Strain Insulator.

In connection with this work the writer was called upon to design the insulating details for this crossing, a description of which may be of interest.

The insulators used in this crossing are of two kinds, the saddle insulator on the towers, which support the weight of the cables, and the strain insulators that insulate the cables from the anchorages and take the entire pull of the cables. The former are composed of glazed porcelain and made by cementing together with sulphur four separate porcelain shells with a heavy conical steel pin sulphured into the center one. Over this pin is slipped a tapering porcelain sleeve. The weight of one of these insulators is 75 lbs., exclusive of the pin, and measures 17 inches in diameter at the outer petticoat. Six of these insulators comprise a group to support a wooden platform in which are six deep holes that fit down over the main body of the insulators. An eave extends around the edges of the platform to protect somewhat the insulators underneath from driving rain, and a spout is arranged to carry off the accumulated water.

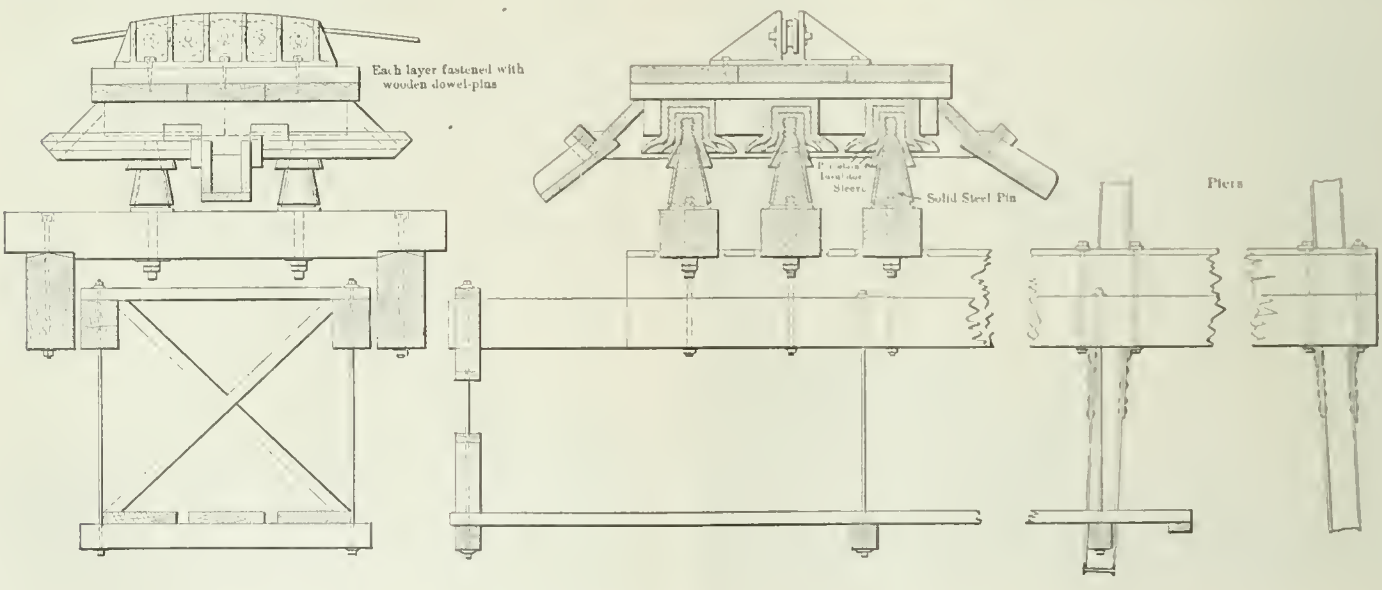

Each layer fastened with wooden dowel-pins
Porcelain Insulator Sleeve
Solid Steel Pin
Piers

Fig. 5.—Saddle and Insulators.

On top of the platform is placed the cast iron saddle proper, which contains five grooved steel sheaves set in line on which the cable rests and allows for any movement due to expansion and contraction. The six saddle insulators are bolted to two heavy timbers extending out 8 ft. from the tower, thoroughly kiln dried, filled and varnished to repel moisture. These timbers present a considerable length of creepage surface, and add in no small degree to the general insulation on the towers, while the saddle insulators themselves have stood 100 and 10,000 volts under test, with one terminal connected on the outer surface and the other to the pin; and added to this, the thick wooden platforms have been boiled in paraffine.

Before taking up the strain insulators it will be stated that in designing the towers the question of the cables swinging together in heavy winds was given careful consideration, and for this reason a horizontal separation of 20 ft. was provided between cables; but since being put into service it has been found that owing to the great weight for so small a wind surface presented there is no appreciable movement of the cables even in the strongest gales.

The designing of the strain insulators presented considerable difficulty. It was first decided to adopt porcelain in their construction, and the failure on the part of the manufacturer to turn out an article that was in any degree perfect mechanically, finally led to the adoption of micanite. This substance has been the salvation of the insulator, for it combines great mechanical with dialectric strength, but, unfortunately, does not possess good surface insulation; that is to say, the shellac which is used to glue the layers of mica together

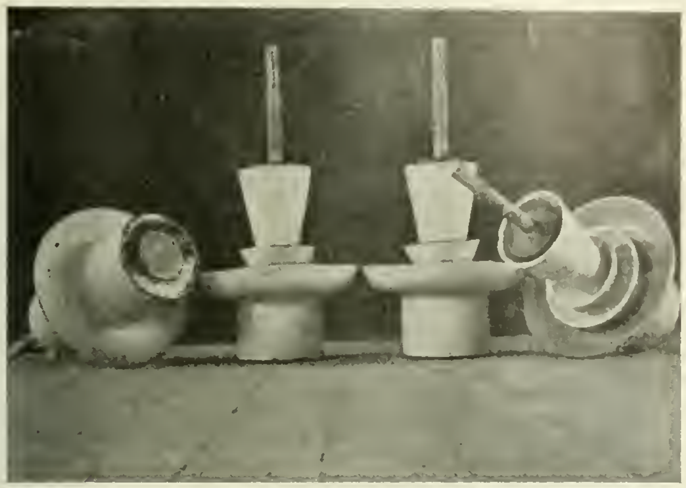


FIG. 6.—SADDLE INSULATORS.

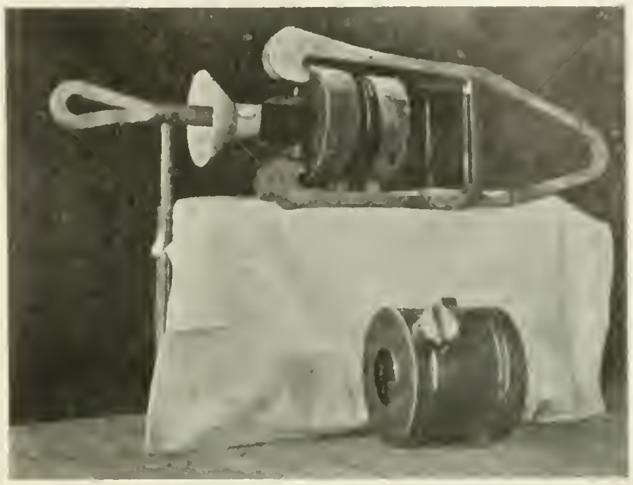


FIG. 9.—STRAIN INSULATOR OIL TANK REMOVED.

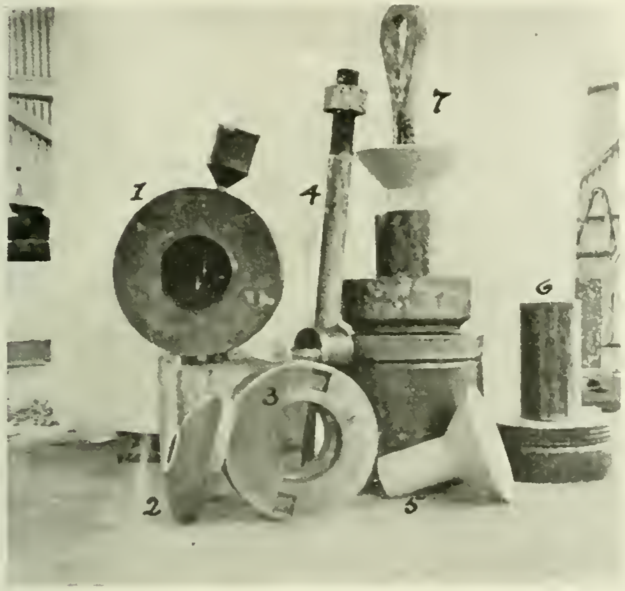


FIG. 7.—STRAIN INSULATOR PARTS.

1.—Copper oil tank. 2.—Washer. 3.—Steel collar. 4.—Draw bar. 5.—Porcelain tube. 6.—Micanite bushing resting on micanite cup. 7.—Complete insulator.

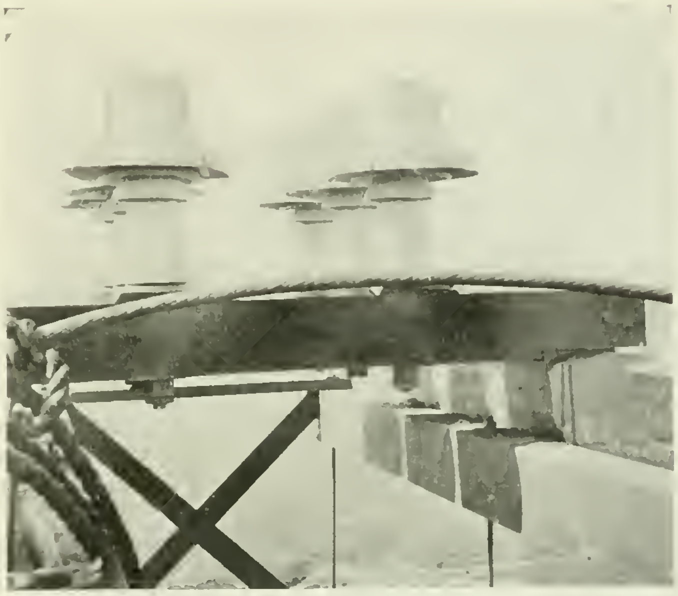


FIG. 10.—SIX SADDLE INSULATORS IN POSITION.

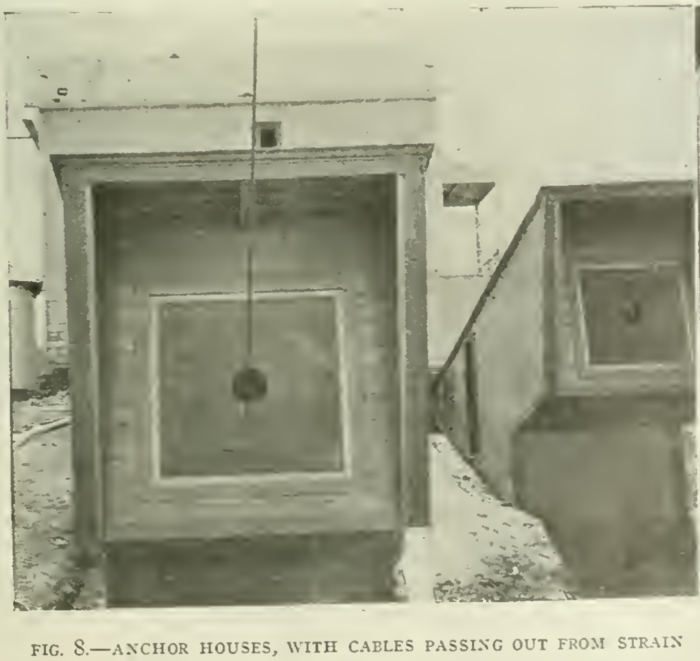


FIG. 8.—ANCHOR HOUSES, WITH CABLES PASSING OUT FROM STRAIN INSULATORS.

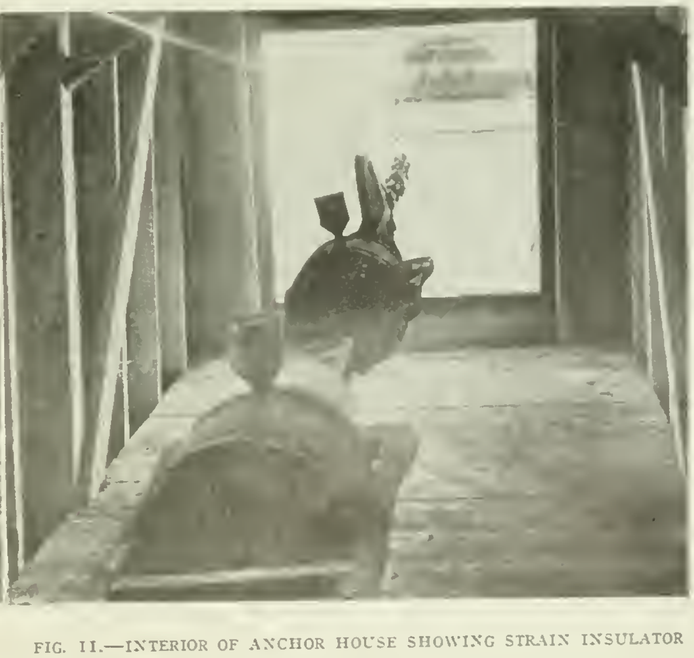


FIG. 11.—INTERIOR OF ANCHOR HOUSE SHOWING STRAIN INSULATOR ATTACHED TO CABLE.

SPANNING CARQUINEZ STRAITS WITH HIGH POTENTIAL TRANSMISSION LINE.

oxidizes and offers a low creepage surface. This defect was overcome by combining with the micanite in this insulator the advantages of oil and porcelain, using the porcelain where mechanical strength was not required.

The detailed sectional drawing and photograph of the unassembled parts will best describe the arrangement of this insulator. The conical porcelain tube here shown gives ample surface insulation between the drawbar and the steel collar corresponding to the difference of potential of the insulator, while the oil inside the copper tank acts in like service as well as to prevent arcing between opposite parts. The grooves shown on the flange of the micanite bushings are to increase the length of creepage surface, which, even in oil, is for this voltage not wholly to be relied on unless ample distance is given. The small cylinder or funnel on top of the tank is provided for filling it with oil and to inspect the oil level. While one of these strain insulators has sufficient insulation for the voltage used, it was deemed best to place two of them in series, so in case one gave out there would still remain a protection from grounding the cable.

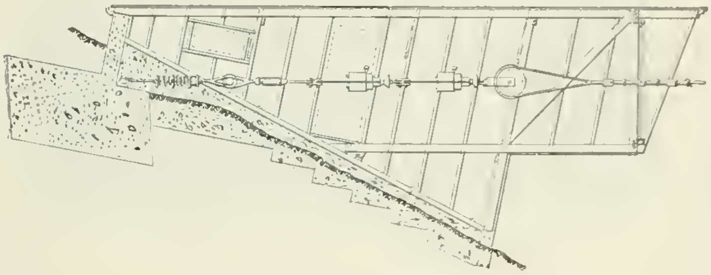


FIG. 12.—ANCHORAGE AND SHELTER.

It will, of course, be observed that no means are provided on the insulators themselves to prevent the interception of leakage to earth due to moisture on the surface, as in the case of the petticoat in line insulators. This, owing to the position in which the insulators are placed, makes such an arrangement impossible; therefore, a shelter was built over each set, and the entrance of the cable through the end of the house provided with a large window of plate glass with a hole 9 inches in diameter through which the cable passes.

Conductors are soldered to the cables just before they enter the anchor houses, and are led to the two sub-stations near by at either end of the crossing; there, by means of high-tension switches, any cable can be thrown out of service and repairs on it or on any of the insulators made, after first grounding the cable to be operated on, since the static effect is quite heavy.

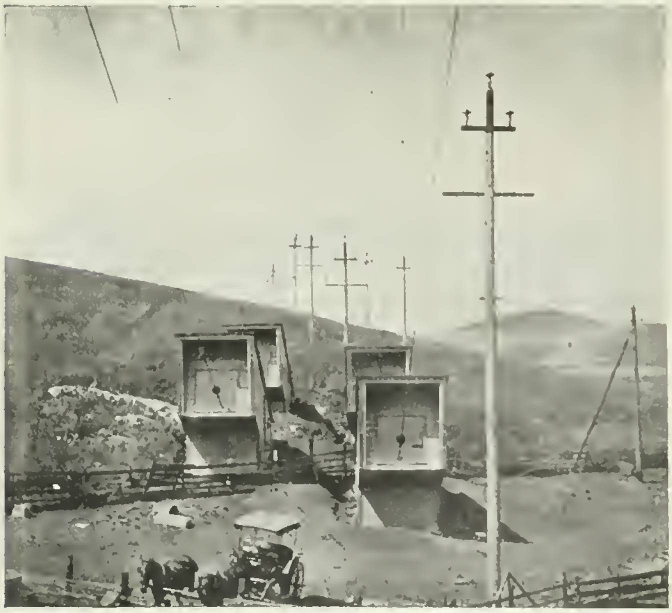


FIG. 13.—GENERAL VIEW OF ANCHORAGE.

The sub-stations mentioned also contain step-down transformers of 1500-kw capacity for each station from which 5000-volt current is transmitted from five to nine miles up and down each side of the Bay, where it is used for power and lighting at the various towns and manufactories on the way.

The Polyphase Induction Motor for General Power Service.

By Ralph D. Mershon.

Although the polyphase induction motor has been on the market for a number of years, and many of them are installed and in successful operation, it is evident from statements made from time to time that few people have a clear conception of its characteristics and applicability. A variety of misconceptions obtain in regard to it, and as a result, the comparisons drawn between the direct-current motor and the induction motor frequently lead to conclusions which are erroneous and much to the disadvantage of the latter.

There undoubtedly exist conditions which can be better met by the direct-current motor, especially the series motor, than by the induction motor, just as there are other conditions which can be better met by the induction motor. There is, however, a middle ground where either motor is capable of doing the work to be done and doing it well, but where the simplicity and reliability of the induction motor and its accompanying apparatus often make it to be preferred, and where the advantages to be gained by employing it will usually outweigh any greater expense which its use may involve. This common field includes that of general power service, in which power is to be supplied in small amounts at numerous points, and usually for work requiring practically constant speed.

The points in regard to which the induction motor is most seriously misunderstood are: *A*. Starting torque. *B*. Speed control. *C*. Disturbance, at starting, to voltage of supply. *D*. Power factor.

A. The starting torque of the induction motor may be as high or higher than that of a shunt motor of the same power. A starting torque equal to two or three times full-load running torque is usual, and it may be made as much higher as is necessary for the work in hand. If abnormal means be in each case resorted to for obtaining a high-starting torque, the limit will be reached sooner with the direct-current motor than with the induction motor.

B. Given a direct-current shunt motor supplied from a single source of e. m. f., and controlled as to speed by a rheostat in the armature circuit; and given an induction motor with slip rings and a rheostat in its secondary circuit—the motors are identical as to speed control. The shunt motor may be started, stopped, reversed, run at high speed or low speed with great torque or little torque; so may the induction motor. If the operator were allowed to see only the rheostat handle and the machinery driven, he would not know whether he were operating a direct or alternating-current motor. The same is true for a motor without slip rings, and controlled by varying the voltage impressed upon it.

In some kinds of work it is desirable that when running at any one of a number of different speeds the motor shall act as a constant speed motor; that is, the speed shall not materially vary with varying torque. This is not the characteristic of any motor under rheostatic control, as under such conditions the torque and resistance, jointly, determine the speed, a diminution of either raising the speed and an increase lowering it. This requirement is usually met in the case of the shunt motor by installing two or more supply circuits of different voltages, fed from separate generators or from separate commutators on the same generator. It may be met in the case of the induction motor with one generator and one supply circuit by so winding the motor that by means of the controller its connections may be changed so as to give it different numbers of poles, a greater number for the lower speeds and a lesser number for the higher ones.

C. An induction motor can be started under load with practically no more disturbance to the circuit than takes place with a shunt motor. An induction motor with a starting rheostat in its secondary circuit starts as does a shunt motor with a rheostat in its armature circuit; and though the disturbance may be slightly greater with the induction motor because of the fact that its power factor is less than unity, the difference with good apparatus and lines well installed is inappreciable. The power factor of such a motor when starting with a given torque is the same as when running with that torque; as the full-load power factor should be 90 per cent or over in a well-designed motor, the power factor when starting a load with full-load torque should be at least as high as 90 per cent. It is true that an induction motor with a "squirrel cage" secondary, and having therefore no moving contacts and no starting rheostat in the secondary, will, under some conditions, produce a considerable disturbance if started under load or run below speed, since the power factor of such a motor when so operated is not so high as that of a motor under rheostatic control, though at full speed it may be as high or higher; but such a motor, if installed with a knowledge of the facts, is put in with a tacit agreement to such starting disturbance as may have place, in view of the inherent advantages of such a piece of apparatus. If, as often happens, the motor may be started under a light load, the starting of a motor of the "squirrel cage" type will not produce any objectionable disturbance.

D. Contrary to the ideas often held, the power factor has in general nothing to do with the efficiency of an induction motor. It is possible to have a motor with a low-power factor and a high efficiency, or vice versa; in fact, it is comparatively easy to design a motor with a high-power factor and a low efficiency—much easier than to obtain a motor whose power factor and efficiency are both high. As the customer's meter registers only the true power, a low-power factor can affect him only as it may affect the regulation of the circuit feeding his premises.

A low-power factor will, however, affect the company supplying the power:

(*a*) By increasing, for a given amount of power delivered, the losses in the lines, transformers and generator over what they would be with unity power factor, thereby decreasing the efficiency and capacity of the electric system.

(*b*) By increasing, for a given amount of power delivered, the drop in the lines, transformers and generator over what it would be with unity power factor.

As to (*a*), it is evident that the lower the power factor the greater the amount of current required for a given amount of power. It may be safely assumed that with the average induction motor of good design running at half load, the power factor will not fall below .8. It will, in fact, exceed .8 at half load, and at full load and overloads it will be 90 per cent or more, so that the power factor of the average motor operating under average conditions my be safetly taken as .8. By exercising some care in the selection of motors for the work to be done by them so that their average load shall be as near full load as possible, this figure can be very materially increased. If such a motor requires an amount of power represented by 100 amperes at a power factor of unity, when operating at a power factor of .8 it will require $100/.8 = 125$ amperes. If the motor be the only one operating on the lines, transformers and generator feeding it, or if the other apparatus on the circuit be only such as has an 80 per cent power factor, the increased current will mean a loss in the generating and transmitting apparatus corresponding to 125 amperes instead of 100 amperes. The efficiency of the system will be decreased somewhat, and if there be a limit in the allowable loss in the system, the capacity of the generating and transmitting apparatus will be less than with a power factor of unity.

If the motor operates on a circuit which, in addition, supplies other apparatus having power factors differing from .8, the decrease of efficiency and capacity will be determined, not by the power factor of the motors on that circuit, but by the power factor of the circuit as a whole, and usually the combined power factor will be greater than that of the induction motor load. This is a point frequently overlooked.

Suppose that the power factor of the motor load on a circuit is .8, then for an amount of power which with power factor unity would be represented by 100 amperes, there will be required by the motors 125 amperes. If on the same circuit there be a load of incandescent lamps taking the same amount of power as the motors, the lamps, whose power factor does not appreciably differ from unity, will require 100 amperes. It is easy to show that under such conditions the resultant current, instead of being 225 amperes, will be less than 214 amperes, and the power factor will be 93.6 instead of .8.

In most plants doing a general lighting and power business, the maximum load comes at a time when there is a much greater proportion of lights than motors, which results in a high-power factor. At other times in the day—even at that time when the motor load is a maximum—there is usually ample capacity in lines and apparatus, since the total demand in current is then less than that at the time of the greatest lighting load. Under these conditions the question of reduced capacity from low-power factor does not figure. In the case of plants supplying a motor load exclusively, the power factor of a given circuit is, of course, identical with that of the motor load upon it.

This question of power factor might be discussed with reference to the use of synchronous motors or condensers for raising its value. The condenser is constructed to-day for commercial work is not however, always so reliable a piece of apparatus as is desirable, and it is not always convenient or economical from an operating standpoint to employ synchronous motors. The use of either results in an added complication to the system, and it is better to look upon such means of raising the power factor as one to which we may resort if necessary rather than as regular or indispensable part of a polyphase system.

As to (*b*), the increase of current due to lower-power factor will increase the drop in the system, but in addition there will be an increase of drop other than that accounted for by the increased current, due to the fact that, with a given current, the effects of line and transformer reactance and generator armature reaction are greater with a low than with a high-power factor. This may or may not impair the regulation. If the variations in load on a circuit are due to motors going off or coming on the circuit, the regulation will be impaired somewhat by reason of the low-power factor; but if the variations of load are due to variations in the loads on the motors, the regulation may be actually better than if the power factor were high. This is due to the fact that though the power demand becomes greater the current over the line does not increase in proportion to it, and the power factor consequently becomes better with such increase of load.

As regards efficiency, direct-current shunt motors and induction motors are on about the same plane, with a slight advantage in favor of the induction motor as regards efficiency at light loads.

It appears, therefore, that, excepting perhaps some very special cases, the induction motor may be made to fulfill any condition which a direct-current shunt motor will meet, and that for general power work they are on a par so far as flexibility and adaptability are concerned. There remains the question of expense in the two cases, including under the head of expense not only the first cost of the motors, but that of the generators and lines necessary to enable the rendering of satisfactory service.

Where power is to be transmitted any considerable distance, alternating current must be used, and at the end of the transmission there is the alternative of using, for the local distribution, alternating currents and induction motors, or that of regenerating, either by means of rotaries or motor generators, and distributing by means of direct current. In this case the point to be decided is as to whether it is cheaper to install the greater generator line and transformer capacity, if any, required for the induction motor, or to install regenerating apparatus requiring constant attendance and a more elaborate sub-station than in case of static transformers alone. The writer favors the former as being generally cheaper in the end, except in some special instances, and as allowing the use of a type of motor which, while an elegant and efficient piece of mechanism, approaches the simplicity and reliability of a wheelbarrow about as nearly as one could ever reasonably expect a piece of moving electrical apparatus to do.

Where the power is to be distributed at a short distance from the generating station, as in the case of a factory, the increased cost, if any, of the induction motor plant must be balanced against such advantages as can be gained by the use of the simpler and more reliable apparatus—an advantage which, while a great one in most instances, is of less importance in others, and cannot be readily figured in dollars and cents. The decision in such a case must be the result of the best judgment of the engineer based upon his knowledge and experience.

The above discussion ignores the synchronous motor as a factor in general power distribution. Such a motor does not lend itself to general power service. The induction motor may be started, stopped and operated by a novice, and will hang on to its work under conditions which would put any other kind of motor out of service; but the synchronous motor with its starting devices and complicated switchboard arrangements requires an attendant of some experience to start, synchronize and operate, and will not stand up to its work under the difficult conditions which the induction motor will meet.

In addition, unless the synchronous type of motor be given considerable attention during operation, the advantages aimed at in its use will not be realized, since a high power factor, either on the motor or the circuit as a whole, means careful adjustment of field charge for varying load. By careless adjustment of field charge the synchronous motor may become more of a detriment than an advantage to the general service, since each synchronous motor can be made to raise or lower to a greater or less extent the voltage of the supply circuit or even of the system.

Novel Features at Telephone House, England.

THE National Telephone Company, Limited, which controls the whole of the telephone system in the United Kingdom, has recently removed into its new home in Telephone House, a handsome building which has been erected on the banks of the Thames at the corner of the Victoria Embankment and Temple Avenue. The building is 250 ft. by 50 ft. wide, and its front on Temple Avenue runs at right angles to the Embankment. The building is a seven-story one, five being above ground and two under the level of the street. This building takes the place of five separate offices, in which the work of organizing has hitherto been carried on. These are merely the head offices of the company, and have nothing to do with the exchange work or the work of the numerous exchanges in London and throughout the country. The offices of Mr. W. E. L. Gaine, general manager of the company, are in this building, together with the offices of the engineers' staff and the secretarial staff, and it may be said that there are in the whole building employed about 320 people, 20 of whom are typewriters. Special reference ought to be made to the arrangements for communicating with the "typists," as differing from those in most offices where a number are employed who, as a rule, take their dictation directly in the room of the person dictating. In Telephone House, however, the typists never leave the room in which their machines are situated, a small telephone exchange being situated near the head typist's machine. Telephone arrangements with a headpiece similar to those used by the regular telephone girls are attached to each typist's machine. When any of the staff, therefore, desire to dictate letters they immediately put themselves in telephonic communication with the head typist who switches them onto any one of the typists who has the least work to do at that particular moment. In that way there is no time lost in sending for a girl to come from a considerable distance or in going up and down flights of stairs. When a letter is to be dictated it is dictated instantaneously, and a service of messenger boys deliver the letters at intervals to the various departments.

Telephone House, London.

In the basement are contained the stationery stores for the whole country, as the head office in London is the only purchasing department of the whole National Telephone Company. The chief office in every district has no authority whatever to buy as much as a pencil, and all the stationery is distributed from the head office at Telephone House. In this basement is also a small printing shop driven by an electric motor, where much of the regular printing of the company is done. There is also a complete testing shop for the testing of all instruments, before being packed for delivery, and also for the testing of samples of goods on which tenders to supply are made. In the basement also are stored special electrical stores for all the companies, consisting of telephones, condensers, retardation coils, induction coils, etc., and there is also stored in the basement a special emergency stock of everything used in telephone work. The offices in general are light and airy, and little artificial illumination is required in ordinary circumstances. Many of the rooms are also heated both by hot water and ordinary fires, and are connected with a system of ventilation operated by electric fans on the roof.

We may say, in a word, regarding the telephone system of which the building described above is the head office: London is divided into six departments, and has 47 exchanges; and the whole country is split up into 61 districts, each of which is independent of the other, and reports directly to the general manager at Telephone House. In December last there were 988 exchanges throughout the country, which take care of 200, 202 stations or subscribers, with the enormous number of 682,857,864 messages per year. The business of the National Telephone Company is steadily growing in spite of the opposition which is about to spring up in the shape of municipal telephones and Government Post Office telephones, and arrangements have recently been made for the establishing of another large exchange in London which will be operated on the central battery system, the apparatus for which will be furnished by the Western Electric Company, of London. The apparatus at present in use by the National Telephone Company varies somewhat, part being American make, part English and part of Continental manufacture. The National Telephone Company has been in the habit of buying wherever the best market could be obtained, a practice of which it will be hard to cure the average Englishman of intelligence.

At the annual dinner of the company in London on May 17, when over 200 members of the staff were present, Mr. Gaine, who presided, stated that during the year 29.221 subscribers had been added. The business, or number of messages, had increased 15.3 per cent, up to 712,000,000, while the post office telegraphs had transmitted 90,000,000 telegrams, an increase of only 2.88 per cent.

Lord Kelvin pointed out that all subscribers to the post office telephone system would be compelled to get into touch with the National Telephone Company's subscribers. He thought the Government would correct the mistake which they were making, in the future. In the meantime, there was nowhere in the world to be found better appliances than those of the company, which would welcome every improvement, from whatever source.

Cost of Changing Power.

Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York City, in a recent statement, gave some interesting figures in connection with the operations of that company's system. The value of the plant thrown away by the change from cable to underground trolley on the Broadway, Lexington Avenue and Columbus Avenue lines he places at $0,000,000. The total cost of the installation of the cable system was about that amount, in addition to $10,000,000 for real estate and constructive work on the roads. The installation of the electrical plant has cost another $10,000,000. Last year the conductors on the system collected $15,500,000 in nickels.

Magnetic Attraction in Dynamos Due to the Armature and Field being Non-concentric.

By EDGAR KNOWLTON.

THE magnetic attraction due to the displacement of the armature or field is important to the dynamo builder, and also to the engine builder, when the dynamo is mounted on the engine shaft. If the armature and field are concentric when first installed the subsequent wear of the bearings will shorten the air-gap on the under side and cause an additional pressure on the bearings. If the gap be smaller at the top than the bottom the attraction will cause a deflection of the stationery member. This is not a very serious matter with machines of small diameter, but with machines of large diameter it should not be overlooked. Many engine builders require that the magnetic attraction be stated for a specified displacement, and it is the object of this article to give a fairly accurate method of calculating this attraction. Certain assumptions will be made which, while not strictly correct, greatly simplify the problem and introduce no serious error.

The accompanying drawing represents the field and armature of an eight-pole dynamo, and shows the paths of the magnetic fluxes. When all the air-gaps of the different poles are equal the fluxes are also equal. Should the air-gaps vary the fluxes will also vary inversely as the reluctances of their circuits. Of course, the reluctance of the metallic part of the circuit varies with the flux, but this is so small a part of the total reluctance that it is neglected for the sake of simplicity.

It may be well to give here a table of the notations which will be used in this article. The densities mentioned are pole face densities in lines per square inch:

d = displacement of the armature.
$V_1 V_2 V_3$, etc., = variations in the air-gap of poles 1, 2, 3, etc.
= practically $d \cos A_1$, $d \cos A_2$, $d \cos A_3$, etc.
g = average normal gap in inches.
a = normal reluctance of one air-gap.
b = normal reluctance of one-half the complete circuit.

$$j = \frac{b}{a} = \frac{\text{ampere turns for one-half the circuit}}{\text{ampere turns for one gap.}}$$

$$h = \frac{da}{gb} = \frac{d}{jg}$$

$$h \cos A_1 = \frac{\text{change of reluctance due to } V_1}{\text{reluctance of one-half the circuit}} ;$$

and similarly for the other poles.

$\mathfrak{B}_N$ = normal density.
$\mathfrak{B}_1$ = density of the flux from pole 1 to 8 after displacement.
$\mathfrak{B}_2$ = density of the flux from pole 1 to 2 after displacement.
$\mathfrak{B}a$, $\mathfrak{B}b$, etc., = density of poles 1, 2, etc., after displacement.
A = area of pole face in square inches.
N = number of poles.

Referring to the illustration, it is seen that as the displacement takes place the air-gaps below the horizontal are decreased and those above are increased; consequently the attraction of poles 1, 2, 7 and 8 is increased, and the attraction of poles 3, 4, 5 and 6 is decreased. The attraction of pole 1 is the same as the attraction of pole 8; that of pole 2 the same as that of pole 7, etc. In calculating the attraction we substract the attraction of pole 5 from that of pole 1, and to obtain the vertical component multiply the difference by $\cos A$. Since the attraction of pole 8 equals that of pole 1 and the attraction of pole 4 equals that of pole 5, we multiply by 2 and have the resultant vertical attraction of poles 1, 8, 5, 4. Proceeding in the same manner with the other four poles and the problem is completed.

We will now take up the derivation of a formula which may be applied to all cases. The magnetic attraction of any pole before displacement is

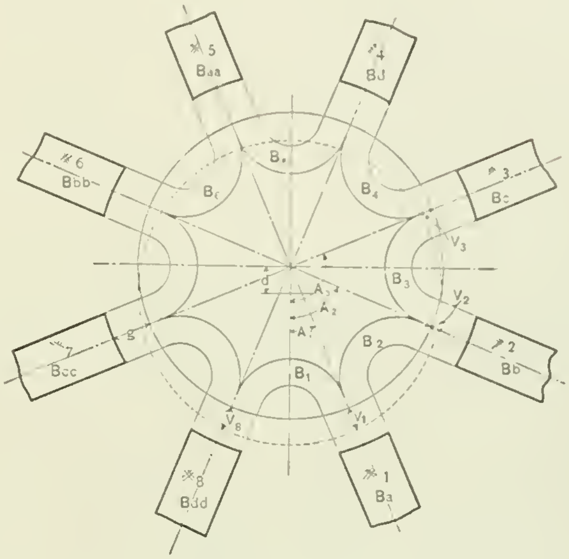
$$P = \frac{\mathfrak{B}_N^2 A}{72{,}134{,}000}$$

In order to obtain the attraction after displacement, this formula must be multiplied by the square of the ratio of the density after displacement to the density before displacement. The pole face density of any pole is a mean of the densities of the two fluxes which enter or leave the pole.

We will first consider pole 1. The change in the reluctance of the gap for pole 1 is $\frac{ad \cos A_1}{g}$

The change for pole 8 is $\frac{ad \cos A_8}{g} = \frac{ad \cos A_1}{g}$

The change for pole 2 is $\frac{ad \cos A_2}{g}$



ILLUSTRATING AIG-GAP DISPLACEMENT.

Therefore, the reluctance of the path of the flux $\mathfrak{B}_1$ after displacement is

$$2ja - \frac{2ad}{g} \cos A_1, \text{ and}$$

$$\mathfrak{B}_1 = \mathfrak{B}_N \frac{2ja}{2ja - \frac{2da}{g} \cos A_1} = \mathfrak{B}_N \frac{1}{1 - \frac{d}{jg} \cos A_1}$$

Substituting h for $\frac{d}{jg}$

$$\mathfrak{B}_1 = \mathfrak{B}_N \frac{1}{1 - h \cos A_1}$$

$$\mathfrak{B}_2 = \mathfrak{B}_N \frac{2ja}{2ja - \frac{da}{g} \cos A_1 - \frac{da}{g} \cos A_2} = \mathfrak{B}_N \frac{1}{1 - .5 h \cos A_1 - .5 h \cos A_2}$$

$$\mathfrak{B}a = \frac{\mathfrak{B}_1 + \mathfrak{B}_2}{2} = \mathfrak{B}_N \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)}\right]$$

The reluctance of the path of flux $\mathfrak{B}_5$ after displacement is

$$2ja + \frac{2ad}{g} \cos A_1$$

and the density

$$\mathfrak{B}_5 = \mathfrak{B}_N \frac{1}{1 + h \cos A_1}$$

and

$$\mathfrak{B}aa = \mathfrak{B}_N \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)}\right]$$

The attraction of pole 1 after the displacement is

$$P_1 = \frac{\mathfrak{B}_N^2 A}{72{,}134{,}000} \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)}\right]^2$$

and the attraction of pole 5 is

$$P_5 = \frac{\mathfrak{B}_N^2 A}{72{,}134{,}000} \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)}\right]^2$$

The difference between the attraction of the two

$$P_{15} = \frac{\mathfrak{B}_N^2 A}{72{,}134{,}000} \left\{ \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)}\right]^2 - \left[\frac{1}{2 + 2h \cos A_1} + \frac{1}{2 + h(\cos A_1 - \cos A_2)}\right]^2 \right\}$$

multiplying by $2 \cos A_1$ (see explanation above) we have as the vertical downward attraction of poles 1, 4, 5 and 8

$$P_{18} = \frac{\mathcal{B}N^2 A}{72{,}134{,}000} \left\{ \left[\frac{\sqrt{2 \cos A_1}}{2 - 2\,h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 - h\,(\cos A_1 + \cos A_2)} \right]^2 - \left[\frac{\sqrt{2 \cos A_1}}{2 + 2\,h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 + h\,(\cos A_1 - \cos A_2)} \right]^2 \right\}$$

Proceeding in the same manner with poles 2, 3, 6 and 7, we have as their vertical component

$$P_{27} = \frac{\mathcal{B}N^2 A}{72{,}134{,}000} \left\{ \left[\frac{\sqrt{2 \cos A_2}}{2 - h\,(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 - \left[\frac{\sqrt{2 \cos A_2}}{2 + h\,(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 \right\}$$

The quantity $\frac{\sqrt{2 \cos A_2}}{2}$ appears because the density of flux $\mathcal{B}_3$ does not change; the gap of pole 3 being increased the same amount that the gap of pole 2 is decreased. Theoretically, this is not true, but the difference is too small to take into account.

We then have as the total vertical resultant of the attractions of the poles of an eight-pole dynamo

$$P_t = \frac{\mathcal{B}N^2 A}{72{,}134{,}000} \left\{ \left[\frac{\sqrt{2 \cos A_1}}{2 - 2\,h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 - h\,(\cos A_1 - \cos A_2)} \right]^2 - \left[\frac{\sqrt{2 \cos A_1}}{2 + 2\,h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 + h\,(\cos A_1 + \cos A_2)} \right]^2 + \left[\frac{\sqrt{2 \cos A_2}}{2 - h\,(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 - \left[\frac{\sqrt{2 \cos A_2}}{2 + h\,(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 \right\}$$

Let the value by which we multiply $\frac{\mathcal{B}N^2 A}{72{,}134{,}000}$ be denoted by C. It can readily be seen that $\frac{C}{h}$ is not a constant for different values of h. In order to determine whether or not any serious error is introduced if we consider that $\frac{C}{h}$ is a constant, the writer has made extended calculations and finds that with the usual values of h that $\frac{C}{h}$ is practically constant.

These calculations also show that it makes but little difference whether the plane of deflection is through a pole or between two poles. It was found that C had the following values:

4 poles $C = 2$
6 poles $C = 4.7$
8 poles $C = 7$
10 poles $C = 9.6$

Above 10 poles $\frac{C}{h}$ is practically the same numerically as the number of poles.

The formula then becomes for

4 poles $P_t = \frac{\mathcal{B}N^2 A\,h}{36{,}067{,}000}$

6 poles $P_t = \frac{\mathcal{B}N^2 A\,h}{15{,}350{,}000}$

8 poles $P_t = \frac{\mathcal{B}N^2 A\,h}{10{,}304{,}800}$

10 poles $P_t = \frac{\mathcal{B}N^2 A\,h}{7{,}525{,}000}$

12 poles and above $P_t = \frac{\mathcal{B}N^2 A\,N\,h}{72{,}134{,}000}$

This last formula may be changed to a form that may be more convenient for some designs.

Let r = ratio of pole arc to pole pitch,
l = length of pole along the shaft,
d = diameter of armature in inches,

then $A = \frac{l\,d\,\pi\,r}{N}$ and substituting this value of A.

$P_t = \frac{\mathcal{B}N^2 h\,l\,d\,r}{23{,}000{,}000}$ and if r is a constant it may be still further simplified.

The number of poles considered in the calculations to determine the value of $\frac{C}{h}$ were 4, 6, 8, 10, 16, 20, 24, 32, 48, 72 and 80 poles, The work was carefully checked, and should be reasonably correct notwithstanding the long calculations involved.

* * *

Elements of Illumination—XXVI.

By Dr. Louis Bell.

In cases where concentration of light downward along the axis of the lamp is desirable, efficient results are attained by combining lamp and reflector, that is, by shaping the bulb of the lamp itself so that when the part of it nearest the socket is silvered on the outside it shall form an effective reflector of proper shape. Obviously when the lamp burns out or dim the whole combination becomes useless, in which respect the combination is less economical than an ordinary lamp in a carefully designed reflecting shade like the McCreary. On the other hand, the reflector lamps are, on the whole, somewhat more efficient during their useful life, and for general purposes of illumination are much less obtrusive.

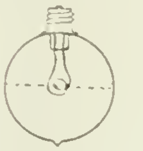


FIG. 1.—SPHERICAL BULB.

In such lamps the bulb, instead of being pear-shaped, is spherical or spheroidal, with the upper hemisphere silvered, the silvering being protected by a coat of lacquer. The filament usually has several convolutions of rather small radius, so as to bring as large a proportion of the incandescent filament as possible near to the center of the bulb. A filament so disposed throws an unusual proportion of the light upwards and downwards when the lamp is mounted with its axis vertical, but, of course, at the expense of the horizontal illumination.

It has sometimes been proposed to use a filament so shaped in an ordinary bulb under the notion of throwing a strong light downwards. Evidently, however, such a lamp throws just as much light upwards toward the opaque socket and the ceiling as downwards toward the tip. Hence there is no gain on general illumination, and no important gain in the downward illumination unless the lamp is mounted with a reflector. Fig. 1 shows in outline a nominal 50-cp spherical bulb lamp with a silvered upper hemisphere, and Fig. 2 the curve of light distribution in a vertical plane. The maximum downwards is about 75 candle-power, while a fair amount of light is thrown out toward and up to 30 degs. from the horizontal. The dotted curve shows the distribution with the silvered bulb, the solid curve the distribution after the silvering had been removed.

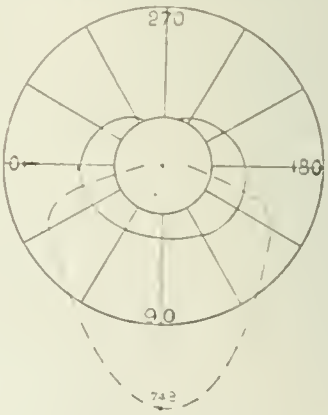


FIG. 2.—CURVE OF DISTRIBUTION IN VERTICAL PLANE.

Fig. 3 shows a common type of reflecting bulb lamp. As usually employed, the lower part of the bulb is ground so as to soften and diffuse the light. The general characteristics of reflector lamps and their field of usefulness have been discussed in a previous paper, so that it is here hardly necessary to say more than to reiterate that whenever a downward light is desired reflector lamps may furnish a most useful means of getting it. Their weak point, as generally made, is a tendency to produce a spotted effect through too great concentration of the light along the central axis. If a projector effect is the one thing desired silvered bulb lamps are not the best means of getting it, and for their greater usefulness as illuminants they should be so constructed as to give a nearly uniform *hemispherical* distribution. Most of the silvered bulb lamps on the market fail to do this. And it should be noted that since the whole lamp is lost when the filament breaks there is a strong temptation to fit such lamps with a low efficiency filament to give a longer life. A properly designed lamp of this class planned for hemispherical distribution could not fail to be of much use in illumination, and could be produced at a very small extra cost above standard lamps.

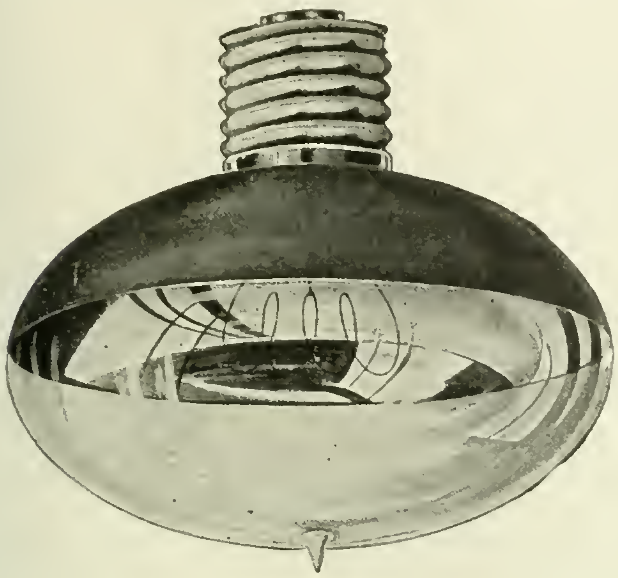


FIG. 3.—REFLECTING BULB LAMP.

For various illuminants shades require to be somewhat modified in form, and an enormous variety of shades and reflectors are on the market, of which these described may merely serve as samples. Shading the radiant whatever it may be is a simple matter, and so is the use of a pure reflector (best when of silvered glass) to direct the light in any particular direction. But the commonest fault of powerful radiants, as we have already seen, is too great intrinsic brilliancy, which calls for diffusion, and good diffusion without great loss of light is difficult of attainment, particularly if at the same time there is need of redistributing the light so as to strengthen the illumination in any particular direction.

By far the most successful solution of this troublesome problem is found in the so-called holophane globes, devised a few years ago by MM. Blondel and Psarondaki, and now in somewhat extensive use, both here and abroad. The general principle employed by these physicists was to construct a shade of glass so grooved horizontally as to form the whole shade of annular prisms. These are not formed as in a lighthouse lens to act entirely by refraction, since in the attempt to bend the rays through a large angle by refraction alone there is a large loss by total reflection. The prisms of the holophane globes are relieved, as it were, at certain points, so that rays which need to be but little deflected are simply refracted into the proper direction, while those that must be greatly bent to ensure the proper direction, are affected by total reflection. This combination of refracting and reflecting prisms in the same structure accomplished the efficient redistribution of the light in the most perfect manner The diffusion remained to be accomplished, and the means adopted was to form the interior of the globe into a series of rather fine, deep, rounded, longitudinal grooves. The total result is a great reduction of the intrinsic brilliancy, coupled with almost any sort of distribution required, the total loss of light meanwhile being less than in any other known form of diffusing shade or reflector. Fig. 4 shows in detail considerably magnified the structure of the holophane prisms and the combination of refraction and reflection that is their characteristic feature. Here the ray *A* is merely refracted in the ordinary way, emerging with a strong downward deflection from the prism face in the direction A^1. Ray B, B^1 is totally reflected at the face b^1, and then refracted outwards at *b*. *Cb* is strongly refracted and emerges horizontally from the surface *c*, while $D\ D^1$ is refracted at entrance, totally reflected at d^1, and again refracted at emergence from *d*. The net result is to keep in this particular form of prism surface, all the rays turned downward below the horizontal. Obviously other prismatic forms might be employed, which would give a very different final distribution, but the principles involved are the same.

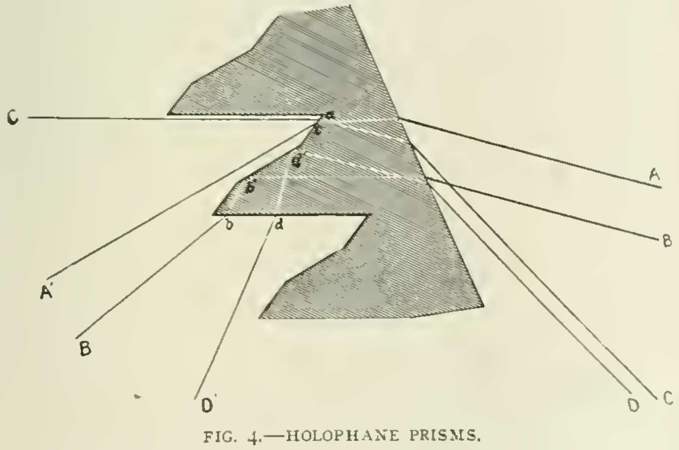


FIG. 4.—HOLOPHANE PRISMS.

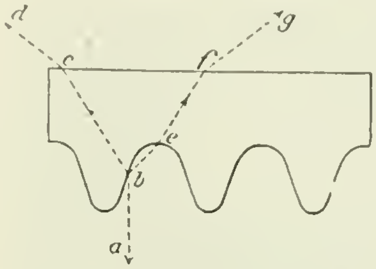


FIG. 5.—DIAGRAM OF INTERIOR FLUTING.

Fig. 5 shows, likewise, on a greatly enlarged scale, the interior fluting, which accomplishes the necessary diffusion of light. The ray *a* is here split up into a reflected component, afterwards refracted, i. e., *b, e, f, g*, and a purely refracted component, *b, c, d*. The shape of the flutings is such as by this means to secure very excellent diffusion at a very small total loss of light. The inner and outer groovings being at right angles produces a somewhat tessellated appearance, but aside from this the surface is quite uniformly illuminated.

These holophane globes are made for all kinds of radiants, but are most commonly applied to Welsbach gas burners and to incandescent electric lights. Evidently the shape of both grooves and globe will vary with the purpose for which the shade is desired, which results in a very large number of forms from which a selection may be made for almost any variety of illumination. It should be noted that these holophane shades both diffuse and redistribute the light in a very thorough manner. Speaking generally, they are of three distinct classes. The first is laid out, according to the general principles of Fig. 4, and is intended to direct most of the light downwards, serving the same end as a reflector, but giving at the same time the needful diffusion without the use of a ground or frosted globe. The general results are strikingly shown in Fig. 6, which gives a very clear idea of what such a globe actually does.

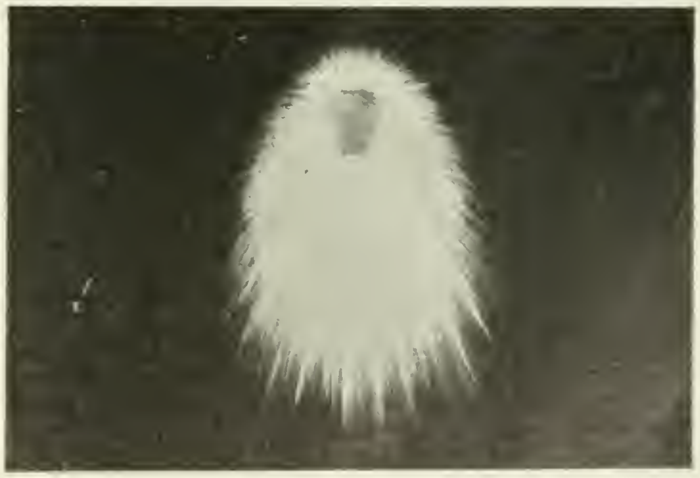


FIG. 6.—DIFFUSION OF LIGHT BY HOLOPHANE GLOBE.

The second class of globes has for its purpose a fairly uniform distribution of the light, mainly below the horizontal, and it is intended for ordinary indoor lighting, where a particularly strong light in any one direction is quite needless. Its effect is shown in Fig. 7. The third general form of holophane globe is designed for the especial purpose of throwing a strong light out in a nearly horizontal direction, and is shaped so as thus to redistribute the light, putting it where it is most useful for such work as street lighting, large interiors, and the like. The effect produced is admirably shown by Fig. 8. The shapes of globes shown in these last three figures are those intended for mantle burners.

In general, the scheme enables a good degree of diffusion to be secured together with almost any peculiarity of distribution that could be wanted, and with a degree of efficiency that is unequaled by any known system of shades or reflectors, unless it be the French lighthouse lenses, as will be presently shown by some details of tests.

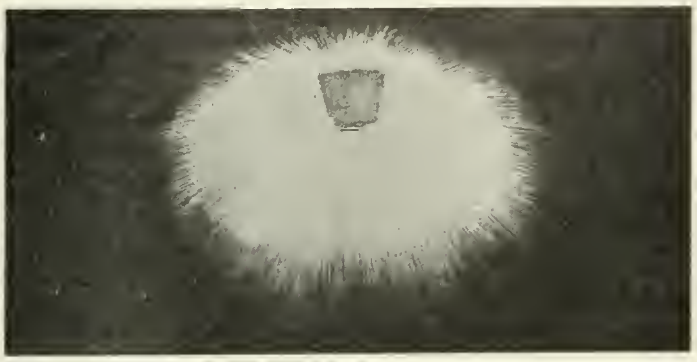


FIG. 7.—MAIN DIFFUSION BELOW THE HORIZONTAL.

One does not generally get such a combination of good qualities without certain disadvantages that must be taken in partial compensation. In the holophane system the weak point is dirt. The doubly grooved surface makes an excellent dust catcher, and a layer of dust can easily be accumulated quite sufficient to cut down the efficiency very materially. And, moreover, a hasty dab with a rag does not clean a holophane globe, it must be gone over carefully and thoroughly. When kept clean, the globes actually will do just what is claimed for them, and are not at all a merely theoretical development superior only on paper, but they *must* be kept clean, and should not be used where they cannot or will not receive proper attention.

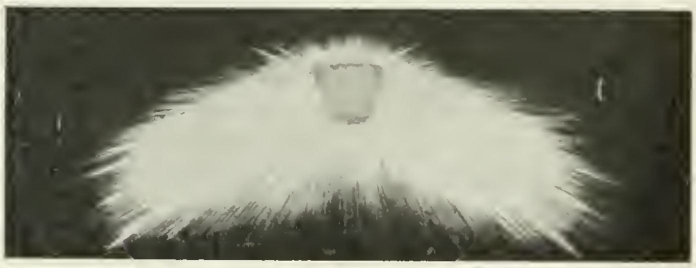


FIG. 8.—HORIZONTAL DIFFUSION.

This is probably the chief reason, aside from the extra cost, why such globes have not been more extensively used for street lighting, to which their power of redistributing the light in the most useful direction admirably fits them. The results obtained in tests of these globes are so striking as to merit examination in some detail.

Telephone Consolidation in Wisconsin.

Negotiations are under way for the consolidation of all the lines of the Fox River Valley, Wolf River and Little Wolf Telephone companies. This consolidation would make the strongest independent telephone company in this State, and one of the largest in the Northwest. The Fox River Company operates a toll line from Kaukauna to Dale, connecting with the Little Wolf toll lines, and is now building a local system in Appleton, besides having franchises for systems in Kaukauna, Neenah and Menasha.

The Wolf River Company has exchanges of 100 each in Waupaca, New London and Weyauwega, besides exchanges in eleven other towns along the Wolf River. The Little Wolf Company has its main exchange of 580 instruments at Fond du Lac, with exchanges also in Oshkosh, Green Bay, Ripon and 61 other towns in the Wolf and Fox River districts as far north as Shawano, Clintonville and Seymour. The consolidation will be under the name of the Fox River Valley Telephone Company, with headquarters at Appleton.

Storage Battery Auxiliaries—I.

By Lamar Lyndon.

In the application of storage batteries to systems on which the delivered power varies, certain auxiliary apparatus is required except in those cases where the battery is placed at the end of a long feeder to compensate for line drop and also to afford power storage. The function of this apparatus is to vary the e. m. f. at the battery terminals with variations of load, causing absorption or discharge of current as conditions may require.

This apparatus generally takes the form of dynamo-electric machines, the e. m. f. of which acts on the battery circuit to raise or lower its e. m. f., and are known as "boosters." It is the purpose of this article to describe the various booster systems in use and to show the conditions to which each is suited.

Boosters are classified as shunt, series, compound, differential and constant current.

The shunt booster is, as its name indicates, a shunt dynamo driven from any source of power, its armature being in series with the circuit from the dynamo to the battery. This booster is used in plants where the battery does not take up load fluctuations, but is of service merely in carrying the peak of the load, being charged during periods of light load and discharged in parallel with the dynamo when the peak of the load comes on.

The series booster is a series dynamo placed in series with the battery and the two connected across the mains. It is suitable only for power work, and is not now commercially used.

The compound and differential boosters are used chiefly on railway and power systems where the drop due to long feeders is troublesome. They may be used on systems supplying both lights and power, but are not so satisfactory for this work as the constant-current booster.

The constant-current booster is used almost exclusively in buildings where lights and power are to be operated from the same system, and where the feeders are short and the line drop not large. It is also being largely used on electric railway and power work, owing to its cheapness as compared with the compound and differential boosters, and the fact that its regulation can be made better with a smaller machine.

"FLOATING" BATTERIES.

In the foregoing, mention was made of batteries being placed at the end of long feeders for the double purpose of reducing the drop due to heavy currents flowing for a short period over the line and, in a measure, to relieve the power station of fluctuations. In such cases the battery is simply connected in parallel with the circuit, and the charge and discharge are effected by the feeder drop.

When a small load only is on the circuit, the feeder drop is small and the potential at the battery terminals is sufficiently high to send a charging current into the battery. A heavy load causes a greater feeder drop, lowering the potential at the far end across which the battery is connected and the battery discharges, operating in parallel with the generator, and supplying an amount of current proportional to the load, and inversely proportional to the distance of the load from the generator compared with the distance between battery and generator.

A clearer understanding of this subject may be obtained from the following analytical discussion:

Let E_0 = generator e. m. f.
E_A = battery e. m. f.
I_x = current from generator.
I_0 = current supply to load.
r_l = total resistance of circuit exclusive of battery resistance.
r_x = resistance of circuit up to point of application of load.
$r_l - r_x$ = resistance from point of application of load to battery.
R = resistance of battery.

Call the average charging current I_{av} amperes where there is no load on the circuit. Then

$$E_0 - I_{av} \times r_l = E_A + I_{av} \times R \qquad (1)$$

$$\text{or, } E_A = E_0 - I_{av}(r_l + R) \qquad (2)$$

Having determined E_A the number of cells in series is fixed and

$=\frac{E_A}{2}=N$ (3), the relation between I_x and I_0 is established by the following equation:

$$E_0 - I_x r_x - (I_x - I_0)(r_l - r_x) = E_A + R(I_x - I_0) \qquad (4)$$

in which $I_x - I_0$ is the current from the generator to battery at any instant. When $(I_x - I_0)$ is negative (load greater than generator current) the battery is discharging.

Solving for I_x in eq. 4, this is found to be

$$I_x = \frac{E_0 - E_A + I_0(R + r_l - r_x)}{r_l + R} \qquad (5)$$

which shows the generator current under any conditions of load or voltage, when the generator is compounded to give a constant e. m. f.

If the generator be a shunt machine another factor must be included. Take, for instance, a shunt dynamo that gives 550 volts at no-load and 520 volts on full-load of 150 amperes.

The maximum voltage is $E_{max} = 550$. The voltage at any load $= E_{max} - I_x h$, in which h is a constant $= .2 = \frac{E_{max} \dot{-} E_{min}}{C_{max}}$

Formula 5 becomes

$$I_x = \frac{E_{max} - E_A + I_0(R + r_l - r_x)}{r_l + R + h} \qquad (6)$$

This formula shows that with a shunt machine the generator *current* variation is less than with a constant potential or compound machine, but that the voltage drop is greater at the point of application of the load.

The floating battery has the advantage of simplicity, and acts instantaneously, as it has no time lag, which is always present in a booster, as the latter depends on changes in its magnetization to effect changes in e. m. f.

The variation in voltage required and the fluctuation in generator load are, however, too great to admit of successful operation on any but a railway or power circuit, and generally a proper booster would help the regulation greatly.

SHUNT BOOSTER.

In cases where there are no sudden changes of load, but in which "peaks" occur, the load changing gradually and requiring a considerable time to rise from minimum to maximum, and descend again, the simple shunt booster is applicable. As before stated, this is a simple shunt machine with its armature in series with the battery, and on charge adds an e. m. f. to the generator e. m. f., the resulting voltage being great enough to send a charging current into the battery. When fully charged, the battery, with all end cells cut out, has a potential approximately equal to that of the generator, and when the load peak comes on it is connected in parallel with the dynamo to the bus-bars and assists the latter to carry the heavy load.

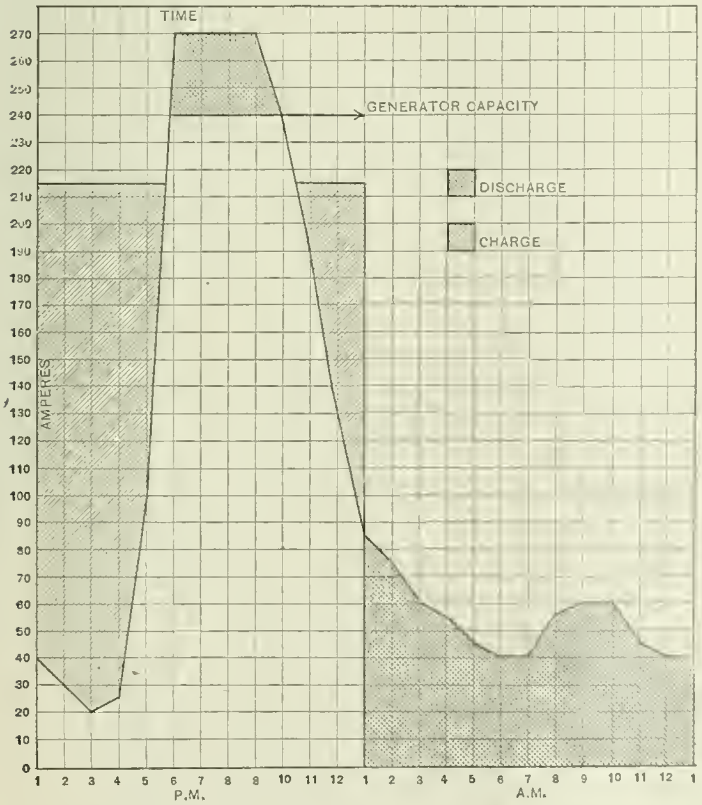


FIG. 1.—LIGHT LOAD DIAGRAM.

Usually the battery is made large enough to carry the entire load during periods when the current demand is small. As the battery discharges and its voltage falls the end cells are cut in and the proper potential thus maintained at the battery terminals. Fig. 1 shows the type of load diagram to which this system is suited.

The e. m. f. of the booster may be varied by means of a rheostat in its field circuit, as is usual with shunt machines. Fig. 2 shows the connections of this system.

In Fig. 2, G is the main generator, B the booster, S_1 a double-pole single-throw switch, S_2 and S_3 single-pole, single-throw switches, S_4 a single-pole, double-throw switch, and S_5 a battery end cell switch.

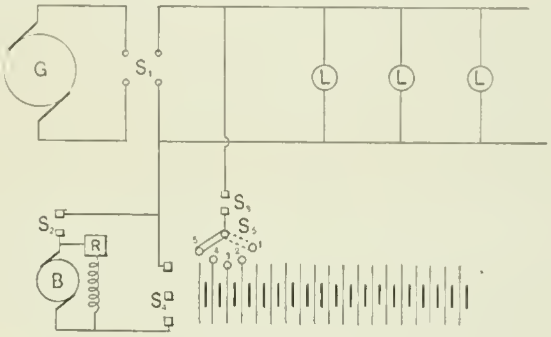


FIG. 2.—CONNECTIONS OF THE SYSTEMS.

To charge, S_1, S_2 and S_3 are closed; S_4 is closed downward and S_5 put on the fifth or last point. Part of the generator current will go into the line and part through the booster into the battery. Charging current is adjusted by means of rheostat R, which varies the e. m. f. of booster.

To discharge, open S_2 and throw S_5 to first point on end cell switch. Next, S_4 should be thrown over to the upper clip. The battery is then in parallel with the generator with all end cells cut out. As the e. m. f. of the battery falls, and cells are cut in by switch S_5. When S_1 is opened the batteries supply the entire load.

The size of the booster required varies with (*a*) the maximum rate of charge; (*b*) the voltage of the systems.

As a concrete example, assume a 110-volt, two-wire system, with a load curve such as shown in Fig. 1. The maximum load here is 270 amperes, and the generator capacity 245 amperes. During the period from 5:30 o'clock to 10 o'clock the load on the external circuit exceeds the generator capacity, and this excess must be supplied by the battery. It is also intended that the battery alone shall furnish current from 1 a. m. to 1 p. m.

From the load diagram the maximum charging current is found. This is seen to be 195 amperes. The maximum booster voltage is found as follows:

If $E_0 =$ generator voltage, then the number of cells in series $= \frac{E_0}{1.8}$; also $\frac{2.5}{1.8} \times E_0 =$ maximum voltage of battery. Let $R =$ resistance of battery circuit, including the booster armature.

Let $I_x =$ current flowing into battery at any time when battery voltage $= E_A$

Then $E_B = E_A + I_x R - E_0$ (7) in which $E_B =$ voltage of booster.

In the case under consideration the total number of cells required is 61. The number of cells required in circuit when the battery voltage is a maximum $= \frac{E_0}{2.5} = 44$. This latter number should be increased, as the voltage of the cells even on slight discharge will fall below 2.5. If 2.3 be taken as the maximum cell voltage on discharge the number will then equal 49. The end cells $= 61 - 49 = 12$. If the normal charge rate of the battery is 40 amperes, assume that it will be one-fourth this amount at full battery voltage, and assume the battery resistance to be 0.2 ohm, then $61 \times 2.5 = 152.5 =$ max. battery voltage, and $10 \times .2. = 2 = \Phi_x R$. Then $154.5 - 110 =$ max. booster voltage $= 44.5$.

As it is sometimes desirable to raise the e. m. f. and charge more rapidly than the normal rate, the booster should always be capable of generating a voltage about 20 per cent in excess of the theoretical. The booster capacity is fixed by knowing the maximum voltage and amperes it will carry.

The power of the motor should be the same as the booster capacity to give rapid charge on rising voltage of battery. Eighty per cent of the theoretical will be large enough an allowance for the machines, as the maximum load endures only a short period. The armature of the booster operating on the system with the load diagram shown in Fig. 1, must be able to carry a load varying from 175 to 195 amperes for three hours. This determines the armature dimensions.

It is to be noted that the shunt booster system is not applicable where sudden fluctuations occur that are great compared with the generator capacity, and that it is not automatic in changing from charge to discharge, this being done by hand. It is, however, simple, does not complicate the switchboard, and fully meets the requirements of systems supplying loads such as shown in Fig. 1.

This type of booster is often installed with a switch to reverse its field and give an e. m. f. assisting the battery to discharge. The field winding may be connected across the bus-bars or battery terminals if desired, the winding, of course, being proportioned to suit the e. m. f. impressed on it. This booster system was patented by H. Ward Leonard, Sept. 2, 1890 (Patent No. 435,700), after an interference by C. O. Mailloux, which was finally adjusted between the parties at issue.

SERIES BOOSTER.

H. W. Leonard's patent of Sept. 2, 1890, also covers the use of series-wound machines as boosters. The connection to the battery is the same as that of the shunt booster—machine and battery in series and connected across the line. With no current flowing into or out of the battery the e. m. f. of booster is zero.

Should the voltage on the line rise because of a decrease of load and a charging current go into the battery, the booster will give an e. m. f. tending to send more current in. The reverse conditions occur when discharge takes place. The series booster acts so as to compound the battery and tends to maintain a constant e. m. f. on the line, whatever the load may be. It depends for its operation on the fact that the generator voltage must rise and fall with the load, and therefore can be used only with a shunt dynamo or its equivalent as the source of supply. This system is suitable only for power work, and is analogous in its operation to the case of the "floating" battery. It is not commercially used, as the compound and differential boosters give better service, under the same conditions.

Charging Facilities for Automobiles.

When the out-of-town use of electric automobiles is discussed the question is often raised in a dubious way, as to the existence of proper facilities for charging and storage of vehicles. We give below an interesting list of the charging plants between New York City and Greenwich, Conn., a distance of possibly 30 miles. It will be seen that there are 10 plants, averaging one to every three miles:

No. 1. West Chester Village, near Morris Park; No. 2. Union Port, electric power house.—Both convenient to Westchester Country Club and Century Golf Club. No. 3. Pelham Manor, near station of N. Y., N. H. & H. R. R., Harlem River branch; convenient to N. Y. Athletic Club, Pelham Country and Golf clubs; at the laboratory of Mr. E. T. Gilliland. No. 4. New Rochelle, Rose and Hugenot Streets, one block from N. Y., N. H. & H. R. R. station, at livery establishment of Mr. Charles H. Coe; vehicles cared for and batteries recharged. No. 5. New Rochelle, electric power house, Webster Avenue. No. 6. Larchmont, Boston Post Road and Chatsworth Avenue, opposite golf links, and convenient to Larchmont Yacht Club; J. Maddox & Sons. This will be a model station for the care of vehicles and recharging of batteries, also the Central office of the company. No. 7. Rye, "Rye School for Riding and Driving," at N. Y., N. H. & H. R. R. station, and the entrance to Apawamis Golf Club; care of vehicles and recharging of batteries. No. 8. Portchester, Portchester Electric power house, after June 1. No. 9. Portchester, directly opposite N. Y., N. H. & H. R. R. station, at livery establishment of Charles H. Benedict; care of vehicles and recharging of batteries. No. 10. Greenwich, after June 1, 1901, near entrance to Fairfield Country Golf Club and at station of N. Y., N. H. & H. R. R., or other locations convenient for residents of Belle Haven.

Scranton's New Independent Telephone Exchange.

By Kempster B. Miller.

Within the past year and a half the Lackawanna Telephone Company, of Scranton, Pa., under the able management of Mr. S. E. Wayland, who is also general manager of the People's Telephone Company, of Wilkesbarre, Scranton's sister city, has planned, contracted for and put into operation a strictly modern telephone exchange to compete with the Bell company in that city. That this exchange was planned and manufactured, and is now being operated by companies in the independent field, will make a description of it more interesting, for it will not only represent what may be considered modern telephone practice of to-day, but will also show the trend of the independent telephone movement in its race with its older and erstwhile stronger competitor.

The exchange was originally planned for 2400 subscribers, but long before it could be installed it was found that this number was inadequate and an order was placed for two additional sections, making the immediate capacity of the original installation 3000 lines. The ultimate capacity of the exchange is 6000 lines. The switchboard is of the relay multiple type, with lamp line signals and central battery, all sources of current, both for talking and signaling, being located at the Central office. The switchboard consists of 10 multiple sections, the equipment of which will be referred to later on.

The exchange is located on the third floor of the Republican Building on Washington Street, directly opposite the courthouse, and the exchange operating room is shown in Fig. 1. The sections now in place are numbered from 1 to 10, while the proposed future extension run up to the full capacity of 6000 lines. This proposed extension will when made necessitate the removal of the partitions between the rooms in the front of the building, which rooms are now used as the general offices of the company. When thus enlarged, the operating room will extend almost the entire length of the building.

The entire central office equipment of the telephone exchange including switchboard, power plant and all inside cables, and also the subscribers' telephones were furnished by the Kellogg Company, of Chicago. The line cables terminate in thirty-two 100-cable heads, arranged in the terminal room on the first floor of the building. The cable heads are of the Cook pattern, and are provided with heat coils and carbon block arresters of the well-known Cook pattern. From the cable heads, which are mounted on iron racks, cables are led through an iron trough or runway, which is suspended 12 inches below the ceiling of the first floor, to the cable shaft, which extends from the first floor to the third floor.

The cables, after leading up the cable shaft, terminate on the line side of the main distributing board. From the switchboard side of the main distributing board, cables are led to the relay frame on which both the lien and cut-off relays are mounted. From this frame cables lead back to the line side of the intermediate distributing frame and from the switchboard side of this latter frame other cables lead to the answering jacks and lamps on the various sections of the switchboard, and still others to the multiple cables running throughout the entire length of the switchboard.

The cables from the cable heads to the main distributing board each have 102 pairs. Those from the main distributing board to the relay have 21 pairs. Those from the relay frame to the intermediate distributing board are 63-wire, each being formed of 21 pairs and 21 single wires to match. The cables from the intermediate distributing frame to the answering jacks and lamps have 63 wires each, and those from the intermediate distributing frame to the multiple runs have 21 pairs each. All of this cable is 24 B. & S. gauge, tinned and insulated with a single wrapping of silk and a single wrapping of cotton, the cotton covering of each wire being colored in conformity with well known color codes. After the wires are bunched in the cables, they are served with a separate wrapping of heavy manilla paper, and are then braided and treated with beeswax.

The connections between the line and the switchboard side of the main distributing frame are made with jumper wire of No. 22 B. & S. gauge, tinned, the insulation being a heavy wrapping of silk and a braid cotton, the whole being saturated in beeswax. This is. of course, in twisted pairs, the colors being red and white. Similar jumper wire is used between the two sides of the intermediate distributing frame.

The function of the main distributing frame is, of course, to change the connection of any line from the outside with any line lead-

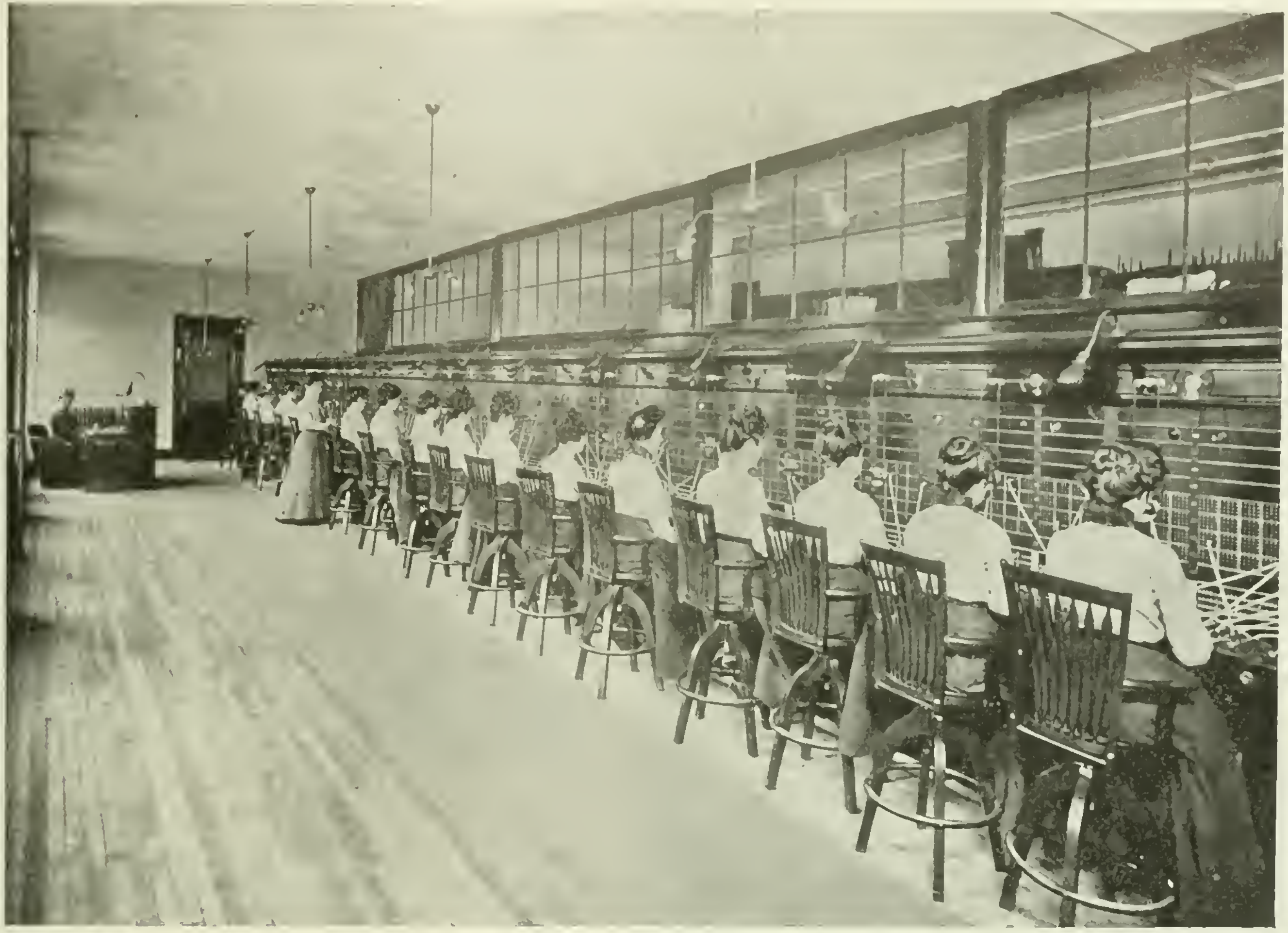


FIG. 1.—FRONT OF BOARD.

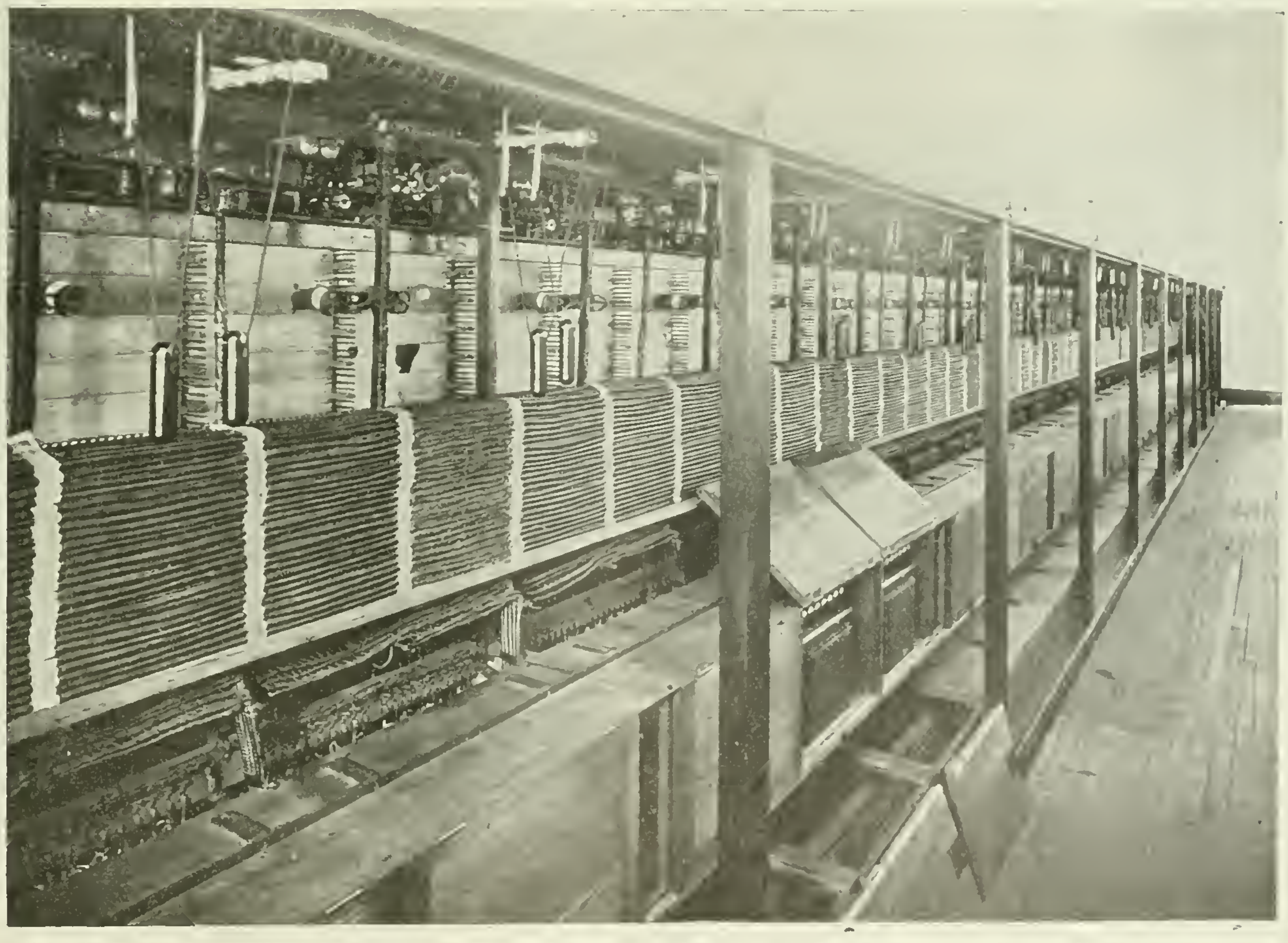


FIG. 2.—REAR OF BOARD.

SCRANTON'S NEW INDEPENDENT TELEPHONE EXCHANGE.

ing to the switchboard. The function of the intermediate distributing frame is to change the relation between the answering jack and line signal, and the corresponding multiple jacks, this latter being for the purpose of the future arrangement or adjustment of the number of answering jacks necessarily handled by any one operator.

The main view of the exchange is shown in Fig. 1, and a front view of a small portion of the board showing the apparatus in greater detail is shown in Fig. 3. This latter figure shows well the arrangement of the brass foot rails at the bottom of the board, and removable panels under the key-shelves and the key-shelves themselves. Also above the key-shelves are shown the answering jacks with the corresponding line lamps. These answering jacks and lamps are arranged 20 per strip, such lamp being just below the corresponding jack. Above the answering jacks and lamps, but separated by white holly strips are the multiple jacks, and above these are the spaces for the multiple jacks required by future growth. These latter spaces are filled by blank ebonized panels. The multiple jacks are divided by white holly strips into banks of five strips, thus making 100 jacks in each bank. Each section of the board is divided by vertical style strips into six panels, there being two panels for each operator's position and three positions for each section. The arrangement for illuminating the face of the board and the suspension of the transmitters is also clearly brought out.

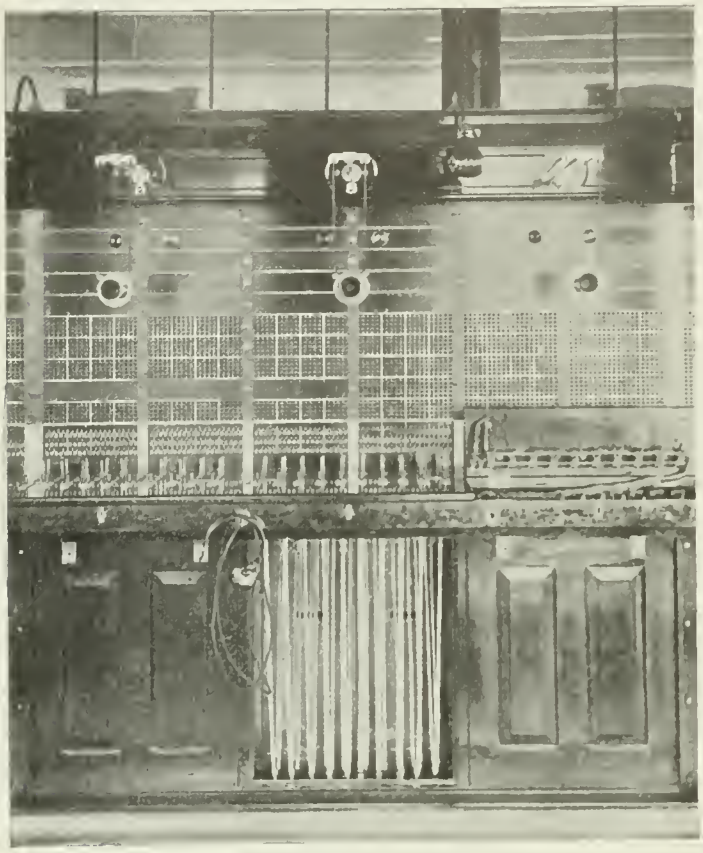


FIG. 3.—A PORTION OF THE BOARD.

Fig. 2 shows a rear view of the switchboards, and perhaps gives one as good an idea as it is possible to obtain, without an actual examination of the exchange itself, of the construction of the switchboard frames and the arrangement of the apparatus and the wiring. One of the greatest problems in the planing of a large switchboard is the arrangement for the systematic stowing away of all the cables and wires in such manner as to give easy access to all wire, and more particularly to all portions of the attached apparatus. It is a problem involving the placing of a great number of parts in a minimum amount of space, and at the same time of making all parts readily accessible at a moment's notice. One is reminded somewhat in looking at the rear of a well constructed and properly maintained multiple switchboard of the interior arrangement of a man-of-war, not on account of any similarity in construction, but principally because of the evident pains taken to secure economy of space, and also because of the extreme neatness everywhere apparent.

Under the roof boards of the switchboard may be seen the power wiring and some small apparatus such as operator's induction coils, pilot relays, etc. Below this, and running the entire length of the 10 sections, may be seen the multiple cables, each of which consists of 21 pairs of wire, each pair in each cable being tapped off at each section and connected with the spring jack at that section belonging to the line represented by the particular pair.

The multiple cables after passing through the entire length of the switchboard are led downwardly through the burning section located at the end of the first section installed. The rear view of the cables in the turning section are more clearly shown in Fig. 4, where it is seen that the entire body of multiple cables are bent down to the floor, after which they pass through a horizontal running box to the proper terminals on the switchboard side of the intermediate distributing frame.

Below the multiple cables may be seen the cables leading to the answering jacks and the line lamps. These cables are, of course, individual to each section, that is, each cable leads to one particular group of answering jacks and line lamps and to no other. From each answering jack and its corresponding lamp, the circuit requirements are such that three wires must be lead to the switchboard side of the intermediate distributing frame, and as the answering jacks and their corresponding line lamps are arranged in units of 20 of each, each of such units is connected with a corresponding terminal strip on the intermediate distributing frame by a 63-wire cable; that is, the cable consists of 21 pairs and 21 single wires.

A general view of the relay frame is shown in the left-hand detail of Fig. 6. This frame is of iron, and upon it are mounted in strips of 20 each the line and cut-off relays. The strips upon which these are mounted are of iron, and as the relays themselves are largely constructed or iron, this arrangement affords a fire-proof construction, whereby, even though a single relay were subjected to a heavy current, which might destroy its winding, it is impossible for it to transmit any damage to the other relays.

The relays strip is of heavy wrought iron, having a large number of holes cut in it for the reception of the screws which hold the relays to the plate, and also for the passage of the relay terminals which project through the mounting strip to the rear. All of such terminals which are common, as, for instance, those which are connected to one terminal of the battery, are made common on the back of the strip by short connecting wires soldered directly to these terminals and to the proper common wires running throughout the length of the strips. The other terminals which, in each case, must be maintained strictly individual to the lien represented by their relays are connected through cables to the switchboard side of the

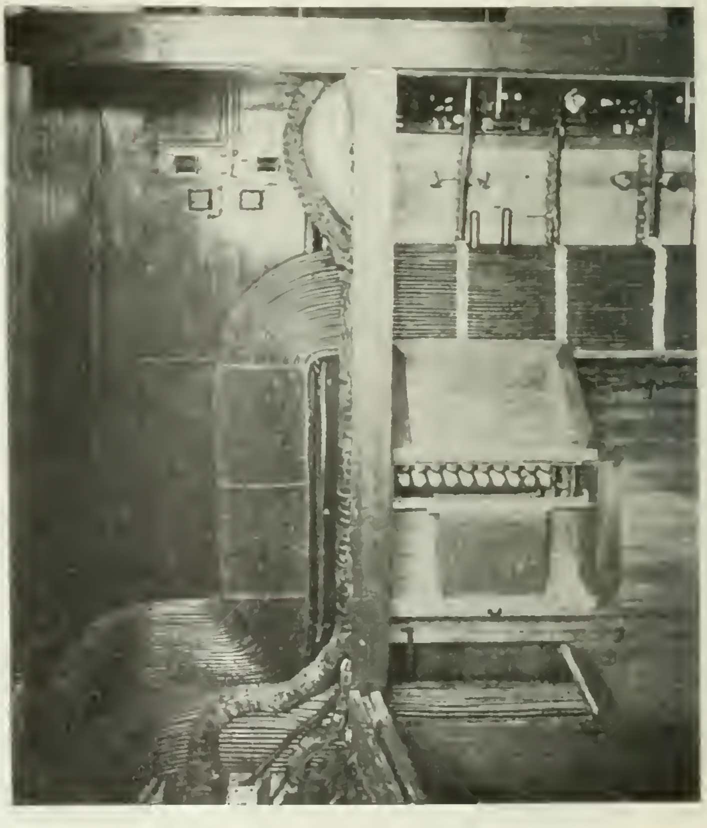


FIG. 4.—CABLES IN TURNING SECTION.

main distributing frame or to the line side of the intermediate distributing frame, as has already been pointed out.

The relays are seen to be mounted in pairs, a small relay alternating with a large one. The large relay in each case is the cut off relay, which is actuated by the operator on plugging into the line to cut off the normally connected line signal, and at the same time to make complete the talking circuit. The small relay is in each case the line relay, the coil of which is placed directly in the line circuit as it normally exists, and the contacts of which serve when the relay is operating to close the circuit of the signaling lamp.

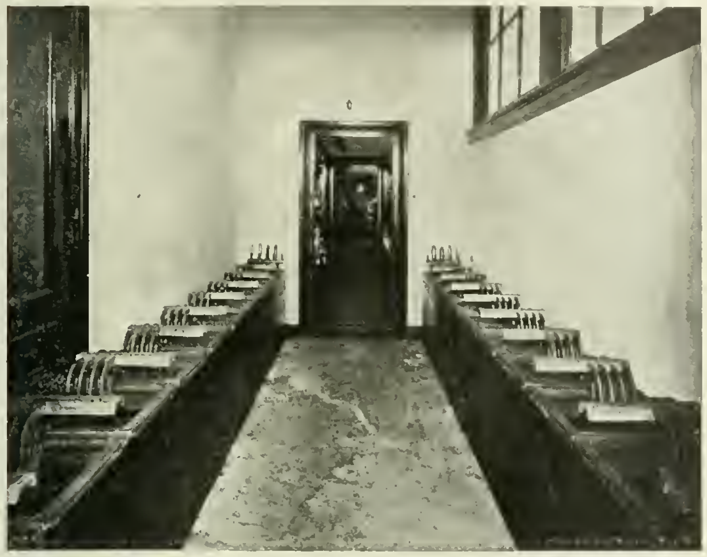


FIG. 5.—STORAGE BATTERY ROOM.

Each switchboard section is at present equipped with 300 answering jacks and line lamps, although arrangement is made whereby this number may be increased or diminished. As each section is provided with three operators' positions, this makes under the present arrangement an average of 100 subscribers to be served by each operator.

For handling connections, each operator's position is provided with 10 pairs of plugs and cords, with ringing and listening keys and supervisory lamps, there being one supervisory lamp for each plug, or two for each pair. The supervisory relays which control the illumination of the supervisory lamps in connection with each plug are mounted in banks of 10 on iron strips fastened directly on the back of the legs of the switchboard section. These relays are so arranged that when a connected subscriber hangs up his receiver, the relay will be actuated, to cause the illumination of the corresponding lamp, but at no other time can the lamp be lighted. As a consequence, it is not until both lamps corresponding to the pair of plugs used in making the connection are illuminated that the operators feels at liberty to pull down the connection.

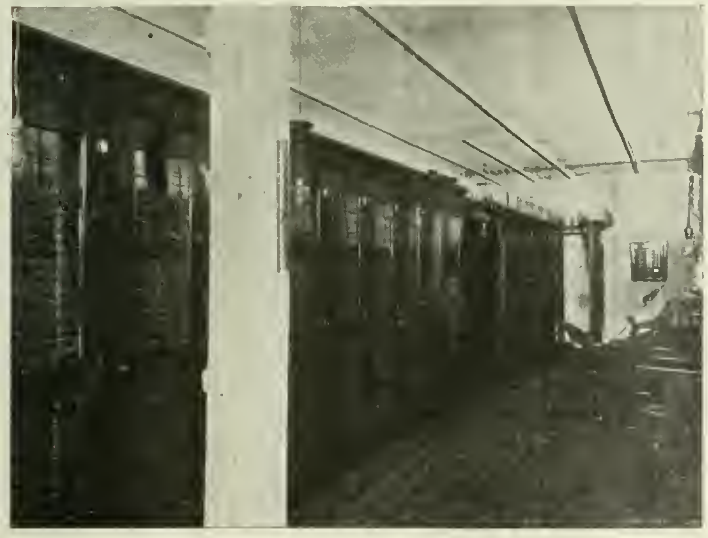


FIG. 6.—RELAY FRAME AND DISTRIBUTING BOARD.

Both line and supervisory lamps are of approximately one-third candle-power, and are adapted to work on 24 volts, which is the voltage furnished by the two storage batteries.

A 3-cp, 24-volt lamp is located at each operator's position; that is, in the second, fourth and sixth panels of each section, and these are used as line pilots, one of these lamps being illuminated whenever and as long as any line lamp on its position is illuminated. Lamps of the same description, but mounted in the first, third and fifth panels of each section are used as supervisory pilots, to show an operator whenever a disconnection is desired at her position. These pilot lamps are merely safeguards against the neglect on the part of an operator to notice one of the small line or supervisory lamps; also being in plain view of the chief operator, they serve as tell-tales to show whether or not the local operators are properly attending to their signals.

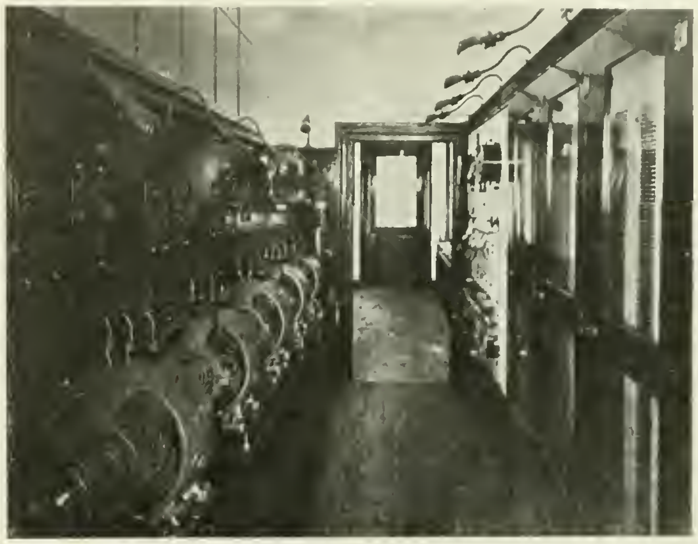


FIG. 7.—POWER ROOM AND SWITCHBOARD.

In Fig. 5 is shown the two storage batteries for supplying all direct currents for the exchange. These batteries each consist of 10 "American" cells. The tanks are of wood, lined with lead. The capacity of the cells, as at present equipped, are 360 ampere-hours each, but when the full number of plates are added, the capacity will be brought to 840 ampere-hours. The storage battery room has a cement floor, with a drain, and means for artificial ventilation is provided. The discharge leads from the batteries lead direct to the fuse board (Fig. 6), in the power room which immediately adjoins the battery room. From this fuse board wires are led to the individual cord circuits at each section, these wires being formed in 11-pair cables, one cable serving each section. This fuse board is of marble in an angle iron

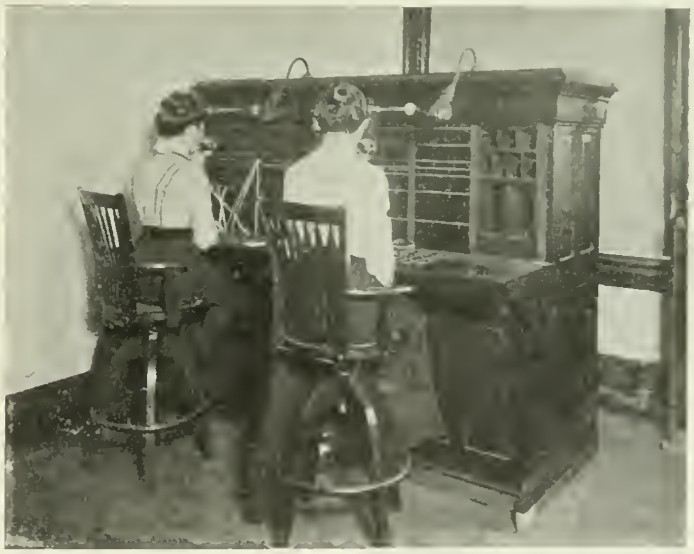


FIG. 8.—TOLL BOARD.

framework, and is shown at the right of Fig. 11, which figure illustrates the complete power plant.

The power switchboard for handling all heavy currents required in the exchange, such, for instance, as the current for the charging and ringing machines and the charging and discharging circuits of the storage batteries, is also shown on the right of Fig. 7. This consists of a marble slab mounted on an iron framework and equipped with a Weston round pattern voltmeter and ammeter, with necessary switches, two circuit breakers, with under and overload attachments, together with the usual full equipment of ammeter shunts and knife switches, and fuses for accomplishing the circuit changes as required.

On the left of Fig. 7 is shown charging and ringing machines. These are mounted on a power table built of angle iron, enclosed in paneled woodwork. The machines are of the Roth type, manufactured in Chicago, and are of the following brief specifications. One ½-hp ringing machine, primary 110 volts direct, secondary 75 volts pulsating and alternating; one ½-hp ringing machine, primary to run off 10 cells of storage battery, secondary 75 volts pulsating and alternating; three 2-hp twin machines for charging, primary 115 volts and secondary 28 volts. These machines are equipped with all necessary starting boxes and field rheostats. By this arrangement, both batteries may be charged at the same time, while the third charging machine may serve as a reserve in case of a breakdown of either one machine. The ringing machine normally runs from 110 volts direct current mains, but if this current fails, the other ringing machine may be run from one of the storage batteries. By this means a temporary shut down of the 110-volt direct-current supply will not cause a corresponding shut down of the exchange on account of lack of ring current.

For handling the toll business in this exchange a separate switchboard section is used. This is provided with a high-wound tubular line signal for each toll line entering the exchange, and also with special toll cords enabling the operators to make a connection through the exchange as from one toll line to another or to connect any toll line through a local toll trunk line with any subscriber in the exchange.

A chief operator's desk is also used, this having two operators' positions, each position having five pairs of cords and plugs, with complement of supervisory lamps and other signals. This board is provided with a modern chief operator's outfit, including listening-in circuits to the various operators' positions on the main board.

The multiple switchboard is built entirely on an angle iron framework, which alone, without the aid of enclosing woodwork, serves to support all apparatus in a rigid manner. The woodwork on the front of the board is mahogany, giving a dead finish, and presents a handsome appearance. The key-shelves are all of five-ply mahogany, the different layers having the grains run in alternate directions in order to prevent warping. The plug-shelves are covered with leather to better withstand the wear and tear of the plugs.

Probably the most striking feature in connection with this exchange is the fact that it is operated on what is known as a "two-wire" multiple system. The circuits of the board have been so simplified that none of the answering or multiple jacks require more than two contacts, and therefore the multiple cables which usually contain three or four wires for each line contain only two for each line. Another advantage derived from the two contact jacks is the fact that two contacts only are required in the plugs, and this makes possible the use of a flexible cord having but two conductors. When it is realized that in a large multiple switchboard one of the greatest items of expense and also one of the most prolific sources of trouble lies in the multiple jacks the reducing of the jack to its simplest form is of manifest importance. Not only is this so from the standpoint of cheapness and freedom from trouble, but the limit of the capacity of the multiple board is determined by the size of the spring jack, or more properly by the closeness with which the spring jacks can be mounted in relation with each other. With the old three, four and five-contact jacks, telephone manufacturers seldom attempted to reduce the size of jacks to such an extent that they could be mounted closer than a half inch apart. It is an easy matter to so reduce the size of a two-point jack as to enable the placing of them with ⅜ inch between centers, and even in extreme cases the distance between centers can be reduced to ¼ inch.

The jacks in the exchange described in this article are mounted on ½-inch centers, horizontally, and 7-16-inch centers vertically. The lamp jacks are ½ inch each way.

Judge Thomas on Independent Telephony.

JUDGE JAMES M. THOMAS, of Cleveland, president of the Independent Telephone Association of the United States, general manager of the United States Telephone Company, the largest long-distance company of the country, has been the central figure of the independent movement, and who is in a better position than perhaps any other person to talk on the operating end of the industry, was asked last week by the Cleveland representative of this paper to present his views on the growth and strength of the independent movement.

Speaking of the history of the independent movement, Judge Thomas stated that the first company to cope with the Bell monopoly commenced business in 1893 in a small town in Kansas. This was immediately after the expiration of the early Bell patents covering the basic principles of the telephone. The movement at once spread with amazing rapidity, especially in the Central States of Ohio, Indiana, Michigan and Iowa. About the middle of 1894 a number of managers of independent companies in Ohio met and organized the Independent Telephone Association, of Ohio. A year later, on June 22, 1895, the Independent Telephone Association of the United States was organized by delegates from seven States. At the fourth annual convention of the association held in Cleveland last year nearly every State and Territory in the country was shown to be represented by independent telephone companies, while the amount invested in the movement was estimated by one authority at $200,000,000.

Speaking of this figure, Judge Thomas said that while he had never prepared an estimate on the subject he thought that $200,000,000 would fall considerably short of the valuation of the entire independent properties of the country. "The Federal Telephone Company alone," said he, "has more than $6,000,000 in cold cash invested in its properties, and besides the long-distance lines of the State, it controls only a small percentage of the total number of companies in Ohio."

Judge Thomas was asked as to the present status of patent litigation. He stated that the expiration of the early Bell patents prior to 1893 had opened the way for the first independent companies. Most of the Edison patents had also expired at that time, and the Berliner patent expired in 1894. The famous Berliner patent case, which has been before the courts for some years, and which was recently settled, was what is known among the independents as the second Berliner patent. The Bell people made an application for a second patent on what was claimed to be the same invention that was patented before. The recent decision of Judge Brown leaves this invention open to the independent field, although it is quite probable that the plaintiffs may decide to appeal the decision to the Circuit Court of Appeals. The Carty patent case covering the method of bridging telephones is now being heard before the Circuit Court at Pittsburg, and the decision will probably be announced in the near future. When this case is disposed of the entire modern telephone system will be open to the world, with the possible exception of some minor patents, more on method than anything else, which can easily be avoided. The switchboard patents are all open, and the highest type of switchboard apparatus, known as the multiple central energy system, is now being built by the independent manufacturers.

Speaking of the extent of the independent toll systems of the country, Judge Thomas said that while several of the more important States are now thoroughly covered with independent toll lines, this branch of the business is still in its infancy. Included in what may be called strictly toll lines, or, more properly speaking, trunk lines, there are probably in the neighborhood of 7000 miles in actual operation. The leading companies and the territories covered are as follows: The New Long Distance Telephone Company covers a territory within a 70-mile radius of Indianapolis, the United Telephone & Telegraph Company, of Bluffton, Ind., covers the territory north of Indianapolis, and the National Telephone & Telegraph Company, of Ft. Wayne, covers that territory. The three companies interchange business and cover the State of Indiana very thoroughly. They operate about 1000 miles of lines. Ohio is covered better than any other State in the country by the lines of the United States Telephone Company, of Cleveland. This company has 2300 miles of line in Ohio alone, connecting about 200 exchanges. The United States Company reaches into Kentucky as far as Ashland and Catlettsburg, into West Virginia as far as Huntington, and has lines extending across Michigan from Toledo to Saginaw and Lansing. The lower end of this line is not yet completed, but in all there are about 150 miles owned by this company in that State. In Michigan there is also the Citizen's Telephone Company, owning about 50 miles around Grand Rapids, and the Union Telephone Company, of Bad Axe, owning about 200 miles in the northern section of the State. These two companies interchange service, and the United States Company has connection with both. The Iowa Telephone & Telegraph Company, of Cedar Rapids, has built a number of lines, and contemplates covering the entire State connecting numerous exchanges already in operation. At St. Louis, the Kinloch Long Distance Telephone Company, which is a part of the independent company in that city, is building considerable territory around St. Louis. It is their intention to cover the whole of Missouri and Western Illinois. This will be a very extensive system when completed, and at present the company has about 500 miles in operation. In Texas, the Texas Telephone & Telegraph Company proposes to connect all the leading exchanges in that State, and already has built about 500 miles of lines. Pennsylvania is being covered by four companies. The Pittsburg & Allegheny Telephone Company, of Pittsburg, has about 100 miles of lines in the neighborhood of Pittsburg. This company has just completed a line to the Pennsylvania boundary, connecting with the United States Company's line, giving through connection from Cleveland to Pittsburg. Eastern Pennsylvania is covered by the Interstate Telephone Company, of Philadelphia, which has about 600 miles in operation. This company is now building a line which will take it into Jersey City. The Union Telephone & Telegraph Company, with headquarters at Erie, has about 300 miles of toll line connecting with Meadeville, Oil City and other important towns. A number of important towns in New York State are being connected by the Consolidated Telephone Company, which, by the way, is a Cleveland organization. This company is building along the lines of the New York Central and Erie railroads, and it is the intention to build clear across the State to connect with New England lines. New England is not yet covered by trunk lines, although the Massachusetts Telephone & Telegraph Company, of Boston, is connecting a number of cities which it is building in that section. A New York organization known as the Telephone, Telegraph & Cable Company has a line connecting New York and Boston with lines touching a number of points on Long Island. The Interstate Telephone & Telegraph Company, of North Carolina, having headquarters at Durham, has several hundred miles of toll lines in that State. The Pittsburg & Allegheny Telephone Company, of Pensylvania, is building toll lines in the vicinity of Baltimore under the name of the Maryland Telephone Company. This company has completed a through line from Hagarstown to Baltimore and then up to Wilmington, Del. It proposes to build on to Philadelphia and also to Washington.

This covers, said Judge Thomas, practically all the main long-distance companies, which correspond to the American Telephone & Telegraph lines of the Bell properties. Of the sectional and local toll lines, no accurate estimate can be reached. The practice of connecting up the farming districts and the small towns in the vicinity of the leading exchanges, is becoming more and more common, and it is this tendency to thoroughly cover their districts with low-priced and satisfactory lines that is accountable for much of the strength of the independent companies. Ohio is undoubtedly the highest example of the independent movement in respect to toll lines. In that State more than 1200 hamlets, villages and towns are now reached by the independent lines. In the majority of cases the counties have been thoroughly connected up by the companies located at the county seats, each company building that section of toll line necessary to connect with the next. The various small systems are given through service by the lines of the United States Company. This plan is being followed in nearly all the States touched by the trunk lines mentioned, and it is only a question of a few years when the entire Eastern and Central sections and much of the Western section will be covered in this manner.

Judge Thomas stated that at the present time it is not possible to talk from New York to Chicago over the independent lines, but he predicts that before very long the entire Eastern half of the continent will be connected by through trunk lines. At the meeting of the Independent Telephone Association of America held last year a committee was appointed to endeavor to make arrangements for through connections with the various long-distance companies, also for traffic rates, so that the receipts from long-distance service could be divided on an equitable basis. It is probable that this committee will have an interesting report to make at the convention to be held in Buffalo.

Judge Thomas expressed himself as averse to the idea that the independent and Bell companies will ever make conciliatory arrangements for the exchange of service. Said he: "If it comes at all, it will be because favorable inducements are made by the Bell people to the individual independent companies, and I feel certain it will not come until competition has forced them to extreme measures. I know of nothing that would lead to such arrangements at the present time. I believe that the future of the telephone business is that there will be two great companies, as in the telegraph business. I do not believe it will be possible, at least for many years, to absorb all of the small independent companies by reason of the somewhat unusual conditions which brought them to life. In nearly every instance the exchanges in small towns were organized by citizens of the towns or surrounding country, who were unable to secure satisfactory service from the Bell people at a reasonable price. They built their exchanges and at once connected up the surrounding districts, thus in a great many cases securing more subscribers than the local Bell company. The investment proved profitable, and now that long-distance service is being given them, the business is increasing and the investment is correspondingly improved. In nine cases out of ten the local stockholders are satisfied with their business, and are inclined to hold on to their properties. Eventually it may be possible to secure the controlling interests in these exchanges by means of an exchange of securities, but I think it would be the work of a lifetime to absorb them absolutely. My opinion is that the toll lines will ultimately come together into some working arrangement, and that the stock of the local companies will be owned about as they are now. Some of the companies will secure control of the larger ones in their territory, but it would not surprise me if in the course of a few years there will be one great independent telephone company that will control the toll lines of the country. The talk of consolidations is in the air at present, and has been during the past year, but so far as I can learn, nothing is being accomplished. They say that the telephone and telegraph companies of the country will get together, but when it comes to working it out, it will he found a difficult propostion."

Judge Thomas was asked as to his opinion of the possibilities of machine telegraphy for night loads. He said: "There are several systems now being experimented upon. I have examined the Delany system, and am satisfied it is a great success. I believe it will be adopted eventually by some of the long-distance companies for furnishing news to daily papers. It would be of immense value for the Associated Press, and would effect great saving in time and cost of sending messages. It seems almost incomprehensible, but it is a fact that you could send enough matter over a single wire in a few minutes to fill one of the big Chicago newspapers. The Delany system accomplishes the work by perforating a roll of paper with a Morse key. You put, say, 40 telegraph operators at work preparing the matter as it is received during the day. They work just as though they were telegraphing, and when the time comes to send the matter to the press, the roll is placed on a machine and transmitted at the rate of 4000 words a minute, being reproduced at the other end in Morse characters. In experiments I have seen the ribbon on the machine stand out straight, 40 ft., the velocity being so great. The Delany device is being experimented with by the Pennsylvania Railroad Company in sending official business, and I believe it is effecting a great saving. Mr. Delany has sold a system to the British Government, and I believe it is to be adopted in connection with their Post Office Department lines. The advantages of such a system for newspaper service can hardly be estimated. The chief feature is that instead of holding the circuits for hours, the news is all sent in a few minutes over a single wire, which saves putting up additional circuits."

Newspapers are rapidly awakening, remarked Judge Thomas, to the advantages of the long-distance telephone in sending messages. At the present time the United States Telephone Company is building a number of special service wires connecting direct with newspaper offices at different points in Ohio. The ordinary instruments are used, and the messages are transmitted as usual by some one who has been trained to talk accurately and rapidly. The messages are received in the newspaper office by a stenographer, written out and handed over to the typesetting machine. It has been found that material for 1200 words can be transmitted in this way in three minutes, and the saving in toll charges is about one-half the cost of telegraphing. This system is bound to grow, but undoubtedly it will eventually be superseded by the machine telegraph."

Speaking of the steps being taken towards standardizing apparatus, Judge Thomas stated that to a large extent this being accomplished by the manufacturers. At the recent meeting of the Ohio association, a committee was appointed to work in this direction, and it is believed that it will only be a question of time when apparatus will be standard, or nearly so. The advent of long-distance lines is doing much to bring this about, since exchange managers have found it impossible to give good long-distance service unless their instruments are similar to those used by other companies. And the increased business through the long-distance service makes it economy to go to the expense of standardizing.

As to the possibilities for independent exchanges in larger cities not now covered, Judge Thomas stated that inside of two or three years all of the important cities of the country will undoubtedly have the independent service. He referred to the situation in a number of the leading centers. In New York the Knickerbocker Telephone Company recently held a meeting and decided to commence the work of construction at once, the necessary capital having all been raised. The people at the head of the New York company are also interested in the independent company at Boston. In New York about 6000 subscribers have already been secured, and in Boston about 5000. At Boston the company has in operation a small system connecting all the hotels, passenger stations and a number of other points, operating in all about 400 telephones. In Philadelphia, the Keystone Telephone Company has commenced construction work, and has the streets torn up for conduits at the present time. A large number of subscribers have been secured. In Chicago, the United Telephone & Telegraph Company has an application before the City Council, and the matter will probably be settled within a few days. At Cincinnati, the Fitzimmons Telephone Manufacturing Company has held a franchise for nearly two years, and has installed about 1100 telephones reaching all the principle hotels and business houses. The company also maintains about 28 miles of toll lines. At the present time the company is making arrangements to extend its system throughout the entire city, and it also proposes to absorb the independent lines at Covington and Newport. It is also making arrangements for long-distance service by building a line to connect with the lines of the United States Telephone Company. At Dayton, Ohio, the independent company has just secured a franchise from the Probate Court after a fight lasting more than two years. Three companies are working for a franchise in Toledo at the present time. One of them has secured 3000 subscribers.

Louisville, Ky., is just starting to build, and a large list has been secured. Memphis, Tenn., has just completed a fine exchange. Work is just being started on an exchange at Youngstown, Ohio, and the same people are building at Portland, Seattle, Tacoma and several other important points in Washington. The Detroit People's Telephone Company was organized recently by Cleveland people to build in Detroit, and it is probable that the same company will build at several other points in Michigan, with toll lines connecting the various points. Thus far franchises have been refused the independent people in Buffalo, Washington and a few other centers, but it will only be a question of time until the people demand lower rates and better service, and admit the independent companies.

"To sum it all up," said the Judge, "the future of the telephone business amounts almost to a question of how soon manufacturers can supply apparatus and material to supply the villages and towns not now covered. At the present time the business is growing faster than it can be taken care of, and there is hardly a large company in the country but what has many subscribers on the waiting list, simply because instruments cannot be secured to connect them up at once. The work in many towns is being held up for the same reason. The question of finance no longer troubles people who are well known as responsible and experienced promotors. The recent decision on the Berliner patent case has done much toward clearing the atmosphere, and together with the remarkable showing made by some of the companies, has furnished capitalists with the assurance that telephone investments are safe and fruitful. On the Cleveland Stock Exchange, telephone securities are now an important factor of the situation. The bonds of the Cuyahoga Telephone Company have all been sold to a local underwriting syndicate, while the bonds of the Columbus Citizen's Telephone Company were first taken by a syndicate and then placed on the bond market. This company recently paid a good dividend, despite the fact it has been doing business less than one year. Recently Columbus bonds were sold as high as 101. The bonds of the Akron company were recently taken up at popular subscription, being the first telephone securities sold in this way in this section. They were taken up within a few days after they were first offered. Bids on Columbus Citizen's stock have advanced to 75, but none is being offered at any price. Cuyahoga Telephone Company's stock has gone up from 5 to 47 in one year."

Judge Thomas has heard from independent managers in all sections of the country, and the probabilities are that the attendance at Buffalo will be much larger than at any previous convention, especially in view of the fact that it gives delegates an opportunity of killing two birds with one stone. A. M. Kellogg, the well-known Chicago manufacturer who has recently visited a number of important centers in the interests of his concern, states that the independent people everywhere are enthusiastic over the work being done by the association, and says that the attendance will eclipse those of previous meetings. More papers than ever will be presented, and the authors have been selected with great care, each of them being the best possible authority on the subject which he will handle

Observations on Desk Telephones.

By G. R. Jenks.

For many years the Bell telephone companies made an extra charge when subscriber's preferred "nickel-plated desk stands" in place of the regulation wall sets. Nowadays some of them are relaxing and are furnishing these at the same rate. Most of the independent companies, however, still charge extra for the desk stand. A quite usual charge is $10 a year, a sum which would pay outright for pretty much any desk stand on the market. The excuse for the charge is that the long cords are hard to keep in repair, and that the instruments are especially liable to damage from falling on the floor. Sometimes it is urged that the extra convenience to the subscriber should be paid for. The subscriber's time is saved by having the telephone at hand all the time, and time is money.

This is perfectly true, but while the subscriber's time is saved by the device, the telephone companies' time is also saved, and in a much greater degree. Not only is the time of the operator economized, so that they can do more work, but there is the time not wasted while subscribers are getting up from their desks and crossing their rooms to answer calls.

The advantages are most felt at points where the telephone plant is most expensive, and where it is necessary to utilize it to the fullest extent, and at points where the measured service is in effect the direct advantage is shown at once. "Busy" calls are not paid for under the measured system, and as desk telephones do the work more promptly, they are not so often busy. It follows that the more desk telephones there are in use, the fewer are the "busy" calls, and the more the calls that are paid for. It was, therefore, at points where the measured service is used that these desk stands were first given without extra charge.

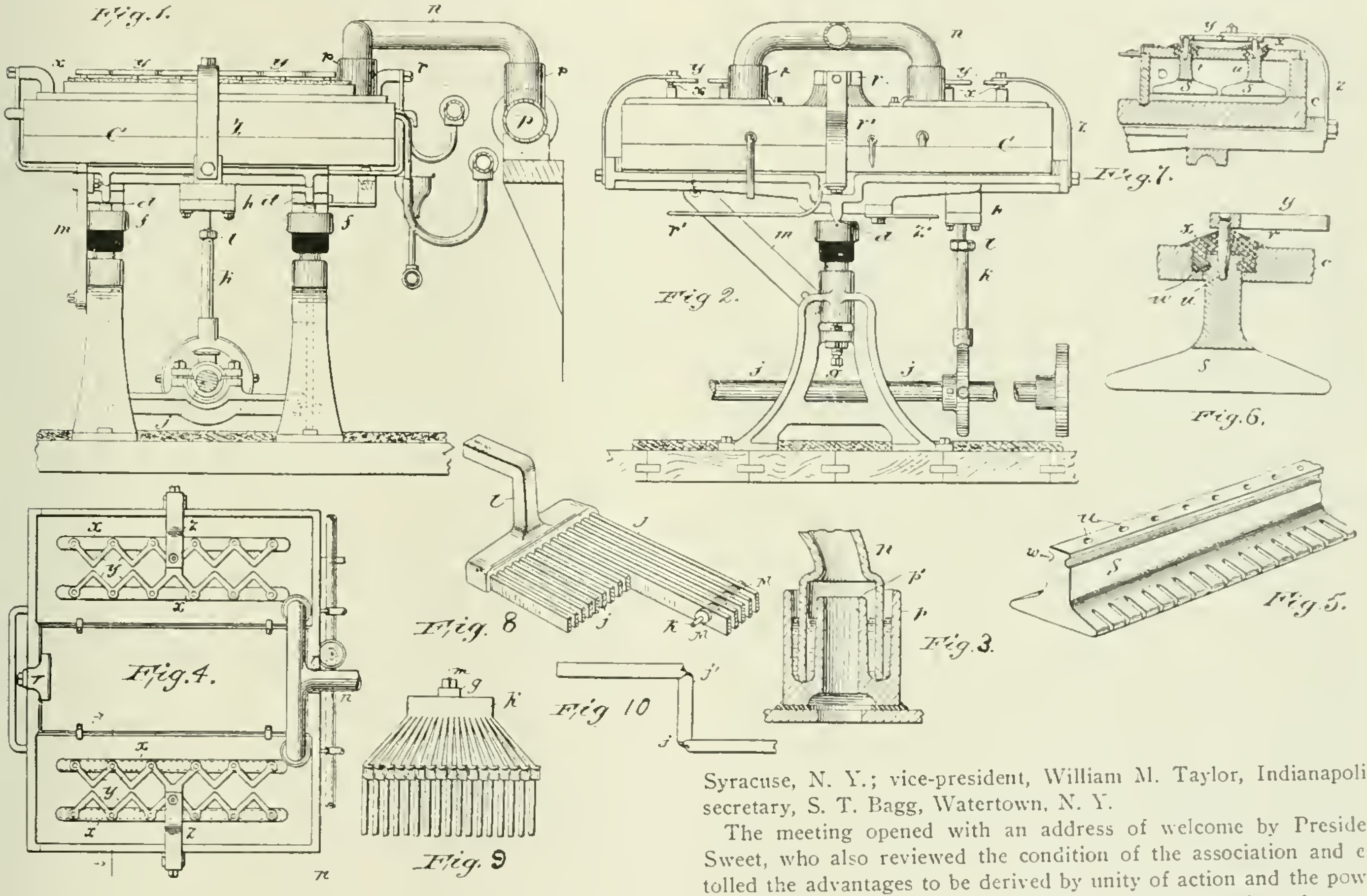
The independents do not go in much for measured service. Indeed, some of them declaim against it, not seeing or not caring to see that under the "unlimited" system the small users of the telephone are paying the large users' bills. In like manner, they do not see that even under the unlimited system the better their service and the fewer their "busy" calls, the more subscribers they will get. When they thoroughly appreciate this we may expect them to be more logical in the matter of charges for desk stands. Possibly they will go even farther and make a reduction when desk stands are used.

Improved Castner Cell.

Details of the Castner electrolytic cell as modified by Mr. Max Mauran of Niagara Falls, are now available through a series of patents, assigned to the Castner Electrolytic Alkali Company, and issued to Mr. Mauran May 28. The patents cover all details of the cell—the supporting and rocking mechanism, the anode, cathode and gas connections—while retaining the general structure, as shown by the original Castner patents, and first installed in the works of the Matthiessen Company at Niagara Falls. This cell, it will be recalled, is simply a rocking trough divided into three compartments by partitions depending into grooves in the bottom plate, the anodes being located in the external compartments and the cathodes intermediate, while a layer of mercury constituting a bi-polar electrode, flows intermittently between the external and intermediate cells, being charged with sodium in the former and regenerated in the latter. The new cell is distinctly practical, presenting the advantages of ready adjustability and easy accessibility for repairs, and is provided with simple but effective electrodes and connections.

As appears from the general views (Figs. 1 and 2), the cell body C is supported at three points—the two knife edges d and the ball and socket joint h—each with an interposed insulator. These three supports are independently adjustable, the knife edges by the set screws g, and the ball through the split tube k and clamping-nut l, permitting the cell to be accurately leveled and therefore to operate with the minimum quantity of mercury. All cells of a series are rocked in unison by a shaft j, through the intermediary of eccentrics and the ball and socket joints. A wooden safety link m insures the cell against upsetting in case of breakage or removal of the eccentric bar. Induction and eduction pipes for the electrolyte and the outlet for the caustic liquor appear at the right of Fig. 1.

The chlorine mains and conduits do not admit of the use of flexible connections with the rocking cell, but are constructed, as shown in detail in Fig. 3, to secure a positive seal without interference with the movements of the cell. A liquid seal p, p', is mounted upon the cover of each anode compartment, and a similar one upon the chlorine main P. Into these seals extend the three downwardly turned ends of a T-shaped earthenware pipe n, latitude being afforded for the necessary side play during oscillations of the cell.



FIGS. 1 TO 10.—IMPROVED CASTNER CELL.

Figs. 4, 5, 6 and 7 show in detail the anodes and connections thereto. The anodes are supported from the cover of the cell instead of being inserted through the side walls as heretofore, and the dangers of breakage and displacement are minimized by substituting for the long series of horizontal pencils, a few relatively large blocks of graphitized carbon having the form of inverted T-bars, the shanks being laterally grooved as at w for a supporting Portland cement seal x, engaging the grooves and the rabbeted edges of the cover. The flanges are channeled by wide saw keys s to permit chlorine bubbles to escape freely. For the electrical connections, the shank of each anode bar is drilled, as at u, to receive a series of carbon pins, preferably ordinary arc light carbons coppered and tinned at their exposed ends, and connected together and to the main current leads z, z', by a zig-zag leaden strip y, soldered to the pencils, and allowing by its form considerable expansion of the parts without snapping the connections or in any way impairing the seal.

Fig. 8 shows a form of cathode consisting of a series of parallel wrought-iron bars j, spaced by bolts and washers K, M, and united by a cast iron head l, a close joint free from any interposed chilled surface being secured by the process known as "burning," a considerable quantity of cast metal being poured through the mold to thoroughly heat the ends of the wrought iron bars before any is allowed to solidify. An alternative form of cathode, in which each wrought iron bar is bent twice sharply upon itself, all of the ends being then welded into a homogeneous bar k, is illustrated by Figs. 9 and 10. The welded ends are tapped to receive the screw m for clamping the negative terminal g.

Meeting of High Speed Engine Builders.

The United States Association of High-Speed Engine Builders met in semi-annual convention in Indianapolis, May 28 and 29. Twenty leading manufacturers, chiefly from the States of New York, Pennsylvania, Rhode Island, Ohio, New Jersey, Illinois and Indiana, were present. The present officers are: President, J. E. Sweet, Syracuse, N. Y.; vice-president, William M. Taylor, Indianapolis; secretary, S. T. Bagg, Watertown, N. Y.

The meeting opened with an address of welcome by President Sweet, who also reviewed the condition of the association and extolled the advantages to be derived by unity of action and the power of association. Professor J. B. Stanwood, of Cincinnati, read a paper on "Experience with Throttling Engines," followed by a paper on "The Relationship of Architects and Engine Builders," by S. H. Brubaker, of Indianapolis. "The architect," said Mr. Brubaker, "had to have a training in so many lines that it was impossible for him to be an expert on engines, but what he did know was apparently not appreciated by the engine builder." This paper brought out many criticisms of a friendly nature, and the countercharge was made that the architects often thought that they knew most about the engines, that they were in the habit of putting the engine-room in some secluded nook, so built around that the machinery had to be put into position before the building was completed. It was decided that it would be a good thing if some concerted action be taken.

A secret session was had for the purpose of regulating certain abuses of the trade, and of reaching some agreement, so that in constructing engines for electrical work there may be more uniformity of pattern, thus simplifying the work. The labor question and the control of prices were kept in the background, as the association is largely social in its character, and has no intention of uniting for the purpose of controlling trade or hampering individual effort. The members of the association were entertained at the Columbia Club at a smoker, and also at a banquet at the Denison Hotel. The secretary read a paper prepared by E. H. Burdeck, of Syracuse, N. Y., on "Conditions and Warranties of Construction Contracts." This paper brought out considerable discussion. The convention adjourned to meet in New York next November, when new officers will be chosen. All expressed themselves as having been well entertained by the people of the Hoosier capital.

Telephonic Consolidation in Pennsylvania.

The directors of the Central Pennsylvania Telephone Company, whose headquarters are at Williamsport, and of the Pennsylvania Telephone Company, whose offices are at Harrisburg, have decided to consolidate the two Bell companies. A meeting of the stockholders of the Central Pennsylvania Company, to approve or disapprove of the consolidation, will be held, it is said, July 25, and as the parent company is in control the change will, of course, be made.

Some improvements will be introduced in the Central Pennsylvania Company's territory by General Manager M. H. Buehler, of the Pennsylvania Company, June 1. The consolidated companies will have the advantage of enlarging their long distance revenues in each other's territory, the largest percentage of which now goes to the American Telephone & Telegraph Company. It is reported that the general offices will be moved to Harrisburg, although this is not certain. Whether the present officials of the Central Pennsylvania company will be retained cannot be learned, and probably is not yet decided.

It is stated that the consolidation of the two telephone companies will be in effect within 60 days, and that the stockholders of the Central Pennsylvania, whose capital is $1,100,000 and the par value of whose stock is $100 per share, paying 6 per cent., will receive in exchange for each share of their stock two shares of the stock of the Pennsylvania Company, whose par value is $50 and dividends 5 per cent.

The territory of the Central Pennsylvania Company is from Scranton to Altoona and from the New York State Bradford County line to the Northumberland line; the Pennsylvania Company's territory runs east to Allentown and Bethlehem, including two counties in New Jersey, and northwest to Lycoming County.

R. M. Bailey will continue as president of the Central Pennsylvania; J. E. Wilkinson as treasurer, and John S. Furst as secretary, until the consolidation becomes operative.

The Poulsen Telegraphone Patents.

The issue of June 1 of the *American Inventor*, printed in Washington, D. C., contains a sensational article under the head of "The Loss of a Million," and relating to a Poulsen telegraphone patent. According to the article, it was recently discovered that the United States patent on this invention is invalid for the reason that it was issued seven days beyond the period which may elapse between the grant of a foreign patent and the application for a United States patent. It is stated that this discovery was made when the patent was being investigated by the attorneys of some capitalists, who wished to buy the American patent, and were willing to pay $1,000,000 for the same. It is also stated that the German patent was sold for $250,000. We print below a communication on the subject of the article from Mr. W. A. Rosenbaum:

"In reply to your inquiry as to the article recently published in a journal known as *The American Inventor*, concerning a patent on the Poulsen telegraphone, in which my name was mentioned, I beg to say that nobody has "lost a million." Mr. Poulsen did not find himself with nothing to sell, and the capitalists who wished to take up the manufacture of this invention and who made this "sensational" discovery, have purchased the patents on the telegraphone, nothwithstanding the discovery, and are quite satisfied with their purchase. The alleged imperfection in the patent referred to affects only one of a long list of patents on the telegraphone, and, furthermore, this particular patent is, in the opinion of many who are competent to judge, far from being invalid.

"I do not, as alleged, lay the blame for the late filing of this application upon my foreign correspondents, and while I did inform the editor of *The American Inventor* that I would give him the facts in the matter if he would delay his article until the next issue of the paper, he has, nevertheless, preferred to publish a garbled and incorrect statement in advance, and I, therefore, consider it undesirable to further discuss the matter in the columns of that paper."

Telephone Press Service.

The Federal Telephone Company, of Cleveland, which controls the long-distance lines of the United States Telephone Company, has closed contracts with the New Democrat Publishing Company, of Canton, Ohio; the Crisis Publishing Company, of East Liverpool, Ohio, and other papers of Stark, Summit and Columbiana counties, for special leased wire service for use in distributing news to the different papers throughout these counties. The United States Company is now building the first branch of the line from Canton to Alliance, from Alliance to Salem, and from Salem to East Liverpool, with branches to different parts of the county. The newspapers of the counties mentioned are also making arrangements for through connection with Cleveland, and will receive their news direct from that city as a center of distribution for all news in Northern and Central Ohio.

Although the system has thus far been worked out only on a limited scale, it has shown a marked saving in time and expense over the old method. The correspondent in sending his matter to the different papers in the district, has the lines all connected at one time, thus there is no need of repeating the message a number of times, and it is not necessary to send the material in skeleton form, leaving it to the tender mercies of the telegraph editor to put it into shape. Each newspaper has its stenographer, and the message is simply read to all clients at once, and taken down in short hand.

The saving in telegraph tolls is remarkable. One of the best-informed newspaper correspondents in the State who recently tried the service made the statement that he could send over the telephone within the three-minute limit for $1.20 what would cost him from $3 to $3.50 in telegraph tolls. Experiments have shown that 1200 words can be read off in three minutes—but not often.

The system is attracting much attention in Ohio, and it is understood that a movement is under way for the formation of a press association for handling news reports over leased telephone circuits. The name of this company has not yet been made public, but it is understood to have the sanction of the Ohio association dailies.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON STEAMER.—A Halifax, N. S., dispatch states that the steamship Lake Champlain arrived on May 30, among those on board being Professor Stacy, sent out from England by Professor Marconi to test the wireless telegraph. Tests were made from the steamship to the station at Holyhead, a distance of 60 miles and also from the steamship to Rosslar, a distance of 70 miles. Messages were sent for many of the passengers. It is said that the tests were highly satisfactory.

ELECTRICAL TIDE INDICATOR.—Through a printer's error, the next to the last paragraph in the article on "An Electrical Tide Indicator," in our issue of May 25, is rendered meaningless—the compositor having omitted four lines and joined part of one sentence to part of another sentence four lines below. The first part of the paragraph referred to should read as follows: "The float, which consists of a closed copper cylinder 12 inches in diameter, *actuates the disk C through the medium of a sprocket wheel and gear and pinions. The float rises and falls in a well 14 inches square with an opening ½ inch in diameter, which serves to minimize the effect of wave action. The disk (Fig. 3) consists of a piece of hard rubber 8 inches in diameter* and ¾ inch thick, having 120 copper pins inserted near its outer edge." The words italicized are those which were omitted.

ELECTRIC RAILWAY MOTOR CONTROL.—A patent issued May 28 to E. C. Parham describes a method of electric railway motor control designed to retain many of the advantages of the series-parallel system and obviate certain of its defects. Assuming two motors, in starting up the two armatures are in parallel and the two fields in series. In series with the fields is also a starting resistance coil. As speed is attained, the starting coil is gradually cut out, and at the final notch of the controller a resistance coil is shunted across the two fields in series, thereby weakening them. The armatures remain in parallel at all positions of the controller, and in series with the fields. While this method of control is not as economical on the lower speeds as the series-parallel system, it is claimed that on the whole it is more economical owing to the use of resistances at several notches in the latter system, which, besides, is seldom used to its greatest advantage owing to ignorant or careless handling. Considerations of first cost and repairs are also said to favor the system patented.

MUNICIPAL ELECTRICIANS.—At meeting of the executive committee of the International Association of Municipal Electricians in Philadelphia the following topics of papers to be read at the sixth annual convention of the association, which will be held at Niagara Falls, N. Y., Sept. 2, 3, 4, were selected and assigned: "The Need and Value of a Set of Rules for Outside Construction," P. H. Trout, Jr., Lynchburg, Va.; "Underground Electrical Construction from a Municipal Standpoint," Edward F. Schurig, Omaha, Neb.; "The Protection of Fire and Police Telegraph Wires from High-Tension Currents and Lightning," W. M. Petty, Rutherford, N. J.; "Improved Storage Battery for Municipal Purposes," J. W. Aydon, Wilmington, Del. A paper will also be read by well-known electrical engineers dealing with the advisability of placing high and low-potential conductors in the same conduits and manholes. The committee consists of Morris W. Mead, president, of Pittsburg, Pa.; John W. Aydon, Wilmington, Del.; Adam Bosch, Newark, N. J.; Frank P. Foster, Corning, N. Y., and Frank C. Mason, of Brooklyn, N. Y. After adjournment, the committee called, by invitation, on Chief Walker, of the Electrical Bureau of Philadelphia, and secured from him a partial promise to appear at the coming meeting of the association, and give the members a talk on "The Lights and Shadows of Municipal Experiences from a Municipal Standpoint." Chief Walker introduced the committee to his successor, John C. Sager, who was already known to the leading members of the association. The committee were entertained by him later at the Hotel Stratford. The Municipal Electricians now have representatives in 110 American and Canadian cities, and are in a flourishing condition. Special arrangements have been made by all the leading railroads, which will permit the members of the association, their families and friends, to attend the association meeting at Niagara Falls, N. Y., Sept. 2, 3, 4, and at the same time visit the Pan-American Exposition, which is being held in Buffalo. Special arrangements for their entertainment have been made by Mayor Butler and Chairman Donohue, of the executive committee of the association. Further details of the programme are in the hands of Mr. F. C. Mason, superintendent of telegraphs, 16 Smith Street, Brooklyn, N. Y.

METALLURGY OF ALUMINUM.—Metallurgical processes which involve the use of calcium carbide as the reducing agent, possess an especial interest due to the fact that they are, in an indirect manner, electro-chemical, for the energy used for the reduction is as truly electrical as though the effect were produced directly by electrolysis instead of indirectly through the medium of the carbide furnace. Hence a discussion of such processes always involves the question of relative efficiencies as between fused bath electrolysis and electric furnace reduction—a question which generally solves in favor of the furnace. This question is raised but not answered by a patent recently issued (May 28) to Mr. Henry Spencer Blackmore, of Mount Vernon, N. Y., for the reduction of aluminum compounds by the reaction therewith of a carbide. Mr. Blackmore finds that aluminum oxide is reducible by aluminum carbide with liberation of the metal of both reacting bodies and in accordance with the equation, $Al_2O_3 + Al_4C_3 = 6\,Al + 3\,CO$, the reaction being strictly analogous to that employed by M. Moissan some years ago for the preparation of metallic chromium. If, however, the oxide and carbide of aluminum be employed in the solid state it is found that the aluminum is either volatilized or so distributed through the residual charge as to render its collection impracticable, and accordingly it is proposed to suspend or dissolve the oxide and carbide in a molten bath, which remains inert with respect thereto, and which so reduces the temperature of the reaction and so alters the character of the medium as to permit the liquid metal to be tapped off. Two procedures are described: In the first, a mixture of cryolite and lithium fluoride is fused, and the oxide and carbide of aluminum are alternately added, the reaction occurring readily, it is said, and the aluminum separating freely. In the second, oxide of aluminum is added to the bath and calcium carbide then introduced, the effect being to produce aluminum carbide within the bath by reaction between the cryolite and the carbide of calcium, this aluminum carbide then reacting with the oxide present to yield the metal. The calcium fluoride formed interferes to no marked degree with the operation, and in the early stages serves to promote the fluidity of the metal. Eventually, however, the bath must be regenerated or renewed. Mr. Blackmore is authority for the statement that he has succeeded in producing aluminum by reduction by calcium carbide, on an experimental scale, at an expense not exceeding 7 cents per pound.

LETTERS TO THE EDITORS.

Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest the editorial comments in the issues of April 27 and May 18 upon the necessity for further college teaching of electro-chemistry along the lines of the modern German theories, and the views expressed by your several correspondents. It is, of course, true that not all phases of the theory as applied to dilute aqueous solutions can be extended to electrolytes of every kind, but the conceptions of the German school afford the best insight into the changes occurring in an aqueous electrolyte, and it would seem unquestionable that a knowledge of them should be acquired by all dealing or expecting to deal with the subject. That such knowledge should be supplemental to and not in substitution for the engineering training which is the prime need, is obvious.

In the course of several years' connection with the Electro-Chemical Division of the Patent Office I have noted with interest the attitude of working electro-chemists with respect to the modern ideas, and have watched for signs of a reaction of the theory upon the practice. The great theories of the past have proven not only explanatory, but eminently suggestive; that in question affords satisfactory explanation of many matters before obscure, but has not as yet modified the practice of any existing industry to any marked degree.

The Patent Office does not require that an applicant explain his process other than by a clear and full statement of the procedure and the result. It does, however, request that the theory be set forth so far as practicable, and it is worthy of note that the statements furnished by the inventors, one and all, adopt the terminology, more or less correctly applied, of the German school. I can only conclude that they have found these modern conceptions to be the most helpful, convenient and expressive as regards the phenomena noted.

Of late indications have not been lacking that suggestions due directly to the dissociation theory will in time react upon the industries. It has been found that when solutions of a dilution corresponding to complete dissociation are employed for the electrolytic manufacture of pigments, a pronounced change comes over the character of the process, affecting both the purity of the products and the ease with which the electrodes are kept clear; the discovery of the new bleaching agent, potassium percarbonate, seems to have followed directly from observations upon the dissociating effect of water at various temperatures upon the soluble carbonates; considerations of solution pressure now govern to a large extent the selection of a cathode for reduction of nitro-compounds; and the direct applicability of the results of dissociation measurements to the preparation of freezing mixtures is recognized. These few instances are sufficient to show that the modern conceptions cannot be safely neglected by any one having to deal with industrial electro-chemical problems.

Clinton Paul Townsend.

Washington, D. C.

Buying Patents.

To the Editors of Electrical World and Engineer:

Sirs.—Applicants for patents are usually so discouraged by the rejection of claims on a prior patent, that they drop the case, unless arguments and amendments are possible. Sometimes, however, the earlier patent is for substantially the same invention, in which case an expedient may be adopted which is too often overlooked. From the fact that within one week I have been engaged to negotiate the purchase of patents from three different patentees of anticipating patents, I thought it would be well to call the attention of manufacturers, inventors and patent solicitors to the expedient of buying up patents that stand in their way. The earlier patentee may have been unsuccessful in introducing his invention into practice, not because of any demerit of the device, but because he has not had the proper facilities, and as a consequence he is apt to be willing to dispose of his rights at a reasonable figure. On one occasion of note in my experience, the patent upon which claims were rejected was owned by a company which had not paid its State taxes for two years. That patent, therefore, cost my clients only $1,300. In another instance a company wanted to pigeon-hole a new system, and I sold the United States patents for my clients at $15,000, and the foreign at $15,000, a small sum in comparison with the loss which would have followed by a new competitor in the field. In another case a manufacturer owned a patent, but by manufacturing, he would infringe a second patent. He knew that he infringed, and, therefore, willingly paid me $3,000 for the patent. There are cases where the patents infringed have been bought at a few hundred dollars instead of a few thousand. It all depends upon the lowest figure the earlier patentee is willing to accept. In conclusion, let the applicant for a patent, as a last resort, authorize his solicitor to obtain an offer from the patentee whose patent is cited by the Patent Office as an anticipation of claims. Should the applicant be a manufacturer or associated with capital, and able to afford an investment, he may conclude that he is fortunate if the patent is not yet introduced, and is not heaping up piles of money to the inventor.

New York City. Edward P. Thompson.

DIGEST
OF
Current Electrical Literature.

Dynamos. Motors and Transformers

Polyphase Working.—Eborall.—An abstract of his third lecture on this subject. He dealt with synchronous motors. A polyphase synchronous motor can be started unloaded partly by virtue of the eddy currents produced in the pole pieces and partly as a hysteresis motor; but it takes two or three times the full-load current to get the motor up to speed of synchronism by this means. Thus when synchronous motors of a large size are used it is desirable to run them up to speed with small induction motors, or in the case of motor-generators to start up if possible with the direct-current machine as a motor. He discussed the variations of the exciting current and the V-curves of synchronous motors. He referred to the regulation of the direct-current voltage of rotary converters by varying the impressed voltage on the slip-rings by connecting in circuit a choking-coil arrangement. This inductive regulator consists of a shunt and series winding one of which is movable to vary the distance between them and consequently the inductance. The regulation can be done quite automatically, however, by compounding the field-magnets of the converter and profiting by the properties of the V-curve. As the current increases, the machine is over-excited, the leading current is increased, and, acting in the opposite direction to the lagging effect of the circuit, increases the voltage. He dealt at some length with the question of hunting. Unlike the generator, where a star connection is preferable, the transformer should have a mesh connection when possible, for the simple reason that with mesh connected coils the set is not wholly broken down should one of the coils fail. He was emphatic in his advice that wherever lighting work is to be done, three-phase transformers should be used in preference to combinations of single-phase transformers, which latter is the American practice. In the three-phase transformer the return path of the flux is through the other two coils, with the result that every transformer acts as a balancer. It is also the cheaper to make, up to 100 kilowatts. In the form in which the three-phase transformer is made in continental Europe, the reluctance is not the same for each of the three magnetic circuits, and hence the no-load current is not the same in each phase. All this amounts to in practice is that where several transformers are used care should be taken to arrange them that the larger currents are not all put in one phase, so as to balance the irregularity. As regards construction, he does not favor the shell type, and prefers a butt joint at the yoke (instead of lapping), on account of the facility it gives for replacing a burnt-out coil.—Lond. *Elec.*, May 17; *Lightning*, May 16.

Lights and Lighting.

Miners' Lamps.—Walker.—The conclusion of his Brit. Inst. Elec. Eng. paper on "Electrical miners' safety lamps." He gave figures of the cost of working of the Sussmann lamp. The figures relate to a batch of 600 lamps in use at the same colliery, but used in three shifts by three sets of men, working at different portions of the 24 hours. The total running cost was 16 cents per lamp per week, against 4 cents per lamp per week, with the old oil lamp. The percentage of failures of lamps which were taken into the pit was, when he left the colliery 0.25 per cent, although at first it was as high as 4.25 per cent, the percentage of failures of oil lamps under the same conditions being 1.25 per cent. He also gave a review of the various attempts to use primary battery lamps as miners' lamps. An account is also given of the extended discussion which followed.—Lond. *Elec.*, May 10.

REFERENCE.

Blue Printing by the Electric Light.—An illustrated description of a method of the Gen. Elec. Co. to use the light of enclosed-arc lamps for making blue prints.—*Eng. News*, May 23.

Power

Electric Installation in a French Mine.—Davies.—An abstract of a paper, read before the Inst. of Mining and Met., in which he gives a description of the electric installation which has been working the argentiferous lead and blende mines at Pierrefitte in the French Pyrenees since 1898. The total fall available was 20.13 meters, and the quantity of water 2200 litres per second. Two 420-hp turbines are installed, directly coupled to dynamos giving 400 amperes at 750 volts, when running at 425 r. p. m This voltage was chosen to permit of interchange of current with the Pierrefitte-Canterets electric railway, which has a 3000-hp station 2 miles higher up the river. There are in all eight motors, one 100 horse-power for compressor, one 30-hp crusher motor, five 28-hp motors for jiggers and vanners, and one 10-hp motor for the machine shop.—Lond. *Elec.*, May 17.

REFERENCE.

Water Power in Switzerland.—Prasil.—A well illustrated article on the development of turbine building in Switzerland and the equipment and capacity of the great turbine-building works, and of the important water-power plants erected in Switzerland since 1889—*Eng. Mag.*, May, June.

Traction.

Accumulator Traction on German Railways.—Gayer.—A paper on the experiments made with accumulator cars on sections of the Bavarian Palatine Railway system These cars are run on sections where there is not enough local traffic to justify the operation of many way trains with steam locomotives, and yet where a frequent service is very desirable. They also act as feeders for through express trains by picking up passengers at way stations and carrying them to the express stopping places. The four cars which were in operation in 1900, covered 58,000 miles on main lines and carried 300,000 passengers, two of these are four-axle cars with a seating capacity of 112 and two are three-axle, carrying 68 passengers. On some of the trips a trailer is carried which adds 50 to the seating capacity. The cars are heated and lighted with current from the accumulators which are placed in wooden boxes under about two-thirds of the seats. These boxes are carefully lined with isolacite and linoleum, have an outlet at the bottom for any acid which may get spilled, and are ventilated to allow the escape of fumes. There are six cells in each box, each cell containing 7 positive and 8 negative plates, 30 square centimeter. The connections are screwed. Each car carries 156 cells, with a guaranteed capacity of 225 ampere-hours, and as only about 120 ampere-hours, on the average are consumed on the longest run, there is a reserve of about 90 per cent. This large reserve was provided in order to avoid discharging the batteries too far, and also to allow for any depreciation. The batteries are charged at the end of every trip for a time varying from 30 to 75 minutes, with a current of 150 to 200 amperes. For each car there are two four-pole motors, which drive both axles of the truck through gearing with a ratio of 1 to 3. The cars run at an average speed of about 24 miles per hour, and cover about 90 miles a day. The empty cars weigh about 57,000 lbs., the batteries about 33,000 lbs., and the motors

8800 lbs., a total of about 99,000. When carrying 106 passengers, a motorman and a conductor, the total weight is about 117,000 lbs., or about 14,600 lbs. load per wheel. The cost of such a car with its electric equipment is given at about $13,750. Allowing for depreciation of the battery and assuming its electrical efficiency to be 65 per cent, and the price of 1 kilowatt-hour to be 24 cents, it is found that the total operating expense, taking interest, depreciation and everything else into consideration, is 10.5 cents per car mile, or 0.1 cent per seat-mile. These figures are lower than those for steam traction under similar conditions.—*Glaser's Annalen;* abstracted in *Eng. Mag.*, June.

Kingsland Surface Contact System.—An illustrated description of the surface contact system devised by Kingsland and exhibited in operation on an experimental track at Wolverhampton. The principal feature of the system is the use of a revolving tappet wheel to work the switches, operated by "striker bars" attached to the cars. The wheel is placed in a slot between the tram rail and an additional rail, into which the striker bar projects, and the switch is enclosed in a water-tight box beneath the pavement. The contact studs are, as usual, placed midway between the rails, and the return circuit is made by the rails themselves. It is claimed that the operation of the switches by a positive mechanical action does away with the difficulties and uncertainty with which the surface contact principle has generally been associated. The details of the system are described and illustrated.—Lond. *Elec. Rev.*, May 10. Further descriptions of this system in Lond. *Elec., Elec. Rev.*, May 17. The latter journal makes some criticism, but considers the system eminently practical, and the only surface contact system on which it would pin its faith for permanency.

Economy of Electric Traction in France.—A discussion of the experiences of six French tramway systems which have recently changed over from animal to electric traction, the results being analyzed in a number of tables. The most characteristic feature of the substitution of electric traction for animal is the increase in the number of passengers carried, which varied between 209 and 37 per cent. The frequency of traffic is one of the most telling causes for the popularity of the electric roads. The following opinion of de Marchena is quoted. When a line is overloaded with passengers, the receipts increase in proportion to the number of cars in service, but after reaching a certain point, which might be called the "saturation point," the increase in receipts grow less than the increased frequency of service. Nevertheless, when the operating expenses are small, it is profitable for the road to pass this point and increase the service as long as the extra receipts exceed the extra expenses. "With electric traction in particular, a railway is not being worked to the best advantage until the activity of circulation is such that each car carries only a few passengers." The increase in gross receipts varied from 158 to 49 per cent. The receipts per car mile show a decrease, varying between 24 and 0 per cent. The decrease in operating expense per car mile carried, between 53 and 15 per cent. But owing to the much greater number of car-miles with electric traction, the total operating expenses increased. This increase varied between 90 and 36 per cent, but was in every case less than the increase in gross receipts, so that there was a gain in the net receipts, varying between 1035 and 136 per cent. Notwithstanding the much larger investments due to the electric equipment, there is an increase in the rate of dividends in every case with two exceptions, where it was governed by local circumstances.—*Le Genie Civil;* abstracted at some length in *Eng. Mag.*, June.

Massachusetts.—A long illustrated article on the street railway system of the Massachusetts Electric Companies.—*St. R'y Rev.*, May 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Great Grimsby.—An illustrated description of this British municipal electric plant. The generating sets comprise three 150-hp steam dynamos, running at 550 r. p. m., and two 75-hp steam balancers running at 550 revolutions. The larger dynamos are designed to have an output of 192 amperes at 480 volts when running at normal speed, but they are also capable of running steadily at any e. m. f. from 460 to 520 volts as shunt machines from no-load to full-load, with a variation of speed not exceeding 5 per cent from the normal, and they carry 20 per cent overload for a short time. These machines are also compound wound for working the system of tramways that is being introduced, the compound winding being so proportioned as to raise the voltage from 500 at no-load to 550 at full-load without adjustment of the shunt regulating resistance or alteration of the engine governor. There is also a battery of Tudor cells for the day-lighting load, capable of giving 60 amperes for five hours, or 120 amperes for 30 minutes. They are charged by two boosters driven by a single motor. The charging current is 60 amperes, and the boosters raise the station voltage 10 to 70 volts, as desired when running at 1000 r. p. m., or 90 volts with a 5 per cent increase of speed.—Lond. *Elec.*, May 17.

Hartford.—A long illustrated description of the Hartford Electric Light Company's system. There are two separate hydraulic stations at which 500-volt, two-phase current is generated, transformed to 10,000-volt, three-phase by the Scott system and transmitted to the central receiving station in the city. At this station is also placed the steam auxiliary. Operated in connection with it is a sub-station in which the current generated both by the steam plant and the water-power plants is transformed and converted for distribution, and where a balancing storage battery is installed, while smaller sub-stations in other portions of the city take care of the constant current (alternating) arc lighting system.—*Elec. Rev.*, May 18.

REFERENCE.

Heating from Central Stations.—Adams.—The first part of an article on the design of pipes for hot-water heating from central stations.—*Elec. Rev.*, May 18.

WIRES, WIRING AND CONDUITS.

Insulation Resistance of Gloves for Wiremen.—Janet.—A paper read before the Internat. Soc. of Elec. in Paris, in which he gives an account of laboratory experiments with low and high pressure. He measured the insulation resistance of six different types of insulating gloves for wiremen at a pressure of 105 volts, first in dry and then in wet condition. For the dry tests each glove was filled with mercury and suspended to a height of 8 inches in a basin of mercury. For the wet tests instead of the mercury fine sand was used, moistened with acidulated water. The insulation resistance in megohms was found to be for the six types, as follows: 0, 0; 0, 0; 540, 4; 4800, 420; 6200, 24; 52,500, 157; the first numbers referring to the dry tests and the second to the wet tests, respectively. He also made wet tests for determining the effective e. m. f., at which the gloves broke down under high-pressure alternating currents. Three types broke down at low voltage, while three other types broke down at 2500, 1000 and 11,000 volts efficiency, respectively. These six types of gloves had been tested on account of a competition, arranged by the Assoc. of Manufacturers of France for preventing accidents, in order to better the manufacture of insulating gloves for wiremen. In the discussion which followed Hillairet said these tests confirmed his opinion, that insulating gloves cannot generally be regarded as an effective protection, and that it would be better to forbid their use than to rely upon them in contact with dangerous conductors. Wiremen with gloves should not touch the conductors directly, but only such parts as are already insulated, like the non-metallic handles of interrupters.—*Bull. de la Soc. Int. des Elec.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Conductivity of Air and Salt Vapors.—Wilson.—An abstract of a Royal Society paper, in which he describes experiments undertaken to obtain information on the variation of the conductivity of air and of salt vapors with change of temperature, and on the maximum current which a definite amount of salt in the form of vapor can carry. Among other things he found that the maximum current carried by the salt vapor (at 1300 degs. with 800 volts) was found to be nearly equal to that required to electrolyze the same amount of salt in a solution. He regards this fact as considerable evidence in favor of the view that the ions are of the same nature in the two cases.—Lond. *Elec.*, May 17.

Influence of Pressure and Temperature on Dielectric Constants.—Koenigsberger.—A development of equations differing essentially from those of Thomson, Drude, Duhem, and others, owing to the fact that he takes into account certain quantities of energy not considered by those authors and which, he thinks, makes a great difference in the case of high dielectric and magnetic constants. He shows that "in solid and liquid bodies the change of a parameter in the electric field has a different effect from that which it would have outside the electric field (or the magnetic field in magnetic substances), and that when such substances are electrified, the phenomenon of electrostriction, of Thomson's heating, etc., must be observed."—*Ann. der Physik*, No. 5; abstracted in Lond. *Elec.*, May 17.

Disruptive Discharge in Electrolytes.—Broca and Turchini.—In experimenting with electric oscillations of a wave-length of some

400 meters, corresponding to a frequency of about 1,000,000 per second, they found that the properties of an electrolyte placed in the discharge circuit were profoundly modified. Under favorable conditions very powerful disruptive discharges passed through highly conducting liquids, thus showing that for this order of frequency the electrolytes behave as dielectrics. They believe that at sufficiently high frequencies all transparent electrolytes behave as dielectrics.—*Comptes Rendus,* April 15; abstracted in Lond. *Elec.,* May 17.

Oscillating Sparks.—Hemsalech.—An ordinary spark has a very irregular shape, owing to the irregular distribution of the metallic vapor given off by the electrodes. Besides, the luminous track produced by the initial discharge is strongly marked. He has, however, found that if a variable inductance is inserted in the circuit, then on increasing the inductance the shape of the spark becomes more and more regular, and the initial discharge recedes more and more into the background so that eventually the discharge appears to consist entirely of incandescent vapor. The shape then taken by the spark is that of a sphere or ellipsoid, with its major axis along the discharge path.—*Comptes Rendus,* April 15; abstracted in Lond. *Elec.,* May 17.

Vacuum Tube Discharge.—Korn.—If two electrodes, mounted in a vacuum tube about 2 cm. apart, are both connected with the negative pole of an influence machine or an induction coil, and a discharge is produced, a bright surface appears between the electrodes, and when one of them is lengthened, the surface approaches the corresponding electrode. This phenomenon was first described in Jaumann and used by him to support his theory of longitudinal light. His experiments have been repeated by the present author, who has added an interesting new fact. The bright blue trace of the "*J*-surface" on the wall of the tube is not always straight. It is, in fact, generally wave-shaped and the displacements of the surface are marked by a simultaneous progression or retrogression of the wave-line.—*Ann. der Physik,* No. 5; abstracted in Lond. *Elec.,* May 17.

Becquerel Rays.—Rutherford.—An account of an investigation of the effect of heating radio-active thorium compounds. Red heat increases the radio-activity to about three times its original value. White heat destroys it almost completely, and cooling the specimen leads to no recovery. If the temperature never exceeded a red heat, the preparation returns to its normal activity on cooling, but a bright red heat considerably retards the process. The behavior of radium preparations is very much more remarkable. A bright red heat increases the radio-activity 5000 times. Further heating seems to interfere with or partly destroys the radio-activity at the lower temperatures. He inclines to the conclusion that the radio-activity is due to some chemical process within the material. Dorn's observation that the radio-activity is increased by moisture confirms this supposition.—*Phys. Zeit.,* April 20; abstracted in Lond. *Elec.,* May 10.

REFERENCE.

Wimshurst Machine.—A French Academy note on the theory of the Wimshurst machine without sectors.—*L'Elec.,* May 11.

Electro-Chemistry and Batteries.

Porosity in Storage Battery Plates.—Fay.—A comparison of the Plante and Faure types of accumulator plates. For the Faure type it has generally been supposed that the active material is so porous that a thickness of 0.4 inch of the salts in compressed pastilles would not be excessive, but this supposition is only correct, provided reference is made to batteries in which the rate of discharge is based on 10 hours for the complete discharge, and, furthermore, provided the active material is not dense as it would be if applied under great pressure. Plates made of pastilles often harden in service, especially in vehicle work, so that the porosity is diminished. The watt output per pound in batteries of this class is about as follows: Ninety per cent of rating up to the 20th discharge, 100 per cent of rating from the 20th to the 50th discharge; 83 per cent from the 50th dicharge, the changes being gradual. This result is based on the observations of the performance of over 300 batteries in actual service, the negative pastilles being about three-eighths of an inch thick. The porosity factor does not affect the electro-chemically formed plate, as it does the pastille type. He gives a comparison of both types, the weight of complete cell is 33 lbs. for the electro-chemically formed type and 34.75 lbs. for the pastille type, respectively. The weight of element only 25.5 lbs. and 27.5 lbs.; the weight of electrolyte 6 and 5.75 lbs.; the output rate in amperes 30 and 30; the duration of discharge 5 and 4 hours; the ampere-hour output 150 and 120 ampere-hours. The electro-chemical type, weighing about 95 per cent of the weight of the other type, gives 100 per cent output as against 80 per cent output for the other type, taking the electro-chemical type in comparison at a time when the other type is at its best. He says that batteries in which the output depends to any great extent on porosity, like the pastille type, will not survive, in vehicle work at any rate. He recommends for electro-chemically formed plates to have plates weighing about 7 lbs. per square foot, so grooved and then formed as to give the output below under these conditions. Weight of lead per cell 78 per cent, electrolyte 17 per cent, jar and separator 5 per cent; output at the rate of 5 amperes per pound, at a 5-hour rate of discharge, when formed to the maximum, reference being had to vehicle batteries in which the plates are about 50 per cent higher than they are wide. On this basis the life of the electro-chemical type of battery will be commercial and a delivery wagon equipped with such a battery will cover 240 miles per week, on 0 charges of the battery.—*Elec. Rev.,* May 18.

Copper Process.—Zwaluwenberg.—A brief article on the extraction plant of the Arlington Copper Company at Arlington, N. J. The ore consists of sandstone and shale impregnated with a number of compounds of copper, principally the green carbonate, with small proportions of chalcocite, a silicate, and an occasional color of cuprite. The ore is to be treated by a method which varies little in principle from the Siemens & Halske process for the treatment of similar ores, but differing considerably in the manner of manipulating the material. The copper will be extracted from the ore by a leaching operation, the solvent consisting originally of dilute sulphuric acid, but after being used for some time containing considerable ferric sulphate. Before it is subjected to the action of the solvent, the ore will be dried, crushed and roasted. The solution containing the dissolved copper will be subjected to electrolysis, the copper being obtained in metallic form and ferric sulphate regenerated at the anode, thus rendering the liquor available for the extraction of copper from a fresh portion of ore. It is expected that the solution can be used for some time before becoming seriously fouled by soluble substances present in the ore.—*Eng. and Min. Jour.,* May 25.

Behavior of the Aluminum Anode.—Bartorelli.—An account of measurements with the voltameter. He uses a sulphuric acid solution of 5 per cent in volume, and a platinum cathode and an aluminum anode. For a current density between 0.004 and 0.1 ampere per square centimeter, he found that the ohmic resistance of the voltameter decreases with increasing current density, that it is independent of the distance of the electrodes and inversely proportional to their cross-section. Further, that the polarization e. m. f. depends only upon the current density and increases with increasing current density, the increase which is small in the beginning, gradually becomes smaller and tends to a certain limit.—*Phys. Zeit.,* May 11.

REFERENCES.

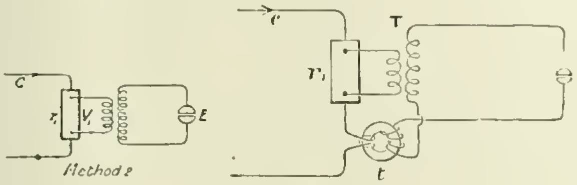
Determination of Copper.—Smith.—A detailed description of an electrolytic method of determination of copper, which he thinks to be by far the best, where not more than 10 assays are required daily.—*Eng. and Min. Jour.,* May 25.

Benzidine.—Loeb.—An account of a continuation of his researches on the electrolytic production of benzidine.—*Zeit. f. Elektrochemie,* May 9.

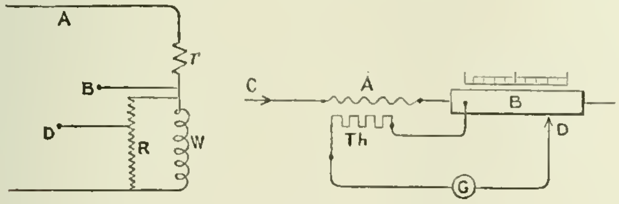
Lowering of Freezing Points.—MacGregor.—The first part of a paper on a diagram of the lowering of freezing points of electrolytes.—*Elektrochem. Zeit.,* May.

Units, Measurements and Instruments.

Alternating-Current Measurements.—Campbell.—An illustrated Brit. Inst. Elec. Eng. paper on test-room methods of alternating-current measurements. He first deals with transformer methods of measuring current, voltage and power. One well-known method is to send the whole current to be measured through the primary coil of a transformer, the secondary of which is connected to an ammeter. For this method it is necessary to have an air-core transformer, or one with a well-closed iron circuit, also relatively low resistance and high inductance in the secondary circuit. Another method, shown in Fig. 1, is to pass the current through a low non-inductive resistance r_1, giving a small voltage drop, which is transformed up so as to give readings on the electrostatic voltmeter *E*. Here the measuring instrument, being electrostatic, is unaffected by variations in frequency, and, if of good type, has a very high degree of accuracy. For currents from 5 amperes and upwards, the resistance r_1 should be so small that not more than 0.5, or at most, 1 volt, is lost in it. If the voltmeter reads to about 120 volts, this necessitates a high transformation ratio, at least 1:100, in the transformer. To keep the voltmeter readings proportional to the current, he finds it best to use a transformer with a well-closed iron circuit and a highly inductive primary coil of very low resistance. While for the latter reason a considerable weight of either iron or copper would be required, he shows in a numerical example that very fair accuracy may be attained with quite a small transformer. It is possible, however, to compensate for changes of frequency by the modification shown in Fig. 2. Here the total current *c*, after passing through the small resistance r_1, passes through a turn or two on a very small compensating transformer *t*, whose secondary is connected (reversed) in series with the secondary of the main transformer *T* and the voltmeter. As the frequency is raised, the transformer *t* subtracts more and more from the voltmeter reading, and thus compensation can be secured. He then describes several methods of measuring power, among them the following modification of the usual three-voltmeter method, which gets over the difficulty that in order to get good readings the auxiliary resistance would use up a considerable fraction of the total available voltage, and would tend to alter the wave-forms in the circuit. In Fig. 3, *r* is a relatively small resistance and *R* a very high resistance in parallel with the load *W*. A convenient fraction, say, the *n*th part, is picked off *R* by the part *B D*, and the three-voltmeter method is applied to *A B D*. The result, multiplied by *n*, gives the power taken by *W*. He then refers briefly to the measurement of power-phase differences close to 180 degs., and discusses at some length the testing of watt-hourmeters with real non-inductive loads, inductive loads, and fictitious loads. He mentions thermopile methods and describes the interesting zero method of measuring direct current, shown in Fig. 4. The current passes, wholly or in part, through the thin wire *A* and also through *B*, a strip or rod of very low resistance. The heating of *A* by the current causes the thermopile *Th* to give an e. m. f. *e* which is balanced against a part of the voltage drop along *B* by moving the slider *D* until the deflection of the detector galvanometer *G* is brought to zero. The graduations of the scale of the slider are directly proportional to the current measured. He then describes a method of obtaining steady currents with varying supply voltage. He accomplishes this by means of a Wheatstone bridge arrangement with two different metals for the wires, of large and small temperature coefficients, respectively. The method is described and its function is explained by diagrams. The paper is concluded by some remarks on zero methods of measuring current.—Lond. *Elec. Rev.*, May 10, 17.



FIGS. 1 AND 2.



FIGS. 3 AND 4.

Alternating-Current Measurement.—ADDENBROOKE.—A communication in favor of his electrostatic instruments. He compares briefly the dynamometer with the electrometer as a watt-meter. He says that he has worked out carefully a complete scheme for calibrating and operating a set of instruments on the dynamometer principles, on as similar lines to his own as he could, and that he came to the conclusion that to ensure equal accuracy and equal facilities, the dynamometer set would be much the more cumbrous and costly, besides which several advantages are wanting which are readily obtainable with an electrostatic method.—Lond. *Elec.*, May 10.

REFERENCES.

Industrial Magnetic Measurements.—MONTPELLIER and ALIAMET.—A continuation of their illustrated serial. They describe the torsion permeameter of Carpentier and the magnetic bridge of Holden.—*L'Elec.*, April 20.

Registering Instruments.—PERRIN.—A long illustrated paper read before the Internat. Soc. of Elec., in Paris, in which he gives a description of a large number of instruments for registering current, e. m. f. and power curves.—*Bull de la Soc. Internat. des Elec.*, April.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Acoustic and Electric Constants of the Telephone.—WIEN.—An interesting investigation of the question how much the telephone, as an electromagnetic apparatus on the one hand and as an acoustic apparatus on the other, is sensitive for various frequencies to the same degree. This question is fundamental for a distortionless transmission of speech. He determined the acoustic and electric constants of the following four telephones: A Bell telephone, an older telephone by Siemens & Halske, a newer telephone by Siemens & Halske, and a box telephone by Apel, of Goettingen. The distinctness of speech was about the same in all the four telephones. To show how the current depends on the frequency for constant e. m. f. he gives in a table the effective resistance and inductance of the four telephones for frequencies varying between 0 (constant current) and 16,000. The effective resistance, in accordance with the greater loss of energy through eddy currents, rapidly rises with increasing frequencies, and even attains the 13-fold value of the original resistance in the newer Siemens telephone. The Bell telephone has by far the smallest resistance of the four. The effective resistance, on the other hand, decreases, most of all in the old Siemens telephone, when it falls to about one-fifth of its value for 256 periods. The latter change is of great influence at the higher frequencies, as it causes an increase of the current at constant e. m. f., and an increase of the loudness of the higher notes. On the other side, the magnetic induction falls with increasing frequency and reduces the amplitude of the diaphragm and the intensity of the higher notes. There are, therefore, two opposing influences. Whether they just compensate each other at a certain point or whether the higher notes are strengthened or enfeebled, depends upon external conditions, such as the resistance and capacity of the line, etc. Of wider influence are the purely acoustic properties of the telephone. He gives a table of the sensitiveness of the four telephones, determined by him by measuring the current strength in hundred-millionths of an ampere, that produced a current which he could just perceive with certainty at break and make with his right ear, for 13 frequencies varying between 64 and 16,000 periods per second. The Bell telephone has all along a smaller sensitiveness than the other three instruments, in accordance with its smaller resistance. All the four telephones show a specially high sensitiveness for the currents between the pitches 500 and 3000. Both downward and upward the sensitiveness decreases rapidly, so that, for instance, in a Bell telephone for *N* equals 64, a nearly 10,000-fold current intensity, or a more than 100,000,000-fold current energy is required to produce an audible note than for *N* equals 1024. This steep fall in the sensitiveness for high and low pitches cannot be explained solely by the acoustic properties of the telephone or the proper notes of the diaphragm, but is most largely due to the variations in the sensitiveness of the human ear. The most important and characteristic notes of the human voice fall between the pitches 500 and 3000, where all the four telephones show the greatest sensitiveness. This circumstance probably conduces greatly to the distinctness of transmission. On the other hand, the differences in sensitiveness for comparatively small differences of pitch are very great just within this range, since the most important proper notes of the diaphragm fall within it. The human ear has, however, an astonishing sensibility for the characteristic marks of the vowels and consonants, which are not even obliterated by the great changes in the timbre bound to take place in consequence of the acoustic and electromagnetic properties of the telephone.—*Ann. der Physik*, IV., 3; translated in Lond. *Elec.*, May 10.

REFERENCES.

Wireless Telegraphy.—An illustrated description of the Popoff-Ducretet apparatus for wireless telegraphy.—*Sc. Amer.*, May 25.

Telephone Switchboard.—An illustrated description of the telephone switchboard used by the German Mail Department, which is also in charge of telephony in that country.—*Elek. Zeit.*, May 2.

MISCELLANEOUS.

Response in Living and Non-Living Matter.—An editorial on Dr. Bose's theory of response in livng and non-living matter, propounded by him in a recent Royal Institution paper. His researches lead to the discovery of an universal action underlying certain phenomena in both living and inorganic matter. He discussed the responses of living muscles and nerves to different kinds of stimuli and their representation by diagrams. He then discussed the response of inorganic or non-living matter. When a piece of wire is placed in a galvanic circuit and one end of the wire is momentarily subjected to mechanical stimulus, as by twisting or tapping it, an electrical response takes place in the form of a current between the injured or stimulated end and the normal end of the wire. He experiments with an apparatus for measuring and recording such responses and found that the response and recovery curves obtainable from it correspond in the closest possible degree with the physiological curves obtained from living nerve and muscle.—Lond. *Elec.*, May 17.

REFERENCE.

Paris Exposition.—The 18th part of the illustrated serial, dealing with the telephone exhibit of the British Post Office, the Siemens & Halske 14,000-subscriber flat board, the Commelin & Viau gas accumulator and an electrically-driven dogcart of English make.—Lond. *Elec.*, May 17.

New Books.

Jahrbuch fur Elektrochemie. V. und VI. Jahrgang, 1898-99. Von Dr. W. Nernst und Dr. W. Borchers. Halle: Wilhelm Knapp. Volume for 1898, 496 pages and 195 illustrations. Price, 20 marks. Volume for 1899, 431 pages and 204 illustrations. Price, 16 marks.

One of the serious disadvantages resulting from the increasing amount of technical literature published at the present time, is that the busy man, who is generally the very one who wishes to keep posted on new or important developments, cannot read it all and often, cannot even take time to pick out from the large amount published, that part (usually a small fraction), which is of permanent value. It is therefore of great value to any profession if some one capable of doing so, collects and publishes annually all that which is worth keeping for reference. This is what is being done for the science and industry of electro-chemistry, in this excellent annual publication, of which the above are the two latest volumes published. It may safely be said of this work what can be said of comparatively few, that it should be in the hands of every one interested in this subject. To the busy man it will save its cost many times over.

Of the two authors, Nernst is so well known to electro-chemists for his scientific work that his name is a sufficient guarantee that the scientific side is in able hands. The other author, Borchers, has also achieved some international fame as editor of one of the best journals on electro-chemistry, although we regret to say that he is often too apt to introduce his personal views in a very decided way; in the comparatively young science and industry of electro-chemistry it does not always follow that if there is a difference of opinion, one of the parties must necessarily be entirely wrong. The present work, however, is a well digested and arranged compilation, and is therefore largely free from personal views of the editors, although opinions are often expressed, which, coming from authorities, are generally reliable and conservative and add to the value of the book.

Besides these two authors there are associated with them in the preparation of this book, Prof. Dr. Elbs, who has charge of all that which refers to the generation of current, accumulators, and organic compounds; Prof. Kuester, in charge of electric analyses, and Prof. Danneel, who cares for the purely scientific subjects. Prof. Borchers prepared the portion on electro-metallurgy and apparatus. Nothing appears over the name of Nernst, who may therefore be more of a general consultant.

The subjects are well arranged and classified, so that if one wants to know what has appeared on a certain subject, it will all be found together under that title. The matter consists mostly of a digest of all that appeared on each subject, including tables of data, and illustrations when necessary, and is always accompanied by references to the original journals. In some cases references are also given to articles which, being of less importance, are not abstracted. At the conclusion of each section there is a list of patents with their reference numbers, issued in the principal countries during the year. Each volume concludes with a two-page list of the best books on this and allied subjects published during the current year; also, a list of technical and scientific journals, which, however, is quite incomplete. This is followed by a very long index by authors and another by subjects. There is also a good table of contents at the beginning of the book.

The preparation of this annual involves considerable work, as it is not a mere collection of individual abstracts, but rather a connected account, and it is hoped that the quality of the work in succeeding years will continue to be as good, notwithstanding the fact that both Nernst and Borchers have recently severed their connection with the *Zeitschrift fuer Elektrochemie*, of which they were joint editors for a number of years, and in which capacity they had an excellent opportunity of remaining posted on what was being published.

Instruments et Méthodes de Mesures Électriques Industrielles. H. Armagnat. Paris: Georges Carré et C. Naud. 586 pages, many illustrations. Price, 12 francs.

The greater part of this book is a collection of a series of articles by the author, which appeared some time ago in one of the leading French electrical journals and were noticed and abstracted at the time in the Digest of this journal, the readers of which are therefore already familiar with the substance of the book. The author, as the head of the measuring department of one of the leading electrical and physical instrument makers of the world (Carpentier of Paris), has naturally had extended and valuable experience with electrical instruments, their theory, and their design, and he may therefore safely be considered an authority on this subject.

The book is divided into two parts, the first on instruments and the second on measurements. The first chapter deals with the general theory of instruments giving deflections, and includes discussions of the theories of suspensions, deflections, oscillations, etc., and the best arrangement of suspension systems, etc. as found from practice. This is followed by such general subjects as the scales, mirrors, beams of light, etc., and the laws governing them. The succeeding chapters are devoted each to one class of instrument, with the theory of its action, formulas used therewith, illustrations of forms of the instruments, etc.

In the second part, which constitutes about one-third of the book, the theories of the various methods of measurements are given, beginning with a discussion of the question of errors, a chapter being devoted to each class of measurements—not only the more usual, but also those not generally included in books on measurements, such as those relating to co-efficients of induction, magnetic fields, magnetic properties of iron, etc.

In general, the treatment of the subject is of a high class, involving a thorough knowledge of the theories of measurements and instruments, and the book will be found to be very useful to those who work with or are interested in electrical instruments, chiefly of the higher class for laboratory and research work. Commercial measurements, and those in shops, as in the testing of electrical machines and transformers, are not included, as the subject is treated in a general way, leaving it to the one who uses the methods to select the one best adapted.

As the author is associated with an instrument maker, the instruments described are naturally those of this maker. In fact, much of the book deals with this particular maker's styles and types of instruments, which is not to its discredit, as they have a world-wide reputation, but this limits the scope of the work more than is desirable, as other makers also make good instruments. The Weston instruments, for instance, which are so well known, are, it seems, not even mentioned in the whole book. While the maker with whom the author is associated, may not, and to the knowledge of the reviewer does not, approve of the Weston type of instrument, this is no reason why they should not be mentioned, though perhaps they are excluded as being a commercial instrument which can be used without a knowledge of its theory or properties.

Some bias is also shown in other subjects. For instance, while numerous pages are devoted to the Clark standard cell, and several to the Daniell, the Weston cadmium cell, which is recognized by such a high authority as the Reichsanstalt to be the superior, is referred to only in a few lines, which state that it has a very small temperature co-efficient, adding that the tests made with it have not been sufficiently numerous (as though the number of tests was of more importance than their quality) to give an exact idea of its properties. The author was evidently not familiar with the work of the Reichsanstalt with this standard cell. The Daniell standard cell, on the other hand, which the reviewer believes to be nearly obsolete, is said to be one of the most constant, and most used. While thus the book may be highly recommended and contains much that is useful, it is not quite as broad and impartial as might be desired.

BOOKS RECEIVED.

ELEKTRISCHE VERBRAUCHSMESSER DER NEUZEIT. Von Johannes Zacharias. Halle: Verlag von Wilhelm Knapp. 351 pages, 195 illustrations. Price, 15 marks.

CENTRAL ELECTRICAL STATIONS. Their Design, Organization and Management. By Charles Henry Wordingham, A. K. C. London: Charles Griffin & Co., Limited. Philadelphia: J. B. Lippincott Company. 496 pages, 136 illustrations. Price, $7.50.

ATOMS AND ENERGIES. By D. A. Murray. New York: A. S. Barnes & Co. 202 pages, with diagrams. Price, $1.25.

CENTRAL STATION EXPERIENCES. A Series of Narratives on the Trials and Tribulations of a Steam Engineer while Learning to Run an Electric Station. From *Power*. New York: The Power Publishing Company. 106 pages, illustrated. Price, 75 cents.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Buffalo, N. Y., June 19, 20 and 21, 1901.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES. Next meeting, Buffalo, N. Y., June 11, 12 and 13, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

OLD TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., Sept. 4, 1901.

The General Electric Pan-American Exhibit.

THE first large exhibit to be completed in Electricity Building at the Pan-American Exposition was that of the General Electric Company. In view of the delay in getting most of the exhibits in this building ready, this enterprise on the part of the company's representatives who planned and installed the exhibit was most commendable. The more so as the exhibit is such a large and comprehensive one, including types of all of the company's modern apparatus and supplies. The company occupies the entire northwest corner of the building. The Exposition service sub-station for decorative lighting consisting of 19 air-cooled transformers, of 250-kw capacity each, with the necessary switching apparatus, was rented to the Exposition Company by the General Electric Company, and forms part of its exhibit. This bank of transformers takes Niagara power at 11,000 volts, and transforms down to 18,000 volts for supplying the decorative illumination of the buildings, which is the great electrical feature of the Pan-American. The main 11,000-volt circuit to this sub-station is opened by one of the new electrically operated three-pole oil-break switches of the type which will be first commercially used on a large scale in the power house and sub-stations of the Manhattan Elevated Railway in New York, and which has already been described in these columns. It is operated by an electric motor from a small switch on the main panel of the switchboard. The first movement of the electric motor releases springs which throw the switch open to make a quick break, and the motor then continues running until it has put the springs under tension to make the return stroke. When the springs have been compressed the motor circuit is automatically opened at a contact on the switch operating mechanism. The motor always runs the same way for both opening and closing, and the reciprocating motion necessary to open and close the switch is furnished by a crank which the motor operates through the medium of a worm gear. The motor circuit operating the switch is controlled either by hand from the main panel of the switchboard or by a magnetic overload-circuit breaker on the main panel, which closes the motor switch in case of a short circuit on the line. The coils of this circuit breaker are connected with a small series transformer in the main circuit. The main 11,000-volt circuit, after leaving the main switch, supplies six banks of transformers, and in the circuit to each bank is a hand-operated three-pole oil switch.

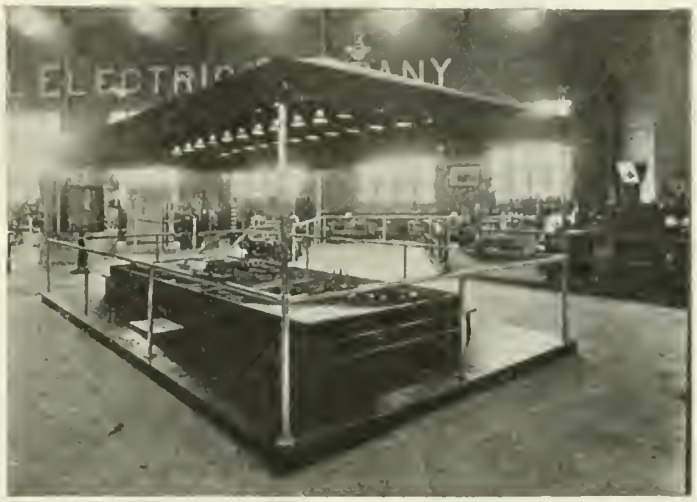


FIG. 1.—MODEL OF THE GENERAL ELECTRIC COMPANY'S WORKS.

The main panel has, in addition to the motor switch operating the main switch and the circuit-breaker switch, a polyphase Thomson recording wattmeter. The 1800-volt secondaries of the 18 transformers are all connected onto a common set of bus-bars from which 12 three-phase feeder circuits are taken for the distribution around the buildings. Each feeder circuit has a three-pole oil switch, hand operated, and an indicating wattmeter.

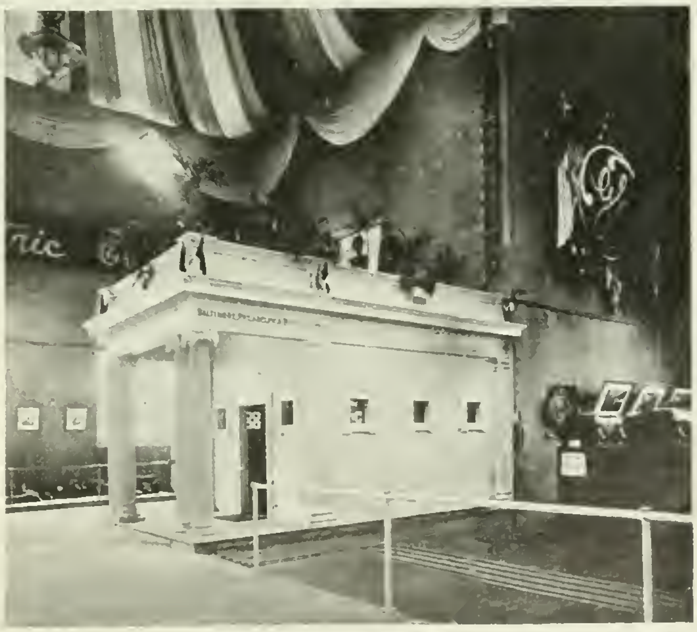


FIG. 2.—HEADQUARTERS.

Probably the first thing to attract attention in the General Electric exhibit is the big field ring, which is one of five being built for the Niagara Falls Power Company's new plant. It is for a 5000-hp generator of a construction similar to that of the machines in the present plant. It is of nickel steel of a tensile strength of 40,000 lbs. per square inch within the elastic limit, weighs 17 tons and is 12 ft. in diameter outside. It will be remembered that this field ring is the revolving part on the Niagara machines, hence the necessity for great tensile strength.

After the field ring, the next most prominent piece in the exhibit is a 200-kw, three-phase alternator, of the new compensated revolving field type, having the exciter geared to the main armature shaft. By gearing the exciter, it can be maintained at a definite phase relation with reference to the armature. By putting three collector rings on the exciter armature and connecting them to the secondary of a transformer in series in the main circuit, the voltage of the exciter is increased with the load without the introduction of any rectifying devices. It is also pointed out that the drop in voltage with inductive load is better compensated for by this method than by any automatic method heretofore introduced. The 200-kw generator in the exhibit is designed for direct connection to engine or water-wheel and runs 200 r. p. m.

The operative part of the company's exhibit (outside of the Exposition sub-station which is separated by a railing from the General Electric Company's regular exhibit), begins with a bank of three 50-kw oil-cooled transformers operating on Niagara power at 25 cycles, and reducing from 1800 to 360 volts. A 200-hp synchronous motor is run every evening belted to a 100-kw compensated revolving field type alternator running 1900 r. p. m., which furnishes 2300-volt alternating 60-cycle current to two 75-light constant current series transformers, which light the Electricity Building. It also supplies a 5-light model of a constant-current transformer, made with a glass case so that the operation of regulation can be watched. This is supplying five enclosed-alternating arcs and one series incandescent. A very commendable feature of the arc lamp exhibit is that of putting very dark inner globes around the arc so that the action of the arc can be observed, and surrounding the feeding mechanism with glass instead of metal so that the feeding mechanism can also be observed. These lamps belong to what the company calls the interchangeable type. All use the same globes and casings, and differ from each other only in the mechanism necessary for the different circuits.

The mining department is well represented by a 10-ton mining locomotive which is one of a number built for the Union Pacific Coal Company. It is 30-inch gauge, and has 3500 lbs. draw-bar pull at 8 inches per hour. The brake shoes can be removed through doors in the top and the journal boxes can be taken out of the sides. Next to the mining locomotive is an electric mining hoist built by the Lidgerwood Manufacturing Company, 96 Liberty Street, New York, to which a G. E. 52-railway motor is geared. A further mining exhibit is a 50-hp three-phase induction motor geared by single reduction to a three-cylinder pump running 150 r. p. m.

The marine exhibit has one of the General Electric Company's neat 15-kw marine units consisting of a high-speed engine direct connected to a generator running 400 r. p m. There is also a demonstrative exhibit of the use of tell-tale lamps in connection with bow and side lamps. When one of the bow or side lamps breaks, a relay in the pilot house lights up some danger lights before the pilot. Then by the pilot throwing a switch, a reserve lamp can be thrown in, at whatever lantern it is needed.

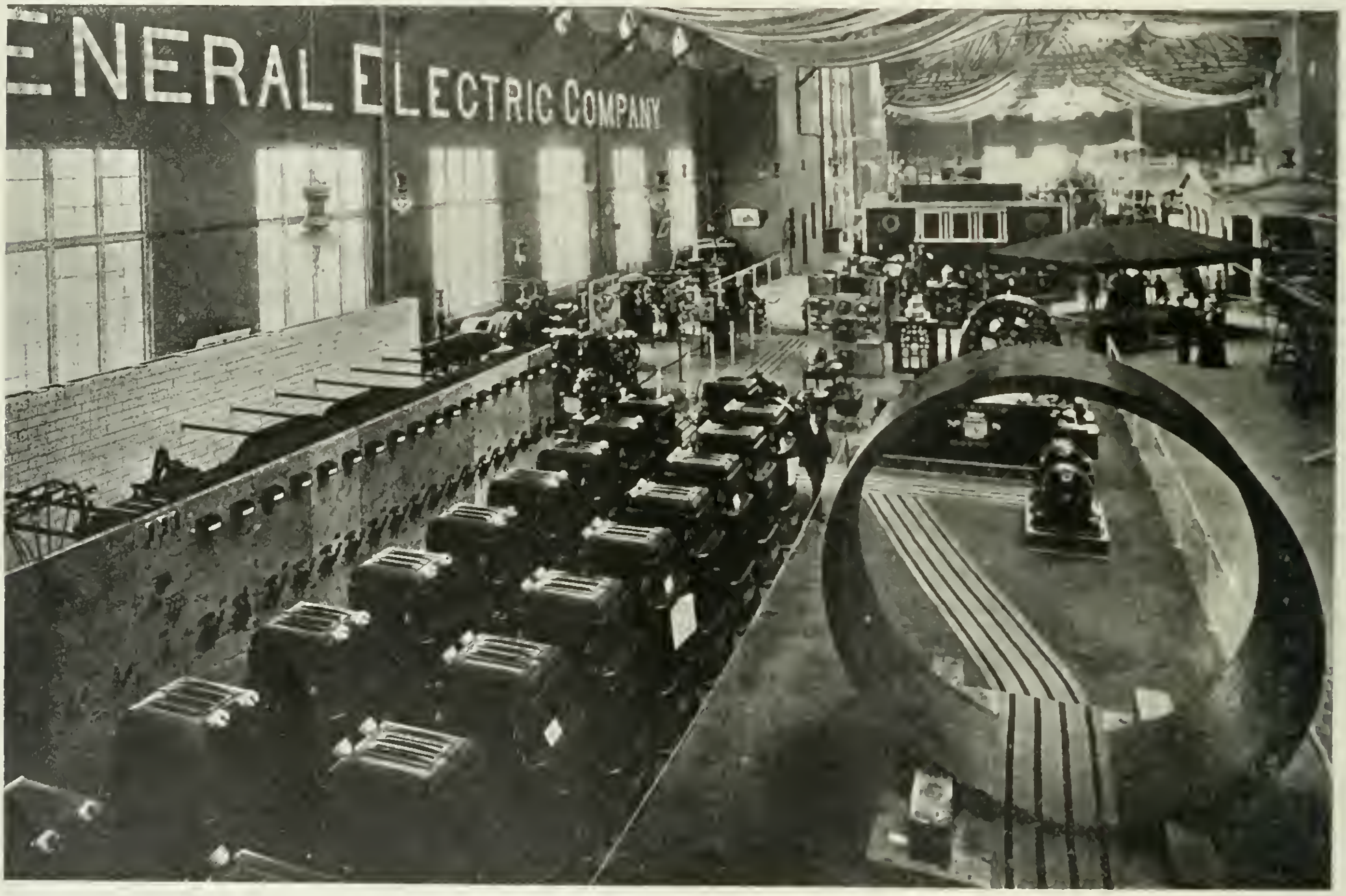


FIG. 3.—GENERAL VIEW OF THE EXHIBIT.

The railway exhibit has several features publicly shown here for the first time, most prominent among which is the new multiple unit system with two 125-hp motors in stationary operation and all auxiliary apparatus, as it is to be applied on the Manhattan Elevated railway at New York.

Two Brill 27 trucks are shown under a car floor frame on which are placed a couple of B 19 electric brake controllers. The trucks have four G. E. 67, 38-hp motors mounted on the four axles, and the truck is raised from the floor so as to show the operation of the electric brake with trolley on or off. A small two-cylinder air compressor for suburban and elevated motor cars is also in the railway exhibit. Railway motors of 25, 50 and 75 horse-power are shown on the floor so that the railway motors exhibited include the principal sizes from 25 to 125 horse-power.

A 7-hp motor generator reducing from 220 to 110 volts direct current for automobile charging, has been put in the space as representative of that class of work. On the switchboard are two types of oil switches and all the forms of quick break knife switches, and direct-current circuit breakers. Another side of the board is devoted to the indicating and recording instruments made by the company. A third side has some circuit breakers for high-tension circuits in which the break is made inside a long tube, and the heated gases throw out the piston which makes the contact, and so break the arc. The motion of the two pistons which make the double break is downward. Numerous small applications of the electric motor, in which the general public will be interested are shown, for example, motors applied to a meat chopper, a spice grinder, a coffee grinder, an emory wheel stand, and fans and sewing machines. One of the landmarks of the exhibit is a Brush multi-circuit arc machine of 120-light capacity in four circuits. On a revolving frame in the middle of the space are all the incandescent lamp sockets made by the company, surmounted by a huge Edison socket. In another frame are all the porcelain supplies made, and in another the wires and cables. Visitors who attended the Paris Exposition are also greeted with the familiar sight of the illuminated model of the company's different works.

The foregoing is but a general review of this company's exhibit, many parts of which are highly worthy of a detailed study.

New Telephone Apparatus From St. Louis.

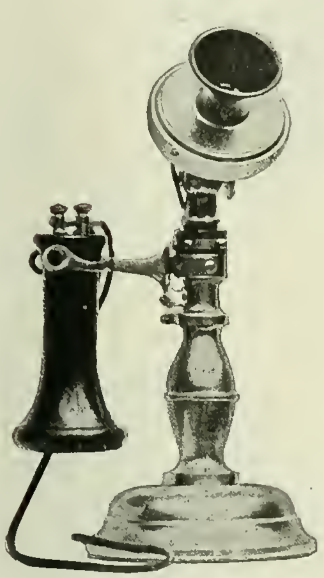


FIG. 1.

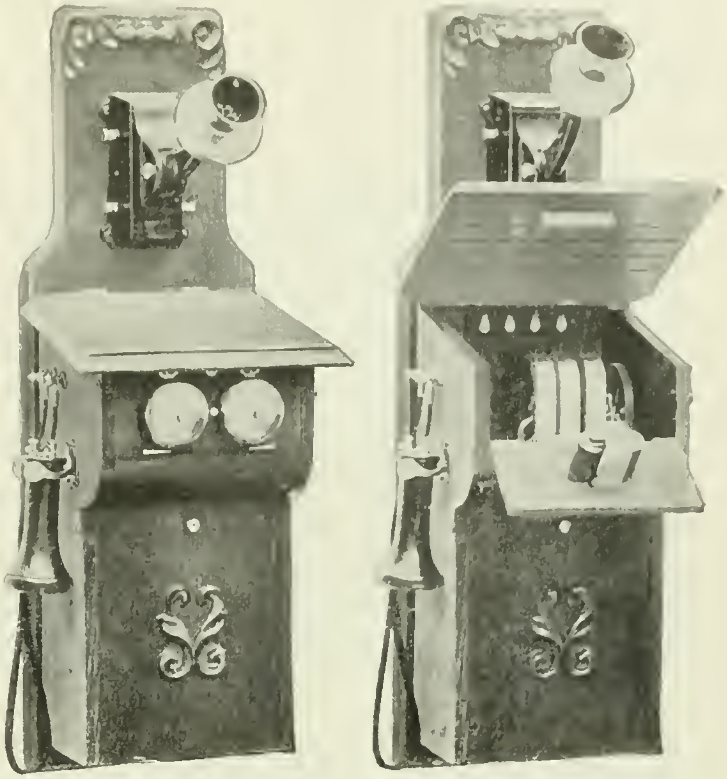
The Central Telephone & Electric Company, of 909 Market Street, St. Louis, has issued recently a batch of excellent trade literature relative to its new telephone apparatus for this season. It has now issued nearly a dozen catalogues on this class of output, so that its production is already well-known to the trade and to users.

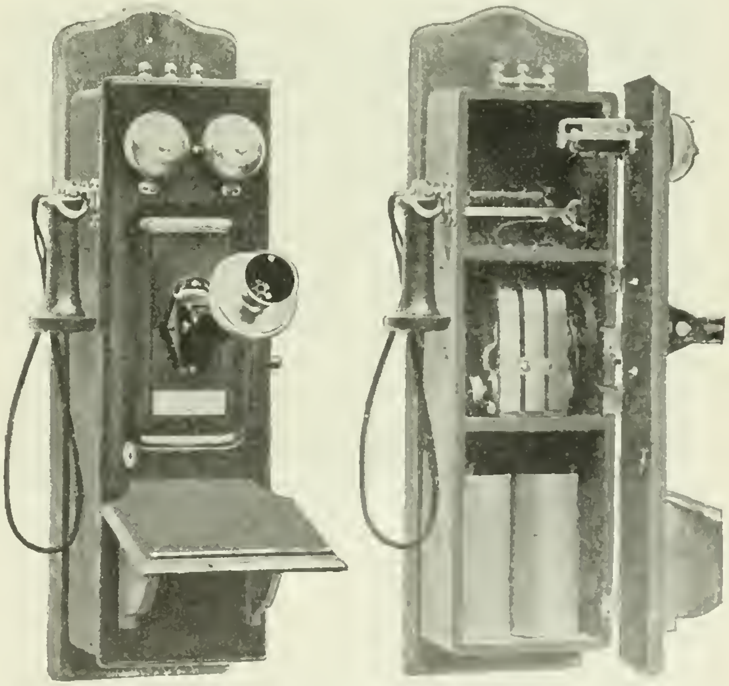
A few of its latest specialties are herewith illustrated. Fig. 1 is its new No. 1 desk telephone, which is made in the Bell style, with sundry modifications and improvements. It includes its improved "Twentieth Century" transmitter, with the induction coil placed in the base, which, with the stand, is a heavy casting of brass finely nickel-plated. Platinum contacts are used on the gravity hook, the receiver cords and connecting cords are wrapped in silk, and the terminal block has the binding posts and connections marked plainly. The receiver is furnished with adjustable hard-rubber case, but the solid receiver can be had if desired.

Figs. 2 and 3 illustrated the Central Telephone & Electric Company's type called by it "Our Leader," being made on an exclusive design of very handsome appearance. In efficiency, utility and the general accessibility of all the parts, it has many recommendations. As will be noted, the receiver and the generator handle are on the same level, and at the height of the arm of the average man, while the transmitter is correspondingly on the level of the mouth. The transmitter connections are made with four binding posts in such a simple manner that the part can be removed in an instant. The other working parts are, as will be observed, under the writing desk lid, and equally accessible there on the application of a screwdriver to the two small screws that hold the lid down. Two Columbia dry batteries finish the equipment, and the set is furnished in either golden oak or walnut, which is supplied in series generator or bar bridging forms.

Figs. 4 and 5 illustrate the company's "Competition" dry battery type, with a different arrangement of parts, but of less costly woodwork and assembling, although the transmitter, receiver and generator are the same. It is built only in the golden oak finish, and is supplied with two Columbia dry batteries. It can be had with series or bar bridging generators, as desired.

The Central Company has also been pushing actively its switchboards, including the full metallic circuit for large exchanges, the small exchange boards, toll line boards, etc. In the 100 drop-board the drops are restored by direct action of the plug on the indicator without any additional mechanism. The drops fall backward, thus enabling the board to present a smooth, even surface, and preventing the operator from knocking down any indicator accidentally. The plug can be inserted slowly or quickly with the same positive restoring under all circumstances. Each drop coil is iron cased to avoid induction effects, and the drops are so constructed that the magnetic pull is secured at both ends. Both line drops are cut out of circuit when the plugs are inserted and the self-restoring ring off drops are cut in. There is only one contact to be closed in the night-bell circuit. The smaller boards and toll line equipments are equally ingenious and compact in construction.


FIGS. 2 AND 3.—NEW TELEPHONE APPARATUS.


FIGS. 4 AND 5.—NEW TELEPHONE APPARATUS.

Interior Telephone System for the Majestic Hotel, New York City.

The Lambert Schmidt Telephone Manufacturing Company feels especially gratified over securing the contract for installing the largest interior telephone equipment ever given out in New York City. The Majestic Hotel, ranking as one of the finest hotels in this country, has been heretofore using an indicating system, and finding it inadequate for complete intercommunication service, has decided to make the change, and placed the contract with the Lambert Schmidt Company for a 500-line telephone equipment. The switchboard will be arranged with two operator's positions, and so that each operator can reach every jack on the board. This illustrates the compactness of the parts. The line drops will be of their automatic restoring type. The clearing-out signals are small incandescent lamps set in the table panel directly in front of the plugs. The switchboard will be supplied with the full complement of cross-connecting cords and plugs, listening cams and ringing keys, and night-bell circuit operated by relay. The operator's transmitters will be mounted on overhanging adjustable arms, and the receivers of the watch case pattern provided with triple adjustment head gears.

The current for the telephone system will be supplied from a storage battery located in the engine room of the hotel, this battery being provided with an appropriate power switchboard with ammeters and voltmeters for properly regulating the current. At the telephone stations will be located a small, compact instrument, consisting of transmitter, receiver, bell and switch hook. As the receiver is removed from the hook at the telephone the line drop at the switchboard rises and stays in that position until an answering plug is inserted in the correct jack, thereby cutting off the current from the drop, when it immediately restores to normal, covering the number. The operator throws down the listening cam, ascertains the connection desired, inserts the calling plug of the pair in the jack of that number, and throws down the ringing key, thereby signaling the station wanted. When the conversation is over, the hanging of the receiver on the hook at the telephone station raises the clearing-out drop directly in front of the pair of cords in use, and this drop stays in that position until these cords are withdrawn, when it automatically restores.

The notable feature of the switchboard is the sensitiveness of the drops. They are designed with the armature laid over the top of the coil, pivoted at the back of the drop and adjusted by a nut and coil spring. The shutter tips up as the armature is pulled toward the magnet. Its nice adjustment is demonstrated by the ability of the current of a single common dry cell to lift it up sharply. These shutters are made substantial, and will withstand severe handling. The line jacks are made of heavy phosphor bronze springs, with large break on the drop connections. The type of board used in this plant was illustrated in these columns April 13 last in connection with a description of the telephone plant of the Manhattan Hotel, New York, which plant was also installed by the Lambert Schmidt Company.

This interior telephone plant of the Majestic Hotel is an independent telephone exchange in every sense of the word. It illustrates a development in the telephone field that has not heretofore been thoroughly appreciated, and should serve as a model for the consideration of the many large hotels now being erected. The Lambert Schmidt Telephone Manufacturing Company has equipped many hotels, this being its finest plant in that line.

New Desk and Interior Telephone Apparatus.

The accompanying illustrations show some of the latest telephone apparatus for general interior work, and of "Bell type," made by the Haines & Noyes Company, of Chicago.

Fig. 1 is its new style of desk set. On this instrument it has done away with the use of outside contacts, and all contacts are in the base and of platinum. By this method, should the instrument fall, the contacts cannot become injured in any way, nor can they become dirty, covered with dust or corroded.

Another style made has a heavy cast base and copper upright, with cast throat. It is fitted with a standard transmitter, which has a heavy cast brass front and brass parts, and does not pack. This instrument is furnished with a Bell type bipolar pony receiver, with water-shrunk hard-rubber shell.

Fig. 2 is the latest Haines & Noyes telephone for hotels, apartment buildings, etc., for both local and interior use. This instrument is for its central energy system. It is furnished with a transmitter on a short movable arm, and with its standard receiver described above. It is provided with double-gong vibrating bell or buzzer, as described, and with silk-wound induction coils with fibre heads. It has a long lever gravity hook, with platinum contacts. It is furnished with any kind of backboard desired, and is of heavily enameled black metal.

The instrument shown in Fig. 3 is one with which the Haines & Noyes Company states it has had much success in equipping hotels throughout the country. It is for interior use only, and contains several special features. It is furnished with a hard-rubber water-shrunk bipolar receiver and standard transmitter, with a heavy brass cast front, and contains a long lever gravity hook with platinum contacts. The backboards are furnished in ebony, oak, mahogany or walnut, as desired. It may be had with single gong vibrating bell or buzzer.

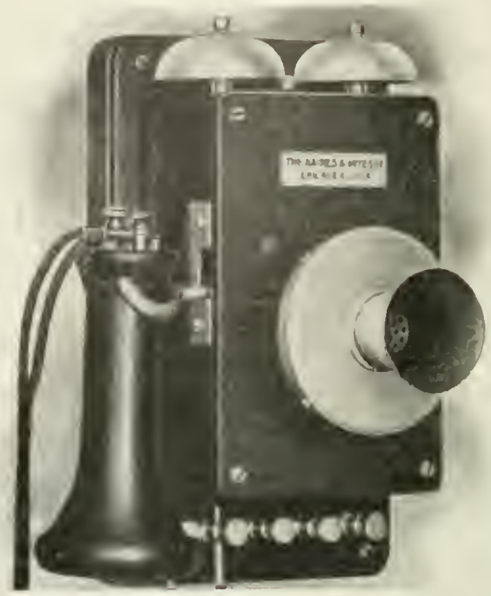
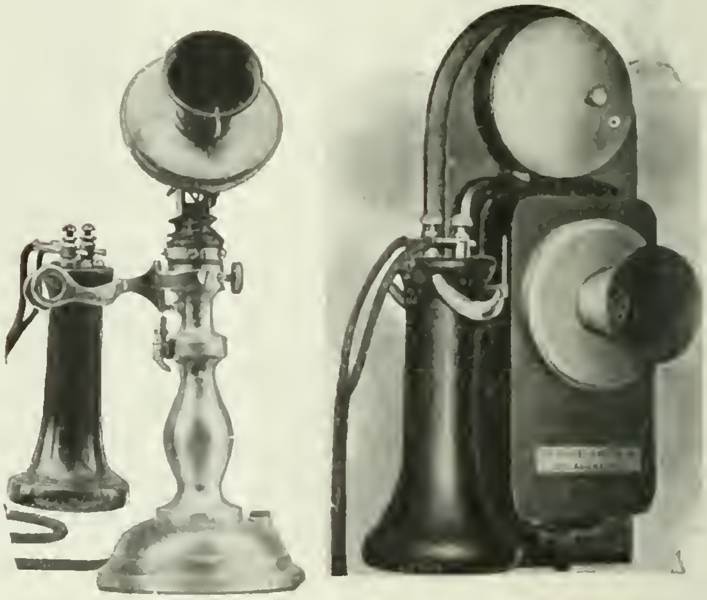


FIG. 2.—INTERIOR TELEPHONE.

The Haines & Noyes Company makes a specialty of private telephone plants for hotels, offices, factories, hospitals, private residences, steam and electric railroads, etc.


FIGS. 1 AND 3.—DESK AND INTERIOR TELEPHONE.

A New Departure in Chandelier and Ceiling Fan Combinations.

The accompanying illustrations show exterior and sectional views of an interesting and novel combination ceiling fan and chandelier made by the Boston Electric Heating & Power Company, Boston, Mass. Fig. 1 shows an external view of the combination, while in Fig. 2, to the lettering of which reference is made below, is shown the interior and working parts, *A* being the yoke, *B* the resistance, *C* the snap switch, *D* one of the live rings by means of which the electrical connections are made; *E* the guide bearing running in the oil cup *F*, *G* the bracket arm of the chandelier, *H* the oil tube shown open for insertion of oil; *J* the hardened steel washer of the lower or working bearing upon which the step runs, *K* the fan attached to the lower end of the hollow shaft, and *L* the thumb nut attached to the switch spindle which projects downward through the hollow shaft.

The yoke *A* is attached to an ordinary pipe hanger at its upper end, and to its lower end is attached the motor and working parts. Attached to this yoke, but insulated from it, are two metal rings with suitable binding posts to which the line wires are attached and which are carried to the switch, motor and electric lights in the arms. By this arrangement the wiring which, in a four-arm chandelier, would otherwise be complicated, is of the simplest construction. Within the yoke is hung the switch, which, with the resistance, gives two speeds, found in practice to be ample in this style of fan. Full speed is about 650 r. p. m., slow speed about 450 r. p. m. Attached to the hollow shaft is the hardened tool steel step *E*, having a downwardly projecting flange which enters the composition cup *F* in such a manner that while guiding the shaft it allows no portion of the shaft to touch the bearing. The well in the center of this composition cup *F*, together with the holes in the flange, prevent any oil from working up the step and thence onto the shaft and downward into the motor. The arrangement of the oil tube is such that oil may be inserted until it overflows at the point of insertion, without a possibility of any flowing into the well in which the shaft runs. As the upper and lower bearings are practically alike, it will be seen that no matter how careless the oiling, there is no danger of getting oil into the motor or throwing it from the pan.

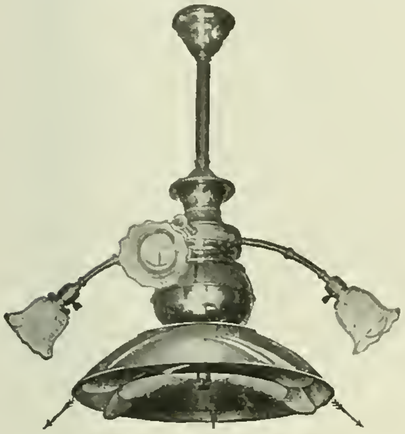


FIG. 1.—VIEW OF COMBINATION.

The lower bearing is provided with the hardened steel washer *J*, upon which the flange of the step rests, thereby supporting the entire load of the shaft and fan. The fan consists of upper and lower spun brass disks, the upper disk having an opening in the center for the inlet of its air supply. These floats are arranged vertically about the center of rotation. The lower disk is attached to the hub, which in turn is attached to the hollow motor shaft. This arrangement of disks and floats forms a noiseless centrifugal fan of such shape that when it is revolved the air is delivered outward and downward in the form of a cone. An 18-inch fan will cover, with a sufficient breeze, an area 18 ft. in diameter.

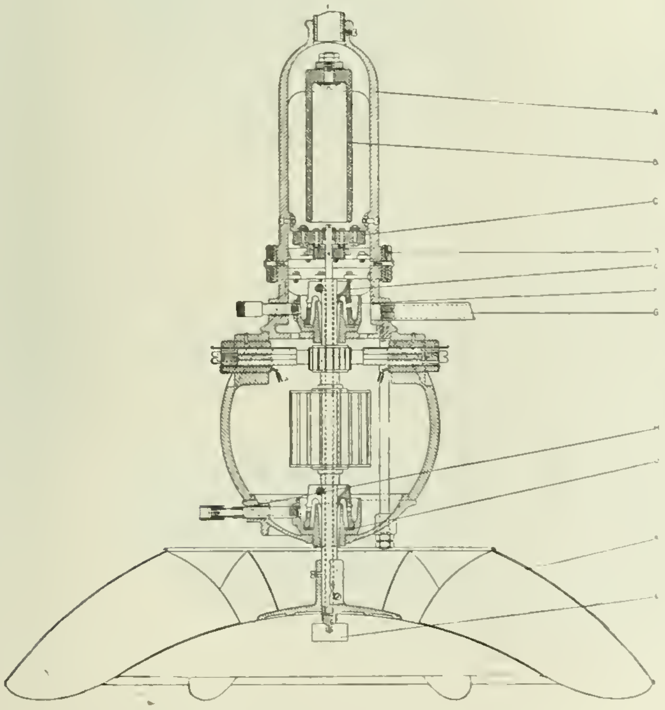


FIG. 2.—SECTIONAL VIEW OF COMBINED APPARATUS.

New Factory of the Strowger Automatic Telephone Exchange.

In January, 1901, the Strowger Automatic Telephone Exchange moved its factory from Boston to Chicago, bringing the factory to the home office of the company. The magnitude of the automatic switchboard business will be a surprise to many, and is well illustrated by the accompanying view of the assembling room in the new factory. Secretary Harris reports that a force of 300 men is now worked night and day. The factory is working on a 15,000 subscriber board for Havana, Cuba, for the Red Telephonica, and also on boards to take care of 30,000 subscribers for the Illinois Telephone & Telegraph Company, of Chicago. The Strowger Automatic system is used in Washington on the exchange connecting all of the principal Government departments, and is becoming very popular in Berlin.

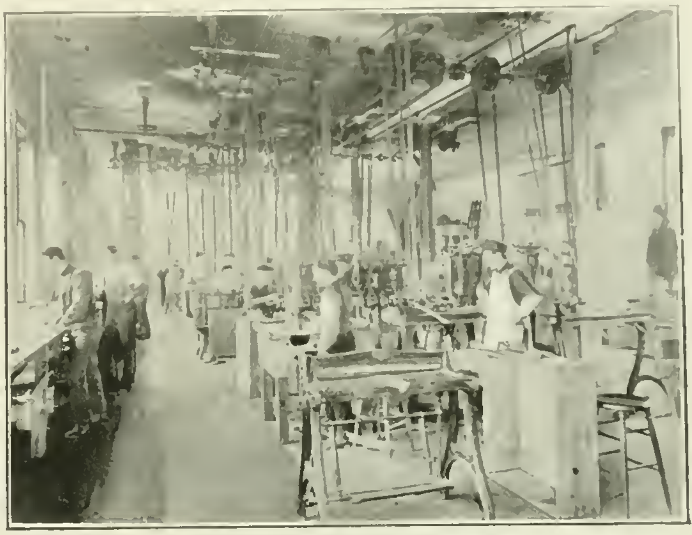


FIG. 1.—STROWGER TELEPHONE FACTORY.

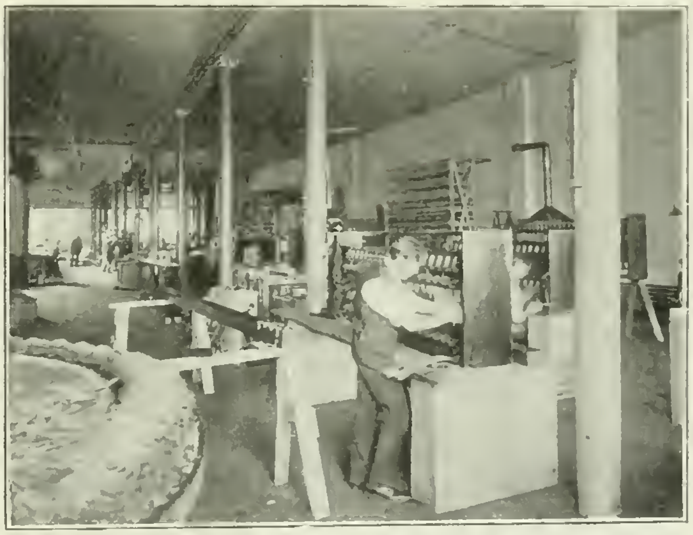


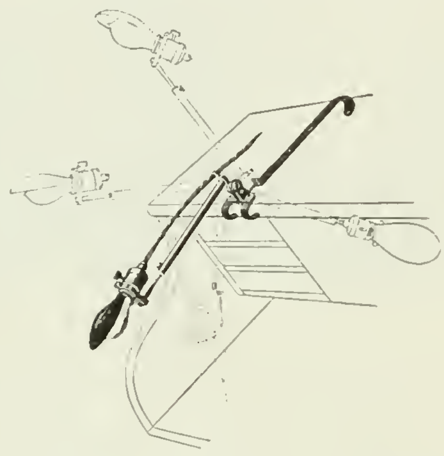
FIG. 2.—STROWGER TELEPHONE FACTORY.

An Exchange for Party Line Service Only.

Springville, in New York State, offers something which is unique and novel in the independent telephone field, and that is an exchange which is composed entirely of party lines. The Springville Telephone Company organized and commenced operation October, 1900. As it was compelled to meet active party line competition from the Bell Telephone Company, it decided to face it with a like system, and cast about to see if they could not furnish its patrons a better service. After investigation it placed the contract with the Sterling Electric Company, of Lafayette, Ind., for equipping the exchange with their entire apparatus, consisting of switchboards, protective devices and selective signal non-interfering telephones. It has to-day in operation 150 subscribers, each one of whom is upon a selective signal party line. Its service is in every way satisfactory to its patrons, and its treasurer, Dr. Waite, writes that, in his opinion, it could not be improved upon. He deems the selective signal telephone the coming instrument of to-day. The company is enjoying rapid growth.

A New Desk Lamp.

The Smith & Hemenway Company, New York City, is introducing the Ferguson adjustable lamp bracket, one of the most novel and up-to-date roll-top desk lamps on the market. It is adjustable to any size rolltop desk or upright piano, and can be fastened on without the assistance of screws or nails. The reflector can be placed at any desired angle to prevent a glare in the eyes. It is ornamental and handsomely finished in enamel and nickel, and at the same time very durable. It is simple in construction and operation, and is quickly adjusted. There are no springs to get out of order or make bad contact. The accompanying cut illustrates a few of the angles at which it can be placed.


DESK LAMP.

Telephone Call Registers.

The American Toll Telephone Company has lately added to its already complete line of pay stations a new call register for measured service. The Bell Companies have for years considered this part of their service very profitable to them, and these small instruments are in use in very large numbers. As yet the independent companies have not had access to an instrument of this kind, but the above company has already taken large orders for its machine from them. It is built on different lines from the register used by the Bell companies. It cannot be tampered with in any way, and it is impossible to obtain signals by rapping the box on the side.

CALL REGISTER.

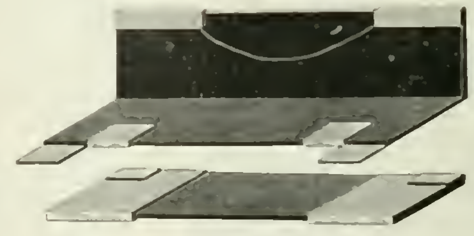
Many telephone companies are now advertising measured service at the rate of 600 calls for 3 cents per call, all over and above that at 5 cents per call. This call register notifies the operator, and also keeps an accurate account of all outgoing calls, thus saving all disputes between subscriber and central, as the register is in plain view of the subscriber. This part of the telephone service is one that may be investigated by independent companies with much profit to themselves and satisfaction to patrons. The instruments can easily be attached to any telephone.

Washington to Baltimore by Automobile.

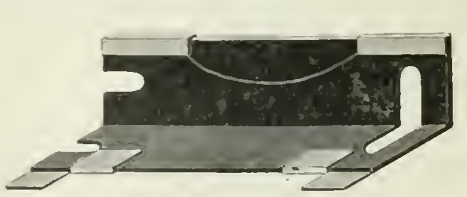
A Mark XII. Columbia runabout, owned by Mr. George Howard, treasurer of the National Safe Deposit, Savings & Trust Company, of Washington, D. C., and equipped with new Exide battery, made the trip from Washington to Baltimore on one charge, last Wednesday, May 29, under conditions that made the trip a remarkable one from the point of battery endurance. An automobile run had been planned from Washington to Baltimore that day, but the falling rain and heavy condition of the roads kept every vehicle from starting except the Columbia runabout, in which were Otto Jacobi and Chas. Baxter. When Baltimore was reached the cyclometer indicated a run of 44 miles, and 8 miles of this distance was over roads that required an excessive amount of current to keep the vehicle in motion. This section of the road is described as one of layers of mud and sand over rough fillings of broken stone. In some places the mud was so deep that the motor was covered. There was sufficient current left to carry the vehicle several miles around Baltimore when the vehicle reached that city, bringing the total mileage on one charge of the batteries to 50. The condition of the roads prevented any attempt at speeding.

A New Telephone Renewable Fuse.

The Sterling Electric Company, of Lafayette, Ind., which is one of the largest manufacturers of telephone apparatus in this country, has added to its already complete line of equipment something new in the shape of a renewable fuse. In the manufacture of its different protective devices it discovered that many fuses offered upon the market were not substantial and easily broken before operating. Consequently, it has perfected a fuse which is virtually indestructible, 100 per cent of which are always ready for use, regardless of their handling, and one which can be re-fused, as its operation does not destroy anything but the fuse wire itself. These are made in standard sizes of 1½ to 4 inches, either of the Western Union or Postal type, the fuse wire having a capacity of from ⅛ of an ampere to 2 amperes.


W. U. TYPE OF FUSE.

The body of this new article is made of black fibre, so creased that it can be folded in a book form. This body is tipped with copper. The fuse wire is soldered between the copper tips upon the inner side of the fibre folder. After being fused it is folded together and clamped with a portion of the copper tip In this way the fuse wire is always enclosed in slack form. It admits of cleaning, bending, twisting or rough handling, without destroying the fuse.

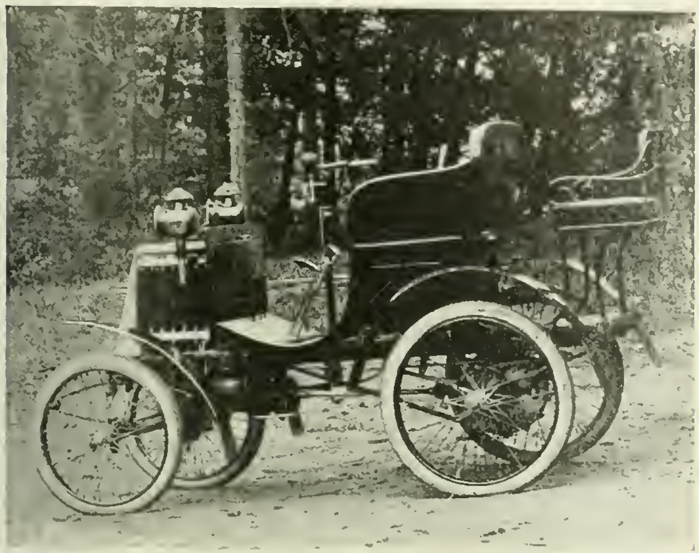

POSTAL TYPE, OPEN FOR REPAIRS

In the operation of the fuse, in the case of the action of electric current, the fuse wire only is destroyed. The folder can be reopened and new fuse soldered to place between the terminals. Telephonists can readily see the practicability of this device and the large saving due to the fact that 100 per cent are good to start with, regardless of the handling, and that the devices are readily re-fused at practically no expense. We show the Postal and Western Union types of the standard 2-inch fuse opened for repairs, and also a cut of the device fused ready for service.

A Tourist Motor Car.

Mr. H. Ward Leonard, the well-known electrical engineer, has of late devoted considerable attention to automobile work, favoring specially vehicles of the gasoline type, and the result is already seen in some new types of great interest, one of which we illustrate.

Mr. Leonard investigated the subject thoroughly in France and England in 1894 and also in 1895. Last year he decided to undertake to manufacture an automobile, and spent several months investigating the various types abroad, especially those in France. He finally decided to manufacture the present car, which is almost identical with the "Reynault" car, which has made such a fine showing in the various races during the last summer, especially the 800-mile race from Paris to Toulouse and return upon which occasion this car made an average speed of 24¼ miles for the 800 miles, when equipped with a 5-hp De Dion-Bouton motor.



CENTURY TOURIST MOTOR CAR.

He makes this car in two sizes, one of which is equipped with a 3½-hp water-cooled De Dion-Bouton motor and the other which is equipped with a 5-hp water-cooled De Dion-Bouton motor. He will also place on the market this summer a still larger car equipped with a 6½-hp motor, the arrangement of the machinery being practically the same as in this car, but the car being a larger one and suitable for carrying four passengers.

The car shown in the cut when equipped with a 3½-hp motor will make about 25 miles per hour on a good level road, and upon the average Americanroads will keep up an average speed up hill and down of about 15 miles per hour. When equipped with a 5-hp motor the maximum speed on a level road is between 30 and 35 miles per hour, and the average speed up hill and down on ordinary roads will be between 20 and 25 miles per hour.

One of the strongest points in this car is the very flexible arrangement of the engine relative to the back axle, and the extremely easy springs with which the car is provided. All parts of the mechanism that require any possible attention are extremely accessible at the front of the car, and all of the moving machinery; that is, the engine, variable gear and the back axle gear, are all enclosed in dust-proof metal boxes, with all the mechanism running in a bath of oil. The car is one of the most noiseless. Upon all level roads, and when the grade is 4 per cent or less, there is no variable gear in motion, the transmission of power being direct from the engine to the back axle. This reduces the amount of wear of the mechanism, results in a great saving of power, and also greatly reduces the noise under the usual condition of operation.

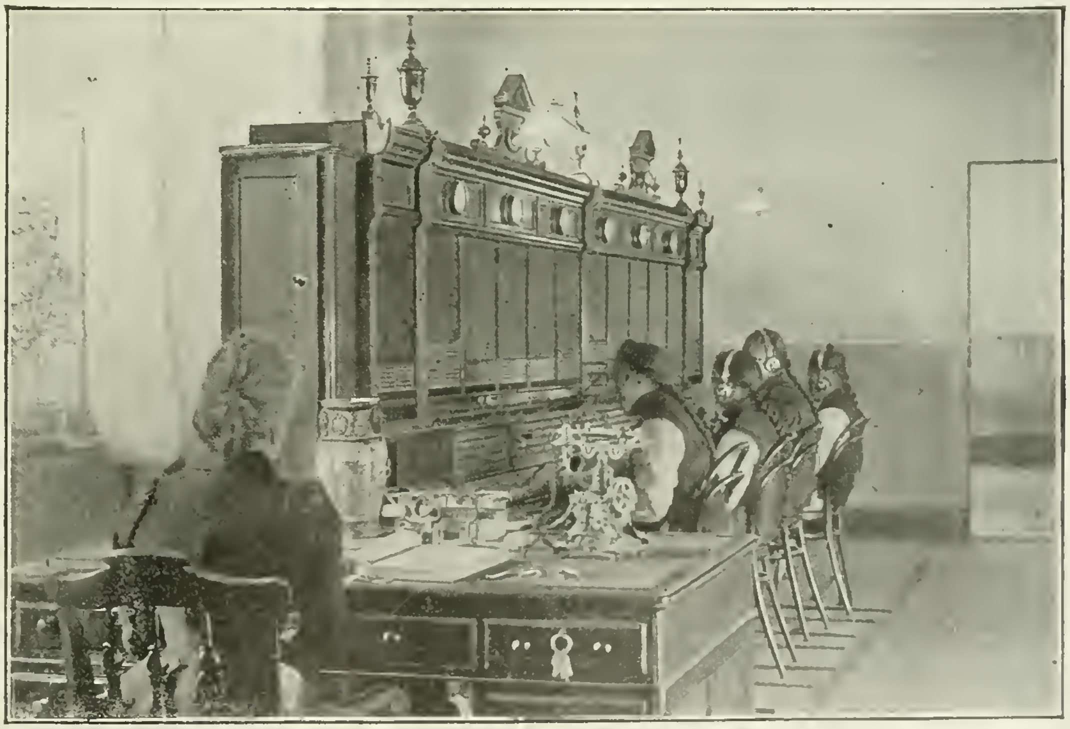
* * *

The Shanghai, China, Telephone Exchange.

While China is one of the largest countries of the world in point of area and population, it is backward in many respects in adopting the improvements of modern times. With very few railway and telegraph lines, it has fewer telephone lines or exchanges. By courtesy of the Ericsson Telephone Company, 296 Broadway, New York City, we illustrate the first sections of a telephone switchboard installed at Shanghai, China, and recently placed in operation. This is a full multiple board, made by L. M. Ericsson & Co., Stockholm, Sweden, and the ultimate capacity is 5000 subscribers. Our readers will observe that while the "chief" is a lady operator, and was imported from Sweden with the switchboard, the others are all natives. It is said that they are remarkably apt in learning to operate, quick in their movements, and naturally patient and persistent, and they readily become expert operators.

The operation of the Ericsson full multiple switchboard is extremely simple, each section being divided into five panels for convenience, and in large boards an annex is placed at each end. The plugs and cords are placed on two different planes, the answering below and the calling above, which is of great advantage to the operator as the answering jacks are just above the answering plugs, thus separating them entirely from the calling plugs and multiple jacks. In case of a call the operator answers and can connect directly from her own division with any other subscriber in the board, thus giving very quick service and saving the time of the calling subscriber and of the other operators.

Each operator has 18 pairs of cords and plugs, which provides for the busiest exchanges. The board is so made that busy subscribers' lines can be removed from one operator to another, thus distributing the work quite evenly. Each operator has a counter, which records automatically all the outgoing calls from her division of the board. It is said that this will be made a model exchange, and additional sections are on the way to Shanghai now, which will increase the size of the board. Other sections are to be supplied as may be required. As switchboards of this same pattern are already in operation in this country, the Ericsson Company will take pleasure in giving further information to those who are interested.



TELEPHONE EXCHANGE, SHANGHAI, CHINA.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 2 per cent, nominally. Time money was easier, the rates being 4 per cent for 30 days to 6 months. There was a better demand for mercantile paper, the closing rates being 4 per cent for sixty to ninety days' endorsed bills receivable; 4 a 4½ for choice four to six months single names, and 5 a 6 for others. In the stock market there was greater activity and prices advanced, although the public is slow in entering the speculative market. The renewed interest in railroad stocks stimulated other securities. United States Steel stocks advanced in sympathy with the main market and on dividend rumors. Metropolitan Street Railway was the active feature in the traction group, on the anticipation of increased earnings on the Broadway line under electric operation. This stock closed with a net gain of 4¼ points. Brooklyn Rapid Transit made a net gain of 6 points on somewhat diminished trading, the sales aggregating 72,047 shares. In the electric list General Electric stands at the head in activity. The number of shares sold was 10,150, the net gain in price on the week's business being 10¼ points. Western Union also shared in the general advance, closing with a net gain of 2¾ points. There was active trading in this stock, the shares sold being 20,900. In the market for outside securities the general tendency of prices was upward, although the volume of trading was exceedingly limited, except on the last two days of the week. Following are the closing prices at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	May 25.	June 1.		May 25.	June 1.
General Electric	223	233¼	Electric Vehicle	11½	11
Brooklyn Rapid Transit	75⅝	81⅝	Electric Vehicle, pfd	18	17
Metropolitan Street Ry	169¼	173½	General Carriage	2	2
American Tel. & Cable	99¼	99½	Illinois Elec. Veh. Tran	⅞	⅞
Western Union Tel	92	94¾	Hudson River Tel	120	120
American Dist. Tel	—	—	N. E. Elec. Veh. Tran	3	3
Commercial Cable	—	—	N. Y. Elec. Veh. Tran	1⅛	1
Electric Boat	15	19	Tel. & Tel. Co. of Am	5	5
Electric Boat, pfd	40	45	N. Y. & N. J. Tel	169	169
Electric Lead Reduc'n	3½	3½			

BOSTON.

	May 25.	June 1.		May 25.	June 1.
New England Telephone	—	—	Erie Telephone	58	58½
Mexican Telephone	2½	2¾	General Electric, pfd	—	—
Westinghouse Electric	63	64¼	Am. Tel. & Tel	180	173½
Westinghouse Elec., pfd	—	—	Boston Electric Light	*240	240*

PHILADELPHIA.

	May 25.	June 1.		May 25.	June 1.
Electric Storage Battery	63	53	Philadelphia Electric	5⅞	5¾
Elec. Storage Batt'y, pfd	60	60	Pa. Electric Vehicle	1¼	1
Elec. Co. of America	9	8	Pa. Elec. Veh. pfd	1	1
General Electric Auto	—	—	Am. Railways	45¾	45

CHICAGO.

	May 25.	June 1.		May 25.	June 1.
Chicago Edison	*175	173	Chicago Telep. Co	260	260
Chicago City Ry	255	255	Union Traction	16½	18¼
National Carbon	15⅞	15⅞	Union Traction, pfd	57½	58
National Carbon, pfd	83	83	Northwest Elev. com	49½	49

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*Asked.

WASHINGTON TRACTION.—Announcement of default of interest and plans for reorganization of the Washington Traction & Electric Company was issued last week by the majority bondholders. The Reorganization Committee consists of George W. Young, chairman; John C. Brown, James Timpson, William H. Hollister, Gardiner M. Lane. The offices of the Bondholders' Committee will be at No. 59 Cedar Street, New York. The Washington Traction & Electric Company controls all the electric railways in the District of Columbia except the lines of the Capital Traction Company. It also controls the electric lighting plants. The stock and bonds of the company are mainly owned by New York people. The action was the result of a conference of persons interested in New York. The failure to pay the interest renders the company liable to foreclosure. The earning capacity never has been equal to the demands. The company was organized two years ago with a capital of $12,000,000 in stock and $20,000,000 in 4½ per cent bonds. Its property consists of the stocks of eleven street railroads and two electric lighting companies in Washington. The deficits in the company's revenues have been made good at each successive period by those largely interested, and, it is understood, through an assessment on the stock. The present action is attributed to some large holders, including Messrs. Hayward, of Baltimore; Scott, of Wilmington, Del., and F. C. Stevens, of Washington, selling their stock. The purchasers, it is reported, are the Roeblings, of New York. It is supposed that a floating debt has been accumulated. Some conjecture that this has reached $1,000,000 or more Mr. George W. Young, one of the majority bondholders, estimated that it would be four or five years before the receipts of the company on its present basis would meet the operating expenses and fixed charges.

SEATTLE-TACOMA INTERURBAN RAILWAY.—A syndicate has been formed in Boston to build an electric railway between Seattle and Tacoma. Lee, Higginson & Company, Kidder, Peabody & Company, J. M Forbes & Company, and Stone & Webster are members of this syndicate and all the securities have been placed. The road will be 33 miles long and the construction similar to steam railroad construction. Electric cars will be run at high speed, the equipment being able to run at 60 miles an hour, so that people doing business in one city will be able to live in the other. The capital stock will be $2,000,000; there is also an authorized bond issue of $2,000,000, of which $1,350,000 will be issued at once. Stone & Webster have secured enough franchises, rights of way and contracts to proceed immediately with the construction. Rails have been ordered and work has begun. The first instalment of 20 per cent on the subscriptions was paid by the syndicate May 10. Several experts from the office of Stone & Webster visited the Pacific coast within the last few months and have all come back enthusiastic about the prospects of this road. Seattle increased 88 per cent in population in the past decade and bids fair to better this in the next. Tacoma is also showing remarkable increases in all lines of activity

LOUISVILLE'S LIGHTING INTERESTS.—It is stated that Anthony N. Brady, of New York, is the leading spirit in a consolidation of the light, heat and power interests of Louisville, Ky., in the new Citizens' Lighting Company, which has been incorporated under the laws of Kentucky with a capital of $1,000,000. The present companies to be merged in the new concern are the Citizens' General Electric Company and the People's Electric Light Company The capital stock of the Citizens' General Electric Company is 679 shares of preferred at $100 and 4074 shares of common, which are to be converted ratably into 9724 shares of stock and $500,000 bonds in the new company, and in addition $15,000 in cash is to be divided ratably among the preferred stockholders. The 150 shares into which the capital stock of the People's Electric Light Company is divided are to be converted ratably into 276 shares of the new company. It is said that new machinery will be installed and that the territory covered by the old companies will be considerably extended.

WESTERN UNION RIGHTS.—The following financial item gives a pretty good idea of the idiocy of much of the trading that goes on in Wall street: "The market for 'Western Union rights,' securities that the curb brokers in Wall street deal in when times are dull and victims are handy, was on the boom yesterday. Amid a great deal of excitement and heavy trading the price of the rights rose from 12½ to 18¾, later, however, reacting and closing at 13. Several of the outside brokers placed large orders to buy the rights with the curb representatives of F. J. Lisman & Company and J. H. Olyphant & Company, and it was the bidding of these two brokers that advanced the price. Some of the most prominent houses in the Street, these brokers were told, were behind the orders. Both brokers have been trading on the curb but a short time, and when they came to report their purchases to their respective offices they learned for the first time that all the rights represent is the right to lean against a telegraph pole."

THE AMERICAN RAILROAD COMPANY, whose stock has been selling upon the curb recently in New York city, has placed an order for steel engraved certificates with the International Bank Note Company with directions that they be prepared to meet the requirements of the New York Stock Exchange. The company's officers decline to talk for publication, but it is said that large operations centering in New York, Philadelphia, Atlantic City and Chicago are under way. The declared purpose of the company is to build an elevated electric system over existing steam lines for express passenger service with practically any limit of speed as their cars cannot leave the track. Large sums have been spent in perfecting the system on an experimental line and it is now ready to operate.

AMERICAN TELEPHONE & TELEGRAPH.—Directors of the American Telephone & Telegraph in voting to offer stockholders $21,000,000 of stock at par, are presenting them with a very substantial bonus. Present stockholders will have the right to take one share of new stock at par for three now held at 181 for American Telephone. The "right" is figured to have a value of $20. The American Telephone & Telegraph Company has filed a certificate of increase of capital stock from $100,000,000 to $150,000,000. The amount of stock actually issued is $94,237,500. The certificate is signed by Alexander Cochrane, chairman, and Charles Eustis Hubbard, secretary of the meeting at which the increase was authorized.

PITTSBURG CONSOLIDATED TRACTION.—The plan for the consolidation of the Philadelphia Company and the Pittsburg Consolidated Traction Company will, it is said, provide as follows: Philadelphia Company stock to get 50 in a 5 per cent bond and a certain amount of 5 per cent preferred stock and of common stock, the amount of preferred being more than 20 per cent. Pittsburg Consolidated Traction to get 25 in a 5 per cent bond and a certain amount of 5 per cent preferred and of common stock. It is stated that no new cash capital will be required.

CHICAGO ELEVATED CONSOLIDATION.—President Mitchell, of the Illinois Trust & Savings Bank confirms the report that the Northwestern Elevated has purchased the Union Loop, paying $125 per share for the stock. With the new bonds the total bond issue of the two companies will be $15,600,000. The present earning capacity of the two roads would give 5 per cent. on the preferred stock and 1½ on the common.

CHICAGO TELEPHONE COMPANY.—Directors of the Chicago Telephone Company have voted to issue, on October 1, $1,000,000 of additional stock at par to stockholders of record on Sept. 26 on the basis of one share for each eight shares of their old stock. This will make the outstanding capital $9,000,000. Chairman Clark said at the annual meeting that $2,000,000 more stock would be issued this year.

Commercial Intelligence.

THE WEEK IN TRADE.—The wet, unseasonable weather had a somewhat discouraging effect in many lines of commerce, particularly in agriculture, yet there is a general hopeful feeling that sunshine will dissipate all such depressing features. Apart from this, the week was one of little change, except that a somewhat better spirit was shown in the industrial situation, and that some progress was made toward a settlement of the existing labor difficulties. In the iron and steel trade, practically the same conditions as those noted last week still prevail, namely, little new business, while the production on orders is at the maximum. Finished products are generally strong, and the mills are still crowded with business. Railroad earnings continue satisfactory. For the second week in May 55 roads report gross earnings, aggregating $8,716,538, a gain of 9.9 per cent over the earnings during the same period last year. The failures during the week, as reported by *Bradstreet's*, numbered 144, against 192 the week previous, and 135 the corresponding week last year. In the New York metal market copper was extremely dull, but prices were kept at the same level as they have been for the past several weeks. The principal producing interests are still holding Lake at 17c. and electrolytic and casting at 16⅝c.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material, from the port of New York, for the week ended May 22: Antwerp—12 packages electrical material, $808; 90 packages electrical machinery, $6,872. Athens—9 packages electrical material, $268. Argentine Republic—201 packages electrical material, $7,228. British Australia—5 packages electrical material, $69. British East Indies—49 packages electrical material, $3,635; 35 packages electrical machinery, $8,998. British Guiana—17 packages electrical material, $1,261. Budapest—4 packages electrical material, $203. Bremen—1 case electrical material, $105. Brazil—143 packages electrical material, $1,633. British West Indies—2 packages electrical machinery, $231; 1 case electrical material, $11. Brussels—1 case electrical material, $5. Cuba—124 cases electrical material, $4,020. Chili—15 cases electrical material, $174. Christiana—4 cases electrical material, $20. Copenhagen—1 case electrical material, $25. Central America—12 cases electrical material, $237. Dundee—1 package electrical material, $4. Dutch East Indies—4 packages electrical material, $51. Equador—10 cases electrical material, $300. French Possessions in Africa—2 cases electrical material, $20. Glasgow—36 packages electrical material, $5,000; 19 packages electrical cable, $4,750. Genoa—105 cases electrical material, $7,997; 1 case electrical machinery, $150. Gibraltar—2 cases electrical material, $40. Hamburg—39 cases electrical material, $1,286. Havre—72 packages electrical material, $2,215; 3 packages electrical machinery, $360. Japan—223 packages electrical material, $17,457; 136 cases electrical machinery, $25,613. Lisbon—87 packages electrical material, $9,977; 6 packages electrical cars, $35,924. Leeds—4 packages electrical material, $710. Liverpool—132 packages electrical machinery, $12,154; 14 packages electrical material, $602. London—191 packages electrical machinery, $22,183; 111 packages electric material, $6,047; 24 rolls electrical cable, $4,504. Marseilles—6 cases electrical material, $500. Manchester—105 packages electrical material, $15,432. Mexico—7 cases electrical material, $1,183. Naples—2 cases electrical material, $. 7. Preston—1 package electrical material, $30. Philippines—51 packages electrical material, $1,001. Peru—7 packages electrical material, $270. Stockholm—7 packages electrical machinery, $800. Southampton—3 packages electrical material, $300; 6 cases electrical machinery, $1,166. Siam—63 packages electrical material, $3,009. U. S. Columbia—13 packages electrical material, $569. Uruguay—12 cases electrical material, $238. Venezuela—33 packages electrical material, $460.

MINING IN ARIZONA.—An electrical generating plant will be established on the Salt River, which runs through a great copper belt of eastern and central Arizona. Wires will be strung in all directions of from thirty to sixty miles to mining camps. The engineer states in his report that the waters of the Salt River at any season are capable of generating more than 3000 horse-power. The plant will be finished within fourteen months, and contracts are now being made with the principal consumers of power along the route outlined for the delivery of power at the end of eighteen months. The territory embraced by the projected system contains very rich copper deposits and liberal bodies of silver, gold, and galena. At Globe, where wires will first be run, are located the Old Dominion and United Globe copper mines; and a few miles away is the Black Warrior, a new property that is now coming into great prominence. Many million dollars have been taken out of the established mines at Globe, but the output has been unsteady because of the uncertainty of a supply of coal for fuel purposes. Electricity is expected to render the output more constant. In the Mineral Creek district, where the Ray Mine Company, limited, an English corporation, has spent in the neighborhood of $1,500,000 in opening a copper deposit, electric power would overcome serious obstacles. A number of gasoline engines were put in, but they failed to perform their work. This scheme of the San Francisco company seems likely to be the first enterprise of several of the kind to be completed in Arizona.

THE NATIONAL BRIDGE COMPANY has been recently incorporated under the laws of the State of New York; capital stock, $200,000. The purpose of the organization is to construct bridges, more especially highway and electric railway bridges, also steel and iron structural work. The company has already acquired two first class plants, and is prepared to take orders for immediate work, and has, it is reported, a large stock of material on hand. The officers of the company are W. N. Conger, president; A. A. Miller, vice-president; C. W. Smith, secretary; George T. Bacon, treasurer. The general offices of the company are at 45 Broadway, New York.

THE SAFETY INSULATED WIRE & CABLE COMPANY, of New York City, reports that contracts for two buildings, 500 feet by 50 feet each, for its new plant at Bayonne, N. J., have just been let, and that work will begin on them this week. The new dock has now been completed. The buildings referred to will be completed inside of four months. Contracts for boilers, engines, pumps, etc., for installation in the Bayonne works, are expected to be alotted shortly. The company is now busily engaged in completing the 1000-mile submarine cable contract, which was recently received from the United States Government for the Philippines.

J. B. & J. M. CORNELL, of this city, are at present making considerable extensions to their Cold Springs, N. Y., plant, in view of having recently undertaken some substantial contracts for castings required for large marine engines about to be installed in double screw ships now under construction at the New York Shipbuilding Companies' yards, Camden, N. J. The Cornell people will require a fair-sized lot of electrical machinery. So far, contracts have been alotted to the Crocker-Wheeler Company for several motors of various sizes, to be utilized for operating cranes and machine tools.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is about to make shipment of ten carloads of various electric material for the Borough of Salford, England, electric traction system, part of the contract for which was recently undertaken by the British Westinghouse Electric & Manufacturing Company. The value of the shipment is about $50,000.

THE MORGAN-GARDNER ELECTRIC COMPANY, of Chicago, is reported to have secured a large order for electrical mining machinery, to be utilized in the mines of the Compagnie des Forges de Chatillon, near Nancy, France. The Chicago concern has been making some heavy shipments of such equipment to Liverpool for some time past.

LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY, 325 Broadway, New York, has just purchased all the tools and material of the Bruckner Electric Company, and has added the equipment to that of its own factory, which gives it now exceptional facilities for the rapid output of telephone apparatus in large quantities.

EXETER MACHINE WORKS, of Pittston, Pa., are installing a complete coal handling system for the Oxford Paper Company, Rumford Falls, Me., including electrically driven crushers and the Exeter LeGrand conveyors.

RECENT STERLING EXCHANGES.—The Sterling Electric Company, of Lafayette, Ind., reports the following recent orders filled for telephone switchboards ranging from 50 to 1000 lines: Marietta, Ohio; Tremont, Ill.; Cambridge, Ill.; Pittston, Pa.; Decatur, Ill.; Ottumwa, Ia.; Sharon, Wis.; St. Joseph, Ill.; Cheboygan, Mich.; Maglehurst, Miss.; Greenville, N. C.; Brandenburg, Ky.; Freeport, N. Y.; Columbus, Miss.; Long View, Texas; Meadville, Pa.; Fithian, Ill.; Hoopeston, Ill.; Racine, Wis.; West Point, Ind.; Sidney, Ill.; Junction City, Kan.; McConnellsville, Ohio; Jermyn, Pa.; Iowa City, Ia.; West Liberty, Ia.; Greenup, Ill.; Monmouth, Ill.; Milton Junction, Wis.; Auburn, Ind.; Kendallville, Ind.; Nevada, Ia.; Kempton, Ind.; Topeka, Ind.; Champaign, Ill.; Burr Oak, Mich.; Mount Ayr, Ia.; Columbus, Kan.; Cerro Gordo, Ill.; Manito, Ill.; Attica, Ind.; Duncan, Indian Territory; Pekin, Ill.; Wilkesbarre, Pa.; Browns Valley, Ind.; Anderson, Texas; Crawfordsville, Ind.; Warren, Ark.; Winterset, Ia.; Cairo, Ill.; Wolcottville, Ind.; Monticello, Ind.; Stockwell, Ind.; Rochester, Ind.; Marshall, Ill., and Lima, Ohio. The Sterling Electric Company reports also that it is unable to fill orders for its well known protective devices and cable terminals, consequently is largely increasing its machine capacity so as to enable it to cope with the rapidly increasing business.

POWER IN NEBRASKA.—With regard to water power in Nebraska, the Niobrara *Pioneer* says: "The Niobrara River and Bazile and Verdigris creeks are very swift streams, furnishing many excellent mill sites and unlimited water power. The Niobrara Irrigation & Water Power Company, with a capital of $60,000, was organized March 21, 1901, and a survey at once begun. In a distance of five miles it has a fall of 52½ feet. The engineers in charge are Arnold C. Koenig and Charles A. Nippell, and Prof. Stout made the river gauging, finding at a normal stage 1600 cubic feet per second passing the head of the proposed canal. The canal will be constructed during the present summer of 1901 and 2500 horse-power developed. The officers are: B. Y. High, president; G. G. Bayha, vice-president; G. W. Chambers, treasurer, and E. A. Fry, secretary. Only a few of the many fine powers have, as yet, been developed, but the near future will display numerous examples of their utility to man when properly harnessed. The northern part of the county lies over the great artesian basin and several wells have been bored that flow with a pressure of ninety pounds to the square inch. The flouring mill, electric light, water works and small motors are run by the power of one artesian well.

THE BROWN-CORLISS ENGINE COMPANY, incorporated at Milwaukee, Wis., with a capital stock of $1,000,000, has already organized and got down to business. Mr. Julius Wechselberg is president; Mr. Walter F. Brown, formerly of the Harris Corliss, the Allis and the Filer & Stowell companies, is general manager and second vice-president. Mr. Walter S. Whitings, the first vice-president, is the son of the general manager of the Calumet & Hecla copper mine, and is a brother of Mr. C. W. Whitings, formerly with the E. P. Allis Company. The new concern has bought 1200 acres of land at Western Union Junction, Racine County, Wis., and is laying out a manufacturing city to be called Corliss. The factory is to employ 500 men as a starter. There will be a machine shop 500 feet long and 125 feet wide, and a foundry 400 feet long and 120 feet wide. All the buildings will be of steel and brick and replete with the latest tools and labor saving machinery. It is expected that the new company will play an important part in engine construction.

A FOREIGN VIEW OF COPPER PRICES.—The London *Statist*, discussing the statistical position of copper, concludes that though there may be no immediate appreciable decline in the price, yet with the growth of production and check to consumption, especially in Europe, the outlook is for difficulty in maintaining the price of copper at £70 per ton for "standard." Consumption in Europe this year has diminished 20 per cent from 1900, and with this decrease there has been restriction in American exports. The *Statist* thinks it likely that if, by reason of high prices, consumption continues checked and production continues to expand, there is danger of defection of some of the larger companies from the policy of restriction and control exercised by the American syndicate.

LARGE STOKER ORDER.—The Metropolitan Street Railway and Edison companies of Kansas City have just placed what is said to be the largest stoker order ever given in this country outside New York. Mr. P. Albert Poppenhausen, manager of the Green Engineering Company, of Chicago, has sold them 24 Green traveling link grates aggregating a capacity of 12,000-hp. This is the third order from the same quarter and makes a total of 15,000-hp. Other large plants with the Green apparatus are the Milwaukee Electric Railway & Light Company, 4000-hp.; Chicago Union Traction Company, 8000-hp; St. Louis Transit Company, 16,000-hp; Steubenville Traction & Light Company. The Green Engineering Company reports total sales since Jan. 1, 1901, of 27,000-hp.

PURCHASING FOR THE CAPE.—Mr. Charles Bletterman Elliott, of Cape Town, General Manager of the Cape Government Railways, who arrived last week at Southampton, was interviewed by a representative of the *Daily Mail* concerning his mission. This is to purchase material for South African railways. Mr. Elliott said he would remain in England for several weeks, and then go to the Continent and the United States. He added: "I shall devote special attention to the equipment of narrow-gauge roads, and, while in the United States, to the electric lighting systems. I shall prefer to give British manufacturers the preference if their terms and materials are satisfactory, but we must have the best and cheapest equipment it is possible to obtain."

DEMAND FOR ELECTRIC MACHINERY IN SPAIN.—Consul-General Guenther, of Frankfort, under date of April 27, 1901, says that a new electrical company, the "Sociedad General Gallego de Electricidad," has just been formed in Madrid, Spain, with a capital of 2,000,000 pesetas, and two of its engineers, Messrs. Ernesto Presser and Adoolfo Barbe, of Madrid, have been instructed to procure the necessary machinery, etc. Another company has also been formed at Saragossa—the "Sociedad de Aprovechamiento del Rio Gallegos—with a capital of 3,500,000 pesetas. This company will require a great deal of machinery and apparatus.

CAPE FEAR POWER PLANT.—Work has been begun upon the Cape Fear power plant at Buckhorn Falls, North Carolina. The contract for the electric equipment has been awarded to the General Electric Company and for turbines to the S. Morgan Smith Company, of York, Pa. The contract for the insulators, etc., has been awarded to the R. Thomas & Sons Company, East Liverpool, Ohio, and for the transmission lines, which will be 36 miles long, to Mr. John Blair MacAfee, of Philadelphia. Messrs. W. A. Smethurst and Rodney D. Allen will be the engineers, representing Mr. MacAfee in the construction of the transmission line.

ELECTRICITY IN RAILROAD SHOPS.—The Lake Shore & Michigan Southern Railroad Company, which is building extensive shops near Cleveland, has placed contracts for one 400-kw and one 75-kw Crocker-Wheeler generator; one 600-hp and one 125-hp Buckeye engine and 1200-hp of Aultman-Taylor water tube boilers. Contracts for the structural work of the blacksmith shop, locomotive machine shop and power house has been placed with the American Bridge Company.

THE WILLIAM TOD COMPANY, of Youngstown, Ohio, is letting contracts for the erection and equipment of what will be one of the largest foundries in the country. It will be devoted to the production of heavy machinery castings and will be equipped with modern electrical appliances. A contract has been placed with the Penn Bridge Company, of Beaver Falls, for the structural work for the building, which will be 80x400 ft. and 45 ft. high.

ELECTRIC RAILWAY CONTRACTS IN OHIO.—Contracts have just been let for power-house equipment of the Cincinnati & Eastern Railway, the new electric line connecting with New Richmond, as follows: Motors and generators, Westinghouse Company; engines, Buckeye, two of 600-hp each; boilers, the Aultman, Taylor Company, four, each of 300-hp. Car contracts will be taken up within the course of two or three weeks.

ENGINES FOR GENERATING PLANTS.—The Jones Brothers Electric Company, of Cincinnati, Ohio, has ordered a 450-hp tandem compound engine, arranged for direct connection to generator, from the Bell Engine Company, Erie, Pa. The Dayton, Ohio, Malleable Iron Works has also purchased a 175-hp engine, arranged for direct connection to generator, from the Ball Engine Company.

NEW YORK FIRE DEPARTMENT.—Mayor Van Wyck of New York City has approved the ordinance of the Municipal Assembly for the issue of $300,000 corporate stock, for the purchase of sites and erection of new buildings for the Fire Department and telegraph system of that Department.

THE BULLOCK AND WAGNER COMPANIES have secured the contract for the new central station, power and lighting plant, to be erected in Nashville, Tenn. It is reported that the General Incandescent Arc Light Company have the sub-contract for switchboard work.

THE ANCHOR ELECTRIC COMPANY has been organized at Youngstown, Ohio, with a capital of $50,000, for the purpose of manufacturing incandescent and arc lamps and other electrical appliances. Youngstown capitalists are the organizers.

HOISTING MACHINERY FOR BRAZIL.—The Brazilian Government is inviting tenders until July 8 for electrical hoisting and transportation apparatus and machinery for transporting locomotives.

BRIDGE FOR SPAIN.—A bridge is to be built at Bilbao, Spain, over the river there, and bids for its construction are invited by the city until July 18.

MACHINE TOOLS FOR NEW SOUTH WALES.—Tenders will be received until July 1 for the supply of machine tools for the government dock workshops on Cockatoo Island, New South Wales.

General News.

THE TELEPHONE.

DUMAS, ARK.—The Arkansas River Telegraph Company has filed articles of incorporation. The capital stock is $5,000. The incorporators are N. J. Pindall, President; W. A. Cheshire, M. W. Snelling, H. O. Pindall and J. Bernhardt.

WASHINGTON, D. C.—The Subscribers' Telephone Association held a meeting in this city a few days ago. The presiding officer, Col. O. G. Staples, stated that the gathering was in the nature of a jollification, on account of the recent decision of the District Court of Appeals, in reversing the opinion of Justice Barnard in the telephone rate case. This case was referred to more particularly in the legal department of our last issue.

LUMPKIN, GA., has begun the erection of a new telephone system.

CORINTH, ILL.—The Crab Orchard Telephone Company, of Corinth, has been incorporated. Capital stock, $2,000. The incorporators are George O. Mitchell, J. L. Dorris and J. L. Roberts.

ANDERSON, IND.—Capitalists of Muncie, Marion, Elwood, Alexandria and this city are arranging a consolidation of all the independent telephone plants in this section of Indiana. George W. Beers, of Fort Wayne, is the leading spirit in the negotiations. Companies are being organized in Muncie and Alexandria, and Councils of both cities have been asked for franchises.

INDIANAPOLIS, IND.—Articles of incorporation were filed with the Secretary of State by the Mansfield and Carbon Co-operative Telephone Company. The capital stock is $2,500. The board of directors is headed by W. N. Simir. The company will build and operate a telephone plant in, and connecting the two towns, and thence branch out into the surrounding country.

HARTFORD CITY, IND.—The Central Union Telephone Company will test the right of the City Council to revoke its franchise. Fifteen years ago the company was granted a franchise, but after a time abandoned the exchange and maintained long-distance service only. The Independent Company recently pre-empted the field, and then the Central Union began to re-establish its office. The Council revoked its franchise.

NOBLESVILLE, IND.—Judge Neal, of this city, denies the story sent out to the effect that he heard testimony in a divorce case by telephone, listened to the argument of complainant's attorney twenty miles away in the same manner, and then granted a decree.

INDIANAPOLIS, IND.—The Central Union Telephone Company has established a new "minute rate" between this city and Terre Haute. The new rate is twenty-five cents for one minute, and five cents for each additional half-minute. It is practically a division of the old rate of forty-five cents for three minutes.

GOSHEN, IND.—W. S. Chapman, auditor of the Central Union Telephone Company, has exonerated W. E. Branson, manager of the local office here, whose accounts were reported tangled. "There was some confusion in his accounts," said he, "but this was due to the position, which is a vexatious one, owing to sharp competition." Mr. Branson has been placed in charge again, and it is claimed that he possesses unusual aptitude for the business.

JASPER, IND.—The Dubois County Telephone Company, which has been working in the vicinity of this city for some time, has opened its exchange to the public, and all subscribers have free service to and with Tell City, Cannelton, Troy, St. Meinrad, Gentryville, Dale, Leavenworth, Corydon, Marengo and all towns along the Air Line east to New Albany, Salem, Paoli, West Baden, French Lick, Winslow, Petersburg and a score of other towns.

NEW ORLEANS, LA.—It is stated that the consolidation of practically all the independent telephone companies of Southwest Louisiana has been effected at New Iberia. The exchanges which got together comprise those of Baton Rouge, Thibodeuax, Teche, Vermillion and intermediate towns, a stretch of territory embracing about 200 miles. The consolidated company will be known as the Louisiana and Texas Long Distance Telephone Company. R. F. Hoggsett was elected president and general manager. The company will apply for a charter at once. It will be capitalized at $150,000, and eventually intends to get into New Orleans.

HOLYOKE, MASS.—The New England Telephone and Telegraph Company will erect an exchange at Maple and Suffolk Streets. The equipment will be equal to that of any exchange in New England.

BALTIMORE, MD.—The Maryland Telephone and Telegraph Company has now in operation over 100 nickel-in-the-slot public telephone pay stations. Meanwhile the Chesapeake and Potomac Telephone Company has begun installing its nickel-in-the-slot telephone machines in residences, but will not change its rate of ten cents a call for public stations. The residence service is on a six to ten party line, while the pay stations are like the Maryland pay stations, on a one-party line. The Chesapeake Company is now fitting up four new branch stations. The Maryland Company has all of its city branches in full operation, and is rapidly getting its suburban stations under way.

LANSING, MICH.—The Springport Telephone Exchange Company has been incorporated with a capital of $500.

ST. LOUIS, MO.—The Craig Telephone Company, Craig, Mo., has been incorporated. Capital stock, $1,000. Incorporators, F. K. Allen, E. J. Kellogg, W. S. Thompson and others.

JAMESON, MO.—The Jameson Telephone Company has been incorporated with a capital stock of $3,500. The incorporators are A. J. Fuller, W. T. Stovall, J. F. Brown and others.

SEDALIA, MO.—The Queen City Telephone Company, which commenced operations January of this year, has a modern plant. Its apparatus and exchange equipment was furnished by the Sterling Electric Company, of Lafayette, Ind. It comprises Sterling standard flash light transfer switchboard, distributing boards, combined cable terminals and protectors, pole top terminals, cable, line fuse protection and instruments. The company began with 400 subscribers, the service being of such a character and so satisfactory that it has been unable to supply the demands of its new patrons. It is fully expected that before the close of this year 1,000 subscribers will be connected with service to this new and progressive exchange.

RALEIGH, N. C.—The Southern Bell Telephone Company is arranging for the construction of a long distance line from Raleigh to Greensboro, which will for the first time put Raleigh in connection with the principal cities. Bonsal & Co., of Hamlet, will furnish 3,000 poles, and the copper wire and cross-bars have already been shipped.

BRIDGETON, N. J.—The Sussex Telephone Company has commenced the work of extending the new telephone line from Blairstown to Newton.

ALBANY, N. Y.—The Hancock Telephone Company, of Hancock, Delaware county, has been incorporated. Capital, $3,000. Directors, E. J. Colter, C. L. Wheeler and S. N. Wheeler, of Hancock.

NEW YORK, N. Y.—The Atlantic Telephone Company, which controls the franchise granted by the former city of Brooklyn to the New York and Eastern Telephone Company, and which alleges that it had a capital of $5,000,000 all paid in, has made application to Commissioner Kearny, of the Department of Public Buildings, Lighting and Supplies, for a permit to use the subways and to string wires.

ALBANY, N. Y.—The Citizens' Telephone Company, of Elmira, has been incorporated, to operate in Elmira and Chemung county, with a capital stock of $250,000. The directors are Charles H. Stewart, Joel H. Fuller, Kerm F. F. Gill, Charles B. Stowe, Byron L. Moore, Bert G. Hubbell, Cleveland, Ohio; Alexander C. Eustace, Charles H. Knipp, Charles A. Pulford and Joseph P. Eustace, Elmira.

HANCOCK, N. Y.—The Hancock Telephone line, owned by Chester B. May, has been merged into a stock company, capitalized at $3,000, and application made to the State officials for a franchise. The directors are Edmund J. Cotter, Clayton L. Wheeler, Samuel N. Wheeler, Chester B. May, Herbert W. Wagner, Austin D. Johnson and Bernard J. Bussman. Following are the officers of the new company: C. B. May, president; W. H. Wagner, secretary; S. N. Wheeler, treasurer; E. J. Cotter, manager. The system will be extended in various directions, namely: To Starlight, Pa., to Rood's Creek, where connection will be made with the Deposit system; to Apex, connecting with the Walton line; to East Branch, Peakville, Horton, Cook's Falls, Rockland. At Craryville connection will also be made with the new Sands Creek line running over to Cannonsville.

FAIRVIEW, OHIO.—The Union Telephone Company has been incorporated with $10,000, to build a local exchange.

UHRICHSVILLE, OHIO.—The Uhrichville-Dennison Home Telephone Company has been sold to Cleveland people.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company, of Springfield, has been incorporated. Capital stock, $300,000.

CANTON, OHIO.—The United States Telephone Company has completed long distance connection with the Stark County Telephone Company at Canton.

NEWARK, OHIO.—The Buckeye State Telephone Company, of this place, has been incorporated with $10,000 capital stock by local people to build an exchange.

GALLIPOLIS, OHIO.—Work on a new telephone line from Gallipolis, along the river road, via Chambersburg, Crown City and Proctersville, to Ironton, has been commenced.

BURTON, OHIO.—The Burton Home Telephone Company has increased its capital stock from $5,000 to $15,000. A number of improvements and extensions are contemplated.

ASHVILLE, OHIO.—Construction work has been started on the new system of the Citizens' Telephone Company. Work has also been started at Williamsport and Circleville.

ANDOVER, OHIO.—The Jefferson & Warren Telephone Company has 110 telephones at this point, with twenty-five on a waiting list. A new switchboard will shortly be installed.

WILMOT, OHIO.—The Valley Telephone Company, of this place, has been incorporated by H. J. Christman, J. W. Moyer, E. C. Cotton, J. W. Newcomer and A. L. Deal. Capital stock, $1,000. The company will operate lines in Stark, Holmes, Tuscarawas and Wayne counties.

CADIZ, OHIO.—The Harrison County Telephone Company is preparing to establish exchanges in Jewitt, Scio, Harrisville, Freeport and Adena. The company now has 150 telephones in this place, while the Bell Company has only fifty. R. Cunningham is president, and W. W. Potts secretary of the company.

CADIZ, OHIO.—The United States Telephone Company is building a long-distance line from Uhrichsville to Steubenville and Wheeling, through this city, giving long distance connection to the Harrison County Telephone Company's exchange. The Harrison Company is building a number of toll lines to surrounding towns in this county.

EATON, OHIO.—The independent telephone companies of Preble county have appointed a committee consisting of Judge Abram Fisher, Joel Stewart and Ellsworth Horn, to draft a new schedule of rates. The various companies in this county have been unable heretofore to agree on a schedule of toll rates, and many differencees have resulted.

TOLEDO, OHIO.—The Home Telephone Company, which is promoted by Frank Graves and Cleveland parties, has secured nearly 3,000 subscribers. It is stated that arrangements have been made to rent two floors of a large office building for an exchange. The company has not yet secured its franchise from the City Council, but the matter will be settled in the near future.

CINCINNATI, OHIO.—Ordinances to compel telephone companies operating in the villages and towns in West Virginia are being introduced in a number of places in that State. In the main they are aimed to reach those companies having their principal offices elsewhere, and endeavor to escape the payment of taxes in the little towns by the payment of State, county and district taxes in the place where the main offices are located.

STEUBENVILLE, OHIO.—Manager Sapp, of the Bell Telephone Company here, is installing a private system of thirty telephones in the country residence of J. B. Vandergrift, near this place. Telephones will be placed in all buildings on the grounds, and will be connected to an automatic exchange. Wires will all be placed underground. Local and long distance connection will be given through the exchange here.

DAYTON, OHIO.—After a fight lasting more than two years, the Dayton Home Telephone Company has finally secured from the probate Court a twenty-five year franchise for a local exchange. Under the conditions the company may not sell or transfer its franchise, and the city is given the privilege of buying the system at the end of five years. This is the last large town in the State to secure an independent telephone exchange. Harry Kiefaber is president, and Albert Emanuel secretary of the company. Offices have already been opened, and a number of subscribers have been secured. Contracts for material will be closed at once.

FINDLAY, OHIO.—The new exchange of the Findlay Home Telephone Company will probably be placed in operation in the near future. The switchboard is now being installed. It is of the double supervisory, six panelled multiple type of the central energy system, and equipped with all modern improvements, being the product of the North Electric Company, Cleveland. The ultimate switchboard capacity will be 1,600 and the cable capacity 1,300. The farmers in the vicinity of Findlay are taking up the telephone, and contracts have been closed with 200 farmers. J. R. Firman is manager of the Findlay company, which is promoted by Cleveland people.

CLEVELAND, OHIO.—Application for a charter for the incorporation of the People's Telephone Company of Detroit, which is being promoted by the Everett-Moore syndicate of this city, has been sent to the Secretary of State of Michigan. The company will be capitalized at $2,500,000, 70 per cent of which is controlled by the Federal Telephone Company, of Cleveland, and 30 per cent by Detroit capitalists. Among the directors will be H. A. Everett and E. W. Moore, Cleveland; C. L. Palms, Henry Stevens, Alex. McPherson, J. C. Hutchins, Theodore D. Buhl, of Detroit, and Arthur Pack, of Pontiac, Mich. Work has been started on the underground system, and a site has been purchased for a six-story exchange building. The plant will have a capacity of 12,000, and it is expected will be in operation by February 1, 1902.

SAND CREEK, OKLA.—The Sand Creek Telephone and Construction Company, of Sand Creek, Okla., was incorporated May 25, to operate a telephone line. The incorporators are J. A. Meyer, C. L. Beckendike, J. Lutz, A. H. McMahan and N. A. Silverthorn.

PHILADELPHIA, PA.—The Monroe County Telephone Company, Appenzel, Monroe county, has been incorporated. Capital, $3,000.

BELLEFONTE, PA.—The Central Commercial Telephone Company, of this place, has been purchased by, and merged into, the United Telephone and Telegraph Company, of Pennsylvania.

PITTSBURG, PA.—The United Telephone and Telegraph Company, of Pennsylvania, is endeavoring to acquire a line through to Pittsburg. The company now owns all the independent telephone companies between Philadelphia and Altoona, Pa., and has just purchased a controlling interest in the Central Commercial Telephone Company, of Bellefonte, Pa.

HARRISBURG, PA.—The House has passed the Hosack bill against telephone monopoly. It prevents the consolidation of competing telephone lines or acquisition of the controlling interest in the stock or bonds of competing telephone lines, and provides that where any such company violates the proposed act its franchise, property, stock and bonds shall be forfeited to the Commonwealth.

HILLSBORO, TEXAS.—E. M. Turner, of the Hillsboro Independent Telephone Exchange, has perfected arrangements for the exchange in Dallas. A $40,000 plant will be put in with all the latest improvements. It is the intention of the company to extend lines to every section of the county as rapidly as possible.

KEMP, TEXAS.—The Texas Telegraph and Telephone Company has elected the following named officers: Dodge Mason, president and general manager; J. G. Crawford, vice-president; A. J. Still, Jr., secretary and treasurer; R. B. Still, auditor. It proposes extending its line south to Nacogdoches and Beaumont at once, and the work of rebuilding the line from Corsicana to Tyler is now in progress.

RICHMOND, VA.—The Street Committee has passed an ordinance authorizing the Southern Bell Telephone Company to do business in the city of Richmond.

WILLIAMSBURG, VA.—An arrangement for consolidation between the Newport News and Richmond and Chesapeake Telephone Companies has been effected. Both companies will maintain their corporate existence, but only one system will be operated.

MARSHALL, WIS.—A telephone line is being built through this place to connect Sun Prairie, Marshall, Waterloo and Lake Mills. It is expected that there will be a local exchange at this place.

MILWAUKEE, WIS.—Plans are being made by the officers of the Pere Marquette line to furnish its seven vessels with a system of wireless telegraphy. The Marconi system is most favorable. Land stations so far decided upon would be at Ludington, Milwaukee and Manitowoc.

RAWLINS, WYO.—The Rocky Mountain Bell Telephone Company is arranging to build a telephone line from Battle Lake across the divide to Dixon, Baggs, Hahn's Peak and towns in Northwestern Colorado. Ranchmen and others along the line will purchase stock and will hold a controlling interest in the line.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The San Francisco Department of Electricity is extending its underground system under the supervision of W. R. Hewitt, Superintendent of Fire Alarm and Police Telegraph.

SAN FRANCISCO, CAL.—The Nevada Light, Power and Water Company was recently incorporated by Lewis A. Gould, Fred Blauch, Daniel O'Connell, Harry A. Cook, R. C. Van Vleet, H. H. Ferns and S. C. Scheeline. Capital stock, $400,000; subscribed, $700.

SAN FRANCISCO, CAL.—The Sea Power Company was recently incorporated with San Francisco as the principal place of business. Directors, W. S. Duncombe, A. W. Craig, F. Head, P. Crittenden and W. J. Desmond. Capital stock, $1,000,000; subscribed, $2,500.

SAN FRANCISCO, CAL.—The Bay Counties Power Company, which recently completed an electric power transmission line traversing Yolo, Solano, Contra Costa and Alameda counties in California, recently filed a mortgage for $750,000 on all of its property. It gives the Union Trust Company, of San Francisco, a lien on its holdings for that amount.

INDIANAPOLIS, IND.—Specifications are now ready and bids invited for the new public lighting contract for this city.

INDIANAPOLIS, IND.—The Home Heating & Lighting Company is laying conduits for electric lights and power in the mile square granted by council. It is current belief that the public lighting will be awarded to this company, and this was in contemplation when the company first got its franchise. The two companies are believed to have pooled their interests.

CAMBRIDGE CITY, IND.—Several stockholders in the Cambridge City Electric Light Company have filed suit in the Wayne Circuit Court for a receiver. The plant and equipment is modern, but the corporation was practically put out of business recently by the installation of a municipal lighting plant, and the plaintiffs want the affairs of the private concern wound up.

INDIANAPOLIS, IND.—Commercial enterprise, dependent upon electric light and power, is spreading to many small towns throughout the State. During the week articles of incorporation for new industries were filed with the Secretary of State by the Logansport Light, Heat and Power Company, capital $25,000; the Knox Light, Heat and Power Company, capital $10,000; the Jermon Electric Company, of Indianapolis, to manufacture electrical instruments and appliances for physicians and dentists. Several electric light and power companies, incorporated in other States, but doing business in this State, filed articles during the week under the foreign incorporation act.

CLARENDON, MO.—The Clarendon Electric Light and Power Company, of Clarendon, has been incorporated with a capital stock of $6,000. The incorporators are George W. Washington, W. H. Cooke, George T. Morgan and others.

SEDALIA, MO.—Negotiations are pending for the purchase of the properties of the Sedalia Electric and Railway Company, the Sedalia Gas Company and the Sedalia Steam Heating Company, and their consolidation with the Sedalia Water and Light Company.

ST. LOUIS, MO.—According to estimates prepared by expert engineers of the board of public improvements, the three municipal electric light plants to be completed by Aug. 31 will save the city about $115,684.05 in five years. By contract at present meter rates the current would cost $297,725.90 in five years. The cost of the plants and the operation for five years will aggregate $182,041.85.

TRENTON, N. J.—The Butte Electric and Power Company, capital $2,500,000, has filed articles of incorporation. The incorporators are William J. Denning, William W. Mansfield, Charles E. Estabrook, C. R. Dean, Thomas K. Henderson, C. L. Reed, I. F. Keeler, J. S. Anthony and William F. Brayton, all of Jersey City.

FRANKFORT, N. Y.—The citizens of Frankfort, N. Y., have recently voted to bond the village for $18,000, to build a municipal electric lighting plant. Work will begin as soon as plans and specifications can be prepared. Mr. J. F. Tucker is clerk of the board.

WARREN, OHIO.—T. H. and E. W. Gillmer and William Wallace have made application for a franchise to build an electric light plant and heating system in this place.

GENEVA, OHIO.—Citizens of this place have voted against a proposition to bond the village to the extent of $25,000 for the purpose of building a municipal lighting plant.

MT. GILEAD, OHIO.—The Fish-Mansfield Company, of Shelby, has secured a franchise to build a water-works and electric lighting plant here. Construction work will start at once.

PORTLAND, ORE.—The Portland General Electric Company has been granted a permit to erect an auxiliary electric power station. The equipment to be installed includes two engines of 2000-hp and 1200-hp respectively; 15 steam boilers and several generators.

MADISON, WIS.—It is reported that the city will build a $35,000 electric lighting plant.

MANSFIELD, WIS.—The electric lighting plant was on May 22 damaged by fire to the extent of about $4,000.

OSHKOSH, WIS.—This city recently made a ten-year contract for electric street lighting. It is believed to be the lowest contract ever made in the United States for the same amount of service. The price is $48 a lamp per year, the lamps to be of 1,200 candle power each, and of the enclosed arc type. There are 274 lamps, and the saving on the new contract will be $52,342.

MADISON, WIS.—Philip L. Spooner has purchased the water power of the Wisconsin river at Kilbourn City, and will develop the power for operating an electric power plant. Electric energy will be transmitted to Kilbourn City, Madison, Baraboo, Portage and other villages. As Mr. Spooner recently purchased the Madison street railway system, it is expected that the system will be operated from the Kilbourn plant. It is also reported that an electric railway will be built connecting the chain of four lakes. The circuit of the lakes would be some sixty miles in extent.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—The San Francisco and San Mateo Electric Railway has been turned over to the Baltimore syndicate, represented by Messrs. Webb and Blackwell. The road will be extended at once from Baden, Cal., to San Mateo, and later to San Jose.

VINCENNES, IND.—A receiver has been asked for the Citizens' Street Railway Company, of this city.

NEW ALBANY, IND.—The New Albany street railway system was sold on May 23 under a decree of the United States Court to Richard L. Veech, of Louisville, for $56,100.

FRANKLIN, IND.—The Indianapolis, Greenwood and Franklin Traction Company, which completed its extension to this city recently, will be extended to Columbus at once.

MUNCIE, IND.—This city will soon be connected by electric railway with Greenfield, through Middletown, Mechanicsburg, Shirley and other towns. A stock company is being organized.

PORTLAND, IND.—Special elections have been called in Knox, Richland and Penn Townships, Jay County, to vote subsidies in aid of the proposed Ohio and Indiana Traction Company.

ROCHESTER, IND.—A committee of Wabash business and professional men visited this place during the week and took up the matter of building a trolley line between the two cities. The distance is twenty-five miles.

INDIANAPOLIS, IND.—A strike among the union linemen has retarded work on the local street railway lines, the Indianapolis light and power plant and the telephone lines. The linemen have been receiving $2.25 per day. They are demanding $2.50 and overtime pay after a nine-hour day.

DELTA, OHIO.—The Toledo & Bryan Air Line Railway Company has applied for a franchise to pass through the center of this village.

CINCINNATI, OHIO.—Promoters of the traction line between Louisville and Maysville are negotiating for the Frankfort and Cincinnati Railway between Frankfort and Paris, Ky.

STEUBENVILLE, OHIO.—General Manager J. C. Ross, of the Steubenville Traction Company, has closed contracts for the extension of the line to Toronto and construction work will start at once.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company has applied for a franchise for its proposed extension to Wellsville. The company will erect a large car barn at the terminus of the road.

DAYTON, OHIO.—The Dayton & Germantown Traction Company has secured a private right of way from this city to Germantown and Middletown. Surveys have been completed and construction work will start in the near future.

NAPOLEON, OHIO.—The Henry County commissioners have granted a 25-year franchise to the Toledo, Napoleon & Defiance Railway Company. The way granted is along the canal road and the company will occupy that portion adjoining the canal towpath.

CINCINNATI, OHIO.—The Miami and Erie Canal Transportation Company has awarded the contract for overhead material for the electric line on the banks of the canal between Cincinnati and Dayton to the Ohio Brass Company, of Mansfield. The amount is $28,000.

FINDLAY, OHIO.—A company is being organized here to build a line from Findlay to Ft. Wayne, Ind. The incorporators are Dr. W. H. Beggs, Columbus Grove; Dr. H. M. Day, Pandora; C. E. Niles and Dr. J. A. Kimmel, of Findlay; I. H. Whistler, of Benton, and G. W. Reiser, of Ottawa.

STEUBENVILLE, OHIO.—The Steubenville Traction Company has purchased a site for a car barn and repair shop. The former building will be 200 x 50 feet, with capacity for 24 cars, and the latter will be 150 x 25 feet and will be equipped with all appliances for repairing and maintaining cars.

CLEVELAND, OHIO.—The Electric Depot Company, of this city, has been incorporated with $200,000 capital stock by B. Mahler, E. W. Moore, H. A. Everett, A. E. Akins and E. G. Tillotson to build a terminal station to be used as passenger, freight and storage house for the interurban roads entering this city.

TOLEDO, OHIO.—It is stated that a new company, to be known as the Toledo & Port Clinton Interurban Railway, will soon be incorporated to build a line from this place to Port Clinton, following the lake shore. G. W. Acker, C. Dedean, L. Galshall and W. B. Geroe, of Toledo, are said to be promoting the enterprise.

KENTON, OHIO.—The stockholders of the Tiffin & Southwestern Electric Railway Company have organized as follows: Henry Price, president; Robert Carye, first vice-president; W. S. Rogers, second vice-president; J. B. Seymour, treasurer; Thomas Espy, secretary. The capital stock of the company is to be increased from $50,000 to $2,000,000.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway Company has applied for a 25-year franchise between Columbus and Delaware. The company has purchased the Worthington & Flint Railway and the Worthington, Clintonville & Columbus Railway, both of which have franchises, but it desires a blanket franchise over the entire route.

DAYTON, OHIO.—A. E. Appleyard, owner of the Dayton, Springfield & Urbana Railway, and who recently purchased the Dayton, Lebanon & Cincinnati Railway (steam), has announced that the latter road will be equipped for electricity and that passenger cars will be operated during the day time while steam freight trains will be operated at night.

CLEVELAND, OHIO.—The Everett-Moore syndicate is figuring on a number of extensions to the system of the Northern Ohio Traction Company, in addition to those already announced. At a recent meeting of the company it was decided to extend the proposed line from Barberton Wadsworth, on to Medina, thus connecting the county seats of Medina and Summit counties.

LIMA, OHIO.—The Western Ohio Railway Company has secured the right of way for its extension from New Bremen to Sidney and Piqua. To provide for this extension, as well as the one to Findlay, the company will increase its capital stock from $1,000,000 to $2,000,000, and the capacity of the new power station at St. Marys will be doubled by the installation of two 800-kw generators, and engines and boilers to correspond.

CINCINNATI, OHIO.—It is expected that the work of construction on the Indiana & Ohio Railroad, which is being projected by W. H. Schott, of Chicago, will be begun by the middle of July, and that the road will be in operation not later than Jan. 1 next. The line will extend from Bluffton, Ind., south to Pennville, to Portland, to Dunkirk and Redkey, with a branch to Montpelier, thence in a southerly course to Hartford City, a distance in all of fifty miles.

CINCINNATI, OHIO.—The Suburban Traction Company, of Cincinnati, just organized, is officered as follows: Geo. R. Scrugham, president; J. M. Kennedy, vice-president; Lee H. Brooks, secretary, and Guy W. Mallon, treasurer. The line will be twenty-one miles in length, and will extend from Linwood, the eastern terminus of the Cincinnati Traction Company's lines, through Mt. Washington, Fruit Hill, Forestville, Withamville, Amelia, Mt. Holly and Bantam to Bethel, Ohio. The capital stock is $50,000.

OSHKOSH, WIS.—The Board of Trade is endeavoring to interest capital in a project to build an electric interurban railway between this city and Winneconne.

SHEBOYGAN, WIS.—The Common Council has granted a franchise to J. M. Searmann and J. P. Brickbuner to operate an electric railway through the city as an extension to be built this summer to Plymouth and Elkhart Lake. The right of way for the line has been secured.

THE AUTOMOBILE.

FIRE DEPARTMENT AUTOMOBILE.—If the automobile which is to be purchased by the San Francisco Fire Department for Chief Sullivan gives complete satisfaction, the battalion chiefs are also to be similarly provided.

SEEING SAN FRANCISCO IN AUTOMOBILES.—Mr. S. D. Rodgers, president of the Automobile Club of San Francisco, headed a large party of automobilists, who took a number of visiting Congressmen and Senators on a tour of San Francisco and its environs, as a feature of President McKinley's week in 'Frisco.

CROSSING THE CONTINENT ON AN AUTOMOBILE.—Alexander Winton and Charles B. Shanks, who went to the Pacific coast for the purpose of attempting to cross from the Pacific to the Atlantic for the first time in an automobile, left San Francisco for New York on May 20. The route is via Sacramento, Winnemucca, Nev., Ogden, Omaha, Chicago and Buffalo. They carried a packet from Gen. Shafter, Military Commander of the Department of California, to Gen. Miles. Mr. Shanks represents the Cleveland Plain Dealer. The automobile used is a Winton gasoline machine, capable of making thirty miles an hour. They carry tools for clearing the road if necessary.

NEW INDUSTRIAL COMPANIES.

THE HASTINGS ELECTRICAL COMPANY, of Hastings, Pa., has been incorporated with a capital of $3,000.

THE ANTISEPTIC TELEPHONE APPLIANCE COMPANY has been incorporated in New Jersey, with a capital stock of $500,000. The incorporators are E. S. Chambless, T. A. Hickey and P. W. Rider, all of Jersey City.

THE OTIS ELEVATOR COMPANY, with East Orange, N. J., as the principal place of business, was recently incorporated under the laws of the State of California; directors, J. B. Dill, A. S. Bard and L. Calkins; capital stock, $11,000,000.

NEWARK, N. J.—The Federal Development Company has filed articles of incorporation in the County Clerk's office in this city. Its object is to purchase and control lands, power sites, water sites, transportation, telephone and telegraph privileges, to construct and sell railroads, and acquire navigation privileges. The capital stock is fixed at $200,000, divided into 20,000,000 shares of par value of one cent each. The incorporators are Joseph P. Barriclow, Cleveland V. Childs and James R. Mapletoft.

THE ELECTRIC TYPEWRITER COMPANY, having as its purpose the manufacture and sale of a new electric typewriter, with its office in the city of Buffalo, has been incorporated at Albany. The company has a capital stock of $100,000. The typewriter to be manufactured is the invention of George H. Ennis, of Troy. Harry Bates, of Rensselaer, holds a half interest in it. The directors are Edward Michael and former State Comptroller James A. Roberts; his son, Joseph B. Roberts, of Buffalo; Joseph L. McEntee, of Albany, and Harry Bates, of Rensselaer.

LEGAL.

THE CARTY PATENT.—The American Bell Telephone Company is contending in the local United States Circuit Court in Pittsburg against the Anthracite Telephone Company, as to infringement of the Carty bridging bell patent, and the outcome of the litigation is watched by all the telephone interests in the country. The Bell interests are represented by the Western Electric Company, which latter company has asked the court to enjoin the Anthracite Telephone Company from using the Carty method. The plea of the defendant is a priority of use in the device before the patent was issued. The legal representatives of the Bell interests are F. P. Fish, of Boston, and George P. Barton, of Chicago, while the independent companies have their case argued by C. C. Buckley, of Chicago, and R. S. Taylor, of Fort Wayne, Ind. Judges Acheson and Buffington, of the United States Court of the Western District of Pennsylvania, have reserved their decision.

OBITUARY.

MR. C. S. COX, who has been connected with this and other technical journals as correspondent and illustrator for many years, died suddenly on Tuesday morning, May 28. Mr. Cox was not only an expert engraver and draughtsman, but a writer of no mean merit. His technical knowledge of machinery rendered him especially competent in discerning the salient features of power plants or other installations which he was describing. Mr. Cox was about forty-three years old when he died, and leaves a mother.

MR. A. P. BRAYTON, JR., died in Oakland, Cal., on May 12, at the age of thirty-four years, after a very short illness, death being caused by pneumonia. He was unmarried, and was a member of the Masonic order and of the Bohemian Club, besides being very prominent socially and popular with all classes. He was associated with his father in the management of the San Francisco works of the Pelton Water Wheel Company, and he had much to do with the development of the Pelton wheel. The interment took place in Oakland.

MR. J. W. DICKERSON.—The many friends of Mr. J. W. Dickerson will be pained to learn of his death, which occurred on Thursday of last week, at St. John's Hospital, Brooklyn, where he had been ill for about two weeks. Mr. Dickerson was born in 1861, and has been identified more or less closely with electrical journalism for ten or twelve years. In 1886 he went to Chicago from Rochester, N. Y. Soon after he joined the editorial staff of the *Western Electrician*. He left that publication to become the editor of *Electricity*, and thereafter was identified with the *Street Railway Journal* and the *Street Railway Gazette*, of Chicago. He came to New York in June, 1894, and was connected with the *Electric Railway Gazette*, until he was compelled on account of his health to go to Denver, where he made his home for the next three or four years, occasionally visiting his friends in the East. He had only recently returned to New York city to engage again in newspaper work. Mr. Dickerson's friends will always remember with pleasure his unfailing good nature and cheerful disposition, his staunch loyalty to his friends and his strict integrity in all business dealings.

MR. H. V. A. PARSELL.—We regret to state that Mr. Henry Van Arsdale Parsell died last week in New York city, at the age of sixty-eight years. Mr. Parsell was a well-known philanthropist and reformer. He was born in New Brunswick, N. J., and came to New York while a young man. In the early sixties he became assistant secretary of the Young Men's Christian Association, and about the same time was made paying teller of the North River Savings Bank, later becoming secretary of the same institution. He gave up this position in 1889, in order to administer the large estate of his brother-in-law, Norris Peters, and to conduct the celebrated business of photo-engraving founded by Mr. Peters in Washington. Mr. Parsell was a member of the Society for the Prevention of Crime, and spent much of his time at the headquarters of that society. He was treasurer of the New Amsterdam Eye and Ear Hospital, a director in the North River Savings Bank, belonged to the Aldine and Republican Clubs, the Museum of Natural History, the Metropolitan Museum of Art, and the Society for the Prevention of Cruelty to Animals. He was a man of remarkable mechanical and artistic taste, and spent a great deal of his time in his private laboratory, working in wood and iron for his own amusement. It is said that during the last years of his life he gave away a large income in assisting others. He was especially fond of encouraging young men, and his favorite method was to present a bank book with a comfortable sum already entered in it to a youth with an admonition to deposit something every week or every month. His principal work in electricity was galvanoplasty, in which he was very active between 1855 and 1865, doing remarkable work, as evidenced by the loan collection shown at the Electrical Exhibition of 1899. In some of his work the younger Elkington, son of the founder of the famous London firm, was associated with him. In this work he used the Daniell and Smee cells, with modifications to suit the conditions. Mr. Parsell's son, H. V. Parsell, Jr., is well known in the profession as an engineer and inventor of marked ability. The family home had been made by them one of the most interesting laboratories and museums that can be imagined. From cellar to garret it has brimmed over with works of art, curios, scientific specimens, apparatus, tools and costly mechanisms.

PERSONAL.

MR. F. BATHURST, of the Conduit and Insulation Company, London, is to visit this country during the present month on a combined holiday and business trip.

MR. T. D. SMITH, of the United States Signal Corps, has resigned from the service, and is joining the forces of the Davis Coal and Coke Company, West Virginia.

MR. S. DODD, who has for many years past been connected with electrical manufacturing, has become associated with the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

MR. S. G. McMEEN, engineer of the Central Union Telephone Company, gave an address on May 29 before the students of the Armour Institute of Technology, Chicago, on modern telephone practice.

MR. JOHN BLAIR MacAFEE, of Philadelphia, has recently completed the engineering and preparation of maps, profiles, plans and specifications for the Baltimore, Halethrop and St. Denis Railway.

MR. W. L. PROBASCO, of the publishing department of the Westinghouse companies, has gone to Buffalo, N. Y., and will remain at the Pan American Exposition until the exhibits of the Westinghouse interests are completed.

MR. F. A. McCARTY, formerly a contracting engineer for the Westinghouse Electric Manufacturing Company, sailed on May 30 for Sydney, New South Wales, where he will act as electrical engineer for Messrs. Noyes Bros. He left by way of San Francisco.

PROF. F. W. SPRINGER, of the department of electrical engineering of the University of Minnesota, passed through New York last week on his way to Europe, where he will spend a five months' holiday in rest and studying of electrical conditions in the old world.

PROF. ELIHU THOMSON is to deliver the annual commencement lecture before the Washburn Engineering Society at the Worcester Polytechnic Institute, in the lecture room of the Engineering Laboratory on Tuesday, June 11. It is the thirty-first annual commencement of the Worcester Polytechnic.

MR. J. H. RIDER, the lately appointed chief electrical engineer to the London County Council, has been engaged for some time on a treatise on electric traction. It will be published in the autumn, and will treat very fully on the different systems of electric tramways. It will be issued in America by Macmillan.

MESSRS. DAVIES MURDOCK, S. W. Hough and J. W. Buckley, of Baltimore, Md., who are connected with an electric railway system in that city, recently arrived in San Francisco to look over the San Francisco and San Mateo Electric Railway, which was recently purchased by the owner of the Baltimore lines.

MAJOR R. B. HOOVER, until recently manager of the Bell Telephone Company's exchange at Springfield, Ohio., has resigned to accept the position of secretary of the National Magneto Telephone Company, of New York. Mr. Hoover will be succeeded by H. P. Miller, who has been identified with the Bell company at Chicago.

DR. AUGUST RAPS, the amiable representative of Siemens & Halske, of Berlin, who has been studying telegraphic and telephonic conditions in this country, has returned from a trip as far west as Chicago, and sailed this week for Germany. He made many friends and acquaintances while here, and found a great deal of technical interest.

MR. PHILIP DAWSON presided at the dinner of the Savage Club, London, May 11. The menu, in pen and ink sketch, bears a neat three-quarter length of the chairman, and is also illustrated with designs showing how the Savages have applied the modern electric tramway service to affairs of the cuisine, so that you can "switch on what you like."

CAPT. WILLIAM BROPHY, formerly of the Boston Wire Department, has left the service, and of late has been doing expert work for the Boston Edison Company and other parties. As one of the most competent experts in the country in regard to aerial circuits, subways and interior wiring, Capt. Brophy should find his services, now happily available, in very general demand.

MR. E. THURNAUER.—A dispatch from Paris says: "The French press and public are beginning to realize the strides made by the Thomson-Houston Company, affiliated with the General Electric Company, of New York The Metropolitan recently elected two Thomson directors members of its board. Just previously a large company owning tramway systems in ten of the larger French towns elected five members of the Thomson group. A similar thing has happened regarding the Paris Omnibus Company. Mr. Thurnauer, an American citizen, and managing director of the French Thomson-Houston Co., has been appointed general manager of the Paris Omnibus Company's mechanical traction section."

MR. G. G. WARD, of the Commercial Cable Company, who was one of those representing the New York Chamber of Commerce at the reception given by King Edward at Windsor, is quoted by cable as follows: "When we saw the Queen we could scarcely believe it was she; she looked so young and charming. Both the King and Queen appeared to be in splendid health, and they certainly were in the best of spirits." The following is a complete list of the Americans present: Morris K. Jessup, Levi P. Morton, Cornelius N. Bliss, J. Pierpont Morgan, J. Pierpont Morgan, Jr., John T. Terry, George Wilson, Isidor Straus, William Butler Duncan, James Speyer, A. Foster Higgins, Eugene Delano, A. Barton Hepburn, John I. Waterbury, George G. Ward, Levi C. Weir, William H. Parsons, James McCreery, J. W. Pinchot, Vernon H. Brown, George S. Bowdoin and W. Bayard Cutting.

MR. RALPH L. SHAINWALD, president of the Standard Paint Company, New York, the manufacturer of the well-known P. & B. products, sails for Europe on the Feurst Bismarck, June 6, on a business trip, remaining abroad until October. The sale of Ruberoid roofing, P. & B. paints, and other of the P. & B. manufactures in Europe has grown so largely, and is so constantly increasing as to make imperative Mr. Shainwald's trip across the briny, for the purpose of still further enlarging the European factory of the company and increasing the already excellent facilities which the company has for handling its foreign business. Mr. Shainwald will visit the company's branches at London, Liverpool, Belfast, Dundee, Glasgow, Paris, Brussels, Berlin, Munich, Helsingsfors, Hamburg, Turin, Copenhagen, Moscow, St. Petersburg, Amsterdam, Vienna, Odessa and elsewhere. The P. & B. Goods are very popular abroad. In China Ruberoid roofing covers the barracks of both the United States and the German troops quartered there. Ruberoid is also used in the De Beers mines in South Africa. A large lot went to the Klondike a few months ago, while a big quantity accompanies the Baldwin-Ziegler Polar expedition. A great deal of Ruberoid and P. & B. paints is annually sold in Germany, Australia, Spain, Italy, Scandinavia, Russia, Austria, Egypt, West Indies, the Philippines and the Hawaiian Islands.

Trade Notes.

MESSRS. CHARLES A. SCHIEREN & CO., leather belt manufacturers, have opened a branch house in Denver, Colo., at 1315 Sixteenth Street.

THE PERU ELECTRIC MFG. CO., of Peru, Ind., reports large shipments of Pemco rosettes, and is a firm believer in the theory that it pays to advertise a good article.

THE CROKER WHEELER CO. is still hampered by the machinists' strike at its ampere works in New Jersey, but has met the situation quietly and calmly. It has already a large number of new men at work.

BATES FANS.—D. L. Bates & Bro., Dayton, Ohio, have issued their 1901 catalogue of the Bates electric fans. The Bates ceiling fan motors are wound for direct and alternating current; the desk fans for direct current only.

THE INDIANA ARM BRACKET AND PIN COMPANY, of Indianapolis, Ind., reports an unusual large business. This has necessitated doubling its capacity, which now will enable it to promptly take care of the largest orders.

THE ELECTRIC APPLIANCE CO., Chicago, is putting out a high-grade bridging telephone, which is especially recommended for farmers' line work, where a low priced but first class instrument is desired. A catalogue will be sent upon application.

CROSS OIL FILTERS.—The advantages of Cross oil filters are pointed out in a pamphlet just issued by the Burt Manufacturing Company, Akron, Ohio, the manufacturer of this well-known filter. Illustrations show the appearance and construction of the filter.

REMOVAL.—The Russell-Tomlinson Electric Company has removed its factory and offices from Milford, Conn., to Danbury, Conn. In the new quarters the company has doubled its former capacity, and will be able to give prompt attention to all orders and shipments.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, manufacturer of the chloride accumulator, has placed the Pennsylvania sales office under the direction of Mr. E. L. Reynolds, who for a number of years has been associated with the company in its New York office.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is sending out a circular, No. 61, giving illustrations of its elevating and conveying machinery for mills, factories, mines, industrial and power plants. Most of the views show actual installations of the apparatus.

THE STIRLING COMPANY, of Chicago, has just been awarded the contract for the boilers to be installed at the new Cincinnati water works, at California, Ohio. They are of the water-tube type, of about 2,000 horse power. The order was received through the Cincinnati manager, Ed. K. Gillette.

THE CENTRAL ELECTRIC CO., of Chicago, is Western agent for the Falcon Electric Manufacturing Company, arc lamps, fan motors, panel boards and plugs and receptacles. The Central calls attention to the panel boards and plugs and receptacles. They are made in any finish, and are neat, compact and durable.

ENGINEERING SPECIALTIES.—The Julian D'Esté Company, 24 Canal Street, Boston, Mass., in a forty-page pamphlet of recent issue, describes and illustrates its line of Curtis engineering specialties, including pressure regulators, for steam, hydraulic and air pressure; balanced steam traps, relief valves, separators, etc. These various devices are illustrated.

THIRTY DAYS AFTER.—The B. F. Sturtevant Company has issued a neat little pamphlet, entitled, "Thirty Days After," the meaning of which is that thirty days after the destruction of the electrical department in its works at Jamaica Plain, Mass., the shops were again thoroughly established and in working order. It is a story of enterprise and energy.

SMITH & HEMENWAY COMPANY, New York city, is one of the young and enterprising houses in the tool line, and has forged ahead wonderfully in the past few years. It is the publisher of one of the most novel catalogues issued by any house that we know of. It is called the "Green Book of Hardware Specialties." A copy will be sent free upon application.

MR. ROBERT R. McOAUT, of Indianapolis, Ind., was a welcome visitor to the Chicago office of the Electrical World and Engineer last week. He gives a very favorable report of business in connection with his supply store. He states the demand for Varmach dry batteries and leather nail heads from concerns running small motors is very large, this being their specialty.

ROBERT W. BLACKWELL & CO., Ltd., of London, notify us that they have accepted the resignation of Vicomte E. C. Beuret, the director of their Paris office, and that Messrs. E. Estavard and F. W. Vallat are now in charge of it, under Mr. Blackwell's direct instructions. The office will be conducted as heretofore, at 50 Boulevard Haussmann, and the business steadily developed.

PROFILING MACHINES.—The Garvin Machine Company, Spring and Varick Streets, New York, has issued a catalogue of its line of profiling machines. Among the special points about these machines are that there are no belts to give trouble, they effect great saving of floor space, they are simple in construction, are of high speed and of high efficiency. The various styles of machines are illustrated.

SAFETY LIFT.—The Burr Manufacturing Company, Cleveland, Ohio, makes a safety lift that possesses some features of interest to all requiring a device to lift heavy loads. The principal feature is that in case the rope slips out of the hand when the load is off the ground the rope is locked automatically, thus preventing the load from dropping. A folder issued by the company tells all about the device, and the accompanying illustrations show how it works.

FALSE REPORT OF FIRE.—The Century Motor Vehicle Company, of Syracuse, N. Y., informs us that there is no truth in the recent report that its plant was destroyed by fire. The story is contradicted. The company also states that it is able to take care of any orders that come its way, and in filling what orders it has on hand, notwithstanding the labor agitation among its machinists. Enough men remained at work to enable the company to fulfill its contracts.

STURTEVANT BLOWERS.—The B. F. Sturtevant Company, Boston, Mass., has issued a condensed catalogue of the Sturtevant forges, steel pressure blowers, "Monogram" blowers and exhausters, steel plate planing mill exhausters, counter-shafts, blast gates, disk and propeller fans, steel plate, pulley, steam and electric fans, engines, dynamo motors and generating sets; steam heating, ventilating and drying apparatus; mechanical draft fans, exhaust heads, steam traps, etc. The catalogue has 40 pages, and contains illustrations.

THE WARNER ELECTRIC COMPANY, Muncie, Ind., has just issued a new catalogue of the Warner pole changer for ringing telephones. The device is extensively used, and is stated to be safe, reliable and economical. It has been well received by both the Bell and independent exchanges, and has been on the market three years. The company states that 1,200 of them have been sold in that time. Their use covers nearly every State in the Union and four foreign countries. The catalogue gives detailed information and illustrations of the apparatus.

STROWGER TELEPHONE.—The Strowger Automatic Telephone, 141 to 148 Washington Street, Chicago, have recently been extending their facilities, owing to the increase of demand for their apparatus. From time to time articles have appeared in these pages with reference to their apparatus and plants, and the reports in each case have been favorable to automatic methods. The Strowger Company is of opinion that a large and increasing demand now exists for such apparatus, and that much of the future development of telephony will lie along these lines.

THE GOULD STORAGE BATTERY CO., which is now manufacturing a light output battery, is looked upon with favor by vehicle users, because, with a Gould battery producing from ten to twelve volts per pound, a forty-mile run is possible in a heavy vehicle, whereas in a light runabout, to make sixty miles is equally easy. The Gould shops are running full time, with orders well ahead, yet, as their vehicle battery representative, T. J. Fay, puts it, "There is a lumber factory in the same county, and we can spread a wing to any breeze that blows, provided it floats an order."

THE NEW YORK CENTRAL.—In the special issue of postage stamps to advertise the Buffalo Exposition, the Post Office Department has done honor to the New York Central Railroad, the greatest mail carrier in the world. The one-cent stamp represents the lake navigation with which the Central Railroad connects; the two-cent stamp, the famous Empire State express train; the four-cent stamp, the automobiles used in the Central Railroad cab service; the five-cent stamp, the Niagara Falls bridge, past which the Central trains dash; the eight-cent stamp, the locks at Sault Ste. Marie, through which the Central Road steamers pass, and the ten-cent stamps, the ocean steamers with which the New York Central lines connect and ticket passengers to every part of the globe.

NO FURTHER USE FOR THE CHIMNEY.—One of the most interesting features of the equipment of the new Olympia Mills at Columbia, S. C., is the mechanical draft apparatus. The tall chimney which has heretofore been such a distinguishing feature of a cotton mill is completely done away with and for it is substituted a short steel plate stack extending barely above the roof. Draft is produced by two 14 ft. Sturtevant fans driven by direct-connected engines. An outer shell surrounds the stack, and through the annular space between, air is drawn from the atmosphere down into the fan room. The heat thus acquired is further increased by radiation from the fans. This hot air is finally drawn to the fires through ducts extending beneath the ashpits. The entire mechanical draft plant was designed and built by the B. F. Sturtevant Company, of Boston, Mass.

THE NATIONAL BOARD OF FIRE UNDERWRITERS has recently issued a supplement to the National Electrical Code containing a list of electrical fittings that have been examined and approved by the Underwriters' National Electric Association for use under the rules and requirements of the National Board of Fire Underwriters, for the installation of electric wiring and apparatus. The National Board has also recently published in pamphlet form the rules and requirements for the manufacture of private department fire hose for mill and yard use, as recommended by the National Fire Protective Association. Copies of both of these pamphlets may be obtained by addressing Mr. W. H. Merrill, Jr., secretary, Underwriters' Laboratories, 67 East Twenty-first Street, Chicago.

"ELECTROSE," as an insulating material and substitute for hard rubber, is coming forward in a very interesting manner, and it is a well-established factor with the electrical trade all over the world. It has been in the market about ten years, and has shown that it possesses the qualities necessary to a staple article. We understand that it has been greatly improved lately, and that the Electrose Manufacturing ompany, who already had a large plant at 127 to 137 North Tenth Street, Brooklyn, was obliged to increase its plant and its force of employes, owing to large contracts it has booked for home and export trade. All those interested in hard rubber substitutes will be well repaid by investigating Electrose. It is especially well adapted for telephone appliances, for sheets and special insulation fittings.

ERICSSON TELEPHONES.—We have been informed by the Ericsson Telephone Company, 296 Broadway, New York city, that the Ericsson telephone was awarded first prize at Paris, 1881; Madrid, 1883; Vienna, 1884; Stockholm, 1886; Copenhagen, 1888; Chicago, 1893. Its exhibit in Paris in 1900 was from the St. Petersburg, Russia factory, which was also awarded first prize. This year its exhibit of a fifty-subscriber switchboard, and a few of its different telephones at the Pan-American Exposition at Buffalo, is made in Section 8, of the Electricity Building, and Mr. W. Jac. Marland has charge of the exhibit. The company extends to all its friends and patrons a cordial invitation to see its exhibit and talk over its instruments. It is exhibiting its goods in connection with others in a collective electrical exhibit, which will doubtless prove of interest to many of our readers.

THE HAINES & NOYES COMPANY, Chicago, announces that within the next sixty days it will be ready to fill all orders for its new self-restoring switchboard. This board is designed without the use of the old type drop shutter, and is of the visual signal principle. It makes the work of the operator absolutely sure, and greatly facilitates her work, thus gaining two points of great importance, accuracy, and time saving. The visual signal appears when a subscriber calls, as a colored indicator, and locks until the operator answers the call by plugging in, which releases the indicator, when the signal immediately disappears. This signal cannot disappear unless the operator answers the call. The signal cannot appear unless a subscriber calls. A sudden jar of the board will not cause a number to indicate, as in the use of the old-style drop. The jack and signal, which are self-contained and self-restoring, occupy a front space on the board of one and one-quarter inches by one inch, which is exceedingly small—smaller than any other. This board will be used for hotels, private telephone plants, etc., as well as for exchanges.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 28, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

674,858. CONTACT FOR CONTROLLERS OR REVERSING SWITCHES; J. Trier, Chicago, Ill. App. filed Apr. 26, 1900. The contact is a spring pressed rod carrying a shoe, the arrangement being intended to take up wear.

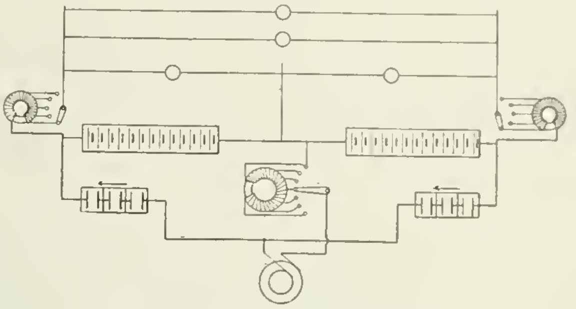
674,860. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed June 27, 1900. A plurality of central offices, a bus-bar at each office, and a common return conductor connecting the bus-bars.

674,861. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed June 27, 1900. Modification of the preceding patent.

674,862. TELEPHONE SWITCHBOARD; E. F. Frost, Washington, D. C. App. filed June 27, 1900. A further modification.

674,867. CIRCUIT OPERATING DEVICE; P. C. Howe, Boston, Mass App. filed March 12, 1900. A thermostat closes a second circuit if the heat continues after the closure of one circuit.

674,890. STATIC MACHINE; H. E. Waite and H. F. Waite, New York, N. Y. App. filed Apr. 10, 1901. The door of the case containing the influence machine has attached to it a charging machine for initially charging the influence machine.


675,158.—System of Electrical Distribution.

674,927. ELECTRODE FOR ELECTROLYTIC CELLS; M. Mauran, Niagara Falls, N. Y. App. filed March 16, 1900. (See page 980.)

674,930. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed March 26, 1900. (See page 980.)

674,931. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed June 14, 1900. (See page 980.)

674,932. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed Oct. 10, 1900. (See page 980.)

674,933. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed Oct. 16, 1900. (See Current News and Notes.)

674,934. ELECTRODE FOR ELECTROLYTIC CELLS; M. Mauran, Niagara Falls, N. Y. App. filed March 16, 1900. (See page 980.)

674,942. AUTOMATIC CURRENT REGULATOR; S. D. Sprong, Long Branch, N. J. App. filed March 16, 1901. In a regulator for maintaining a constant current in an alternating current circuit, a solenoid, in combination with oppositely located oscillating beams supporting the coils of the solenoid from their outer ends and the core thereof from their inner ends.

674,947. AUTOMATIC REGULATING SWITCH; F. J. Tolchard, Paignton, Eng. App. filed Oct. 29, 1900. Relays are arranged to close one or the other of two motor circuits, the motors therein acting to cut out cells of battery.

674,964. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed June 27, 1900. In connection with the usual instruments, it is proposed to use a line constituting a common return for the telephone line circuit and for the transmitter circuit a battery supply circuit grounded at the central office and at the subscriber's station.

674,981. CONTROLLING ELECTRIC MOTORS; E. C. Parham, Brooklyn, N. Y. App. filed Sept. 23, 1899. (See Current News and Notes.)

674,990. CABLE SUPPORTING CLIP; H. P. Copeland, Jersey City, N. J. App. filed March 26, 1901. A strap doubled upon itself to form loops for the supporting and supported cable, the loops being formed by passing one end nf the strap through slits formed in the other end.

675,001. APPARATUS FOR CONNECTING ELECTRIC METERS IN THREE CIRCUITS; J. R. Dick, Brighton, Eng. App. filed March 9, 1900. A three-wire circuit comprising a neutral conductor split into two branches, two substantially equal resistances in the two branches respectively, and measuring instrument in a bridge across the two branches.

675,027. CONTROLLER FOR ELECTRIC CARS; W. W. Tice, Rahway, N. J. App. filed Aug. 1, 1900. Details.

675,033. ELECTRIC ARC LAMP; Curt. Arthur Max Börner, of Berlin, Germany. App. filed July 24, 1900. A plurality of carbons in a parallel row are insulated from each other, and the upper and lower carbon points occupy a staggered relation to each other. The current enters the outermost carbon on one side and leaves the outermost carbon on the opposite side. Means are provided for striking the arc.

675,038. ELECTRIC RAILWAY; P. Farnsworth, Schenectady, N. Y. App. filed May 31, 1900. A railway wherein the only switch coils are in shunts to ground around the car motors from conductor sections which are engaged by the collector carried by the car.

675,049. CIRCUIT BREAKER; S. B. Stewart, Jr., Schenectady, N. Y. App. filed Jan. 21, 1901. The tripping device for the latch is set and released by opposite handle movements.

675,050. ELECTRIC RAILWAY; S. B. Stewart, Jr., Schenectady, N. Y. App. filed Feb. 21, 1901. In an electric railway, the combination with the feeder, of conductor sections, electromagnetic switches for connecting the feeder with said sections, a resistance carried by the car, and means for automatically cutting said resistance into circuit with the successive switch coils after the latter have been energized.

675,056. MAGNETIC SEPARATOR; Thomas A. Edison, of Llewellyn Park, N. J. App. filed June 12, 1897. The magnetic ore is fed directly on the polar face of an oblong bar electromagnet; the non-magnetic rebound and fall on one side of a partition, while the magnetic particles have their gravitational trajectory changed in passing through the field of the magnet and fall on the other side.

675,065. DEVICE FOR OPERATING AND CONTROLLING ELECTRIC AUTOMOBILES; F. F. Loomis, Akron, Ohio. App. filed Nov. 3, 1900. Details of the steering and controlling stand.

675,066. FIRE ALARM DEVICE; N. Malander, Minneapolis, Minn. App. filed May 21, 1900. Details.

675,086. ELECTRIC RAILWAY SIGNAL; W. H. Council, Williamsville, Ill. App. filed April 19,1900. Details of track and locomotive circuit for operating block signals in the locomotive cab.

675,087. TRANSMITTER ARM; J. F. Craven, Pittsburg, Pa. App. filed Jan. 9, 1901. The arm comprises two longitudinal members of stamped sheet metal united in such a way as to form a single hollow arm.

675,114. ELECTRIC MOTOR CONTROL; B. C. Shipman, Wilkinsburg, Pa. App. filed June 25, 1900. When the motor is connected on a short circuit to retard the car, a battery is independently connected to the armature circuit and its connections commutated so that groups of successively lower and lower electromotive force are inserted.

675,127. COUPLING FOR CONDUIT OUTLET BOXES; J. P. Cole, Boston, Mass. App. filed Sept. 15, 1900. A threaded sleeve is attached to the box near the opening to afford a water tight connection for the conduit.

675,142. TROLLEY WHEEL; H. W. Smith, Medford, Mass. App. filed March 6, 1901. The inside of the flanges is covered with insulating material, while the thread and the extreme edges are of conducting material, so that when the wheels ride over a frog the circuit will be continuous.

675,158. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed April 5, 1900. The invention enables the rectification of impulses in both directions, generated by an alternating current dynamo, by the provision of two branches or circuits containing such electrochemical rectifying devices oppositely placed, so that impulses in one direction are directed through one of such circuits, while the opposite impulses pass through the other branch.

675,162. MAGNETIC SEPARATOR; B. Noble, Detroit, Mich. App. filed Aug. 27, 1900. A cylinder having magnet poles exposed on its surface and arranged in a staggered relation with respect to each other

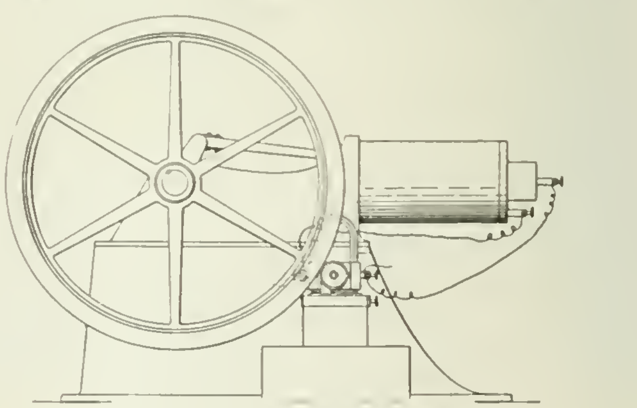
675,177. ELECTRIC SWITCH; G. B. Thomas, Hartford, Conn. App. filed Feb. 15, 1901. An electric switch provided with a moving part, consisting of two pieces of metal, one to receive the mechanical wear, and the other of sheet metal formed with contacts and holding and embracing the first piece.

675,292. VOLTAIC SHOE; E. E. Phinney, Niantic, Conn. App. filed Nov. 3,1900. A voltaic couple is placed in the sole of the shoe.

675,293. CONTROLLER FOR ELECTRIC MOTORS; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Aug. 27, 1898. Details of construction.

675,294. ELECTRICAL CONTROLLING APPARATUS; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Feb. 2, 1900. A single switch device controlls a resistance in a shunt around the motor armature, and also the main circuit, there being a permanent resistance in a second shunt around the armature, but in parallel with the variable resistance.

675,303. ELECTRIC FIXTURE BASE; J. W. Smith, Brooklyn, N. Y. App. filed Oct. 15, 1898. A plate having segmental flanges adapted to be engaged by a plug or stem also having segmental flanges, insulating material being inserted between the flanges.


675,351.—Safety Speed Limiting Means.

675,323. LIFTING MAGNET; E. B. Clark, Chicago, Ill. App. filed May 22, 1900. The magnet is provided with a number of pole pieces and coils, and means are furnished for changing the polarity of groups of pole pieces to adapt the magnet for different kinds of work.

675,351. SAFETY SPEED LIMITING MEANS; G. W. Henricks, Indianapolis, Ind. App. filed March 14, 1901. The pulley of a small dynamo for gas engines is driven by the air current created by the rotating fly-wheel of the engine.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

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Fifth Annual Convention of the Independent Telephone Association of America ... Supplement

THE TELEPHONE CONVENTION

What is regarded as probably the largest telephone convention ever brought together in this country, has been held with success in Buffalo this week by the Independent Telephone Association of America. The meeting was marked not only by large numbers, but by enthusiasm and a general spirit of hopefulness. The manufacturers, represented in force, all reported a large and growing demand for their product, and the managers of the independent exchanges were, with few exceptions, very cheerful as to the future. In some places, the competition has been too long and too strong to admit of any profits, and in other places, the renewal of cheap work by construction of more durability is proving expensive. But, on the whole, the independents may claim both to have justified their existence and to be doing excellent work.

The proceedings of the association still smack overmuch of "politics," and are wanting in technical interest. This is a condition that must be cured if the convention is to be of any benefit annually to the members. Judge Thomas made an excellent legal review of the whole situation from the beginning, but that cannot be done again each year, nor can the Association live on old wrongs now redressed. To-day the cry of "fraud," or that of "monopoly," has no meaning in the telephone art, and to depend upon their utility with the public will be a "waving of the bloody shirt" from which only the deluded wavers will suffer. The contest now is on the broad ground of merit and low rates, and here the independents are increasingly able to hold their own. They would, therefore, do well to let their technical men come more to the front for the open discussion of the endless questions of exchange management and operation. The National Electric Light Association has always been most influential when it has turned its attention to the serious matters of technical improvement rather than to those dealing with patents and politics. We print in full that part of President Thomas's address which gives a resumé of the various epochal stages to date of the telephone patent situation so far as it has affected the independent movement. This presentation we commend to readers who have not followed all of the steps, for nowhere have we seen the story told so connectedly and with such evident knowledge of every detail. While the narration deals with a matter which now, happily, possesses only a historical interest, yet it will always remain a famous chapter in patent annals.

A TECHNOLEXICON.

The Verein Deutscher Ingenieure, or union of German engineers, in Berlin, has recently issued circulars directed into the technological channels calling attention to the fact that there is a desire to secure a reliable technical dictionary comprehending all technical departments, but especially those of the technical sciences and those in which patents are granted. This dictionary it is proposed to prepare in three languages—namely, German, English and French—so that the dictionary shall be essentially a rendering into each of these languages of the meanings of terms employed in that and in the other two languages. In order to carry on the work voluntary contributions to the manuscript are invited from those who are interested in the preparation of such a dictionary.

We think that while it would be very desirable to possess such an international dictionary, and for which the name chosen seems excellently fitted, yet the amount of labor involved in its preparation, and the size of such a dictionary, if in any way complete, staggers the computer. Thus in the English literature of electrical engineering alone, there are at least 20,000 technical terms. Then there are mechanical engineering, chemical engineering and civil engineering to provide for, as well as a number of lesser arts, such as photography. Altogether, if the work were to be carried out thoroughly, we should expect to find at least 100,000 technical words or terms, which it is proposed not only to define in their own language, but also to render into two other languages. This would be a stupendous piece of work, and we can only suppose that the intention is to abbreviate it, and only to print lists of the more important and frequently used terms in technical use in these languages.

For our own part, we think it is quite unnecessary to translate the technical terms of one language into another language. The men who are interested in such a book are, naturally, technologists. As a class, technologists possess sufficient acquaintance with other languages to be content with a dictionary which shall define a technical term in the language to which it belongs, and without any translation into his own language. In other words, what is usually wanted by a technological reader or inquirer is the definition of a term and not its translation. If he reads a book in a foreign language, he must understand sufficient of that language to be satisfied with a definition in the simpler terms of that language. Consequently, we think that it is amply sufficient for all practical purposes if we can obtain a good technological dictionary of English terms in English, a similar one of French terms in French, and a third of German terms in German.

A Rotary Field Electrostatic Induction-Motor.

The new form of electrostatic induction motor of Professor Ho, described this week, is an interesting contribution to electrostatic apparatus from Japan. In view of the steadily rising electric potentials on long-distance transmission lines, it is impossible to say that electrostatic apparatus is devoid of utilitarian interest, while the theory of rotation is very interesting.

There are two standpoints from which a rotary magnetic field hysteresis motor may be regarded, both, of course, leading ultimately to the same result. One is to consider that when a rotating magnetic field sweeps around a simple, unwound, iron cylinder armature, the magnetic hysteresis of that armature causes its induced magnetic poles to lag behind the rotating field poles by a certain angle, and thus develops a tangential pull or torque. The other is to consider the amount of energy which would be liberated in the iron hysteretically by the successive magnetic reversals created under the influence of the rotating magnetic field, and to consider that, according to the theory of least action, the armature will rotate and develop torque, provided that the mechanical energy of rotation is less than the hysteretic energy at quiescence.

It does not seem clear that the torque and motion of the paper cylinder of Professor Arno's electrostatic motor is mainly due to electrostatic hysteresis, although, of course, hysteresis must aid the motion. If hysteresis were the sole moving force, then a solid dielectric cylinder should develop a greater torque than a hollow cylinder of the same material, swinging in air. Any cause which will allow the induced electric charges to lag behind the revolving electrostatic field would produce motion, and it seems possible that a leakage creeping of the induced charges around the paper cylinder might be mainly accountable for the effect. But in regard to Professor Ho's motor, the retardation of charges due to high resistance paths, is clearly the cause of rotation and bears a curious analogy to the very different condition of affairs in the polyphase rotary-field induction motor.

The Performance of the Enclosed Arc.

The report on enclosed arcs and the carbons therefor, prepared by the committee of the National Electric Light Association having this matter in charge, was one of the important features of the late convention and furnishes much food for reflection. The problem of producing a suitable carbon for such work has always been a serious one, and for a time threatened to prove almost insoluble. As usual, however, persistence met its reward, and to judge from the report in question, there would seem to be little trouble in securing from a number of makers, both American and foreign, carbons of suitable grade. The edge of one's self-congratulation is somewhat blunted, nevertheless, by the statement of Professor Matthews in response to a direct inquiry, that for a combination of life and light-giving power, the European carbons still hold first place. Considering the fact that enclosed arcs are little used abroad, and that these foreign carbons are made mostly for export, such a result is all the more remarkable. It would be interesting to know whether this advantage comes from different labor conditions, different processes or different materials, or all together. It is a matter of great finesse to make such carbons, to give them just hardness enough to ensure a good life and prevent smudging the inner globe, without sacrificing intensity or steadiness of burning. Yet we have a pretty distinct opinion that our American makers could easily turn out a carbon as good as the best product of Europe if they stood on a parity with the foreigners in cost of labor and material.

But there is much that the committee report did not include. Steadiness of burning is perhaps the most important practical quality demanded of carbons for any kind of arc lighting, and this cannot easily be made the subject of exact tests. As a general rule, the carbons that give the longest life are a bit too hard for maximum steadiness. Indeed, it is quite certain that in most instances long-lived carbons are rather at a disadvantage. It seems to us that altogether too much importance is oftentimes attached to mere length of burning. Of the five kinds of carbons tested by the committee, the longest lived sort averaged 115.6 hours, and the shortest lived 98.8 hours. That is, when used for street lighting on the winter schedule, the former would burn a little over eight days, the latter just seven. Now, the difference in cost of carbons and trimming per year for these two grades of carbon is altogether trivial compared with even a slight difference in steadiness or efficiency. Of the two, either burns quite long enough for every-day station operation, and quality of light far outweighs so small a difference in life. We omit from this comparison one brand of carbon, which lived only 85.6 hours by reason of the very great difference in clearance between this carbon and all the others. We have a strong suspicion that, as between the carbons tested, careful gauging to uniform clearance would have very materially altered the outcome. A loose-fitting carbon, as is well known to those operating large numbers of enclosed lamps, means a shortened life, and the best results are to be obtained only by using carbons of uniform diameter and caps bored accurately to size. Experience has shown that careful attention to such little details as these are absolutely necessary to the successful use of enclosed lamps. When such lamps are first installed it is a usual occurrence to hear loud complaints of the carbons not coming up to their guaranteed life, but this difficulty vanishes just so soon as the trimmers, used to dealing with open arcs, have become accustomed to their new duties and begin to appreciate the importance of care.

We are glad to note also that the committee is taking up seriously the photometric properties of direct-current and alternating-current series enclosed arcs. These two systems often come into competition, and data for comparison have up to the present time come mostly from people with axes to grind. The preliminary report, however, seems in great measure to confirm these data as understood by those familiar with the subject. The 6.8-ampere direct-current enclosed arc appears to be perceptibly better than the 6.6-ampere alternating arc, but by no very large amount. The difference in distribution is, if anything, rather in favor of the direct-current arc, a point not generally realized. Still, the two are so close together that this advantage counts for little. The results, on the whole, confirm the opinion generally held that at 6.6 amperes the alternating arc is not quite equal in illuminating power to the 6.8-ampere enclosed direct-current arc, but yet pretty near to it. At 7.5 amperes, on the other hand, or even a trifle less, the alternating arc is distinctly better than either the 6.8-ampere enclosed or the 9.6-ampere open direct-current arc.

One thing we earnestly hope the committee will overhaul during the coming year, and that is the series-enclosed arcs, both direct and alternating, taking about 5 amperes. Their real relation as effective illuminants to the ordinary open "half arc," so-called, has never been properly determined, and it is a subject that is likely to be up for discussion in the very near future. Such lights have been used considerably in street lighting, and their equivalence ought to be carefully ascertained before their use is largely increased. The open arc seems doomed in this country, but it has done sterling service for a good many years, and its successor should be made to show entirely satisfactory credentials. We have yet to hear of a case in which the change from open to enclosed arcs was not adjudged by the public a beneficial one, but it is a good idea to know exactly what one is getting, and thorough investigation of the subject is much to be desired.

THE ELEMENTS OF PRECISION.

We wish that once, at least, during his lifetime every engineer were compelled to come down to the very foundations of things and to measure one physical constant with the utmost attainable precision. One who has been through such an experience has widened his scientific horizon for the rest of his days, and acquires a contempt for shifty and slovenly experimenting that stands him in good stead. It does not make much difference what the particular nature of the work of precision may be; it might be nothing more startling than the exact comparison of two standards of length or mass, but it would teach the lesson of the difference between real and pseudo-precision, and teach it too forcefully to be forgotten. More than all else, it would teach the futility of the last few decimal places in almost any result one can mention, and the difference between concordance and exactness. When one gets down to hard facts even our units of length, mass and time are in a state not encouraging to one's scientific vanity, and on these units hang all the others. It is a very pleasant thing to talk glibly about a precision of one part in ten million, and that sort of thing; but there are few who understand what the words imply. It is a perfectly possible thing to compare two metre bars placed side by side with such care that the difference between them is then and there known to the ten-thousandth part of a millimeter. But keep one bar in Paris and send the other to London or Berlin for comparison with a third bar, and no amount of care seems able to insure that the relation between this new standard and the original one will be known with any such accuracy. And after the lapse of a few years there is a very good chance that new determinations will not agree with the old ones. Changes as great as three or four parts in a million have been several times recorded under such conditions.

With standard of mass the case is little better. One can compare, say, 200 grain weights to nearly or quite one part in a million, but one could not be sure of repeating the measurement elsewhere and on a different balance to even one-tenth that degree of precision. And as an absolute quantity the grain is not known anywhere so closely as the figure last mentioned would indicate. Even the measurements of time are far from being such as to give one the fullest confidence in results dependent upon them, although, on the whole, the measurement of time is the most precise known to us. There are 86,400 seconds in a day, and a first-class astronomical clock has its rate kept down to about a tenth of a second per day. The rate may possibly be steady to a hundredth of a second a day for short intervals, so that if there are no errors in timing events other than those involved in the clocks, one could count on time as being measured with great precision. But it would be rash indeed to attempt to measure the time elapsing between two events an hour apart to one part in a million, or anything near that figure, while if only ordinary precautions were taken, errors of one part in 5000 might very easily creep in. When the elements of length, mass and time enter, as they frequently do, the same experiment, the chance of precision is still further diminished, and many a result derived from beautifully concordant experiments has been vitiated by a flaw in one of these basic units. If temperature also enters the result, one's case is yet worse off, for thermometry involves a series of possible errors beside which those of the fundamental units are insignificant. Most physical measurements involve thermometry, and in dealing with any complicated problem the case rapidly goes from bad to worse.

For instance, after half a century of study of the mechanical equivalent of heat, that constant is uncertain by at least one part in two thousand, and perhaps by more. We commonly comfort ourselves by considering the perfection of electrical measurements, yet the standard of e. m. f. is certainly in doubt by at least one part in two or three thousand, even as regards the permanence of the standards, while the electro-chemical equivalent of silver, which is the real basis of so many electrical constants, has not yet been determined with certainty to much, if any, higher degree of precision than one-tenth of 1 per cent. The true value of the ohm is in doubt by a similar amount, and the specific conductivities of the various metals are in far worse case. Fortunately, our working standards can be used for comparative measurements with a fair degree of accuracy, sometimes with a very high degree of accuracy, but in using them one should never forget that they are relative, not absolute measures. For most purposes it is merely relative accuracy that is needful, and there is a great work still to be done in such practical standardization as involves only these relative measurements. It is a task essentially international in its character, and we hope, now that the United States has fallen into the line of progress and established a Bureau of Standardization, for a united international effort that will bring the world's working standards to approximate unity. If this task can be thoroughly carried out, we need not worry much about the absolute values, for these will be worked out in due season. So long as one must apply corrections to the standards one actually works with, and that is presumably for all time, a slight change in the magnitude of such corrections to bring the result into accord with a new absolute determination, is not a very serious matter. Grave errors creep in most readily from the assumption that corrections are needless, for to realize errors is in great measure to avoid them.

Tremendous Trolley Boom in Pennsylvania.

The Pennsylvania Legislature passed bills last week favoring the creation of new trolley and other electric roads in the State. The effect of this legislation is noted in the following dispatch from Harrisburg, of June 8:

It was officially announced to-day that Governor Stone had signed the Emery and Focht rapid transit bills, under yesterday's date. The rush to take out charters at the State Department for street railways under the two rapid transit bills just signed began before it was officially announced that the measures had been signed. Over 100 applications were filed between 7 and 10 o'clock this morning, and it is expected the number will be doubled in the next 48 hours. Several Harrisburg law firms have been working day and night since the final passage of the bills on Wednesday, preparing applications. Secretary Griest announced this afternoon that charters had been issued to 13 street railway companies to operate in Philadelphia and suburbs. The names of the corporators and the routes of the proposed lines were not make public. The list of companies of the week is as follows: Passayunk Avenue Elevated Passenger Railway, capital $350,000; Broad Street Subway Passenger Railway, capital $1,250,000; Western Rapid Transit Street Railway, capital $360,000; Broad Street Rapid Transit Street Railway, capital $150,000; Chestnut Hill & Glenside Rapid Transit Street Railway, capital $150,000; Ridge Avenue Elevated Passenger Railway, capital $850,000; Frankford Elevated Passenger Railway, capital $750,000; Northern Rapid Transit Street Railway, capital $228,000; Germantown Avenue Elevated Passenger Railway, capital $900,000; Southern Rapid Transit Street Railway, capital $90,000; Eastern Rapid Transit Street Railway, capital $540,000; Central Rapid Transit Street Railway, capital $60,000; Market Street Elevated Passenger Railway, capital $1,500,000.

Charters were also granted to the companies in which Messrs. Oliver, Bigelow and other Pittsburg men are interested. The capital stock of the companies and the list of corporators are not given. The State will receive a handsome revenue from these charters. The fee for taking out a charter is $82, in addition to the bonus of one-third of 1 per cent on the authorized capital stock of the corporations. The new laws go into effect immediately.

The New York bankers said to be interested in the project are Kuhn, Loeb & Co and Moore & Schley. The best-known of the Pennsylvanians interested are United States Senators Quay and Penrose, James M. Guffey, Henry W. Oliver, Judge Reed, president of the Philadelphia Company; Thomas S. Bigelow, Richard R. Quay, John M. Mack, Congressman Foederer, and the Mellons, of Pittsburg.

Annual Meeting of the New York Electrical Society.

The New York Electrical Society held its twentieth annual meeting on June 6 at Café Boulevard, in New York City. The meeting was preceded by a dinner, and was followed by a concert. No fewer than 110 members and friends were present, and the evening was a great success. The report of Treasurer Sinclair showed that during the year a deficiency of about $200 had been converted into a balance of about $81, and that the receipts of the society in the year had reached $882.50. Secretary Guy reported that the activity and interest in the society had been maintained at a high level. Among the contributors to the programme had been Mr. Carl Hering, Dr. Kennelly, Mr. C. P. Steinmetz, Dr. S. Sheldon, Mr. K. B. Miller, Dr. Louis Bell and Mr. C. F. Scott, and the society had also visited the central station of the New York Edison Company and the new automobile stables of the New York Electric Vehicle Transportation Company. The average attendance had reached the high figure of 200 per meeting, which probably had not been equaled by any other technical society in the city during the year. The gain in membership had also been quite remarkable. The society had begun the year with 540 members, 90 new members had been elected, 1 had died, 2 had been stricken off the rolls and 16 had resigned. This left a total for the beginning of the new year of 611, showing a net gain of 71 members. During the evening 6 new members were elected.

An interesting feature of the year's work had been the publication of no fewer than three of the lectures, that by Mr. Miller on telephone engineering, and those by Messrs. Steinmetz and Scott on alternating current work, for all three of which there was a large demand.

The society adopted a new constitution and then proceeded to the election of officers for the year 1901-2, and the ticket was unanimously elected as follows: President, Arthur Williams; vice-president, C. E. Knox, re-elected; C. O. Baker, Jr., re-elected; S. L. Nicholson, re-elected; H. A. Lardner, George Harbert Condict, H. V. Parsell; secretary, George H. Guy, re-elected; treasurer, Henry A. Sinclair, re-elected.

Ex-President Dunn then spoke of the highly successful season that the society had had and called for a rising vote of thanks to the retiring president and his associates for their active and effective administration. This having been done the society proceeded to listen to an excellent programme of music arranged by Secretary Guy, which lasted until 11 p. m., and was greatly enjoyed. One of the contributors was Mr. C. McL. Paine, who was formerly in the electrical field, but has of late made quite a reputation as a vocal artist. Among the selections rendered by Mr. Paine was the prize song from the Meistersinger. It was agreed on all hands that the dinner and concert furnished a charming finale for one of the best years that the society has ever had, and afforded a pledge of vigorous and united work in the future. The new president, Mr. Arthur Williams, made a brief and earnest acknowledgment of the hearty reception given him and assured the members that very effort would be put forward to maintain the society on the high plane which had now been reached.

The following were elected to membership: John A. Jamison, Jr., 170 Paterson Street, Paterson, N. J.; W. B. Larrabee, Knickerbocker Telegraph & Telephone Company, 100 Broadway, New York; Andrew Adam Schwinn, Jr., 1463 First Avenue, City; Emerson C. Tibbals, Electric Hydraulic & Pneumatic Power Station, U. S. Naval Magazine, Iona Island, N. Y.; C. Baechtold, Rossiter, McGovern & Co., 16 Morris Street, Jersey City, N. J.; Marcellus Staley, 327 West Fifty-second Street, City.

PRESIDENT ARTHUR WILLIAMS.

PRESIDENT ARTHUR WILLIAMS.

Arthur Williams was born Aug. 14, 1868. He entered the employ of the Edison Electric Illuminating Company February, 1885, at the old Pearl Street station. His first intention was to take a naval course at Annapolis, but seeing the great future then opening out for the electrical industry he determined to accept even a subordinate position with the Edison Company. So great was the difficulty of securing a place in the company at that time that he was content to take a place as an assistant in the meter department. Subsequently he was appointed electrician of the company, and afterwards became superintendent in charge of one of the uptown districts. This was in 1888. In the following year he was made superintendent of construction. In 1890 he was appointed general inspector. In 1893 this office was combined with the general agency, and under that form has since been held by Mr. Williams.

Not only is Mr. Williams' practical knowledge of the various branches of central station operation held in the highest esteem in electrical circles, both here and abroad, but he has made several notable contributions to the literature of the industry. At the Detroit meeting of the Edison Association in 1896 he read an able paper on the relations of the electric supply companies to their customers. In 1899, at the annual meeting of the American Institute of Electrical Engineers at Saratoga, he replied at length to a paper which had been read before the American Institute of Electrical Engineers on isolated electric light plants. The purpose of this reply, which was exceedingly lucid and comprehensive, was to clear up many existing misconceptions as to the relative advantage of the central station service. This contribution, owing to the data which it contains and the able manner of their presentation, remains perhaps the most important in the literature of the subject. In 1900, at the Saratoga meeting of the Edison Association, he read an exhaustive paper on electric elevators, in which the historical side of the industry was treated, as well as the relative efficiency and economy of electric elevation and of other methods.

In 1899 Mr. Williams was elected vice-president of the New York Electrical Society, in whose councils he brought to bear the same energy and judgment which have characterized his commercial career. Mr. Williams' election as president is most gratifying to all sections of the membership of the society, who regard it as insuring the continued activity and success of the organization.

Chaudiere Falls Power Transmission Plant.

By R. Girouard.

The Chaudière River takes its rise in the mountains on the border of the Province of Quebec and the State of Maine. It drains an area of about 2200 square miles, and on account of the denuded state of the watershed as well as the rapid slopes to the river, is subject to rapid and extraordinary fluctuations. The minimum flow of the river in summer months is 35,000 cubic feet per minute. The winter flow shows a very much higher average for the area drained than in the case of the northern rivers flowing into the St. Lawrence. At the point where the plant is located, to which this article relates—about 9 miles above the city of Quebec—the river falls down a perpendicular cliff of about 95 ft., and then reaches the St. Lawrence, 2 miles below, by a series of rapids aggregating 60 ft. in height.

HYDRAULIC DEVELOPMENT.

As will be seen by the small map of Falls and surroundings (Fig 2), the conditions existing at the Falls for an easy and inexpensive development were ideal. The small channel shown to the right of the island was at all times, except during high freshets, free from water. This channel ran for a few hundred feet below the head of the island, when it, like the river, plunged through a gully some 800 ft. long and almost at the level of the water below the Falls.

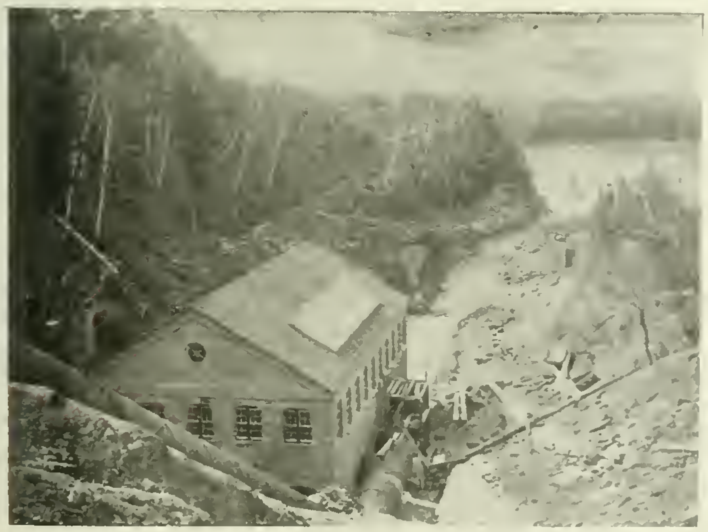


FIG. 1.—GENERAL VIEW OF POWER HOUSE.

At the point immediately where the channel made its descent to the lower level, the gully widened out sufficiently to allow the power house to be built, as well as room for three 8 ft. 3-inch flumes, which it is intended to use when the full power of the Falls is utilized. It will thus be seen that the problem resolved itself in the blocking of the inlet at the island by a bulkhead, and building a suitable dam at some distance above the Falls, to act as a regulating pond in case of exceedingly low water. For reasons that are apparent by looking at the map, the dam was carried across the river some 150 ft. above the Falls and a wing dam built at right angles to the main dam, connecting that part of the work with the bulkhead.

The main dam from the eastern abutment to the point where it connects to the wing dam is 824 ft. long, with an average height of 10 ft. on a base of 20 ft. This dam, as well as all other works connected with the water development, was built of concrete composed of cement one part, sand two parts and broken stone four parts. The foundation of the dam was carried well into the rock, the concrete being placed on a thick bed of cement motar after the bedrock had been thoroughly scrubbed from all adhering dirt. From the main dam the wing dam was carried down 159 ft. to the bulkhead, the crest of the wing dam being at the same level as that of the main dam.

The bulkhead which closes the inlet of the small channel is a massive structure of concrete 120 ft. long and 30 ft. wide at the base, and connects on the western shore of the river to an earthen embankment with a concrete core wall, this last being carried some 200 ft. up the river and then running into a side hill some 300 ft. from the original river bank. The bulkhead is provided with three inlet cones which pass through at the base, one of these being connected to the existing flume. The center of these cones is 15 ft. below normal water level. The rack and headgates are in front of this bulkhead, steel being the only material employed in construction of this part of the work.

The flume, of a diameter of 8 ft. 3 inches, and supported on steel piers, runs 175 ft. from the bulkhead, then dips at an angle, finally ending at the power house at floor level and at a distance of 340 ft. The tail race, which extends 800 ft. from the power house to the end of the island, is partly natural and partly artificial. The difference of level between still water in the pond at dam and in tail race is 115 ft., affording a working head of about 112 ft.

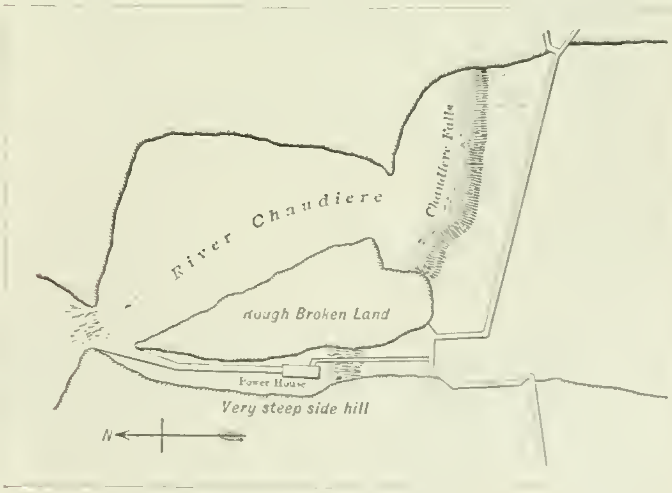


FIG. 2.—MAP OF CHAUDIÈRE FALLS.

POWER HOUSE.

The power house is built partly over a concrete arch which spans the tail race, and partly over natural rock foundation. It is a steel-framed brick building, 80 by 50 ft., with steel truss roof. It is provided with a 15-ton traveling crane, capable of reaching any part of the building. The floor of the building is of concrete, ducts having been provided to carry cables from dynamos to switchboard. Floor of power house was not yet completed when photographs were taken.

The power house has been planned for an ultimate capacity of 5000 horse-power. At present the plant consists of two 1400-hp and two 50-hp waterwheels, made by the S. Morgan Smith Company, of York, Pa. The larger wheels are directly connected to two 750-kw, three-phase 10,500-volt generators. The smaller wheels are directly connected to two 30-kw direct-current dynamos, which serve as exciters. Governing is obtained by two Lombard governors on the larger wheels and by common pawl governors on the smaller wheels. To ensure uniform pressure of water on the waterwheels under variations of load and also to provide for water hammer, the flume is fitted with two 15-inch Lombard relief valves, which open when the pressure exceeds the static head by a few pounds, thereby relieving the flume of any dangerous pressure caused by sudden closing of the waterwheel gates.

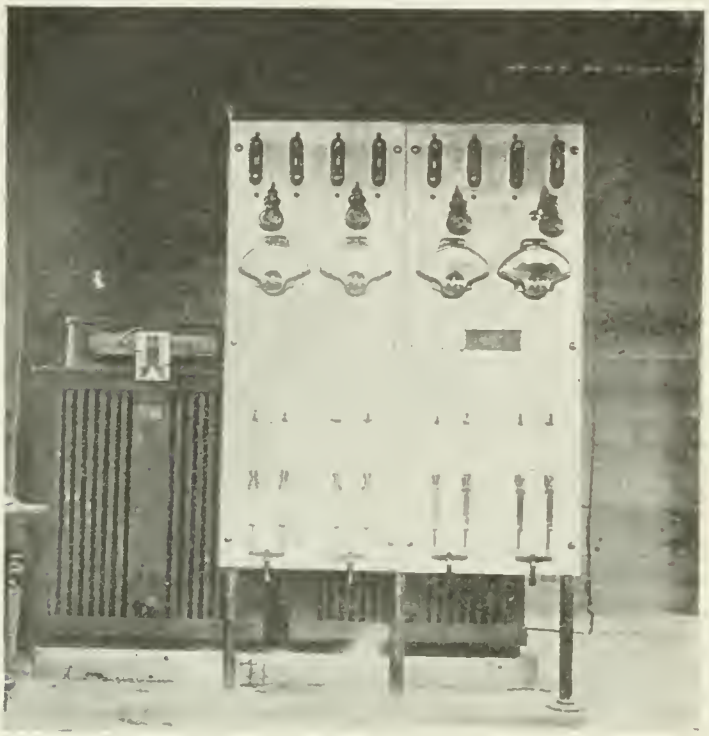


FIG. 3.—LEVIS SUB-STATION.

The generators are of the revolving-field type, three-phase, with a normal voltage of 10,500, but capable of being raised to 11,600 volts. The speed is 400 r. p. m., and the periodicity 66.6. They are single-slot machines, and show a regulation of 7 per cent on non-inductive load. The exciters are compound 30-kw machines, wound for 120 volts at a speed of 950 r. p. m.

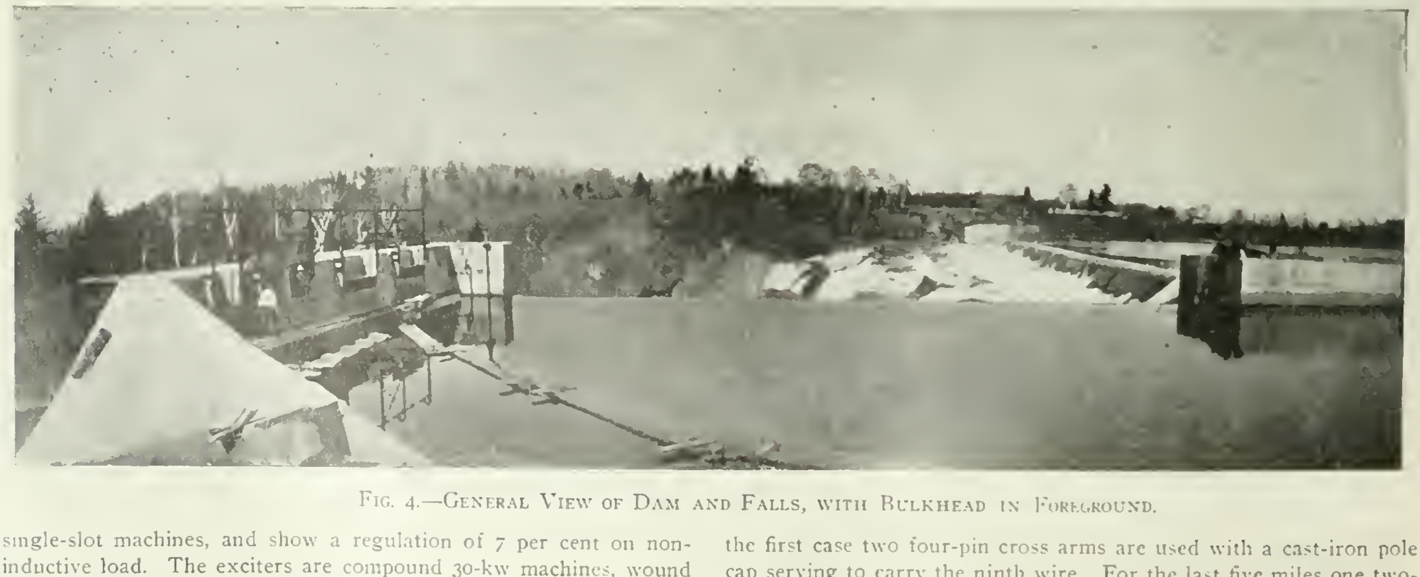


FIG. 4.—GENERAL VIEW OF DAM AND FALLS, WITH BULKHEAD IN FOREGROUND.

The switchboard, of blue Vermont marble, is provided with the usual current and potential transformers as well as a three-phase static ground detector. Oil switches are used for opening circuits of high potential. Fuses on the generators and line are of the spring expulsion type, and Wirt lightning arresters are connected to the line inside the building. All electrical material inside the power house was made by the Canadian General Electric Company, of Peterboro, Ont.

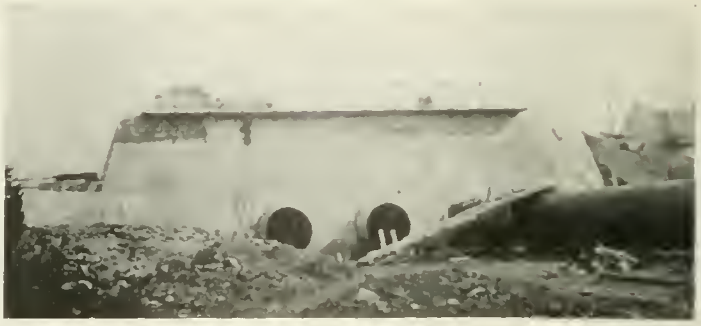
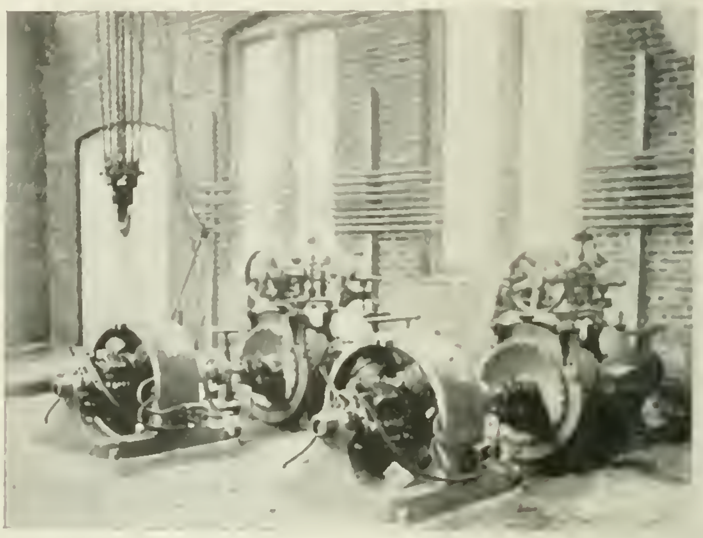


FIG. 5.—INLETS THROUGH BULKHEAD.



FEB. 6.—EXCITERS AND TURBINES.

TRANSMISSION LINE.

This extends from the power house to the city of Levis, nine miles away. Poles are of cedar, 35 to 45 ft. long, and with 7-inch tops. The pole line is designed to carry three circuits of three wires each for four miles (one circuit being connected to a sub-station at that distance), and two circuits for the remaining distance of five miles. In the first case two four-pin cross arms are used with a cast-iron pole cap serving to carry the ninth wire. For the last five miles one two-pin and one four-pin cross arm are used, allowing the formation of two triangles. Poles are spaced 100 ft. No. 4 medium drawn copper is used on the circuits.

There are two long spans on the line, one 500 ft. long over the River Chaudière a few hundred feet from the power house, and another of 300 ft. over the Etchemin River. In the first case hard drawn No. 1 wire is used, and the problem of anchoring and insulating the end of the wires was solved by bringing the wires a complete turn over an 8 by 10-inch beam, and tying the free end to the wire spanning the river, the wire in its turn over the beam being supported by porcelain insulators of triple petticoat pattern. The object of making the complete turn around the beam was to obtain a compressive strain on the insulators instead of the usual side strain, which, with the span in question, would have sheared the tops of any insulator. The strain is also evenly distributed, a condition never obtained where the insulators are in series. The span over the river Etchemin is made in the ordinary way, the wire on this being smaller and distance less.

SUB-STATIONS.

There are two sub-stations, one at Levis and the other at Etchemin. The first is provided with two three-phase—two-phase 150-kw oil-cooled transformers made by the Westinghouse Company, and reducing the pressure from 10,000 volts to 2080 volts. This station is also provided with a small distributing switchboard, consisting of two panels with ammeters, circuit breakers and expulsion fuses of four 100-kw circuits. The Etchemin sub-station is provided with a duplicate equipment of the Levis station, but for one-half the capacity.

All secondary distribution is on the three wire system, using large pole transformers, oil insulated, and made by the Pittsburg Transformer Company.

The population to be served by this plant is in the neighborhood of 20,000, and it is probable that the number of lights wired may reach one per capita, a figure reached and passed by many Canadian lighting companies. The field for the sale of motive power is also a large one, and should yield a good revenue.

The plant is the property of the Canadian Electric Light Company, of Quebec, of which the Hon. L. P. Pelletier, also of Quebec, is president.

The work of development on this plant was commenced at the end of August, 1899, and carried out under the general supervision of the writer, assisted by A. R. Henry, M. E.; T. Pringle & Son, of Montreal, being engineers for the hydraulic part and architects of the power house building.

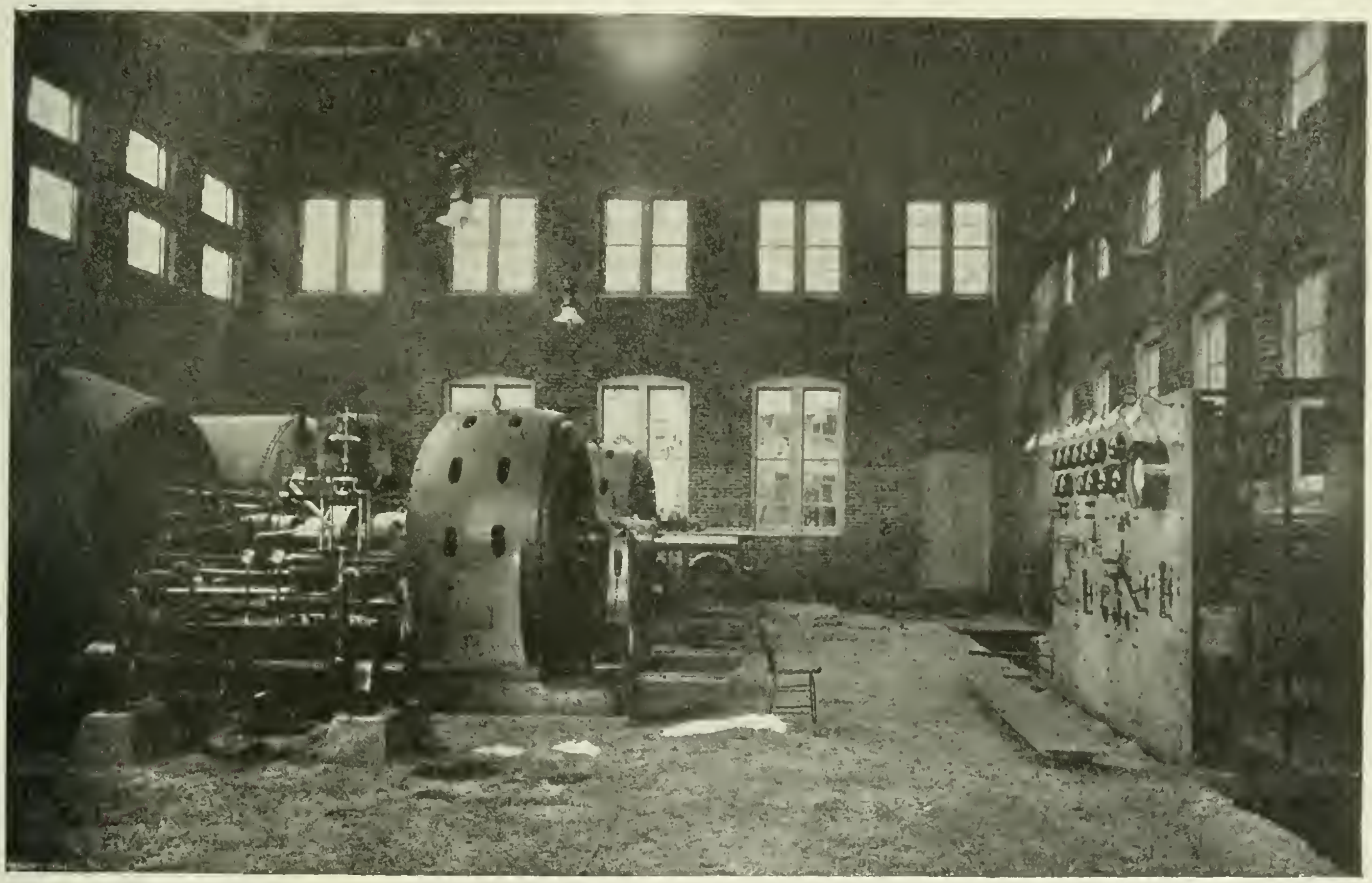


Fig. 7.—Interior of Power House, Showing 750-kw Generator, Turbines, Governor and Switchboard.

Photography and Telephony.

In a recent interesting article in the New York *Sun* reviewing the progress of photography during the nineteenth century, the veteran photographer, Mr. George D. Rockwood, records the following experiments, which apparently have reference to the old transmitter "make-and-break" controversy, as between Bell Reis and others:

Our wonder is often excited by seeing photographs of waves in motion made so quickly that they are apparently still, and of horses jumping in the air, and by the wonderful biographic pictures now reproduced so successfully. The experts who take these pictures say that they are made in a 250th part of a second, but this is slower than the growth of a pine tree compared to some pictures.

I was consulted in a patent case, and the inquiry was made as to whether it was possible to illustrate by photography the following case: One of the claims of the telephone patent is the continuous wire attached to the diaphragm of the speaking tube. This party declared that he could sever that wire and evading the patent produce the proper effect.

Wheatstone measured the duration of the electric spark as one twenty-four thousandth of a second. It would follow that any vibration not quicker than this might be arrested on the photographic plate at any point in its travel. Whereas, according to the investigations of Plateau, the duration of successive impressions on the human eye will average half a second, the electric spark might separate and distinguish photographically waves of which 12,000 impinge on the retina while the first of them is still lingering there. Now the vibrations or waves of air that yield the respective tones or pitches of sound have been accurately measured and counted. Assuming the pitch of the ordinary masculine voice in conversation to be as low as middle C, the number of complete double vibrations imparted by such a voice to the telephonic diaphragm or typmpanum would be 256 a second; that is, counting both ways, 512 movements of the diaphragm with its metallic point making or breaking the electrical circuit at each movement.

To the eye, which retains every impression for half a second, 256 of these movements would make their impression as one, and would give a stationary, fictitious image, if they were of sufficient depth to produce any visible effect whatever, which they are not. The electric spark, however, would give its illumination and do its photographic work within a little more than one-fiftieth of the time of one of the tympanum movements. A succession of such photographs, therefore, would present fortuitously any position of the vibrating point from that of contact to that of extreme reaction with an indefinite number of intermediate positions.

To verify these calculations I carefully focussed the photographic camera on the points of the telephone by daylight, and a battery of Leyden jars was so adjusted that when discharged it would throw the proper illumination on the points. My instantaneous plates were now to be tested under action 500 times quicker than a sensible instant and also invisible minute. Of course, it was as yet a practical question whether the photographic plates could effectively receive as quickly as the electric spark would give this infinitesimal action of light.

Waiting until the darkest hour of night, the plate was uncovered in total darkness, the telephonist began speaking into his instrument, and the illuminating spark was flashed upon the points. This operation was repeated with more than 20 plates in succession. The resulting negatives, on being developed, proved a triumph in two arts and a science. The photographs printed from them showed under the powerful magnifying glass, in some, contact of the points, and in others a variety of infinitesimally differenced intervals between them. Not one of the impressions had more than the one-twenty-four thousandth of a second in which to be begun and ended.

Prof. Bell on the Telephone.

The subjoined, with the signature of Professor A. G. Bell, has been issued by the Press Publishing Company, of the *New York World*, in which it appeared on June 9:

It is exactly 26 years since I put up my first telephone. At that time I was visiting at my father's house in Brantford—a small city in Ontario, Canada. We obtained the permission of the Canadian Government to use a telegraph line four miles long that extended from Brantford to a neighboring village. We put up our apparatus in a friend's house, kindly loaned for the purpose, and as it was over half a mile from the telegraph line, we were obliged to lengthen the wire. No additional telegraph wire was available, so what do you think we used? You would never guess. We could find nothing in the hardware stores but stovepipe wire, and we had to buy up all the stovepipe wire in Brantford to make our line long enough. We did not trouble to put up posts, but tacked the wire to the fence. The communication that took place over this first telephone wire was not a conversation, but a monologue, as we had the transmitter only at one end and the receiver at the other.

In this way the first message was sent over the telephone, and I have been told that Brantford calls itself the "Telephone City" ever since. That was in 1875. A short time afterward Mr. Charles Williams, of Boston, strung a telephone wire from his office in Boston to his house in Cambridgeport, a distance of two miles. This was the first telephone wire to be permanently erected.

Since those small beginnings, what amazing progress has been made! Do you know that there are nearly 2,000,000 miles of telephone wires in the United States alone? If these wires were fastened together they would encircle the earth 81 times. The total number of telephone calls in this country last year was 1,820,000,000. At the rate of 1 cent per call this would amount to enough pennies to form a double row around the globe, and there would be enough left over to make three rows across the Atlantic. And all this has been accomplished in a single generation.

I have recently been traveling through Norway and Sweden, and I was surprised to note the wonderful progress made by the telephone in those countries. In proportion to the population there are more telephones in Norway and Sweden than in any other country, even in America.

The next great step in the improvement of the telephone will be wireless telephony. This is not an inventor's dream. It has already been done across short distances. In the immediate future it will be made practical for social and commercial purposes.

Roentgen Society of the United States.

The second annual meeting of the Roentgen Society of the United States will take place in Buffalo, N. Y., Sept. 10 and 11, 1901, at the University of Buffalo. Applications for membership may be addressed to Secretary J. Rudis-Jicinsky, M. D., Cedar Rapids, Iowa, or to Dr. E. A. Florentine, Saginaw, Mich.

A Rotary Field Electrostatic Induction Motor.

The March issue of the *Journal* of the Institution of Electrical Engineers of Tokyo, Japan, contains an interesting paper by Professor Hidetaro Ho on a new type of rotary field electrostatic induction motor, the non-mathematical portion of which we reprint below:

In 1888 Professor Galileo Ferraris demonstrated in his famous researches on "Rotazioni Electrodynamiche," that by the combination of two simple alternating magnetic fields at right angles and differing in phase by 90 degs., a rotating magnetic field can be generated, and that by means of this resultant field, Arago's historic and classic experiment could be realized. In one of his fundamental experiments he showed also that an iron cylinder rotates in a rotary magnetic field, even when it is cut in such a way that no eddy currents can be produced, and he remarked that the rotation in this case was due to magnetic hysteresis—that is to say, to the lagging of the magnetization of iron behind the rotation of the magnetic field. Tesla's earlier motors also worked upon the same principle, notwithstanding his erroneous attribution of the cause of the torque. Even now this phenomenon is sometimes made use of in starting synchronous machines.

The analogy existing between the behavior of dielectric bodies in an electrostatic field with that of a magnetic body in a magnetic field suggested to Steinmetz that in dielectric media in an electrostatic field—for instance, in the insulating medium of a condenser which is alternately charged and discharged—a consumption of energy takes place, which depends upon the intensity of the electrostatic field according to a law similar to that of magnetic hysteresis To determine this loss of energy and its dependence upon the e. m. f., he made in 1892 a number of tests with a condenser with paraffin paper as insulating medium, and obtained the result, $H = k E^2$, where H is the dissipation of energy by electrostatic hysteresis, E the electric intensity and k a coefficient.

The existence of hysteresis effect in dielectrics, together with the hysteresis motor of Ferraris and Tesla cited above, naturally suggest the possibility of constructing an electrostatic motor upon quite a similar principle, substituting for the rotary magnetic field a rotary electric field and for the iron cylinder one of a dielectric substance This was first done in 1893 by Riccardo Arno, the able disciple of Ferraris himself. A glance at Fig. 1 is sufficient to understand his arrangement. *a, b, c, d* are four metallic segments fixed on an insulating base, and enclosing the space in which the rotating electric field is to be produced. *H* is a hollow cylinder of mica or paraffin paper, suspended co-axially to act as the rotor. Arno obtained two potential differences differing in phase by 90 degs. by means of an inductance and a condensance in series in the secondary of a step-up transformer, which were applied to each of the pairs *a b* and *c d*, thereby causing a rotary electric field in the space enclosed. As was expected, the hollow cylinder was set in motion in the direction of the rotation of the field. Using an ebonite cylinder, 139 mm. long and 61 mm. outside diameter, a torque of 18 gramme-centimeters was obtained at starting.

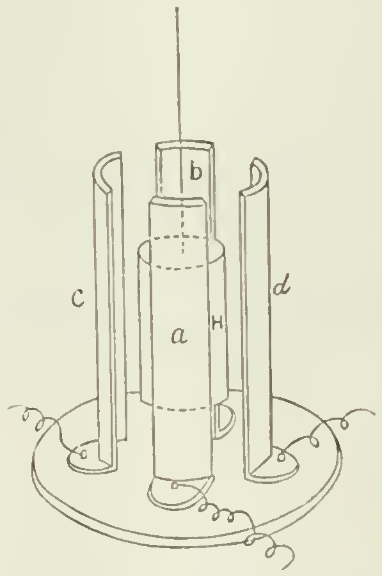


FIG. 1.—STATIC INDUCTION MOTOR.

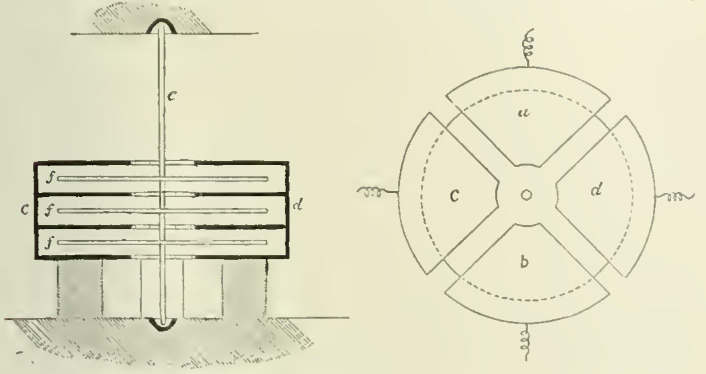
The writer constructed in the Electrical Engineering Laboratory of Tokyo Imperial University in 1894 a model of an electrostatic motor on quite a different principle, which ran successfully, as reported in the issue of the *Transactions* of the Institution of Electrical Engineers of Tokyo of January, 1895.

The stator consisted of four multicellular quadrants, and the rotor was composed of several circular paper disks mounted on a common shaft, and moving as the indicating element of an ordinary quadrant electrometer there being one disk in each layer of cells. The cross section and the plan of the motor as set up are given in Figs. 2 and 3.

in which *a*, *b*, *c*, *d* are quadrants mounted on insulators, *e* is the shaft of the rotor carrying three paper disks *f*, *f*, *f*.

Each disk carries 24 sectors of tin foil arranged radially, each of which is insulated from the rest, except at the inner, where all the sectors are put in communication through radiating pencil lines, as shown in Fig. 4.

The principle upon which the above motor was expected to work was as follows: As the electric field rotates, each pair of sectors diametrically opposite to each other is subjected to an alternating e. m. f., which would produce, if the sectors be absolutely insulated from each other, induced charges in these pieces of tin foil, which charges would appear and disappear simultaneously with the potential differences impressed by the stator, and therefore no torque can be developed. If, on the other hand, the sectors be connected up with small resistances, a very considerable amount of equal and opposite induced charges would appear on the two sectors of a pair, and a considerable attraction between the quadrants and the disks would result; no tangential pull, however, can be obtained since the induced charges appear and disappear simultaneously with the potential difference of the stator. If, however, the resistances have a certain proper value, we may expect such a condition that the flow of charge in the process of induction and neutralization is retarded by the resistance; consequently the charge of a sector would lag behind the rotating potential difference of the stator, in which case a certain torque must be obtained in the direction of the rotation field. This was fully borne out by experiments. The disks rotated with a high speed, though I did not ascertain the amount of the torque developed.



FIGS. 2 AND 3.—CROSS SECTION AND PLAN OF MOTOR.

Afterwards, in 1899, Arno seems to have also adopted the sectorial form of the stator. He uses three sectors excited by three-phase e. m. f.'s, with a suspended dielectric disk, which forms the rotor, the source of torque being electrostatic hysteresis as formerly. I understand that an arrangement quite similar to this was brought out by Dell in America about that time.

It was only some time after my first experiments that I became acquainted with Arno's paper, otherwise I would have undertaken some investigations to distinguish between the torque due to the hysteresis and that caused by the retardation of electrification, and thereby firmly establish my theory. During these four years I was otherwise occupied, and it was only a month ago that I could return to the old subject, and the following experiments were performed.

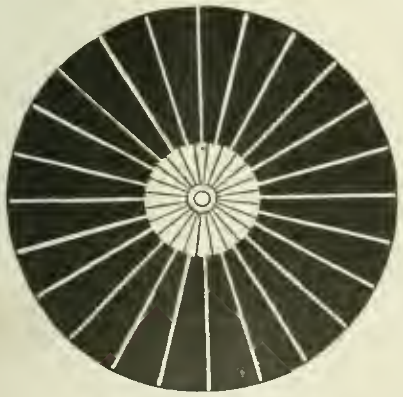


FIG. 4.—SECTOR CONNECTIONS.

Two rotors each consisted of three disks of cork 5.3 cm. in diameter and 2 mm. in thickness. On the peripheries of the disks were attached 18 zinc sectors 28 cm. in length, and insulated from one another as shown in Fig. 5, making the diameter over all about 10 cm. As stator, the multicellular quadrants of the former experiments were again employed, the method of exciting them being also as before, namely, by means of a Wimshurst influence machine to which a battery of Leyden jars was connected as a reservoir, and employing a revolving commutator worked by a small direct-current motor. The revolutions of the rotors and also that of the commutator were recorded by a delicately adjusted Morse ink-writer and a make-and-break device on their shaft, by which means the speed of the rotor and the frequency of the impressed e. m. f.'s were determined with tolerable precision. The torque at standstill was measured by means of a spiral spring, and the torque, while in motion, by means of a spring and balance weights on the ordinary dynamometer principle. The torques of the mechanical friction were also measured and added to the load—the torque in the following results being therefore to be understood as the actual torque of output plus the torque of friction. The maximum potential difference was kept at about 8000 volts and the frequency at 11 per second, through the experiments.

TABLE I.

Torque.	Slip.
.02 gramme cm.	.02
.30 " "	.19
.35 " "	stopped.
Starting torque, .13 gramme cm.	

First, we put on the rotor with cork only, and the results were as shown in Table I.

Secondly, the rotor with zinc sectors was tried and the result was as shown in Table II.:

TABLE II.

Torque.	Slip.
.21 gramme cm.	10
.42 " "	Stopped.
Starting torque, .25 gramme cm.	

Next, the rotor was thoroughly moistened with water, thus destroying the insulation between the sectors, and I could obtain no torque at all. It was then put in a stream of air, and partly dried until the moisture was hardly perceptible, when a great amount of torque was obtained, as may be seen from Table III.:

After this experiment the rotor was completely dried in a stream of hot air, after which the torque and the slip returned again to the values of Table II.

The above results, I believe, fully show the correctness of the principle upon which my model has been constructed. The case of Table II. corresponds in analogy to an ordinary polyphase induction motor with a secondary of infinitesimal resistance; Table III. the same with a certain resistance inserted in the secondary, while Table I. is the case of a hysteresis motor. I call attention to the great increase of the starting torque and also of the slip in Table III.

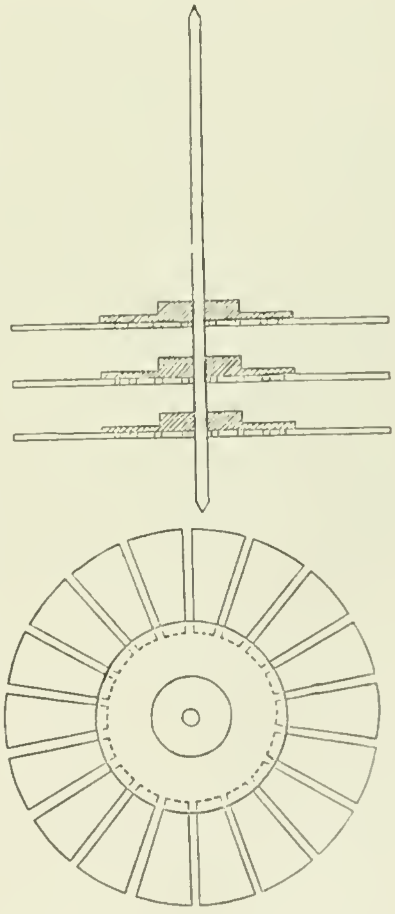


FIG. 5.—ARRANGEMENT OF SECTORS.

The model being a mere toy, I did not plot torque or load curves, but was contented with having shown the possibility of constructing an electrostatic motor upon an analogous principle to that of an ordinary polyphase induction motor. I intend, however, to construct one which is capable of developing a finite amount of power and may be really called a motor.

To show that the moisture has little to do with the hysteresis of the cork, I tried the rotor of cork when completely moistened, which gave no torque, of course, and also when it was partly dried, the Table IV. being the results in the latter case.

A considerable portion of Professor Ho's paper is devoted to the development of a mathematical theory of the motor described. The final equations are compared with those for an ordinary bipolar two-phase motor, and a striking similarity is manifested, the formulas for the one being capable of derivation from the other by a simple substitution.

TABLE III.

Torque.	Slip.
.21 gramme cm.	.51
.42 " "	.84
1.14 " "	.89
1.30 " "	Stopped.
Starting torque, .71 gramme cm.	

In conclusion, Professor Ho says that as the addition of closed circuits in the iron core of the secondary was a great advance in the construction of the ordinary polyphase induction motor, in the same measure his electrostatic motor is much superior to the simple hysteresis motor of Signor Arno.

TABLE IV.

Torque.	Slip.
.02 gramme cm.	.32
.28 " "	Stopped.
Starting torque, .17 gramme cm.	

White Lead by Electrolysis.

The activity of inventors with regard to the electrolytic production of white lead is attested by the fact that the issue of June 4 contains no fewer than four patents for improvements along this line.

The first embodies the suggestion, due to John Bleeker Tibbits, of Hoosick, N. Y., that the color of electrolytically produced basic carbonate of lead (white lead) may be modified by associating with the usual lead anodes, supplemental anodes of copper, whereby the lead salt is mixed with some basic carbonate of copper, which imparts to it a blue tint of which the depth depends upon the relative areas of the respective anodes; or for the same purpose suitable aniline dyes may be dissolved in the electrolyte. By reason of the earlier publication of the foreign patents this idea has been before the public for some years.

Two patents to John A. Yunck, also of Hoosick, cover respectively a process and an apparatus, the former representing to some degree a return to the old Dutch process, for instead of injecting carbonic acid gas into a solution wherein lead salts are electrolytically produced, or of carbonating previously formed hydrate of lead, there is added to the electrolyte an organic acid capable of breaking down under the action of the current with the formation of carbon dioxide, whereby, as in the Dutch process, the production of the basic carbonate proceeds directly, in a single reaction, and entirely at the expense of the electrolyte. As in the Tibbits patent, supplemental anodes are used in addition to the usual anodes of lead, but in the present case these supplemental anodes are of carbon, and it would appear that their main junction is to determine the decomposition of the oxalic or other organic acid present with evolution of carbon dioxide. The whole process is closely analogous to that patented about a year ago to Professor Joseph W. Richards and Charles Roepper, differing mainly in the means employed for decomposing the organic acid, Richards and Roepper relying upon the use of definite current densities. The obvious objection to these processes is the use of such relatively costly chemicals as acetic and oxalic acids for the mere purpose of furnishing carbonic acid gas to the bath.

Yunck's apparatus is an electrolytic cell, designed particularly for carrying into operation the process for the manufacture of white lead invented some years ago by Turner D. Bottome. As here illustrated it consists of a sealed vat, *A*, *B*, Fig. 1, having hung in its upper portion from the superposed grids, *K*, *M* and *L*, *Q*, alternate anodes and cathodes, *P* and *N*, preferably of such open forms as are shown in Figs. 2, 3 and 4, and at the bottom the usual injection pipes, *R*, *s*, for carbonic acid gas. Immediately below the anodes is placed a very efficient agitator, driven by a central shaft *T*, and carrying upon transverse arms, *U*, a series of vanes, *V*, *W*, oppositely inclined to induce counter-vailing currents of electrolyte and to insure that no change in the character of the precipitate shall arise from the impoverishment of the solution immediately surrounding the electrodes.

The Bottome process above referred to consists simply in electrolyzing, with electrodes of lead, a solution of mixed nitrates of sodium and ammonium, due regard being paid to temperature and current density, and the solution being kept saturated with carbon dioxide. Whether the operation be thus conducted, or whether the solutions of lead nitrate and caustic alkali produced at the anode and cathode respectively be maintained separate by porous diaphragms, to be afterward mixed and carbonated as in the later processes of Browne and Chaplin, difficulties arise from the formation within the bath of basic compounds of lead with the lower oxides of nitrogen—nitrites and hyponitrites. The fourth patent of the present issue, granted to Edwin D. Chaplin, of Winchester, Mass., and Henry G. Halloran, of Boston, is directed mainly to overcoming this defect, and consists in adding to the sodium nitrate solution in the anode compartment of a partitioned cell, a certain amount of sodium chloride. Lead anodes are used, and the lead nitrate, which is formed upon passage of the current, is at once transformed to chloride, which is kept in solution by heating the electrolyte. Continued action of the current oxidizes this chloride of lead to chlorate, with perhaps some intermediate oxychlorides. From this hot solution white lead is precipitated by means of an alkaline carbonate obtained by injecting carbonic acid into the cathode solution.

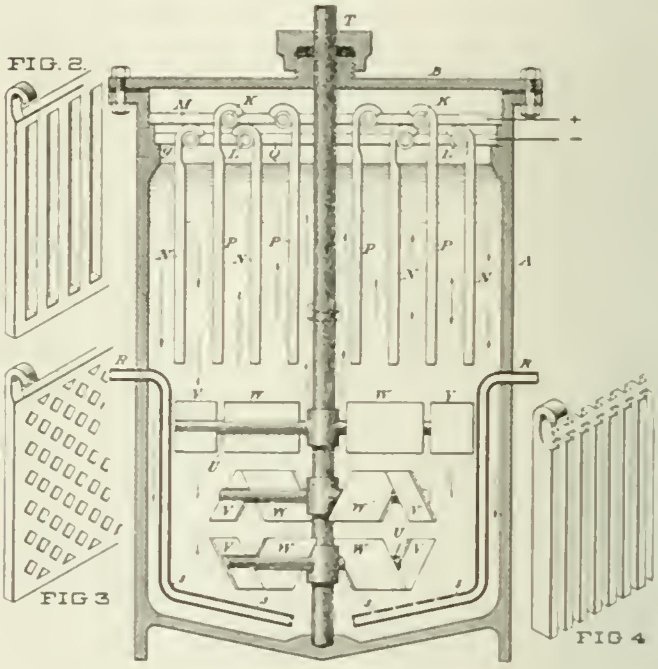


FIG. 2. FIG 3. FIG 4. FIG. 1.

WHITE LEAD BY ELECTROLYSIS.

The electrolytic white lead processes are eminently *cyclical*. Carbonic acid, lead and water enter into the composition of the pigment, but as these substances are always present in excess or are continuously added, the electrolyte is regenerated constantly, and the operation proceeds regularly and without production of any by-product other than hydrogen, and this is available for heating the solutions. In the last-described process, for instance, the precipitation of the pigment leaves the solution practically unchanged in composition, and ready for immediate return to the cycle. There is no class of processes, however, which it is less safe to commend because of the specious simplicity of the cycle, or to condemn by reason of the apparently needless complexity or cost. The question is whether the pigment is obtained in the form of the globular, transparent, colloidal aggregates which exhibit toward oils those peculiar relations which are designated collectively as "covering capacity," or as minute crystals, which, however finely divided, are yet crystals, hard and unabsorbed. It would seem that the precise conditions which govern the separation of the absolutely amorphous precipitate have never been determined with exactness. It is to be hoped that future work, along the lines of the modern physico-chemical theories, will lay bare these conditions; and it can scarcely be doubted that when this shall have been done the electrolytic processes will supersede all others.

Incubation by Electricity.

BY EDWARD E. SHELDON.

SINCE the hatching of an egg results from the application of heat, it makes little difference whether this heat is supplied by the hen or by artificial means. It is claimed for the artificial method that the chicks can be produced so as to be ready at the time when prices are best. Hence artificial incubation has come into extensive use, and as the most extensive application of these machines is in agricultural districts where the kerosene lamp is the standard of illumination, it is not surprising that this same lamp has come to be the standard source of heat.

About two years ago the writer witnessed the destruction by fire of the poultry houses connected with a large New York State institution, the origin of the fire being directly traceable to an incubator lamp, and it occurred to him that here was another legitimate field for electricity in the heating of incubators and brooders. Since that time experiments have been carried out, and with gratifying results.

As a beginning, an incubator said by the makers to be fitted to operate by electricity was purchased from a well-known manufacturer, but it was evident from the first that it would prove unsuccessful. The principle upon which it operated was that an electric stove was arranged so as to heat water in an expansion tank, the water in turn heating the air inside the machine by circulating through pipes. The heat regulation, a very important detail in a machine of this class, was secured by cutting the stove in and out by means of a mercury switch operated directly from the thermostat through a system of levers, but owing to the sluggish action of the thermostat, a very destructive arc was formed each time the circuit was opened or closed, and the pin which dipped into the mercury would last only a few days.

REGULATING MECHANISM OF INCUBATOR.

In order to use this machine in the experiments several changes were made. The small mercury cup was discarded, and one of ample dimensions substituted, and as a means of preventing the arc, a very small solenoid was connected in series with the stove and just under the lever carrying the pin which plunged into the mercury. To this lever was attached the plunger of the solenoid, so that when the pin first touched the mercury the current flowing through the solenoid would throw the lever out of balance and plunge the pin deep into the mercury. On opening, the reverse would take place, the pin breaking the arc instantly. The objectionable feature of this mechanism is that with it close regulation is impossible, partly owing to the large body of water which continues to raise the temperature after the heat is shut off, and partly owing to the solenoid, which prevents opening and closing the circuit at the same temperature. However, this machine has run successfully for two seasons, and the variation in temperature does not exceed three degrees. This variation might be considerably reduced by using a thermostat to close a battery circuit through an automatic switch, which switch in turn closes the main circuit. This arrangement is successfully used in many bacteriological incubators.

After the chicks are hatched, they must be placed in a brooder, and here, too, the kerosene lamp may well give way to electricity. A brooder which we have constructed is heated by coils of iron wire beneath which is a plate of sheet iron. Strips of flannel hang from the sheet iron, and into this flannel the chicks run and huddle together. In another, the source of heat is from incandescent lamps enclosed in a sheet metal box, with strips of flannel as above suspended from the bottom. Both brooders are controlled by rheostats so that any temperature can be maintained at will. It was found that eight 24-cp lamps furnished sufficient heat for a brooder 6 ft. by 4 ft., but this number could be materially reduced by proper precautions in the way of heat insulation—nothing of the kind having been attempted in the above instance.

The objection may be raised that in agricultural districts the current cannot be obtained, but many of the large stock farms already have their lighting plants. The trolley roads could furnish current to many others; and in large poultry yards, where many thousand eggs are hatched each season, it would seem that the small plant necessary would be a profitable investment, especially since nearly all such yards are located in the vicinity of streams which could develop sufficient power for the purpose.

We are told that in Egypt artificial incubation has been carried on so long that the hens have long since ceased to show any inclination to incubate their own eggs. The dynamo may prove to be the emancipator of the sitting hen, as it has been for the street-car horse.

Storage Battery Auxiliaries—II.

BY LAMAR LYNDON.

COMPOUND BOOSTER.

The compound booster is used on railway and power circuits supplying widely fluctuating loads where the batteries serve to prevent excessive feeder drop, and assist the power station, relieving the generating machinery from the sudden heavy current rushes. Diagramatically, this system is shown in Fig. 3.

G is a generator, *E* a battery, *B* the booster armature, *F* a series field, *f* a shunt field, *R* a rheostat in shunt field circuit, *M* and *M* motors, and *S* a reversing switch by means of which the m. m. f. of the shunt field may be added to or subtracted from that of the series field. The operation of this system is as follows:

Under normal conditions the shunt field m. m. f. creates an e. m. f. in the same direction as the battery e. m. f. tending to discharge it. Calling Eo the generator e. m. f., V the booster e. m. f., and E the battery e. m. f., we have $Eo - V = E_A$ (8), when there is neither charging nor discharging current. In this case the generator current equals the external load current. If the load increases, Eo falls, and $E_A + V$ becomes greater than Eo, allowing the battery to begin discharging. The discharge current passing through the series coil produces an e. m. f. proportional thereto, and acting with the shunt coil, thereby increasing V and increasing $E_A + V$, causing a still more rapid discharge. The battery thus assisting the generator causes the load on the latter to decrease and its voltage to rise again until it attains its normal e. m. f.

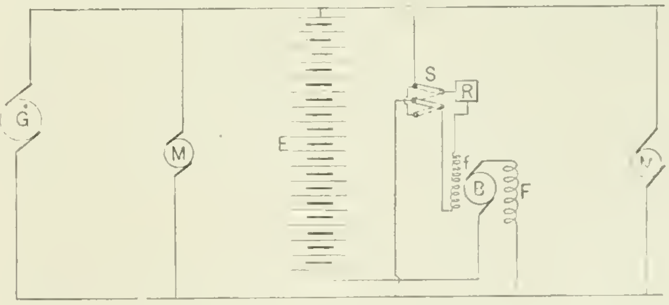


FIG. 3.—DIAGRAM OF SYSTEM.

If the load on the external circuit falls below normal, Eo rises and current starts flowing into the battery. In this case, the series field m. m. f. opposes that of the shunt coil, decreasing V. Then $E_0 > E_A + V$ and the charging current increases until Eo begins to fall, and comes down to its normal value. These changes are, more strictly, tendencies to change which are checked in their inception.

In order to compute the size and windings of the booster and capacity of battery, a load curve is necessary. This in case of a new plant may be made up from assumed data, which, with the amount of data available covering operating plants similar to the proposed plant, will usually be sufficiently accurate to use as a basis for computation.

The armature and series coil must have a current carrying capacity equal to the maximum battery discharge, or $I_0 - I_x$ in which

I_x = generator current.
I_0 = current of external load.
Also let
I_A = Normal external load, equal to average load.
E_M = maximum generator voltage.
E_A = battery voltage at any state of charge (voltage at no-load).
E_N = normal battery voltage.
h = constant which multiplied by the generator current equals drop in generator e. m. f.
R = internal resistance of battery.
k = volts generated in armature per ampere turn on field.
N = number of cells in series = $\frac{E_A}{2}$.

The series turns compensate for the drop due to resistance of the battery circuit. Therefore $T k I = R I$ and $T = \frac{R}{k}$ (9), I being the current flowing into or out of the battery. In this equation the characteristic of the booster is assumed to be a straight line. The factor k also assumes a constant permeability.

When $I_x = I_0$, current flows neither into nor out of the battery, and

$$E_M - I_x h - V = E_A \tag{10}$$

Inasmuch as the booster causes the battery to act as if it had no internal resistance, the only factors that enter into the determination of I_x are V, E_A, E_M and h, or,

$$I_x = \frac{E_M - V - E_A}{h} \tag{11}$$

These are all constants and, therefore, I_x is constant for any given value of E_A, whatever the load, provided the shunt coil is connected across the mains and gives a constant m. m. f.

If, however, the shunt coil is connected across the battery terminals, equation (11) becomes

$$I_x = \frac{E_M - \frac{V E_A}{E_N} + I_0 \frac{R V}{E_N} - E_A}{h + \frac{R V}{E_N}} \tag{12}$$

This shows that the generator current varies with the load if f be connected across the battery. The factor $\frac{R V}{E_N}$ is, however, usually very small as compared with the other quantities.

If V be made small, E_A more nearly approaches $E_M - I_x h$, and the size of the machine is kept down. If V be made large the size of booster is increased, but the number of cells decreased.

Generally, V at normal voltage of battery should be small—5 to 10 volts. The shunt coil, however, must be capable of producing an e. m. f. high enough to maintain the equality of (10) when E_A is at its minimum, and also to preserve the equality of

$$E_M - I_x h + V = E_A \tag{13}$$

when E_A is at its maximum and the field is reversed in direction, the booster adding its e. m. f. to the generator e. m. f. $E_{A\,max} = 1.15 \times E_A$, or V_{max} must equal $.15\,E_A - V$ when connected across the line and $\frac{.15\,E_A}{1.15} - V$ when connected across the battery V_{max} for $E_{A\,min} = 0.1 \times E + V$ for connection across the line, and $\frac{.1 \times E}{.9} + V$ for connection across the battery.

These data fix the shunt winding, and together with eq. (10), the size and resistance of the rheostat. This latter should be capable of varying the shunt coil e. m. f. from 3 volts to maximum by steps of not over 3 volts each.

The size of the motor is fixed by the maximum of voltage multiplied by the current, both being taken at the same instant. This product is a maximum when the battery is at its lowest voltage, and discharging its maximum current.

Assuming 1.8 volts per cell as a minimum, $E_{A\,min} = \frac{E_A \times 1.8}{2} = .9\,E_A$. The voltage then of booster when discharging $I_{max} = 0.1 \times E_A + (I_{max}\,T k) + V$. Watts $= I_{max}\,(0.1 \times E + I_{max}\,T k + V) =$ size of driving motor.

This form of booster can also be connected for normal operation with the shunt coil e. m. f. in opposition to the battery e. m. f., in which case

$$E_M - I_x h = E_A \quad V \tag{14}$$

and the required number of cells in series is greater than when connected with V opposing the generator e. m. f.

The relations of the various quantities can easily be worked out from the equations given by making the proper substitution of signs. In this case

$$I_x = \frac{E_M + \frac{V E_A}{E_N} - I_0 \left(\frac{R V}{E_N}\right) - E_A}{h - \frac{R V}{E_N}} \tag{15}$$

The equation shows that connected in this way the generator load varies inversely as the external load. This would put too great a load on the battery at the time of maximum discharge.

As a concrete example, illustrating the application of the foregoing analysis assume

E_M = 500 volts.
V = 10 volts.
h = 0.15.
I_x = 100 amperes normal.
I_0 = 400 amperes maximum.
R = .2 ohm.
k = .02 volt.
$E_A = 500 - (100 \times .15) - 10 = 475$ volts
$T = \frac{.2}{.02} = 10$ turns.
$N = \frac{475}{2} = 238$ cells.

with any given values of E_A and V, I_x will remain unchanged whatever may be the variation of I_0.

If E_A varies and V be not varied to compensate therefor, I_x will vary, but will be independent of the external load.

When $E_A + V = E_M$, I_x reduces to zero and the battery carries the total external load.

When E_A is a minimum, I_x is greatest if V remains constant.

$$I_{x\,(maximum)} = \frac{500 - 10 - 427.5}{.15} = 416 \text{ amperes.}$$

Of course, this is an abnormal current that might occur under extraordinary conditions, but E_A could never fall to 427.5 volts without manipulation of the rheostat, which would leave the system in an approximately proper condition to make the battery take its share of the load.

The calculations for I_x when the shunt coil is connected across the battery, may be made by substituting in eq. (15). In the example assumed, $I_x = \frac{500 - 475 - 10}{.15 + \frac{.2 \times 10}{475}} = 97.4$ amperes, when $I_0 =$ [illegible]; with $I_0 = 100$, $I_x = 100$ amperes; and for $I_0 = 400$, $I_x = 108$ amperes. The regulation is better with the shunt coil connected to the line.

When E_A rises, and V is not reversed, the battery tends to take all the external load. Therefore, conditions may occur under which I_x will fall as low as 50 amperes, while $I_0 = 400$. The carrying capacity of the booster armature and series coil should be 350 amperes for, say, 10 minutes.

The maximum voltage that the shunt coil can produce is the greater of two maxima; the one when E_A is maximum, and the shunt coil reversed acting to *prevent* discharge; the other when E_A is minimum.

$$V_{1\,max} \text{ for } E_{A\,max} = 475 \times .15 - 10 = 61.25 \text{ volts.}$$
$$V_{2\,max} \text{ for } E_{A\,min} = 0.1 \times 475 + 10 = 57.5 \text{ volts.}$$

The shunt coil, therefore, with all resistance cut out, must be capable of producing 62 volts.

The booster voltage is maximum when E_A is at its minimum and I_0 maximum, and is $(V_{2\,max} + I_{max}\ T\ k)$, in which $I_{max} = I_{0\,max} - I_x$. This is $57.5 + 2\ (400 - 100) = 117.5$ volts. The maximum booster and driving motor capacity is $117.5 \times 300 = 35.25$ kw.

As the maximum is seldom reached and then lasts only a few moments, about 70 per cent of the calculated capacity would be great enough, or 25 kilowatts in the above case. The motor horsepower is $\frac{25}{.746 \times .90} = 37.2$ hp, .90 being the efficiency assumed for the booster.

Fig. 3 shows that the load may come on the line either between the booster and the power station or between the booster and extreme end of the line. The battery and booster may therefore be located on a railway feeder at the point of greatest drop. The battery may also be made to help the power station on the peak of the load by manipulating the rheostat as E_A falls.

This system, depending as it does on the rise and fall of generator e. m. f. with corresponding change of load, requires that the generator be a shunt machine or its equivalent.

Where a plant has in operation a generating equipment of compound-wound dynamos, and this booster and battery system is applied, some change must be made in the generators. If the series field be entirely cut out, the dynamo will not generate the normal e. m. f. at normal load. In order to make use of the existing machines and windings, the arrangement shown in Fig. 4 is resorted to.

In this diagram G is the generator, f and F its shunt and series fields, respectively, E a low-voltage accumulator—usually one or two cells—and R a variable resistance in series with the series field circuit. The battery is connected in multiple with the series coil and resistance R, as shown. When the load on the generator is normal, the drop through $F + R$ is equal to the battery e. m. f. If the generator load rises $(F + R)$, Ix is greater than the battery e. m. f., and the current divides, part going through the battery and the normal current going through $F + R$. Should the load decrease and battery e. m. f. be greater than $(F + R)\ I_x$, the battery discharges and sends the normal current through $F + R$. The variation in Ix will be small, owing to the regulating effect of the main battery and booster on the line.

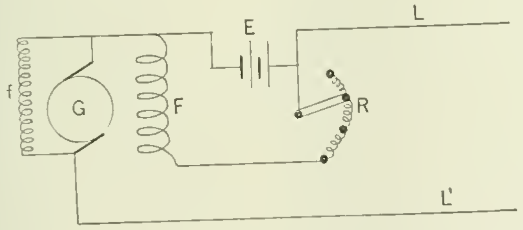


FIG. 4.—DIAGRAM OF CONNECTIONS.

Since, with this arrangement, the generator excitation is the sum of a constant excitation and an excitation that varies inversely as the load, its characteristic will be similar to that of a shunt machine.

The compound booster system together with the described arrangement of compound generator is covered by patent No. 625,099, issued on May 16, 1899, to J. B. Entz. This patent also covers the use of a series booster without shunt field, which is the same as H. Ward Leonard's patent, No. 435,700, of Sept. 2, 1890.

Since boosters usually carry heavy currents at low voltages, the commutator and brush surfaces necessary are often much larger than in the case of standard dynamos. In order to make use of standard commutator segments, to keep the length of the brush holders down to standard and keep the commutator speed within the limits of good practice, double commutators are sometimes used. These are placed, one on either side of the armature, and are connected in parallel.

From the foregoing description it will be seen that the compound booster is automatic within certain limits of battery charge. Any marked change of battery voltage will be followed by a corresponding change in generator current, unless the rheostat be manipulated to bring $Ea + V$ back to normal.

While the theoretical generator current variation is small for a given change of load, there is always a sudden, momentary, current rush from the generator on increase of load, the duration of which is equal to the time lag of magnetization of the booster field. Lights on a circuit with variable load will "wink" on sudden changes of load. In this respect the compound booster is not so satisfactory as the differential and constant-current boosters, as in these *all* generator current passes through the series fields, which, by reason of their self-induction, oppose and check any sudden current rush, giving the booster field time to change its magnetization to the proper degree.

Fig. 5 shows the switchboard connections of a compound booster and battery applied to a railway system. To avoid confusing the diagram, the connections to the voltmeter switch are not shown. These should be such as to show (*a*) battery voltage, (*b*) voltage of battery plus booster, (*c*) voltage of generator. A is a two-way reading ammeter in the battery circuit showing the charging or the discharging current. B is an ammeter in the generator circuit showing the current supplied to the system.

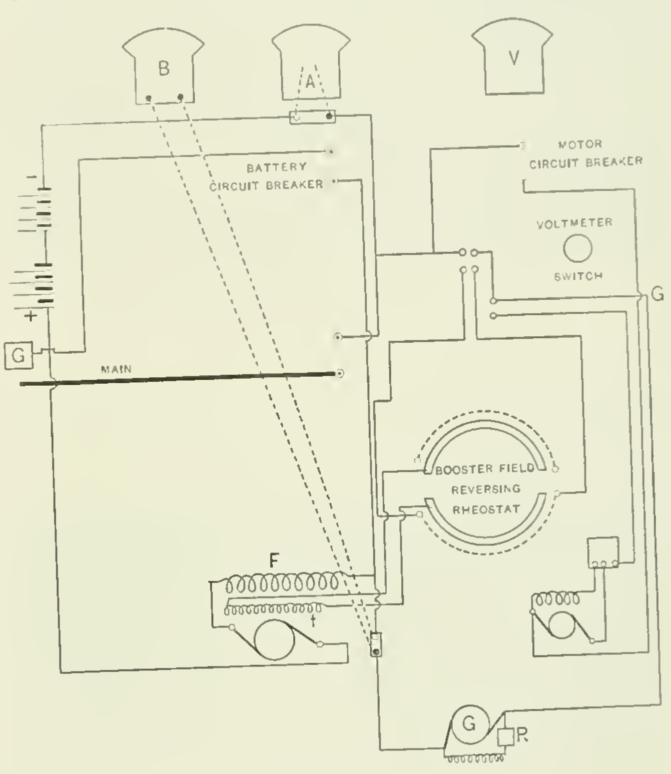


FIG. 5.—SWITCHBOARD CONNECTIONS.

Hours of Daylight.

Some very interesting instruments are set up at various meteorological observatories that automatically register the periods during which the sun is unobscured by clouds during the daylight hours, and tables are printed giving the actual number of hours of sunlight during each year. By comparing the actual number of sunlight hours with the number of hours during which the sun is above the horizon at each place a percentage number is obtained, as in the following small table. In New York City, for instance, 64 per cent of the daylight hours, on the average, are sunny: St. Petersburg, 34 per cent; Hamburg, 28 per cent; Dublin, 33 per cent; Berlin, 39 per cent; Oxford, 30 per cent; London, 23 per cent; Ventnor, 37 per cent; Vienna, 38 per cent; Zurich, 42 per cent; Lugano, 56 per cent; Padua, 46 per cent; Rome, 55 per cent; New York, 64 per cent; Madrid, 45 per cent. The figures for New York are probably true on the average, as it is a very sunny city, but they certainly do not apply to last April and May.

Recent Additions to the Plant of the Niagara Falls Hydraulic and Manufacturing Company.

By Arthur B. Weeks.

THE Niagara Falls Hydraulic & Manufacturing Company, of Niagara Falls, N. Y., whose power house is located at the foot of the gorge of the Niagara, below the Falls, close to the water's edge, has recently installed a new penstock to supply 13,000 additional horse-power for manufacturing purposes.

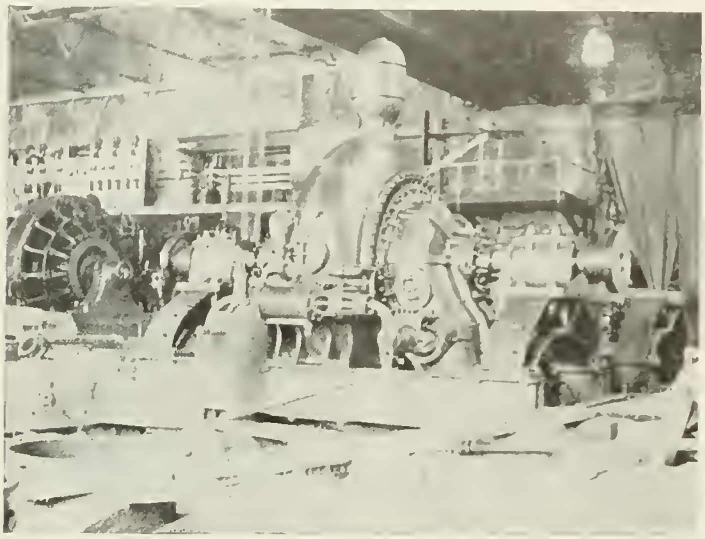


FIG. 1.—ONE OF THE TURBINES.

This penstock, which has been built, as was the one previously erected, by Suthers, Wells & Co., of Warren, Pa., has a diameter of 11 ft., and a head of 200 ft., and extends upward at a considerable distance from the almost perpendicular bank of the gorge. Upon the upper bank, and almost directly in line with this penstock, is a crane of great power, used for raising and lowering machinery to and from the power house.

FIG. 2.—BUILDING STONE ARCHES.

The new penstock will supply power for five turbines, one of which is shown in Fig. 1. The well-known firm of I. P. Morris & Co., was awarded the contract of supplying the turbines. The second valve has just arrived from Philadelphia. When these turbines with their dynamos have been fully installed, the third and last section of this power house will be completed.

FIG. 3.—THE ALUMINUM CONDUCTORS.

The next block of power for this company will, it is said, be supplied from a power house to be located below the present plant, toward the Whirlpool Rapids. This new installation will be for the use of the National Electrolytic Company, the Acker Process Company, the Pittsburg Reduction Company, and others.

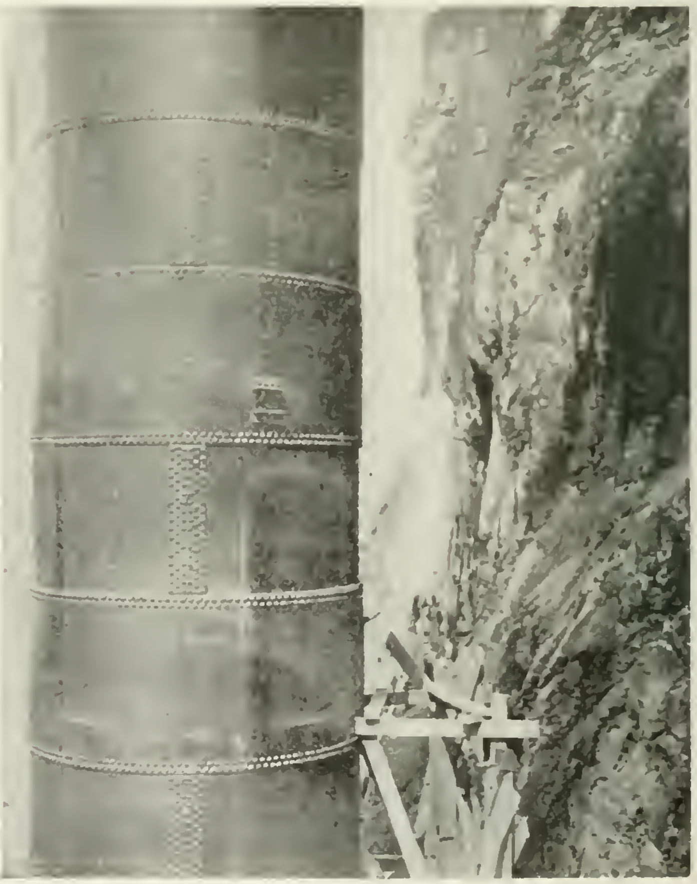


FIG. 4.—PORTION OF NEW PENSTOCK.

As can be partially seen in Fig. 2, men are now at work building stone arches in terraces with concrete, to continue upward to the overhanging bluff, and prevent the falling of great boulders from above, the disintegration of the rocky sides of the gorge being of frequent occurence.

Fig. 3 shows the manner of installing the aluminum bar conductors leading to the mills above. To the casual observer, short circuits might be expected frequently from the fact that bare conductors carrying thousands of electric horse-power, are carried fully 200 ft. up a steel penstock. It is scarcely needless to add, however, that such is not the case.

Fig. 4 shows a portion of the new penstock, and some idea of the nature of the rock formation may be gained from the beetling crags. Work is being pushed day and night to increase the capacity of the hydraulic canal in order that it may meet the increasing demands which will be made upon it.

Independent Telephone Exchange Statistics.

The following is a list of the larger independent companies in the various States. While not strictly up to date, it is probably the only list of the kind in existence, having been compiled by Judge Thomas, president of the Independent Association at the time of the annual meeting last year. It involved the expenditure of a great deal of time and money, which was not repeated this year. The figures for Ohio show towns having more than 300 subscribers, and the list was compiled early this year. In the other States towns having more than 150 subscribers are given:

Alabama.—Birmingham, 1100; Mobile, 565.

Arkansas.—Little Rock, 1500.

California.—Sacramento, 1300; San Francisco, 4000.

Delaware.—Wilmington, 1240.

Florida.—Jacksonville, 805.

Georgia.—Atlanta, 2270; Augusta, 515; Savannah, 620.

Illinois.—Bloomington, 700; Chadwick, 375; Champaign, 450; Charlestown, 240; Chrisman, 250; Danville, 518; Decatur, 810; Jackson, 600; Farmer, 200; Galena, 170; Galva, 165; Harrisburg, 160; Hartford, 173; Hoopeston, 194; Indianola, 280; Lincoln, 340; Mattoon, 470; Morrison, 306; Murphysboro, 210; Rantoul, 250; Rochelle, 400; Rushville, 162; Sandwich, 150; Sparta, 240; Sterling, 300; Sycamore, 318; Winchester, 139.

Indiana.—Ambia, 150; Anderson, 500; Auburn, 175; Bluffton, 820; Campbellsburg, 500; Clinton, 175; Columbus, 350; Connersville, 265; Crawfordsville, 636; Decatur, 200; Delphi, 213; Ft. Wayne, 2000; Green Castle, 220; Greenfield, 370; Hartford City, 300; Palacebrook, 200; Indianapolis, 3680; Jamestown, 200; Kentland, 160; Knightstown, 175; Le Grange, 200; Laporte, 325; Ligonier, 165; Linton, 150; Madison, 253; Michigan City, 504; Middletown, 165; Montpelier, 200; New Albany, 410; New Albany, 1272; Noblesville, 250; North Vernon, 264; Plymouth, 177; Richmond, 1200; Rockville, 160; Rushville, 230; Seymour, 172; Shelbyville, 520; Tipton, 245; Vanceburg, 200; Wabash, 330; Warsaw, 186; Williamsport, 200; Winchester, 220.

Indian Territory.—Chicasaw, 150; So. McAlestor, 250.

Iowa.—Belle Plains, 300; Boone, 475; Cedar Rapids, 875; Clinton, 500; Creston, 250; Decorah, 378; Des Moines, 1500; Dubuque, 2000; Fairfield, 231; Indianola, 180; Iowa City, 480; Iowa Falls, 375; Knoxville, 298; Marshalltown, 575; Nevada, 175; Adebolt, 150; Oskaloosa, 525; Ottumwa, 908; Seymour, 175; Spirit Lake, 600; Toledo, 180; Vinton, 195; Washington, 261; Waterloo, 180; Waterville, 200; Webster City, 300.

Konsas.—Atchison, 800; Beloit, 204; Chanute, 300; Clay Centre, 240; Council Grove, 200; El Dorado, 150; Ft. Scott, 317; Galena, 350; Hiawatha, 210; Holton, 210; Jewell City, 165; Leavenworth, 635; Lyons, 130; McPherson, 163; Manhattan, 321; Newton, 340; Ottawa, 460; Salina, 410.

Kentucky.—Ashland, 350; Bowling Green, 475; Carrollton, 200; Catletsburg, 165; Cynthiana, 205; Frankfort, 240; Fulton, 350; Henderson, 535; Mayfield, 370; Morganfield, 350; Owensboro, 450; Providence, 400; Somerset, 170; Winchester, 245.

Louisiana.—Alexandria, 200; Crowley, 200; Monroe, 200; New Iberia, 250.

Maryland.—Baltimore, 3000; Frederick City, 420; Salisbury, 210; Street, 250.

Massachusetts.—Boston, 400; Fall River, 700; Haverhill, 600; Shelburne Falls, 165.

Michigan.—Adrian, 550; Alma, 800; Albany, 266; Cassopolis, 147; Charlotte, 275; Concord, 150; Escanaba, 400; Fernville, 187; Grand Rapids, 3300; Greenville, 220; Hart, 400; Hastings, 280; Green Mountain, 406; Lansing, 775; Muskegon, 601; Owosso, 384; Saginaw, 2533.

Minnesota.—Albert Lea, 175; Alexandria, 160; Brainard, 190; Chatfield, 300; Crookston, 175; Duluth, 1278; Fairmont, 211; Fergus Falls, 275; Mankato, 440; Minneapolis and St. Paul, 5000; Winona, 625.

Mississippi.—Columbus, 317; Meridian, 415.

Missouri.—Bethany, 225; Boonville, 300; Brookfield, 485; Cameron, 250; Cape Girardeau, 310; Granville, 350; Chillicothe, 360; Columbia, 550; Fayette, 525; Glasgow, 175; Harrisville, 150; Jackson, 150; Liberty, 193; Louisiana, 300; Macon, 460; Marceline, 184; Marshall, 344; Moberly, 250; Shelbina, 300; Slater, 214; St. Louis, 7000; Unionville, 250; Webb City, 235.

Montana.—Billings, 150.

Nebraska.—Alliance, 190; Chadron, 191; Fairbury, 255; Lexington, 235; Nebraska City, 300; Plattsmouth, 400.

New Hampshire.—Laconia, 750.

New Jersey.—Bridgetown, 195; Mount Holly, 200; Newton, 200; Paterson, 1000; Vineland, 182.

New Mexico.—E. Las Vegas, 200.

New York.—Belmont, 150; Brockport, 152; Geneva, 185; Glenn, 159; Gowanda, 280; Greenville, 200; Massena, 182; Niagara Falls, 200; Norwich, 220; Oswego, 245; Rochester, 2000; Silver Creek, 200; Tonawanda, 200; Walton, 175; Watertown, 400.

North Carolina.—Ashland, 800; Charlotte, 415; Durham, 1800; Gastonia, 200; Greensboro, 200; Washington, 665; Wilson, 160.

North Dakota.—Valley City, 221.

Oklahoma.—Blackville, 250; Kingsfisher, 168; Perry, 235.

Ohio.—This list was taken Jan. 1, 1901, or about six months later than those from other States. It is especially interesting as showing the relative strength of the Central Union (Bell) companies and the independent companies. It shows, as has been previously intimated, that Ohio is the stronghold of the independent movement. In nearly every center in the State where the independent people have exchanges in operation, they are stronger than the competition. The single exception to this rule is in Cleveland, which has the largest independent exchange in the country. The figures from Ohio were furnished by local telephone officials in the respective places mentioned. The independent people add, "If there is any doubt about the correctness of this list, our 'friend the enemy' is entirely at liberty to point it out." Ashland County, 722; Akron, 1505; Ashtabula County, 1527; Barberton, 364; Cuyahoga Falls, 288; Bellefontaine, 360; Bryan, 384; Bucyrus, 575; Chillicothe, 700; Cleveland, 7500; Conneaut, 585; Coshocton, 535; Columbus, 5100; Columbiana County, 1784; Delaware, 495; Defiance, 485; Elyria, 780; Fostoria, 480; Fremont, 457; Gallipolis, 350; Ironton, 505; Kent, 400; Kenton, 430; Knox County, 815; London, 582; Lima, 620; Lorain, 600; Lancaster, 360; Massillon, 620; Marietta, 750; Painesville, 480; Portsmouth, 680; Sandusky, 900; Steubenville, 460; Tuscarawas County, 1900; Tiffin, 815; Urbana, 815; Youngstown, 1257; Washington C. H., 622.

Oregon.—Portland, 1100; Dallas, 417.

Pennsylvania.—Ashland, 200; Bellefonte, 675; Cambridge Springs, 210; Chambersburg, 860; Columbus, 414; Cooperburg, 290; Hanover, 300; Hazleton, 440; Indiana, 375; Kittaning, 300; Lebanon, 325; Lewisburg, 300; Nazareth, 300; Norristown, 600; Phœnixville, 162; Pittsburg and Allegheny, 5000; Pottsville, 350; Somerset, 350; Stroudsburg, 250; Summerfield, 500; Winchester, 200; Wilkesbarre, 1270.

South Carolina.—Charleston, 900; Chester, 172; Laurens, 145; Newport, 160; Sumter, 200.

South Dakota.—Deadwood, 500; Canton, 154

Tennessee.—Bristol, 390; Columbus, 500; Huntington, 150; Martin, 185; Memphis, 1600; Sparta, 300; Abiline, 175; Brownwood, 170.

Texas.—Austin, 1200; Palestine, 300; San Angelo, 179.

Vermont.—St. Albans, 260.

Virginia.—Charlottesville, 510; Hampton, 255; Lexington, 220; Lynchburg, 608; Newport News, 510; Norfolk, 1500; Petersburg, 560; Roanoke, 1025; Stanton, 550; Winchester, 490.

West Virginia.—Bluefield, 275; Clarkesbury, 350; Logan, 500; Fairmount, 550; Grafton, 260; Hinton, 272; Huntington, 535; Parkersburg, 640; Roncevert, 300; Wheeling, 1000.

Wisconsin.—Beloit, 400; Ellsworth, 200; Grand Rapids, 260; Hickston, 205; Zanesville, 651; La Crosse, 756; Mauston, 180; Martell, 300; Monroe, 240; Millsville, 150; Portage, 300; Richland Center, 400; Sheboygan, 550; Sparta, 155; St. Croix Falls, 150; Viroqua, 180; Wausau, 400; Wayauwega, 1000; West Superior, 550

The Boston Elevated Railway.

THE first cars for passenger transportation will be run over the Boston Elevated Railway during the present week. Work on this great undertaking has recently progressed very rapidly, and the road is opened to the public ahead of the time that had been fixed. The last girder of the structure was erected on April 12, and for the past three months motormen and trainmen for the system have been under instruction in a school where the men are taught the complicated details of the block signal system as well as the general management of the cars.

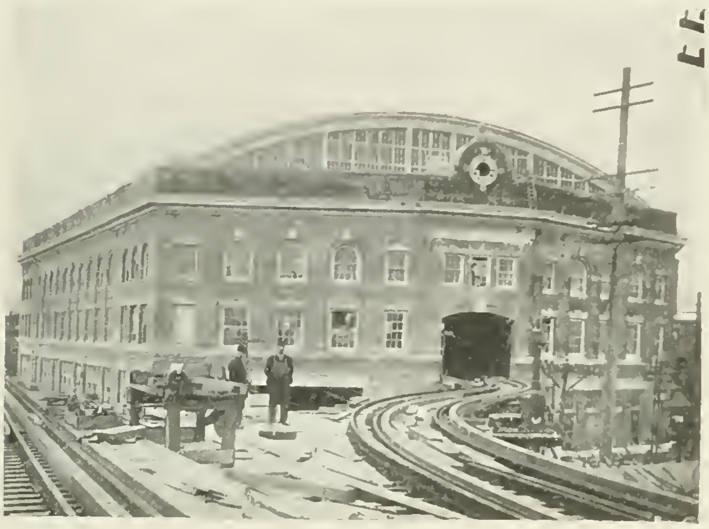


FIG. 1.—CHARLESTOWN TERMINAL.

The total length of the elevated road is about 7½ miles. There will be about 20 stations on the system, which have been so designed as to be ornaments to both the railway and the streets. The terminal stations are large structures handsomely fitted up for their purposes. They are three stories high. The upper story will contain the offices chiefly. At the Charlestown terminal the elevated trains enter the second story and surface cars the lower floor, which is at the street level. At the Roxbury terminal the surface cars are elevated and form into a loop on either side of the terminal station, so that the passengers pass from one system to another on the same level.

The cars are 40 ft. long, and have sliding doors midway in the sides for the entrance and exit of passengers. The seats run lengthwise, and will accommodate 50 or 60 people. The motorman, from the vestibule, will control the entire train, which will be operated on the Sprague multiple unit system. The average rate of speed will be 16 miles an hour over rails weighing 85 lbs. to the yard. One hundred cars will be used at first, and the number increased with increase of traffic. It is intended that at least two trains shall arrive at and depart from each station every seven minutes.

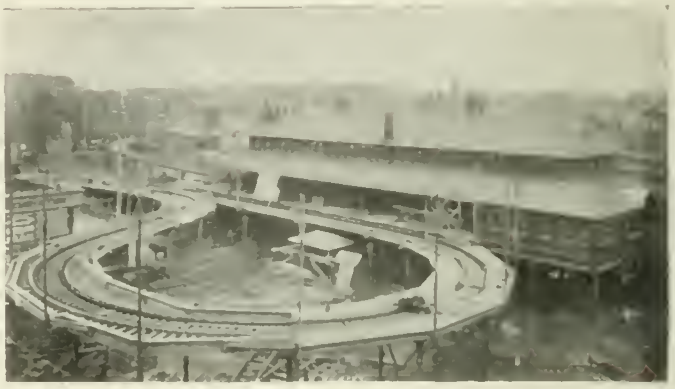


FIG. 3.—ROXBURY TERMINAL.

The system may be said to comprise three sections—a loop for

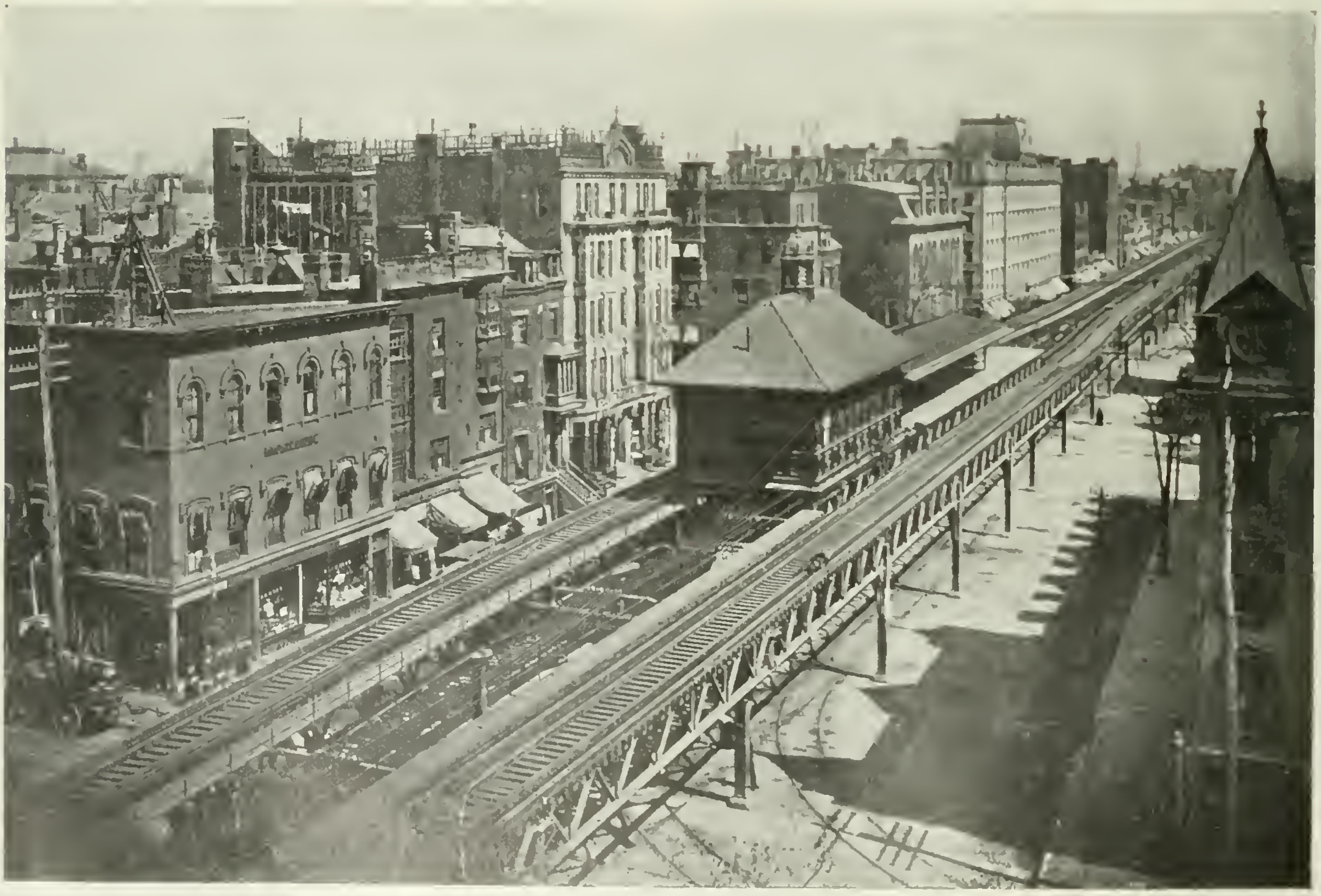


FIG. 2.—STATION AT WASHINGTON AND NORTHAMPTON STREETS.

the part of the system in the heart of the city, a branch through Charlestown, and a branch from the opposite side of the loop at Castle Street to Roxbury. The main or city section or loop is partly elevated and partly through the Subway, somewhat less than half of the length of the loop being underground. This section serves as a loop for both the Roxbury and Charlestown extensions. One class of trains goes direct from Charlestown to Roxbury and vice versa, passing over one side of the loop.

The total cost of the system was $10,000,000, $1,200,000 being represented by the Charlestown line.

Handling New York Baggage and Express by Electricity.

According to President Sanderson, of the New York Electric Vehicle Transportation Company, by virtue of contracts entered into with his company, the Metropolitan Street Railway and the Union Railway can be made available for the long-haul baggage, express and package-delivery business in Manhattan, the Bronx and Westchester. On behalf of the transportation company this statement has been issued:

The New York Electric Vehicle Transportation Company has been trying for a long time to acquire the business of the Metropolitan Express Company. The express company has a contract with the Metropolitan Street Railway Company similar to the contract which has been in operation over the Brooklyn roads for some years.

The Transportation company pays $500,000 to acquire the Metropolitan Express Company and the Century Express Company, payment being made in bonds on the express company's property, with two years' coupons cut off, the bonds being guaranteed by the transportation company; interest, therefore, not beginning for two years.

By that time the business should become very profitable, as the earnings of the company by 1903 should much more than pay the interest on these $500,000 bonds, and the express company then become a large and growing branch of the transportation company's business. The acquirement of this additional business has, therefore, practically cost the transportation company nothing.

The Transportation company pays $500,000 to acquire the Metrothe city, and these will be considerably increased in number, and the facilities for caring for one branch of the business will also very largely cover the other.

Much of the work, especially the delivery of goods from the railroads, will be done at night. The delivery of baggage and of goods sold by stores, which are expected to furnish a large share of the business of the new enterprise, must, of course, be done in the daytime, but the company plans to use only the lines east and west of Broadway, and to avoid the "rush hours." Twelve of the new baggage cars are now almost completed, and the company expects to run the first one on Tuesday. George W. Slingerland, who was formerly connected with the United States Express Company, will be general manager of the express department of the transportation company. The idea appears to be to wipe out gradually the old horse service of the express companies acquired and to substitute automobiles, which will distribute the baggage and express from the main points to which it is carried by the trolley cars of the system. It is believed that the service in Greater New York will be wonderfully expedited and cheapened.

Localization of Sound By the Ear.

In the University of Chicago has recently been carried out an interesting investigation on the capacity for auditory localization in the case of a man totally deaf in one ear. The subject of the experiment lost the sense of hearing in one ear in early childhood as a result of scarlet fever, and tests show him to be nerve-dead in that ear. In normal persons sound-localization supposably depends upon differences in the stimuli reaching the two ears. These differences can be due only to the quality or intensity of the sounds reaching the ear. For example, a sound opposite the right ear is localized in that direction because it stimulates the right ear more than it does the left, and also because, if it be a complex sound, its constituent overtones will be more noticeable in the right ear than in the left, so that it will be distinguished as qualitatively different from the same sound when heard in front, and hence given a different point of origin. In monaural hearing, if this be true, it is, of course, evident that any change in intensity in the sound can afford but ambiguous information as to its place of localization. With qualitative peculiarities of sound, however, it is different. In order to test this commonly received hypothesis the subject of the experiment was placed in the center of a large clock-dial placed horizontally, and the subject attempted to localize the sound by reference to the figures on the encircling dial, his eyes being closed during the conduct of the experiment. The sound stimuli used came from three sources, a tuning-fork, a Galton's whistle, and the snapping sound made by sending an electric current through a telephone. The experiment was provided with a mechanism by means of which the localization of the sound could be exactly registered as though on the surface of an imaginary sphere. The mechanism permitted all the adjustments to be made noiselessly.

The results of the experiments showed that the sound of the tuning-fork, which was a pure tone, practically devoid of overtones, was unlocalizable by the subject, while, on the other hand, the sounds of the Galton's whistle and the snapping-spark, which are filled with overtones, were localized with great accuracy. The degree of accuracy with which the sound was localized seemed to vary quite proportionately with the complexity of the sound. The results of the experiment, therefore, are comformable to the current hypothesis that the power of localizing sound depends on the detection by the nearer ear of differences in quality which the farther ear does not perceive.

Underground Electric Traction in London.

At a special meeting in London on June 7 the stockholders of the Metropolitan District Railway sanctioned Charles T. Yerkes' plan for the introduction of electricity as the motive power of the road. This is the old underground system. The agreement of the railway with Mr. Yerkes provided for the formation of an electric traction company to operate the road. Mr. Yerkes, represented 16 of the most influential firms, bankers and capitalists. The syndicate has bought already shares to the value of £1,250,000, and is ready to buy as many more. It has to construct a generating station at Chelsea, make the necessary alterations in the permanent way, and construct new rolling stock. It was stated at the meeting that the traction company undertook to convert the line without interfering wih a single train. Half a million of ordinary stock paid to the traction company was taken at the nominal price of £25, and £166,000 was taken in 4 per cent debentures at par. Five per cent interest was to be paid to the Americans on the outlay. A syndicate of bankers had undertaken to put up £1,000,000 as security for carrying out the contract.

It is stated from Baltimore that the Maryland Trust Company will be the American financial agent of the enterprise. Colonel J. Wilcox Brown, president of the Maryland Trust Company, spent three months in London in the past year examining the property and its possibilities. He had the assistance of J. G. White & Co., who made a thorough examination of the Metropolitan Railway and submitted an exhaustive report. The Metropolitan District Electric Traction Company, which is organized under the plan, will equip the Metropolitan District Railway Company and control it. The old line serves directly 1,000,000 people along its own tracks. This service will be increased fully 50 per cent, and the average train speed will be 25 per cent faster than at present. Trains with a maximum speed of 25 miles an hour are contemplated.

The Metropolitan has liberal franchises, which permit expansion to meet any requirements in the growth of its business. It is proposed to spend over £300,000 on new rolling stock and nearly £400,000 on a great power station. Other expenditures will increase the outlay to over £1,000,000. It is proposed to buy most of the plant in England.

Robert W. Perks, M. P., solicitor for the company, during the course of the meeting urged the importance of hastening the plans of Mr. Yerkes, giving as a reason that an American millionaire was interested in a project to construct an entirely new electric road from the city to Piccadilly.

Paris Transportation.

The Metropolitan Underground Electric road has carried 36,500,935 passengers since it started, just about a year ago, or nearly the whole population of France.

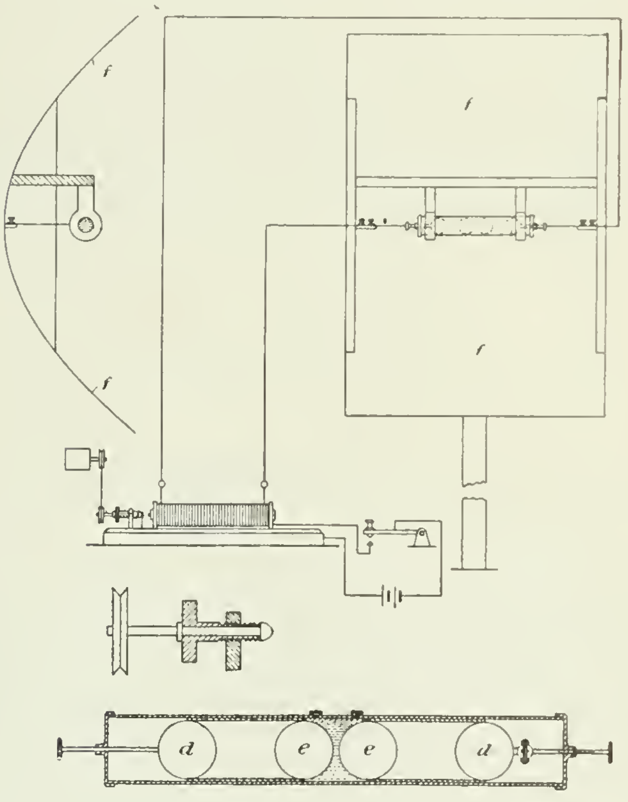
Marconi System of Wireless Telegraphy.

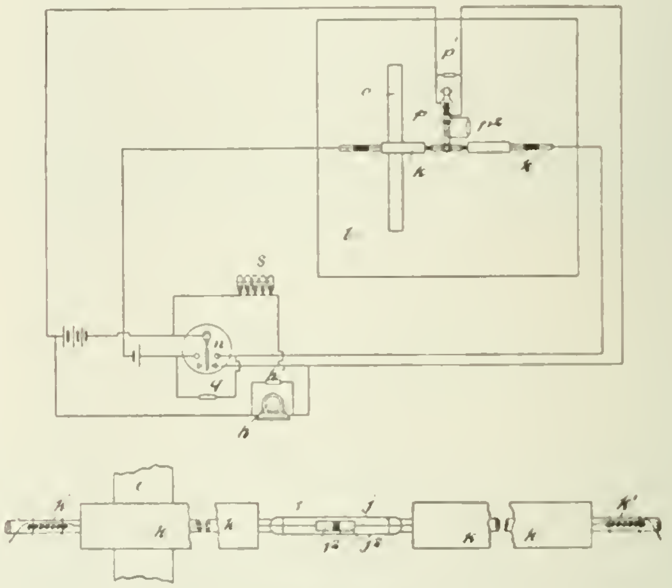
A patent issued June 4 to Guglielmo Marconi on an application dated July 13, 1897, describes in quite full detail the Marconi system of wireless telegraphy, including the methods employed for tuning the circuits and for selective telegraphy.

In the accompanying illustrations, Fig. 1 is a diagrammatic front elevation of the instruments at the transmitting station, and Fig. 2 a front elevation of the instruments at the receiving station. Below Fig. 1 is a longitudinal section of the oscillator to a larger scale, and a detail of the trembler interrupter. Below Fig. 2 is an enlarged view of the receiver.

In Fig. 1 *f* is a cylindrical parabolic reflector, shown also to the left of the figure. In Fig. 2 is a reflector similar to that used at the transmitting station. The reflectors ought to be in length and opening at least double the length of the wave emitted from the oscillator. It is slightly advantageous for the focal distance of the reflector at the receiving station to be equal to one-fourth or three-fourths of the wave length of the oscillation transmitted.

Below Fig. 1 is shown the transmitter sparking arrangement. The Ruhmkorff coil is connected to the metallic balls *d*, which are fixed by heat or otherwise at the ends of the two tubes shown. These tubes fit tightly into a similar tube having end covers through which pass the terminal rods. One or both of these rods is connected to the ball *d* by a ball-and-socket joint, and has a screw head upon it working in a nut in the cover. By turning the rod, therefore, the distance between the balls *e* may be adjusted. On top are holes through which an insulating oil or like material is introduced into the spaces between the balls *e*. With a coil giving an 8-inch spark the distance between *e* and *e* should be from 1-25 to 1-30 of an inch, and the distance between *d* and *e* about 1½ inches. The balls are usually of solid brass of 4 inches diameter, giving oscillations of 10 inches length of wave.





FIGS. 1 AND 2.—MARCONI WIRELESS TELEGRAPHY.

Above the sparking arrangement is shown a detail of the trembler break. This consists of a revoluble central core in an ordinary screw, which is in communication with platinum contacts. The central core is caused to revolve by connecting it to a small electric motor, as shown. By this arrangement the platinums are kept smooth, and any tendency to stick is removed.

The coherer is shown enlarged on the right, and consists of a glass tube containing metallic powder, each end of the column of powder being connected to a metallic plate *k* of suitable length to cause the system to resonate electrically in unison with the electrical oscillations transmitted. For the powder nickel is the best metal, and about 10 per cent of hard silver filings are added to the nickel filings, thus increasing greatly the sensitiveness of the tube to electric oscillations. By increasing the proportion of silver powder or grains the sensitiveness of the tube also increases; but it is better for ordinary work not to have a tube of too great sensitiveness, as it might be influenced by atmospheric or other electricity. The sensitiveness can also be increased by amalgamating with mercury the inner surface of the plugs which are in contact with the filings, just sufficient mercury being used to brighten the surface of the plugs without showing any free globules. Following are the dimensions of the coherer:

The tube *j* is 1½ inches long and 1-10 or 1-12 of an inch in internal diameter. The length of the stops j^2 is about 1-5 of an inch, and the distance between the stops is about ⅓ of an inch. The smaller the spaces between the stops in the tube the more sensitive it proves, but the spaces cannot, under ordinary circumstances, be excessively shortened without injuring the fidelity of transmission. The metallic powders ought not to be fine, but as coarse as can be produced by a large and rough file. All the very fine powder ought to be removed by blowing or sifting. The powder ought not to be compressed between the stops, but left in a loose condition. The tube must be sealed; a vacuum inside is not essential, but is desirable. Usually a vacuum of about 1-1000 of an atmosphere is used. It is necessary for the powder or grains to be dry and free from grease or dirt, and the file in producing the same ought to be frequently washed and dried, and used when warm. If the tube has been well made it should be sensitive to the induction from an ordinary electric bell, when the same is working at one or two yards or more from the tube.

It is desirable that not more than 1 milliampere of current shall flow through the coherer. If a stronger current is necessary, several tubes may be put in parallel between the tuned plates, but this arrangement is not quite as satisfactory as a single tube. It is necessary when using tubes of the type described not to insert in the circuit more than one cell of the Lelanche type, as a higher e. m. f. than 1.5 is apt to pass a current through the tube even when no oscillations are transmitted.

The plates *k* are of copper or aluminum or other metal, about ¼ inch or more broad, about 1-5 of an inch thick, and preferable of such length as to be electrically tuned with the oscillations transmitted.

The means adopted for fixing the length of the plates is as follows: A rectangular strip of tinfoil about 20 inches long is stuck by means of a weak solution of gum on a glass, then by means of a very sharp penknife the tinfoil is cut through the middle. If this detector is some four or five yards away and parallel with the axis of the oscillator, in action it will show little sparks at the end. If the length of the pieces of tinfoil approximates to the length of the wave emitted from the oscillator, the spark will take place between them at a certain distance from the transmitter, which is maximum when they are of a suitable length. By shortening or lengthening the strips, therefore, it is easy to find the length most appropriate to the length of the wave emitted by the oscillator. It is desirable to place this detector in the focal line of the reflector. The length thus found should be made about ½ inch shorter on account of the length of the coherer connected between them.

The two plates communicate with the local circuit through two very small choking coils k, formed by winding a few inches of very thin and insulated copper wire about a bit of iron wire 1½ inches long. The object of these choking coils is to prevent the high frequency oscillations induced across these plates by the transmitter, from dissipating itself by running along the local battery wires, which might weaken its effect on the coherer. The choking coils may sometimes be replaced by simple thin wires, and may also be connected directly to the coherer. The piece o at right angles to the coherer is a support for the rod to which the coherer is secured.

The local circuit in which the coherer is inserted contains a sensitive relay n, preferably wound to a resistance of about 1200 ohms; or this resistance may be the sum of that of the relay and an additional resistance, the relay to be one possessing small self-induction.

In Fig. 2 p is a trembler for tapping the coherer tube, which must be carefully adjusted. Preferably the blows should be directed slightly upward. A platinoid resistance p' is shunted across the trembler, having about five times the resistance of the latter. In shunt with the relay is a series of liquid resistances, s, consisting of tubes filled with acidulated water. Their number should be about 10 for a circuit of 15 volts. They prevent, by their counter e. m. f., the current of the local battery from passing through them, but allow the high-tension jerk of current at the opening of the circuit in the relay to pass smoothly across without producing perturbing sparks at the movable contact of the relay. It is also necessary to place a platinoid resistance in shunt on any apparatus one may be working with on the local circuits. h' is such a resistance around the telegraphic receiver h of about 10 times the resistance of the coils of the latter. Similarly, q' a resistance of about four times that of the relay with which it is in shunt. Such a resistance p^2 is also inserted across the contacts of the relay.

CURRENT NEWS AND NOTES.

ACETYLENE.—The splendid acetylene building at the Pan-American Exposition will be formally dedicated during the convention of the International Acetylene Association at Buffalo, June 20-22. The building contains a complete acetylene exhibit.

NEWFOUNDLAND TELEGRAPHS.—Mr. Reid, the Newfoundland contractor and capitalist, has consented to surrender the telegraphs to the Government and to revise his land grants, so that the rights of other holders will be protected. He will undertake to allow the colony to purchase back from him the ownership of the railway at the end of 50 years by compensating him for the value of the property at that time.

NEW PACIFIC CABLE.—The State Department is in receipt of information concerning work on the British Pacific cable, which is to connect the Dominion of Canada with the Australian confederation. The new cable is to be 5834½ miles in length, the longest ever constructed, and will be transported and laid by one ship, which is now being built for that purpose. The cable will run from Vancouver Island to Fanning Island, which lies south of Hawaii, a distance of 3337 miles, before landing is effected; thence it will be laid to the Fijis, to Norfolk Island and then to Queensland.

TELEPHONES IN RAILWAY SERVICE.—It is stated that the Missouri Pacific Railway Company intends to put in a system of telephones along its lines to connect a station that does not jutsify the employment of an agent with the nearest station that does. A telephone station will be established at the siding and the key to the box will be left with the nearest family. Then when a farmer wants a car set in at the siding or wants to send a message, he can go to the telephone, call up the agent at the next town and transact his business over the wire, instead of being compelled to drive to the next town for that purpose.

TELEPHONY IN BERLIN.—An observant European correspondent writes us: "One afternoon about a fortnight ago, a shower came down in Berlin, and although there was not the slightest indication of lightning or thunder, the whole telephone service of Berlin was suspended for several hours. It was the most ridiculous piece of officialism that I ever heard of. It seems that the minute a drop of rain falls they shut up the telephone exchanges and all hands go out for beer. They don't do it anywhere except under the administration of the Reichspost, there being no such nonsense in Bavaria or Wurtemburg."

RAPID GROWTH OF SHAWINIGAN FALLS.—The electric town of Shawinigan Falls, Que., which had a population of one dozen people two years ago, is now a municipality of 4000 people, all owing to the generation of electric energy there. The town is laid out precisely like the city of New York, bounded on two sides by a river. So far, the chief industries are the Shawinigan Water & Power Company, having at present a capacity of 25,000 horse-power, with capabilities of developing 100,000 horse-power; the Pittsburg Reduction Company, the great pulp factory being constructed by the Belgo Pulp & Paper Company, the Calcium Carbide works, large brick works and a cotton mill about to be constructed. All these industries are the outcome of electric power development.

ELECTRICAL DEVELOPMENT IN CANADA.—Negotiations are under way for the construction of a line of electric railway up the Lievre River, Que. There is abundant French capital behind the scheme. What is proposed is to construct a line of electric railway from Buckingham, 100 miles up the river, to Rapide L'Orignal, the numerous falls on the route affording ample power for the generation of the necessary electrical energy, not only for the railway, but for phosphate mining purposes, which it is intended to carry on in the Buckingham district. Mr. Ulric Rouville, a Parisian capitalist, who owns about 40 acres of these mining lands, is the promotor of the railway, and has laid the plans of his project before the Dominion Government for the purpose of obtaining a subsidy.

SCIENTIFIC RESEARCH.—An Institution for Scientific Research, to be located at Washington, was incorporated May 20. Fifteen prominent educators and scientists have been chosen as trustees, and the officers are President Gilman, of Johns Hopkins University; C. D. Walcott, director of the Geological Survey; Dr. Nicholas M. Butler, of Columbia College, and C. J. Bell, of the Washington Security & Trust Company, are the officers of the institution. The movement originated in the Washington Academy of Sciences, which, in co-operation with the George Washington Memorial Association, has formulated a plan which has been approved by both organizations. The Memorial Association undertakes to secure a suitable site and erect thereon a building sacred to the memory of George Washington, and the Academy of Sciences undertakes to provide for the maintenance and conduct of the institution in the interest of science and literature. There may be joined with it in this work the National Educational Association, the Association of American Universities and the Association of Agricultural Colleges and Experiment Stations. Congress passed an act last March to enable the plan to be carried out, and the new institution was incorporated on May 20. Fifteen prominent educators and scientists have been chosen as trustees.

NAMES OVER THE TELEPHONE.—The following from the New York *Times* as to the difficulty of getting names over the telephone shows how indistinctly most people speak: William Arrowsmith, of the law firm of Joralemon & Arrowsmith, was chatting about men who change their names the other day. "I don't blame some men for going into the courts and getting their names changed since the telephone came into general use," he said. "When a name is nearly all composed of consonants, the owner has good reason for wanting it changed if he is in business and has to tell his name over the 'phone several times a day. Take my own name, a good old English family name. One would hardly think that over the telephone it would be wildly distorted, but it is often done. I have spelled it out slowly, only to hear the answer come back, 'All right, Mr. Irishsmith.' Again, I will get it as plain 'Smith,' and once the man at the other end of the wire replied 'Ironsmith,' and then, in an aside to some friend, 'Wonder he doesn't make it "Blacksmith"!' The latest telephonic interpretation came the other day when a package plainly addressed 'Mr. Eherenschmidt' came to my house. I don't propose to change my name, but if men with 'skys' and other peculiar attachments to their names have as much trouble in proportion as I have, I don't blame them for changing."

THE NORTHWESTERN ELECTRICAL ASSOCIATION.—The summer convention of the Northwestern Electrical Association will be held at Sheboygan, Wis., on June 26, 27 and 28.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—At the commencement exercises of the Massachusetts Institute of Technology President Pritchett made the announcement that the corporation had authorized the immediate erection of a laboratory of applied electricity of the most modern sort, to cost, with equipment, $275,000. It is stated that the new laboratory, when completed, will be the finest of its character of any institute of learning in the world.

ELECTRICAL CONTRACTORS.—The proposed national convention of electrical contractors at Buffalo on July 17 begins to loom up as a large affair. Information can be obtained from the secretary, Mr. W. H. Morton, 31 Catharine Street, Utica, N. Y., as to the meeting itself, and data as to hotel accommodations, etc., can be obtained from Mr. H. I. Sackett, president of the Buffalo Contractors' Association, Builders' Exchange, that city.

BECQUEREL RAYS.—M. Henri Becquerel is reported to have had an odd personal experience with the form of radiation which bears his name. He started out on a journey with a piece of radium in a small cardboard box in his waistcoat pocket. Some time after his journey, M. Becquerel found a mark on his body under the location of the pocket, and further experiment showed that radium rays affects the skin through cardboard and cloth, but that about a fortnight elapses between the contact of the rays with the skin and the appearance of burn marks. It was also found that these burns are much more difficult to cure than ordinary burns.

THE WISCONSIN VALLEY PLAN.—Several telephone companies are doing business in several cities under what is known as the "Wisconsin valley plan." The corporation can sell stock only to such persons as rent its services, and the renter can buy as many shares of stock as he rents telephones, and no more. Whenever the stockholder ceases to rent as many instruments as he holds shares, the company reserves the right to call in and cancel his excess of stock and refund to him its par value. The company bonds itself so to regulate its capital stock that every renter of its service may purchase stock if he so desires. The company must also regulate its monthly charges so as to be able to pay its stockholders a dividend of 1 per cent a month, to be credited to each stockholder on his monthly rental.

LAUNCHING A TUNNEL.—On Saturday a steel tunnel, 250 ft. long, 25 ft. in diameter, and weighing 1200 tons, was launched at a shipyard in Elizabeth, N. J. It was constructed to serve as an intake for the condensing plant of the Thirty-ninth Street and East River generating station of the Edison Illuminating Company, now nearing completion. It is constructed of an exterior and an interior shell of quarter-inch thick riveted steel. Between the two shells is 15 inches of concrete, all of which was in place when the structure was launched. The tunnel will be towed to the new station on the East River, where it will rest on a foundation of piles and riprap built 23 ft. under water. The tunnel will be set to firmly rest on the foundation, and this part of the work all completed in about three weeks. The cost of the tunnel was $75,000.

THE CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—The twentieth annual meeting of the Association of Railway Telegraph Superintendents will be held at Buffalo on June 19, 20 and 21. The list of papers to be read and discussed includes the following: "Importance in Telegraphy of Apparently Little Things," by Mr. T. D. Lockwood; "Rapid Telegraphy," by Mr. Walter P. Phillips; "Storage Batteries," by W. E. Athearn; "Cipher Code for Railroading Telegraphing," by C. H. Rhoads; "Railroading by Telephone," by F. P. Valentine; "Construction of Telegraph Relays from a Scientific Standpoint," by Professor C. E. Freeman, of the Armour Institute; "Line Construction," by C. H Bristol, and "Crossing Alarms," by U. J. Fry. A paper on "Automatic Telephone Exchanges," by Mr. William Maver, Jr., is also promised.

ELECTROPLATED LACE.—The idea that lace or other fabric might be electroplated so as to present a surface of metal while retaining its pattern and, in part at least, its flexibility, dates from the times of James Napier and Schattlaender, the earliest days of practical galvanoplasty. The difficulty lies in the preliminary "metallization" of the fabric, the entire surface of which must be rendered conductive to serve as a basis for the electro-deposit. A patent issued June 4 to Mr. James Hart Robertson, of Brooklyn, and assigned to the Metal Fabric Company, of New York, covers the following method for accomplishing this: The fabric is first dipped in a potassium cyanide solution of silver chloride containing a dissolved binding agent, as gum-shellac, then at once transferred to a solution of silver nitrate. Silver separates regularly over the surface of the fabric, which may then be connected as cathode and electroplated as usual, first with copper, then, if desired, with a precious metal.

ENGINEERING EDUCATION.—The Society for the Promotion of Engineering Education will hold its ninth annual meeting at Buffalo on June 29, July 1 and 2, 1901 The programme includes no less than 22 papers and discussions. Among the topics included are "Cultural Value of Engineering Education," by Professor F. O. Marvin; "Arrangement of Undergraduate Courses in Electrical Engineering," by Professor J. P. Jackson; "The Availability of Correspondence Schools as Trade Schools," by Prof. D. C. Jackson: "The Danger of Excessive Specialization in Undergraduate Engineering Courses," by Professor J. C. Nagle; "Present Tendencies in Technical and Industrial Education," by Professor J. B. Johnson. A discussion on "Graduation Requirements for the Bachelor Degree in Engineering" will be opened by Professors W. G. Raymond, Robert Fletcher and L. S. Randolph. Papers will be read by Professor C. Frank Allen and Mr. William Kent on "The Extent to which Engineering Teachers Should Engage in Outside Work" A paper by Professor Aldrich will be on "Research and Publication Among Engineering Teachers."

CANADIAN ELECTRICAL SOCIETY.—Following is a list of the papers to be read at the next annual meeting of the Canadian Electrical Society, which will be held in Ottawa on June 19, 20 and 21: "Transformation from Constant Potential Alternating to Constant-Current Alternating," by Professor R. B. Owens; "Notes on Construction and Protection of Aerial Transmission Lines," by K. B Thornton; "Dominion Electrical Standards," by O. Higman; "Rates for Electric Light," by H. L. Doherty; "The Influence of the Load Factor on the Design and Operation of a Lighting and Power System," by J. R. Robertson. Discussions will be held on the following topics: "The Best Practice in Cleaning, Trimming and Inspection of Enclosed Arc Lamps," and "The Different Systems of Charging for and Measuring Power Consumed by Induction Motors with Varying Power Factors." An interesting social programme has been arranged by the committee, and on the evening of June 20 the annual association banquet will be held at the Russell House. Visits will be made to the power houses at Chaudiere Falls, Deschenes Rapids and other places of electrical interest.

ELECTROLYTIC ALKALI AND CHLORINE.—An electrolytic cell designed for the production of chlorine and caustic soda from brine forms the subject of a patent recently issued (June 4) to Alfred Merry, of Liscard, and John H. Noble, of Liverpool, England. The anode is contained within a tightly closed porous cup, which in turn is closely wrapped by a cathode of wire gauge, and the whole is immersed in water, a disposition adopted in the prior devices of Drake and Mercer. The novelty lies in the use, within the porous cup, of a supplemental porous sleeve, perforated at its lower portion and surrounding the anode, the inlet and outlet pipes for the brine being so arranged as to permit a rapid upward flow to be maintained between the sleeve and the anode whereby the chlorine bubbles are entrained with the electrolyte. At the same time a considerable head of electrolyte is used, so that the porous vessel is at all times completely filled, and the solution is forced slowly through its walls, insuring that no layer of diffused caustic alkali shall form around the sides of the cell, and by carrying a portion of the current, reduce its efficiency. The inventors state that by this disposition there is gained much more of the theoretic power of the electricity than has hitherto been considered possible. Practical experience, however, has always shown a diaphragm, especially in a cell intended for the electrolysis of sodium chloride, to be costly, inefficient, wasteful of energy, and subject to rapid deterioration, and the proposition to avoid anode polarization by interposing two such elements between the electrodes will hardly meet with favor.

A NERNST LAMP HEATER.—A patent issued June 4 to J. Van Vleck and W. N. Stevens describes a removable heating arrangement for a Nernst lamp. The heater is within a plug, and when this is entered in the glower lamp the heater circuit is closed automatically. Ordinarily the electric heating device is removed from the lamp, and is inserted only when it is desired to set the lamp in operation.

PARIS EXPOSITION REPORT.—The Government Paris Exposition Report will make six octavo volumes averaging about 600 pages to the volume. It will contain more than 300 half-tone illustrations printed on heavy enameled paper, and about 50 maps and plans of the United States' exhibition, areas and installations. As Congress did not provide copies for general public distribution, Mr. A. S. Capehart, late of the U. S. Exposition Committee, ordered a number from the Government Printing Office, which he has had bound in library style. Sets of the same may be obtained from Mr. Capehart (P. O. Box 445, Washington, D. C.), at a cost of $20.

A NEW PRIMARY BATTERY.—A patent granted June 4 to C. T. Sittig, of Gross-Lichterfelde, Germany, describes a primary battery which is designed to combine the advantages of both a dry and a liquid cell. The exterior of the cell resembles that of the ordinary dry cell, the case being of zinc with the top of the cell sealed in. The carbon electrode is centrally disposed within the case, being surrounded by a suitable depolarizing substance such as maganese dioxide, which is retained within a sack surrounding the carbon. Between this electrode and the side of the case is a liquid chamber to which there is an inlet extending through the outer lid, and sealed by a removable screw cap. Through this inlet the liquid chamber may be emptied and filled with a new electrolyte. On a partition near the top of the cell is a layer of loosely packed material such as rice chaff, above which is the asphaltum seal, through which extends two small glass tubes adapted to take off the gases forming in the liquid chamber.

PILOT SWITCHBOARDS.—A patent granted June 4 to L. B. Stillwell relates to the details of pilot switchboards, whereby switching devices may be operated from a distance, and the position of each of such devices indicated to the attendant at the pilot board. The pilot switchboard is a miniature representation of the main switching circuits, having devices which represent the main switching devices, and controlling connections to the main operating means whereby the main devices are controlled by the pilot devices, and indications given of the movements and positions of the main devices. When one of the main switchboard's devices changes its position and connections, either automatically or otherwise, the corresponding pilot switchboard devices are similarly changed in position and apparent connections. The pilot switchboard is so arranged in combination with diagrammatic bus-bars and connections as to convey to the eye an accurate representation of the connections existing in the main switchboard, and give at all times a diagrammatic representation of the main devices and their circuit connections.

ANOTHER CANADIAN POWER ENTERPRISE.—Our Canadian correspondent says that a big project is well advanced towards a starting point for the purpose of supplying the city of Montreal with pure water, cheaper power and light, and an immense cold storage plant. The concern is to be capitalized at $5,000,000. This gigantic enterprise, he says, has already reached a stage where its successful accomplishment is assured. Several New York capitalists are interested in the scheme, and, in fact, are the backbone of the undertaking of which Mr. James E. Wilder, of Montreal, is a prominent promoter. Speaking upon the subject, Mr. Wilder said: "The water power at the Lachine Rapids, between the Hydraulic Company's plant and the Isle Heron, the island itself and a portion of the Panniston farm, have been secured by our company. The power generated by compressed air process will be about 50,000 horse-power, or nearly three times that of the Lachine Hydraulic Company. We have completed arrangements with the Taylor Hydraulic Air Compressing Company, whereby we will use its system. It is the intention of our company to install an immense electric and compressed air plant, part of the compressed air to be utilized in purifying the water and to elevate it on the spot to a height above the present reservoir, which will enable us to supply the whole island of Montreal, and to transmit electric power and compressed air power through the city. The compressed air will supplant steam, and will be used for general power. The exhaust will be used for cold storage. We shall commence work within three months, and it will be pushed vigorously until it is completed. We hope to have everything in readiness for operation in two years."

BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.—The British Institution of Electrical Engineers will make an excursion to Germany this month, leaving London, June 22. The party will be divided into three sections, Group A visiting Berlin only; Group B visiting Berlin and Dresden, and Group C visiting Berlin, Dresden, Nuremberg, Frankfort, etc. The programme in Berlin includes visits to the electricity supply stations of Berlin and to the works of Siemens & Halske and the Allgemeine Elektricitaets Gesellschaft. A visit will also be paid to the Wannsee Electric Railway and the experimental high-speed electric railway near Berlin. Messrs. Siemens & Halske and the Allgemeine Elektricitaets Gesellschaft on Monday evening, June 24, will give a reception and supper to the Institution, and on Wednesday evening a dinner. Other visits in Berlin will be to the new elevated electric railway, the telephone exchange and to the technical high school, where Dr. Slaby will meet the members. On Friday morning, June 28, a visit will be paid to the tool works of the Niles Tool Company, in Berlin, by such members as shall remain over. On Thursday evening Group B will proceed to Dresden, where a reception that evening will be given by the German Electrical Technical Society. On Friday and Saturday mornings meetings of the German Electro-Technical Society will be attended, and in the afternoons visits will be paid to various electrical installations in Dresden and vicinity. At Nuremberg, Group C will visit the works of Messrs. Schuckert & Co., and at Frankfort the Lahmeyer works. An evening reception will be given by Messrs. Schuckert in Nuremberg, and by the local Electro-Technical Society in Frankfort. Visits will be paid to the Wiesbaden and Hamburg central stations and to the Elberfeld-Barmen Mono-rail Electric Railway.

LETTER TO THE EDITORS.

Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the editorial on Electro-Chemistry in your issue of April 27 and to the discussion which has followed, you will perhaps allow a German electro-chemist to add his opinion concerning education in electro-chemistry.

The marvelous development of the electro-chemical industry in this country cannot fail to impress in the highest degree any one when he compares it with the relatively slow progress of practical electro-chemistry abroad. This condition having been reached without modern theories of electro-chemistry having been taught in American technical schools to any considerable extent, the conclusion seems to follow, that there may be no utility at all in these theories. Mr. Burgess, in his letter of May 18, appears to maintain this standpoint, with exemplifications from several highly developed branches of the industry.

But his conclusion, I would say, seems to be rather uncertain. Any invention of a new process or any improvement of an old one is a fact which can be considered and more or less explained with reference to every theory, for the existing electro-chemical industry is an application as well of modern as of old science. But the question is, whether in the brain of the inventor modern theory did not promote the association of ideas finally leading to the result attained. To this question the final technical result cannot give an answer. For that, one has to possess knowledge of the mental processes of the inventor, and if found that modern theory furnished one link in the chain of his thoughts or facilitated his foreseeing difficulties or calculating results, then theory cannot have been useless.

As another proof of the failure of theories, Mr. Burgess points out that in Germany, where most electro-chemical theories have been developed, electro-chemical practice has not made more rapid progress than in this country. But generally practical progress is not made in the study or laboratory where theoretical work is done, and until recently, even in Germany, there were not many electro-chemical engineers sufficiently familiar with the new developments of their science to give any superiority in that respect over the engineers of other countries. At present, in Germany the education of electro-chemists is based on the new ideas.

But from one standpoint the instruction of electro-chemists is still an unsolved problem abroad. At the last year's meeting of the "Deutsche Electrochemische Gesellschaft," Professor Lorenz, of Zurich, read a paper on "Education of Electro-Chemists," prepared at the special request of the association, which was followed by an interesting discussion. The gist of the opinions offered was that, theoretically speaking, an electro-chemist is a man who ought to have complete knowledge of chemistry as well as of electrical engineering; but as time and the capacity of students are limited, the instruction practically cannot be more than a compromise with respect to these two branches, the extent in either direction depending upon the teacher's individual opinion as to whether electro-chemistry is to be considered rather as a department of chemistry than of electricity.

Konrad Norden.

New York, N. Y.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motors.—Eborall.—His fourth lecture on polyphase working, dealing mainly with the construction of induction motors. He first considered the relative advantages of holes and slots in the stator stampings of induction motors. Hole disks are excellent mechanically, but are hard to wind, and they may be troublesome on account of the magnetic leakage over the bridge piece. The latter effect necessitates that the radial depth of this bridge should be diminished as much as possible, and that means that the core has to be machined, instead of the stamping being employed just as they are, as in the case of slotted armatures. As the chief disadvantages of the slot are the difficulty of stamping and its greater magnetic resistance, the balance of the advantage is, in his opinion, in favor of this form. Rotors, on the other hand, are usually hole-wound. He is of the opinion that the permanently short-circuited squirrel cage rotor should be abandoned for a polyphase winding that admits of slip-rings and the insertion of resistances on all motors above 5 horse-power. He emphasized the importance of reducing the magnetic leakage. For this reason many slots per pole per phase must be used in the stator, and this is also necessary to avoid a tendency to synchronism. He gave the following data as a guide in the design of induction motors: Clearance (iron to iron) the 450th part of the diameter of the rotor; flux densities in air-gap, 30,000 lines per square inch, in stator teeth, 60,000, and in rotor teeth, 80,000; current density in rotor wires, 1100 to 1500 amperes per square inch; peripheral speed, 6000 ft. per second; "ampere wires per foot" in stator, 300 for sizes up to 5 horse-power, and 450 up to 100 horse-power. Owing to the small clearance, an essential point is that the case be a stiff mechanical job, this being a particular weakness in polyphase traction motors. The efficiency of polyphase motors is said to be a shade lower than direct-current motors up to 100 horse-power, but their weights are about the same. He pointed out the importance of having the full-rated pressure applied at the motor terminals, the torque being proportional to the square of the voltage. He dealt also briefly with the systems of transmission. He condemned two-phase systems in general, and spoke in favor of three-phase. A point to be observed in the design of the three-core cables for three-phase transmission is that experience in continental Europe has shown that the distance between the conductors and the sheath should be quite as great as that between the conductors themselves.—Lond. *Elec.*, May 24; *Lightning*, May 23.

Speed Regulation of Shunt-Wound Motors.—Stock.—A brief article, illustrated by diagrams, on speed regulation within wide limits, of shunt-wound motors driving machines in paper plants, dyeing plants, etc., where a speed variation of 30 to 1 or even 60 to 1 is sometimes required. The motor has a rheostat in the circuit of the shunt field, and is supplied with current from a special dynamo which is excited by a small compound-wound dynamo having a rheostat in the shunt field. If two motors are required in the shop which have to work independently, he uses two primary dynamos, excited by the same compound-wound exciter. There is a rheostat in each of the fields of each primary dynamo.—*Elek. Anz.*, May 9.

REFERENCES.

Resistance of Short-Circuit Armatures.—Heubach.—An article of a theoretical nature, in which he calculates by simple mathematics the resistance of a short-circuited armature. He gives a simple approximate formula for the apparent resistance of a bar of a short-circuit armature, which gives results good enough in practice. Regarding the best dimensions of a short-circuit armature, he shows how to make this apparent resistance a minimum for a given quantity of copper. He finally shows briefly how to calculate by an analogous method, the value of the stray fields of an induction motor, if the exciting forces and fields have a sinusoidal form.—*Elek. Zeit.*, May 23.

Induction Motors.—E. H.—The first part of an illustrated summary of the present construction of single-phase and polyphase induction motors. He first gives diagrams showing the relation between couple and speed and rotor resistance. He then gives a general outline of the typical construction of the stator and rotor, with illustrations.—*L'Ind. Elec.*, April 25.

LIGHTS AND LIGHTING.

Cooper-Hewitt Lamp.—A general discussion of this lamp and in general of "electric vapor lamps." While it has been commonly considered that a rarefied gas is an exceedingly bad conductor, J. J. Thomson has shown that this apparent resistance is mainly due to the difficulty which the discharge has in passing from the electrodes into the gas, and that if the circuit is made to consist entirely of the rarefied gas, the gas is seen to be a remarkably good conductor of electricity. It is asked whether Cooper-Hewitt has succeeded in making a lamp in which nitrogen is used, as in this case the very high resistance between electrode and gas must be absent. It is said to be possible that the incandescence in the Cooper-Hewitt mercury vapor lamp may prove to be due to a large extent to actual metallic conduction by the mercury vapor along the sides of the tube. The objection to the lamp in its present form is not on the ground of want of efficiency, but the nature of its light If no other vapor than mercury vapor can be found to give good results, then it is feared that the lamp will not prove suitable for commercial use, as the color of the light makes it impracticable, the spectrum of mercury having practically no red lines. Attention is called to an English patent of the General Electric Co., of this country, for commercial electric lamps in which the light is produced by a mercury arc with various substances added to the vapor to give any desired color to the light. It is suggested to improve the Cooper-Hewitt lamp in this direction.—Lond. *Elec. Rev.*, May 24.

Powell.—An illustrated article on the same lamp, in which he describes an observation made in the course of an automatic distillation of mercury in vacuo; when in a spiral in his apparatus sufficient mercury globules had collected to cause a drop to flow and collect other globules in its path, he observed a brilliant streak of greenish light along the track of the rolling mercury. He believes that perhaps "by the rolling of the mercury static electricity is developed which, in the presence of the surrounding heated mercury vapor, gives rise to momentary Geissler tube effects."—Lond. *Elec. Rev.*, May 24.

REFERENCE.

Blue Printing by Electric Light.—Some further particulars on the method of the Gen. Elec. Co., taken from an Am. Soc. Mech. Eng. paper of Reist.—*Eng. News*, May 30.

POWER.

Polyphase Motors for Hoisting.—A brief article on the use of polyphase motors for the operation of mining hoists. While polyphase motors are inherently so constituted that they work to their best advantage when at full and unvarying speed, and at practically unvarying loads, these conditions are the very antipodes of those existing in mine hoists, where the speed, the amount of and variation in load, vary to the widest possible degree. "Nevertheless, the trying conditions imposed are being slowly but surely overcome, and it is believed by many of high repute that the period is not far distant when the application of polyphase motors to every variety of mine hoist will be an accomplished success. The operation of hoists by direct-current apparatus is in as high a state of perfection as is the electric street railway system.—*Jour. of Elec.*, April.

REFERENCES.

Electricity in Manufacturing Works.—ALDRICH.—An abstract of a paper read before the Am. Soc. of Mech. Eng. He gives some general considerations based on electric power in manufacturing plants, and discusses its sanitary advantages, its disciplinary value, the flexibility of the system, and the reliability of service. He considers the economies of electric power, the first cost and the cost of maintenance of electric systems; the influence of electric transmission upon factory buildings, workshop expansion, and the arrangement of machinery. He discusses the relative advantages of individual driving and group driving, the factors determining the selection of the electric equipment, and the efficiency of the electric system.—*Eng. News,* May 30.

Mechanical Applications of Electricity.—RICHARD.—A summary of recent improvements in electric telepherage and elevators.—*L'Eclairage Elec.*, April 20.

Three-Phase Traction.—VON KANDO.—An article on high-tension three-phase traction on interurban lines. After some introductory remarks on direct and alternating-current traction in general, he discusses the advantages due to the use of a high tension, the dangers of high-tension currents, and the rational limit of the tension. He recommends making the tension in the primary as high as possible. The tension in the trolley wire is limited by the following considerations: The cross-section of the conductor decreases with the increase of tension, but should not be smaller than required for giving the necessary mechanical strength. The distance between the transformer sub-stations should not be made too great. A transformer easily stands very large momentary overloads. The distance between sub-stations should be small enough so that the variation in the load is within the limits required by the transformers. He does not favor the system which has been suggested to place the transformers on the locomotives, as this method sacrifices one of the greatest advantages of electric traction, namely, the small dead weight of the motor cars.—*L'Eclairage Elec.*, May 11.

Alternating Direct-Current Converter Stations for Traction.—HOBART.—An article on the "Choice of type and periodicity for electric traction plant." His conclusion is that "for future traction projects, the rotary converter should be superseded by the motor-generator, and the periodicity should be still further lowered for the case of very slow speed steam engines; but it may often still be advantageous to employ rotary converters, and at 25 cycles per second, for plants where the generators are direct connected to high-speed engines."—Lond. *Elec. Rev.*, May 24.

REFERENCES.

Submarine Boat.—WEBER.—An article on the electric equipment of a submarine torpedo boat, with which experiments have been made some time ago by the German Government. It has a battery of 250 cells, with a capacity of 720 ampere-hours if discharged in 12 hours.—*Centralblatt. f. Accum.*, May 15.

Isle of Thanet.—An illustrated description of this new British light railway. The length of the line is 11 miles. The direct-current trolley system is used with high-tension three-phase current transmission, and a converter sub-station.—Lond. *Elec. Rev.*, May 24.

Automobile Exhibition.—An illustrated article on the recent motor car exhibition held at the Agricultural Hall, Islington. The number of motor cars exhibited was near 300, but electric automobiles were greatly in the minority. A review of the electric exhibits is given.—Lond. *Elec. Rev.*, May 17.

Batteries for Automobiles.—FAY.—An article on the rate of discharge of batteries in electric vehicle work. He says that "the battery would be a great success if, in the course of events, the rate of discharge were reduced to that which would discharge the battery in five hours, instead of the present three-hour basis." This is shown by a table giving the battery performance at a three-hour and a five-hour discharge.—*West Elec.*, May 25.

Automobile Construction.—CLEMENT.—A second paper giving notes on automobile construction. He discusses the power losses in the transmission mechanism, the road resistance, the effect of the diameter of the wheels, the road resistance, the resistances due to gravity, and the air resistance. Several tables are given.—*The Rose Tech.*, May.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Storage Batteries in Electric Power Stations.—HIGHFIELD.—An editorial on his recent Brit. Inst. Elec. Eng. paper. "He rejects the regulating cell system, and now regulates by the variable pressure booster, so designed that by varying the field, the pressure can be varied from 0 to a maximum either way. He uses a double-wound armature in one field, each half of the battery being in series with one of the armature windings, and the field is varied by a 30-point rheostat, and a reversing switch so interlocked with it as to vary the volts given by each armature from 0 to 50, each point serving to vary through two volts. The battery center is connected to the neutral bus-bar of a three-wire system, and a good type of balancer is employed. One-half of the battery may be charged by disconnecting the other half entirely from the bus-bars and charging through the balancer." The battery serves as a controller for station pressure, as a store to allow the generators to be run at constant output, and as a general reserve. It is also useful in that it will burn out a line fault that might damage a generator. He estimates the cost of the plant, exclusive of buildings, at $125 to $250 per kw. Allowing $175 as a usual figure, he finds that at a three-hour rate of discharge a battery costs as much per kilowatt as the mechanical plant. "At a one-hour rate the cost per kilowatt is less, and in a lighting plant" he would put in a battery one-sixth to one-fourth the maximum station output, which will carry the peak of the load for three hours. A traction load may usually be run with a battery of one-hour discharge capacity, and its cost will be $75 to $90 per kilowatt. He considers the ideal system for traction to be generation at constant load, i. e., the economical engine load for, say, 16 hours a day. The battery is to take charge of all peaks and absorb its charge when the inverse peaks occur, and it is to take all the load when this is small, as when cars are shedding or turning out. The cost of a battery is said to be about 7 per cent annually for "replating." A battery may, it is stated, have an "efficiency" as high as 84 per cent.—Lond. *Elec. Rev.*, May 17.

Sherbrooke.—An illustrated article on the electric plant of Sherbrooke province of Quebec, Canada. The present capacity is 840 kilowatts. Water power is used to generate two-phase currents of 133 periods at 2400 volts. The current is used mainly for lighting, but there are also installed 23 two-phase motors ranging from 1 to 30-kw capacity and aggregating a total of 240 horse-power.—*Can. Elec. News*, May.

Cham.—An illustrated article on the electric plant of Cham, a small town in Germany. The three-wire direct-current system is used with 300 volts between the outers for lighting and 600 volts between the outers for power purposes. For street lighting 15 arc lamps and 75 incandescent lamps of 32 candle-power are used. In private houses are connected 1600 lamps of 16 candle-power and 3 arc lamps and 20 horse-power of motors.—*Elec. Anz.*, May 19.

REFERENCES.

British Central Station Statistics.—The large annual table of direct-current electricity works in the United Kingdom. There are 117 provincial and 16 London stations. A large amount of information is given in 25 columns; there is no summary.—Lond. *Elec. Rev.*, May 10.

Storage Batteries in Central Stations.—LUNN.—A paper read before the Detroit Eng'ing Soc'y on the installation, operation and economy of storage batteries in central stations, with a description of the battery plant of the Edison Illuminating Co., of Detroit, Mich. —*Jour. Ass. Eng. Soc.*, April.

Chicago.—An illustrated article on the alternating-current lighting system recently installed by the Ill. Central Railroad Co., for its central and suburban stations in Chicago.—*West. Elec.*, May 25.

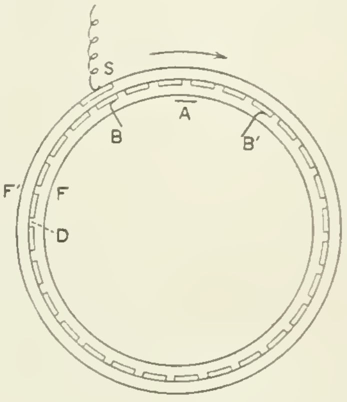
San Mateo County.—PENNOYER.—An illustrated description, with map, of the electric power transmission and distribution system of the Consolidated Light & Power Co., in San Mateo County, Calif.—*Jour. of Elec.*, April.

Rheostat.—HUTTON.—A brief description of a simple rheostat used for a special purpose to absorb 750 kilowatts of three-phase current at 11,200 volts.—*Jour. of Elec.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

"Open Currents."—CRÉMIEU.—A continuation of his very interesting researches. In former investigations he had endeavored to show that electric convection produces no magnetic field. It follows that "open currents" must exist, and he demonstrates their existence as

follows. On an ebonite disk *D*, 37 cm. in diameter and 2.5 mm. thick, segments are "gilt," as shown in the adjoining figure. The disk turns about a central axis between two fixed ebonite disks *F* and *F'*. The disk *F'* bears a tinfoil armature *S*, twice as broad as the moving armatures. Two brushes *B B'*, 60 degs. apart, are in contact with the moving armatures. When *S* is charged, the armature in contact with *B* acquires an induced charge, which passes on to *B'* where it is discharged. If *B* and *B'* are connected there will be electric convection between them on the one hand and electric conduction on the other. At *A* is placed one needle of an astatic system. If *B* and *B'* are joined through a galvanometer, the latter shows a deflection, while *A* does not. If *B* and *B'* are joined through a coil placed near the lower needle of the astatic pair, a deflection of *A* is observed as soon as *S* is charged, and varying with the sign of the discharge. The current circulating in *B B' B* is therefore an open current.—*Comptes Rendus*, May 6; abstracted in Lond. *Elec.*, May 24.



OPEN CURRENTS.

Nitrogen and Tesla Currents.—Kauffmann and Hell.—An account of an experiment in which nitrogen was exposed to the influence of Tesla currents. The nitrogen is contained in a wide glass tube, in which there is a narrow tube filled with mercury connected to one pole of a Tesla coil, while the other pole is connected to an external tin coating on the wider glass tube. On working the Tesla coil, a blue fluted light appears in the wide tube, accompanied by a green fluorescence of the glass walls. The green fluorescence appears to be generated wherever the blue rays impinge upon the glass, just as if these were cathode rays.—*Phys. Zeit.*, May 11; abstracted in Lond. *Elec.*, May 24.

Hysteresis in a Revolving Field.—Dina.—An account of an experimental comparison of the energy dissipated per cycle in a field revolving at a speed of 1200 r. p. m. with that in a field varying successively in steps, the magnetic induction being studied in the latter case by the ballistic method. The hysteresis in the revolving field is greater than the other hysteresis until about a maximum induction of 10,000 and then becomes smaller gradually. At a maximum induction of 18,100 the difference is 9 per cent.—*Rendiconti del R. Ist. Lomb.*, v 33, 1900; abstracted in *L'Eclairage Elec.*, April 20.

Longitudinal Thermo-Magnetic Effect.—Lownds.—An experimental investigation on the effect discovered by Ettinghausen and Nernst, that if in a circuit, consisting partly of bismuth and partly of other metals, the latter be traversed by a current of heat in a certain direction and also be immersed in a magnetic field whose lines of force are at right angles to the heat current, then the e. m. f. of the circuit depends upon the strength of the magnetic field. The present author finds that, when one junction is kept at a temperature of —120 degs., the effect attains a maximum at a field intensity of 2450 units, and then decreases with increasing field, probably becoming negative at a certain strength. This is remarkable in the face of Gamagurchi's result that the transverse thermo-magnetic effect continues to increase with the field, even at the lowest temperatures attained. Both the longitudinal effect and the change of resistance may be represented by the same formula, except at low temperatures, where the longitudinal effect changes sign.—*Ann. der Physik*, No. 4; abstracted in Lond. *Elec.*, May 24.

REFERENCES.

Induction in an Open Circuit.—Koenigsberger.—An account of some experiments made to demonstrate, if possible, the existence of the displacement current induced in a circuit consisting partly or wholly of dielectric material when either the conducting or the non-conducting part of it is placed in a varying magnetic field. He has not yet made a decisive experiment.—*Phys. Zeit.*, May 11; abstracted in Lond. *Elec.*, May 2, May 24.

Photographic Alternating-Current Curves.—Weinhold.—An illustrated article on the use of Braun's cathode tube for demonstrating and photographing alternating-current curves.—*Elek. Zeit.*, May 16.

Condenser Discharge.—Mizuno.—A mathematical paper on the influence of a non-inductive resistance on the oscillatory discharge of a condenser in a circuit having resistance and inductance. The non-induction resistance is connected in parallel to this circuit.—Lond. *Elec.*, May 24.

Hysteresis of Sheet Iron.—Stern.—An account of a large number of measurements of the coefficient of hysteresis in a piece of sheet iron at different parts of the sheet.—*Elek. Zeit.*, May 23.

ELECTRO-CHEMISTRY AND BATTERIES.

Measuring the Velocities of Ions.—Abegg.—A German electrochemical society paper, in which he gives an account of a new and very interesting method of Steele for measuring the transport numbers (relative velocities) of the ions in aqueous solutions. The method is based upon the following phenomenon: When in a vertical tube two different aqueous solutions of about equivalent concentration with one common ion, for instance, Li Cl and KCl, are placed one above the other, and a current flows through them from the Li Cl to the KCl, then the conductivity of the Li Cl is smaller than that of KCl, as the speed of migration of Li is smaller than that of K, at the same time the drop of potential per unit length is greater in Li Cl than in KCl; it is then observed that the boundary surface between Li Cl and KCl is kept well defined, but travels in the direction of the current. The speed at which it travels is the speed of the last K ions, and the first Li ions. The boundary surface is kept well defined, because whenever a K ion diffuses into the Li Cl solution it is automatically driven back by the higher voltage drop which exists there, and as the K ion has a higher speed than the Li ions, the latter cannot follow it quickly enough. On the other hand, when a Li ion diffuses into the KCl solution, it comes into a region of smaller voltage drop and, on account of its lower speed, it cannot keep pace with the quicker K ions and therefore drops back into the Li Cl solution. His method, based upon this phenomenon, is as follows: If he wants to measure the relative velocities of K and Cl, he uses a cell in which the following three electrolytes are placed, one next to the other. Li Cl, KCl, KAc, it will be seen that the first two solutions have the Cl ion common, the latter two the K ion; the acetate ion has a slower speed of migration than the Cl ion. The Li Cl and the KAc solutions are in gelatine preparation, while the KCl is a simple aqueous solution. If a current is then sent from Li Cl to KCl, the positive Li and K ions travel in the direction of the current, while the negative Cl and Ac ions travel in the opposite direction. The boundary surface Li K travels in the direction of the current with a certain speed which is measured. The boundary surface Cl. Ac travels in the opposite direction with another speed, which is also measured. He shows that the ratio of these two speeds represents the ratio of the migration velocities of K and Cl, so that the transport numbers may easily be calculated. The boundary surface between two electrolytes is well defined by the difference of the optical density, so that its position can be measured exactly. The arrangement of the apparatus is described. From the results of some tests given it appears that the method yields quite exact results.—*Zeit. f. Elektrochemie*, May 16.

Increasing the Capacity of the Lead Accumulator by Heating.—An illustrated note on a patent of Heim, who suggests heating the lead accumulator, in order to diminish the viscosity of the sulphuric acid and to quicken the diffusion. From this then results a large increase of the capacity, and tests have shown that this increase amounts to 3 per cent per centigrade degree, which would double the capacity for an increase of the temperature by 35 degs. An arrangement is described and illustrated for heating an automobile battery.—*L'Eclairage Elec.*, May 11.

New Method of Closing Portable Storage Battery Cases.—Sieg.—A description of a new device of the Hagen Accumulator Works, of Cologne. They provide the ebonite covers of their storage battery cases with a soft-rubber border, which is firmly connected with the cover during the vulcanization. The soft rubber border is cut off in such a way that the lower part of the cover fits exactly into the opening of the case and the upper part presses firmly against the walls of the case. The cover has a small hole to permit the escaping of the gases. The arrangement is said to have proved very practical. It is said that exactly an hour is needed to clean an automobile battery of 42 cells, including the time for connecting and disconnecting all screws.—*Centralblatt f. Accum.*, May 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

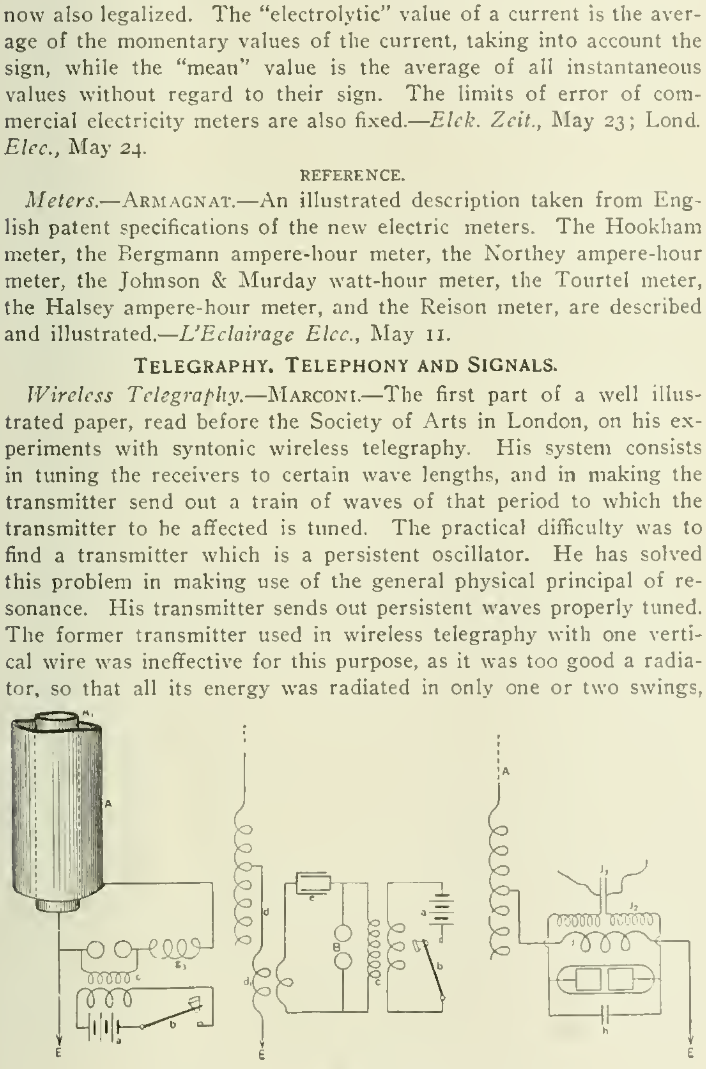
German Standards.—A specification of electrical standards, issued by the German Government. The ampere is the current depositing 0.001118 grain of silver per second from an aqueous solution of silver nitrate, prepared in the following way: It is to contain 20 to 40 parts, by weight, of pure nitrate of silver to 100 parts of distilled water free from chlorine, and it must not be used after 3 grammes of silver per 100 cubic cm. of the solution have been deposited electrolytically. The part of the anode within the liquid is to be of pure silver and the cathode of platinum. When the silver deposited on the latter exceeds 0.1 gram per square centimeter, the silver must be removed. The current density is not to exceed 0.2 ampere per square centimeter at the anode and 0.02 ampere per square centimeter at the cathode. Before weighing, the cathode has to be washed with distilled water free from chlorine until the rinsing water shows no cloudiness when a drop of hydrochloric acid is added to it, then it is to remain in distilled water at 70 to 90 degs. C. for 10 minutes, and again rinsed in distilled water. This last rinsing water must not show any cloudiness when treated cold with hydrochloric acid. The cathode is then dried in hot air, and kept in a dessicator until it is weighed, and after it has been cooled at least 10 minutes must elapse before the weighing. In addition to the volt, ampere and ohm the names ampere-second and coulomb, ampere-hour, watt, watt-hour, farad, henry, the prefixes kilo, mega or meg, milli, micro or micr, and the terms effective, mean, "electrolytic" and maximum momentary value of alternating or variable currents or e. m. f.'s, are now also legalized. The "electrolytic" value of a current is the average of the momentary values of the current, taking into account the sign, while the "mean" value is the average of all instantaneous values without regard to their sign. The limits of error of commercial electricity meters are also fixed.—*Elek. Zeit.*, May 23; Lond. *Elec.*, May 24.

REFERENCE.

Meters.—ARMAGNAT.—An illustrated description taken from English patent specifications of the new electric meters. The Hookham meter, the Bergmann ampere-hour meter, the Northey ampere-hour meter, the Johnson & Murday watt-hour meter, the Tourtel meter, the Halsey ampere-hour meter, and the Reison meter, are described and illustrated.—*L'Eclairage Elec.*, May 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—MARCONI.—The first part of a well illustrated paper, read before the Society of Arts in London, on his experiments with syntonic wireless telegraphy. His system consists in tuning the receivers to certain wave lengths, and in making the transmitter send out a train of waves of that period to which the transmitter to be affected is tuned. The practical difficulty was to find a transmitter which is a persistent oscillator. He has solved this problem in making use of the general physical principal of resonance. His transmitter sends out persistent waves properly tuned. The former transmitter used in wireless telegraphy with one vertical wire was ineffective for this purpose, as it was too good a radiator, so that all its energy was radiated in only one or two swings, and the waves were very greatly damped immediately. A transmitter, which is not only a good radiator but also a persistent oscillator, was devised by him by increasing the capacity of the radiating wire without in any way increasing its radiative power, as shown in Fig. 1, where two cylinders instead of a single vertical wire, are used. The inside cylinder is earthed, while the outside one is connected to an inductance and a spark-gap. The same arrangement of cylinders may also be used in the receiver. The results obtained by this system have been remarkable. When he used an inductance between the spark-gap and the radiating conductor, he found it possible to cause the electric period of oscillations of the receiving cylinder to correspond to that of one out of several transmitting stations, from only one of which it would receive signals. By using cylinders of zinc 7 meters high and 1.5 meters in diameter, good signals could easily be obtained over a distance of 31 miles, these signals not being interfered with or read by other wireless telegraph installations in the immediate vicinity. It is probable that the great majority of the electrostatic lines of force pass directly from one cylinder to the other. The capacity of the radiator due to the internal conductor is so large that the energy set in motion by the spark discharge cannot all radiate in one or two oscillations, but forms a train of slowly damped oscillations, which is just what is required. Another very successful synchronized transmitter and receiver system was the outcome of a series of experiments carried out with the discharge of Leyden jar circuits. The synchronized transmitter is shown in Fig. 2, and the synchronized receiver in Fig. 3. In the transmitter the two electrical circuits $B\ c$ and $A\ d\ E$ must be tuned to the same period of oscillations in order to give good results. The period of oscillation of the vertical conductor A can be increased by introducing turns, or decreased by diminishing their number, or by introducing a condenser in series with it. The condenser c is constructed in such a manner that its electrical capacity may be varied. In the receiver shown in Fig. 3 the vertical wire is connected to earth through the primary of a transformer, the secondary of which is joined to the coherer. In order to make the tuning more marked, he places an adjustable condenser across the coherer. The free period of electric oscillations $A\ j_1\ E$ should be in electric resonance with $j_2\ h$. The condenser h increases the capacity of the secondary resonating circuit of the transformer, and in the case of a large series of comparatively feeble but properly tuned electric oscillations, being received, the effect of the same is summed up until the e. m. f. at the terminals of the coherer is sufficient to break down its insulation and cause a signal to be recorded. In order that the transmitter and receiver are in tune, it is necessary that the product of capacity and inductance in all four circuits should be equal, the resistance being assumed to be very small; but the measurement or calculation of the inductance is not so easy. Experiments, however, confirm the fact that the receiving induction coils having the secondary wound in one layer and at a certain distance, say, 2 mm., have a time period approximately equal to that of a vertical conductor of equal length. If he, therefore, uses an induction coil having a secondary 14 meters long on the receiver, he also uses a vertical wire 14 meters long at both transmitting and receiving stations. By so doing he has the two circuits at the receiving station in tune with each other, and he only has to adjust the capacity of the condenser at the transmitter, which can easily be done. Besides this most successful arrangement, he describes others also, which he has tried. He gives a full history of his experiments. The paper is to be concluded.—Lond. *Elec.*, May 24.



FIGS. 1, 2 AND 3.—WIRELESS TELEGRAPHY.

An editorial discussing Marconi's paper from a very broad point of view. It is said that Marconi has successfully perfected methods of syntonic wireless telegraphy, but it is question whether the accurate tuning of sending and receiving apparatus to a definite wave length is the only conceivable or probable or even the best solution. In syntonic signaling the ether waves are not guided. They spread out in all directions, although they only do useful work in one direction. Much energy is therefore wasted. A guided wave method would be much more efficient, but has not yet been made practically effective. For other forms of signals, guided waves are used, as in the heliograph, the lighthouse, the searchlight, the speaking trumpet, etc.—Lond. *Elec.*, May 24.

Wireless Telegraphy.—An article on Blochmann's theory of wireless telegraphy. As has been noticed before in the Digest, this author points out that the atmosphere which acts as medium of transmission, is not in a state of electrical equilibrium, but is subjected to a severe electrical strain by the permanent electrostatic charge in the earth. This strain may be represented by a series of equipotential surfaces enveloping the earth. The vertical antenna of a transmitting apparatus pierces these equipotential surfaces in a normal direction and the disturbances produced by the intermittent charges of electricity sent into the wire, have their greatest effect in an axial direction. The electric waves spread out in every direction along the equipotential surface, following all the irregularities of its surface. A horizontal antenna is comparatively ineffective, because the maximum potential disturbances at its terminals are not normal to the equipotential surfaces. A combination of the theories of Slaby and Blochmann, "if not complete in every detail, appears to be correct in the main."—Lond. *Elec. Rev.*, May 17.

REFERENCES.

Repeater for Wireless Telegraphy.—The first part of an illustrated account of Guarini's wireless telegraphy experiments, made with his automatic repeater between Brussels, Mechlin and Antwerp, as noticed before in the Digest.—Lond. *Elec. Rev.*, May 24.

Telegraphy and Telephony.—A summary of the progress and improvements, made in telegraphy and telephony during the first three months of this year.—*Elek. Anz.*, May 19.

MISCELLANEOUS.

Electric Pulverization of Metals.—A. Z.—An article in which he says that industrial production of powdered tin, aluminum, copper, etc., is already of commercial importance. He describes an electric method devised by Barry for pulverizing metals. It is based upon the fact that when an electric current flows through an electric conductor, it tends to diminish the diameter. An experiment showing this is described, as is also an interrupter based upon this principle, in which a column of mercury is interrupted by a current flowing through it. For the pulverization of tin he proposes the following apparatus. A crucible, filled with molten tin, has a hole in the bottom, into which is screwed an iron tube, the lower end of which has a small opening through which the tin flows off in a continuous stream into a lower cup. An electric current is sent through the tin; this causes the pulverization of the thin tin stream, the pulverized tin being carried away by a current of gas. For the production of stannic acid, air is used as gas, while for the production of metallic tin a neutral gas like hydrogen is used.—*L'Ind. Elec.*, April 25.

REFERENCES.

Bunsen.—Ostwald.—An address read before the German Electro-Chemical Society, on the life and work of Bunsen. He proposes to change the name of that society into the German Bunsen Society. —*Zeit. f. Elektrochemie*, May 16.

Laboratory.—An illustrated description of the Williams Proudfit Memorial Laboratory of the Rennselaer Polytechnic Institute, of Troy. It is used as an electrical and testing laboratory.—*Polytechnic*, May 27.

Paris Exposition.—Reyval.—An illustrated description of several exhibits of Ganz & Co., a 100-kilovolt-ampere three-phase alternator, a 300-kw single-phase transformer, and a 60-kw direct-current machine.—*L'Eclairage Elec.*, May 11.

The conclusion of the illustrated serial, giving some remarks on the Rieder process of electric etching, a small rotary converter for reducing the pressure of supply mains for medical purposes or for charging small accumulators, the accumulator cars of the Milan-Monza Railway, and the system of electro-pneumatic signals of the Westinghouse Brake Co.—Lond. *Elec.*, May 24.

New Books.

Steam Boiler Economy. A Treatise on the Theory and Practice of Fuel Economy in the Operation of Steam Boilers. By William Kent, A. M., M. E. New York: John Wiley & Sons. 458 pages, 134 illustrations. Price, $4.

This book is the outcome of an active life of engineering work, no small part of which has been spent in the study of the steam boiler and the conditions of its efficient performance. In the preface the author calls attention to the fact that in most of the books relating to the steam boiler, the larger space is given to varieties of form, details of construction, etc., rather than to the conditions which affect the efficiency of the performance. In the present book this order is reversed, and the chief place is given to the points which affect more directly the question of economy of performance.

The work, as a whole, is divided into 17 chapters, covering the following principal topics: The Chemistry of Fuel and Its Combustion, Coal and the Coal Fields of the United States, with a Discussion of the Tests of the Heating Values of American Coals; Special Fuels Other Than Coal; Furnaces and Fittings, Firing, Smoke Prevention, etc.; a general discussion of the action of boiler heating surface, and of the relation between the various factors which affect the efficiency of such action; The Principal Types of Steam Boilers on the Market; The Points of a Good Boiler; Boiler Troubles; Boiler Tests, with a Copy of the Code of 1899, Adopted by the Boiler Test Committee of the A. S. M. E., of which committee the author was a member; Tables of the properties of Water and Steam, Factors of Evaporation, etc. The chapters on the coal fields of the United States and on the tests of heating values are especially full, and bring together in convenient form a large amount of information on these topics.

The discussion of the general question of efficiency leads the author to a formula which, according to the preface, contains all the variables affecting the problem which are measurable, together with a so-called "coefficient of performance," which must be derived from the results of boiler tests, and is useful in comparing one test with another. While the author calls rather special attention to this formula, a doubt may be permitted as to whether its use will aid very materially in the discussion of boiler economy. The measurable quantities will vary between wide and uncertain limits, and it is too much to expect that one coefficient of performance can properly provide for all the non-measurable quantities and their variations. The discussion attending the development of the formula is, however, based on the known laws of heat, and will aid in giving a good understanding of the general relation between boiler economy and the conditions upon which it depends.

In the chapter on the types of boilers found in American practice, the selections for the most part seem to have been made with good judgment, though doubtless many builders will object to finding no mention of their particular type. In the references to water tube boilers one or two prominent types seem to have been omitted, while others are found whose importance may at least be called in question. This chapter is illustrated with cuts of the various types described. These cuts are, however, of quite unequal value, some being small trade catalogue cuts, while others are excellent specimens of technical illustration. Other parts of the book are also illustrated as the needs of the subject matter require.

Taken as a whole, the book is an exceedingly valuable contribution to the literature of the subject. The author's style is excellent and the subject matter is logically arranged and clearly presented. The author's experience has been such as to give him exceptionally good opportunities for acquiring the training and material necessary for the preparation of a book on this subject, and he seems to have used these opportunities to most excellent advantage The work may be recommended heartily to all who are interested in the subject of the economical generation of steam in the various forms of modern steam boilers.

Engineering Practice and Theory. For Steam Engineers. By W. H. Wakeman. New Haven: W. H. Wakeman. 184 pages, illustrated. Price, $2.

The author naively remarks in his preface, "The study of well written books is one of the most advisable ways of gaining knowledge, and that this volume may be considered an addition to those works which have proved to be of interest and value is the sincere wish of the author." We are afraid that the candid critic will meet some obstacles in the way of pronouncing the book "well written," although he may find in it material "of interest and value." For example, Chapter 9 is headed "Planimeters, Compound Engines, Horse-Power Constants," a somewhat grotesque combination in itself, but the treatment is unique; at least, we hope it is. The author says, "The process of dividing a diagram into a number of spaces, and taking measurements in order to determine the mean effective pressure, is a slow one—altogether too slow for this age of the world—and to shorten it, instruments called planimeters have been devised." He mentions four planimeters which he says are "among the most important," and then blandly informs the reader that "full directions for their use may be found in catalogues illustrating them, published by manufacturers or dealers." This is absolutely all the information on the subject contained in the chapter, unless a reiteration of the statement that the planimeter saves time and the insertion of illustrations of two planimeters, be considered information. If the author really thinks he has said anything worth saying about planimeters he might apply the same method to the engines themselves, thus: "Manual labor is altogether too slow, etc., and to shorten it machines called steam engines have been devised; full directions for their use may be found in the catalogues of dealers." The only point of view from which this mode of treating a subject is advantageous is that it saves brain fatigue to the author in this rapid age, when most persons' brains are said to be overworked.

The author has another little way, apparently all his own, too, of filling in all spaces at the ends of chapters with advice on professional ethics somewhat in the "Poor Richard" style. Unfortunately, space limits allow us to quote only one. "An Axiom.—When an engineer is notified that after a certain date his services will no longer be required, he should run his engine to the specified time, and leave everything in good order for his successor." This is sound, moral advice, whether one thinks it germane to the subject matter of the book or not, and the same may be said of the other paragraphs used as fillers in the book.

One of the characteristic features of the book is the carefully edited advertising department following the reading matter. Some of the gray matter saved by the author on the description of planimeters seems to have been devoted to this section. A short dissertation on, for example, "Repairing Valves," is printed on one page, and on the opposite page is printed the advertisement of a valve embodying the features commended in the dissertation. It is to be sincerely hoped that the advertisers who are thus favored have duly appreciated the kindness of the author, and have shown their gratitude in a suitably substantial manner, for a failure to do so would constitute so great a breach of the most fundamental rules of ethics as to call for more moral soliloquies in the chapter "fillers" of the next edition.

Directory of Electrical Societies, Etc.

Association of Railway Telegraph Superintendents. Next meeting, Buffalo, N. Y., June 19, 20 and 21, 1901. (See Current News and Notes.)

Canadian Electrical Association. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901. (See Current News and Notes.)

Northwestern Electrical Association. Next meeting, Sheboygan, Wis., June 26, 27 and 28, 1901.

Ohio Electric Light Association. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

Pennsylvania State Street Railway Association. Next meeting, York, Pa., Sept. 4, 1901.

United Electrical Contractors' Association of New York. Next meeting, Buffalo, N. Y., July 17, 1901.

Independent Telegraph Association of Wisconsin. Next meeting, La Crosse, June 25 and June 26, 1901.

The Ringing Dynamotor and Motor Generator for Telephony.

By D. M. Bliss.

While the amount of energy required for signaling purposes is small compared with that used in charging for direct transmitter service, the selection of ringing or testing generators best adapted to any given case, demands knowledge born of experience, or at least a familiarity with the present state of telephone practice.

There are several factors in the problem at the present time which were unknown in the early days of telephone engineering, and this must be kept in mind in order to secure the best results. The old hand or magneto power generator is rapidly disappearing from the exchange, and in its place is found the more efficient and compact dynamotor or motor generator. As there is some confusion regarding the use of these terms, an explanation just here may not be amiss. Most manufacturers of such apparatus have by common consent selected the name "dynamotor" to indicate a machine having a double-wound armature with a single field system common to both windings, while a "motor generator," as the word indicates, is simply a motor and dynamo, each complete in itself, connected together by belt or coupling and mounted on a common base.

In the dynamotor (Figs. 1, 2 and 3) one of the two independent armature windings, together with the field form the primary or motor part of the machine; the other armature winding generates a current when driven by the motor winding. The voltage of this secondary or generator current is proportioned to the speed, number of turns and strength of the field. The current may be direct, alternating or pulsating in character, according to the arrangement of the windings and the commutator or collector.

Considering efficiency alone, the dynamotor type of ringer is to be preferred, but in a machine in which the total input at the motors may not exceed 200 watts, the question of efficiency is secondary to absolute reliability and perfect insulation. As the primary or motor end of such a machine is frequently operated from 500-volt circuits, and the generator or ringing end always supplies outside circuits, some of them several miles in length, such a machine is peculiarly susceptible to accidents from outside sources, lightning and inductive discharges. It is evident, therefore, that when such an accident happens on one winding, the other is sure to be damaged, as they are both on one core and usually wound together in the same slots.

A characteristic feature of the dynamotor or double-wound type is that the ratio of transmission between the windings cannot be varied, as they are both under the influence of the same field, and therefore any variation of the field strength simply changes the speed, the voltage of the generator end remaining practically unchanged. A slight regulation of e. m. f. may be secured by giving the brushes a forward or backward lead where the design of the machine will admit of it and within the limits of sparkless commutation, or a controlling rheostat may be used in the motor armature circuit, but does not mean satisfactory regulation if the machine is of any size.

A machine of this type is shown in Fig. 1, arranged for delivering a ringing current at the generator end. This dynamotor is used very extensively for general telephone and telegraph purposes, and was one of the first of its class to appear on the market. It has displaced many cells of battery for main and local telegraph work.

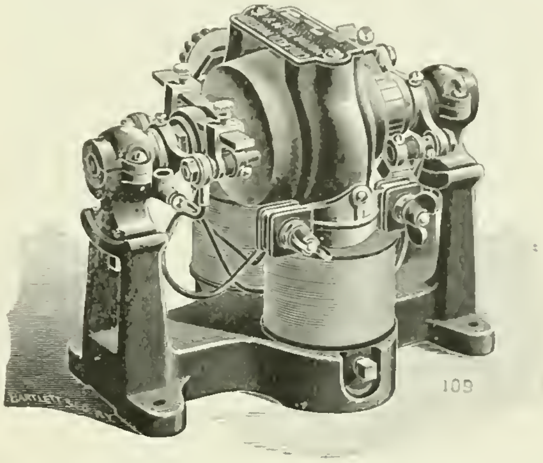


FIG. 1.—DYNAMOTOR TELEPHONE RINGER.

A good illustration of the economy and durability of the dynamotor when operated under favorable conditions is shown in the generating plant of the Boston Fire Alarm system, in which 30 special dynamotors of the Fig. 3 type, designed by the writer, have been in continuous operation for over six years, supplying the entire system directly, no storage nor other batteries being used in connection therewith. In this case, nearly all the fire alarm circuits are underground, and the construction is of the best. This fact, and the numerous protective devices used in such a system have eliminated the possibility of lightning or sneak currents damaging the windings. So far no interruption has occurred, and the operating expenses of the plant are but a fraction of those under the old system, which included a gravity battery plant of over 2000 cells, with the services of two or three men constantly employed in keeping the batteries in good order.

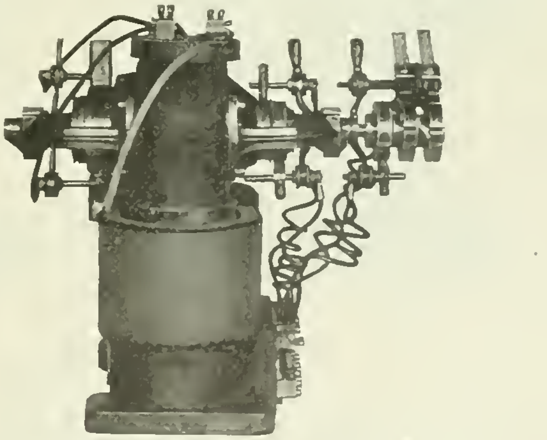


FIG. 2.—TELEPHONE RINGER WITH PULSATING CURRENT.

An interesting modification of the double-wound type is shown in Fig. 2. This machine delivers at the generator end a pulsating current, as well as the usual alternating or ringing current. The armature for one winding is tapped at certain points, and the current led through the collector to a small stationary transformer. This transformer may have a higher or lower e. m. f. than the primary. The advantage claimed by this method is that the secondary or telephone service may be more effectively insulated than is possible when the windings are on a single armature, and it is especially recommended when 220 or 500-volt motor service is available.

The tendency, however, with leading telephone companies is to use motor generators or coupled machines for both charging and ringing purposes. Figs. 4 and 5 give illustrations of this class of construction. Where the conditions will permit, the machine should invariably be coupled by noiseless flexible coupling. In cases where the supply current is alternating and of high frequency, it will be found difficult to find a motor of sufficiently low speed to admit of direct coupling to a ringing generator.

The proper speed for ringing as well as for charging generators is from 900 to 1000 r. p. m. A speed much in excess of this will give too rapid alternations to operate the strikers of the system, especially on bridging bell circuits, which require a comparatively low frequency. Where two machines cannot be coupled, belting must be used, and the best results will be obtained by using a thin, endless rawhide belt not less than one inch wide and thoroughly stitched. At least one of the machines should be adjustable to admit of tightening the belt.

It may be of interest to include specifications for ringing motor generator covering the features now demanded by the leading telephone companies.

The advantages of the motor generator over two machines combined are several, in the writer's opinion, as follows:

First.—The generating e. m. f. may be varied to any desired extent without affecting the speed of the motor, or the r. p. m. may be regulated within considerable limits without affecting the generating e. m. f.

Second.—The two machines are completely insulated from each other, and an accident to one armature will not be followed by damage to the other winding, as is usually the case in the dynamotor type.

Third.—The parts of the individual machines are usually standard and kept in stock by the manufacturers, hence the delay in making repairs or getting new parts is reduced to a minimum.

Specification for 75-watt Motor-Generotor for Ringing and Party Line Service.

General.—This combination shall consist of a generator and motor for delivering a ringing current of not less than 75 watts output, and it must also be arranged for delivering a pulsating current suitable for selective signaling on party-line service. All materials used must be of the best of their respective kind, and the workmanship and finish shall be first class in every respect. The machine shall be so constructed and balanced that when running there will be no vibration or noise.

Bearings and Brushes.—The machines must be provided with self-oiling phosphor bronze bearings, which must be self-aligning and fitted to the armature shaft so that they will run without heating. Carbon brushes must be used of ample length and section fitted to self-feeding brush holders in which the carbons will maintain their proper position on the commutator under uniform tension throughout the life of the brush. The brush-holders must be carried by a movable brush ring, rocker arm or other similar device, and fixed brush-holders will not be accepted.

Type of Generator.—The generator shall be of the semi-enclosed or protected type, and no machine having the armature connections exposed or with loose and frail connection cables will be accepted. Preference will be given to a form in which armature, field and brush leads are within the casing or frame.

Generator Windings.—The machine must deliver continuously an alternating current of one ampere at 75 volts pressure, at a speed of not more than 1050 nor less than 950 cycles per minute. The voltage on open circuit must not exceed 110.

Pulsating-Current Device.—In addition to the usual collecting rings this generator must be provided with a special commutator containing two conducting segments insulated from each other and from the frame of the machine. Each segment must be permanently connected to opposite points on the armature winding. Carbon brushes must be so placed on these segments so as to receive respectively the positive and negative impulses of the alternating current.

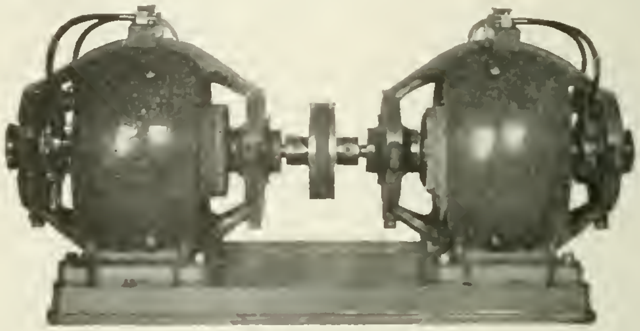


FIG. 4.—SEMI-ENCLOSED MOTOR GENERATOR.

Motor.—The motor must be of the iron-clad induction type, designed to operate on a single-phase alternating current of 104 volts and 60 cycles. It must be self-starting, and of suitable size to drive the generator to which it is connected.

Heating.—The machines must carry their full rated load continuously without any part of them being heated more than 50 degs. F. above the surrounding air.

Insulation.—The insulation resistance between any insulated part and the frame or another insulated part shall not be less than one megohm.

Terminals.—All terminal blocks shall be of ample capacity, readily accessible and plainly marked. Complete diagram of connections must be furnished.

Sub-Base and Coupling.—The generator and sub-base shall be mounted on a cast-iron planed sub-base, on which the two machines must be accurately centered and connected by a flexible insulated coupling.

Efficiency.—The commercial efficiency of the combination should not be less than 40 per cent. Preference will be given to good workmanship and noiseless operation rather than high efficiency.

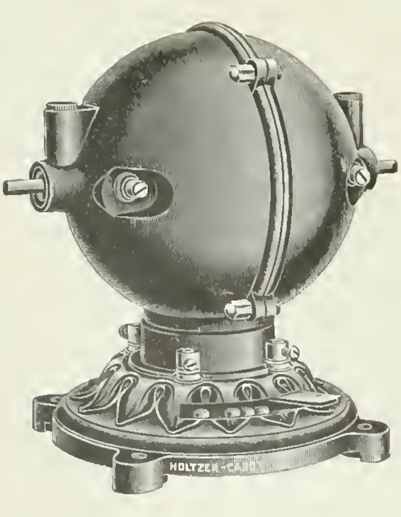


FIG. 3.—DUST-PROOF RINGING DYNAMOTOR.

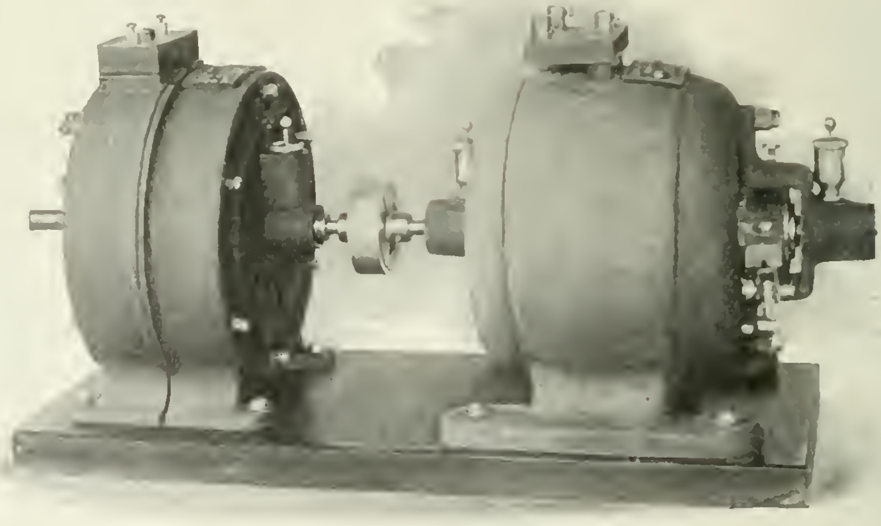


FIG. 5.—ALTERNATING AND DIRECT-CURRENT TELEPHONE MOTOR GENERATOR.

A New Street Railway Generator.

The accompanying illustration shows a type of street railway generator manufactured by the Thresher Electric Company, of Dayton, Ohio. The manufacturer makes strong claims for efficiency in generation and in operation of this type of generator, based upon the machines now installed. The machine has proved equal to the severest service, operating under varying loads ranging from zero to 50 per cent overload within a few seconds, and requiring no attendance further than cleaning and oiling. The polar projections of the field are made separable to permit the field coil to be removed without dismantling the machine as a whole. The pole piece is made either of soft, cast or laminated steel, and the joint, with the frame, is scraped to a bearing to decrease the reluctance to a minimum. This method of construction gives a perfectly balanced field, the reluctance being the same in each circuit, and the pole pieces exactly spaced, a condition which does not exist, it is claimed, when the pole pieces are cast into the ring. The field coils are wound on metallic shells and insulated with a moisture-excluding material. The series and shunt coils are entirely independent to allow perfect ventilation, and in case of accident to either, to permit the damaged part to be repaired without disturbing the other windings.

In the armature construction the features sought have been compactness, solidity and perfect ventilation. Each disk consists of a thoroughly annealed lamination, insulated with Japan varnish. The disks are firmly held in position on the spider by end plates, which are provided with extended flanges to support the windings at both ends, the rear flange being so shaped as to entirely protect the windings from injury. The spider is of open construction, and ventilating disks are provided, to allow the free circulation of air throughout the core body. Projecting from the front end of the spider are lugs, which support the commutator bushing, so that it is entirely independent of the shaft, and being rapidly supported in this manner, all vibration is taken out of the connecting leads. Fig. 2 shows the armature core insulated ready for winding, with the commutator in position. Each armature circuit consists of a continuous copper bar, without joint, formed to shape and completely insulated before being placed on the core, the only joint being where the winding is soldered to the commutator leads at a point easily accessible for inspection and repair. The coils are held in position in the slots by wedges, so that no bands are required upon the core body. This form of winding has many advantages over any other, as will be readily appreciated. It greatly increases the efficiency of the armature by giving the least possible length of circuit, reducing the internal resistance to the lowest limit, and by offering a greater radiating surface, a cooler running armature. It also makes the removing and replacing of a field coil a very simple operation, as a new coil can be inserted by exposing the surface of the armature covered by two pole pieces, without at all dismantling the balance of the machine

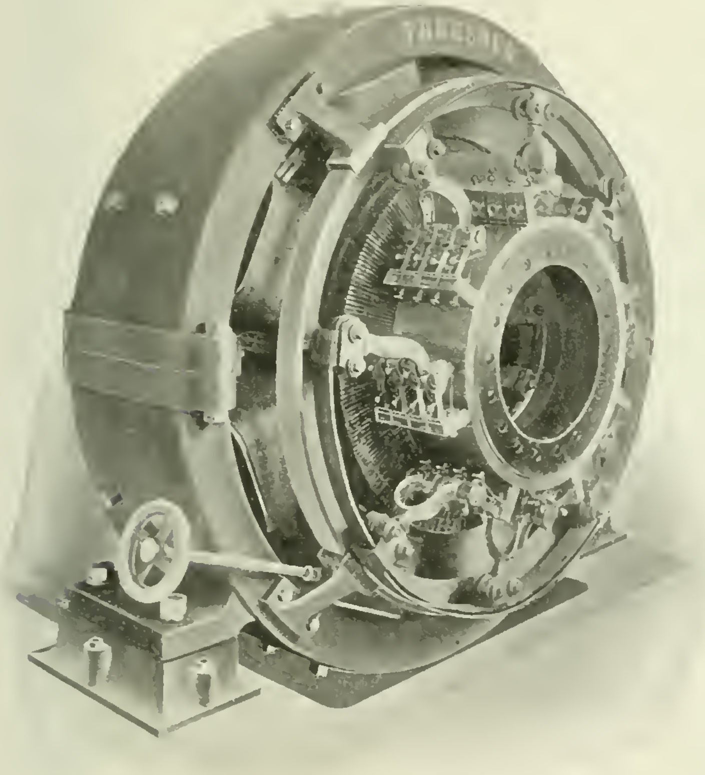


FIG. 1.—STREET RAILWAY GENERATOR.

The commutator is built up in a separate bushing, carried on the armature spider entirely independent of the shaft, so as to be easily removed and replaced by a new one when necessary. The commutator bars are of drawn copper, and insulated with India mica of such character as to wear evenly with the bars. They are firmly held in position by the end flanges, and after being put through the several processes used in the Thresher construction, a loose bar is almost impossible, insuring a very smooth running commutator.

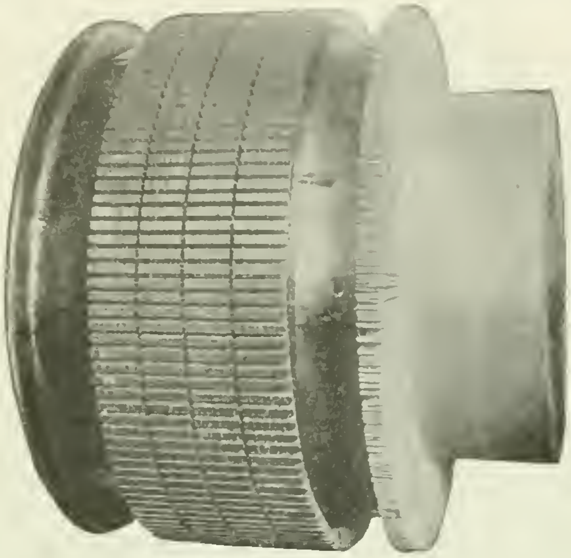


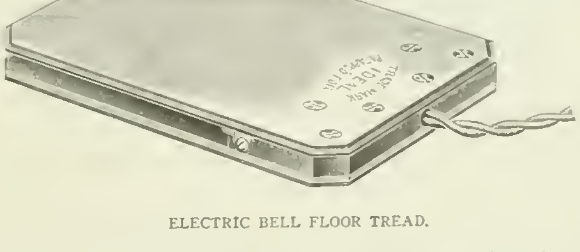
FIG. 2.—ARMATURE READY FOR WINDING.

The brush holders are of the radial type. Each brush is firmly clamped in a socket at the outer end of an independent arm, working freely upon the supporting stem. An even and constant pressure upon the commutator is maintained by a spring adjusted through a ratchet on the arm, and attached at its lower end to a central operating lever, fitting closely to the stem and held in position by a pawl. This spring is insulated from the holder to avoid its acting as a conductor and destroying the temper. A flexible connection extends from the brush support to the fixed portion, giving a positive metallic connection. An extra groove is provided in the stem, so that each brush can be held upright and returned to its former position without changing the spring adjustment.

The stem carrying each set of brush holders is supported by a yoke projecting from an adjustable ring of rigid construction, and from which it is thoroughly insulated, provision being made for adjusting each set of brushes independently. This ring is supported concentrically with the commutator by arms extending from the field frame and provided with a screw adjustment, operated by a hand wheel at the side of the ring, as shown in Fig. 1.

Electric Bell Floor Tread.

We illustrate herewith a new attachment for dining-room bells, which is being placed on the market by the Renim Specialty Company, No. 15 Federal Street, Boston, Mass. The object of this device is to overcome defects of the old style floor-push and cord. It is known as the "Ideal" floor tread, and consists of two heavy spring brass plates 4¾ inches long by 3½ inches wide, with rounded edges,



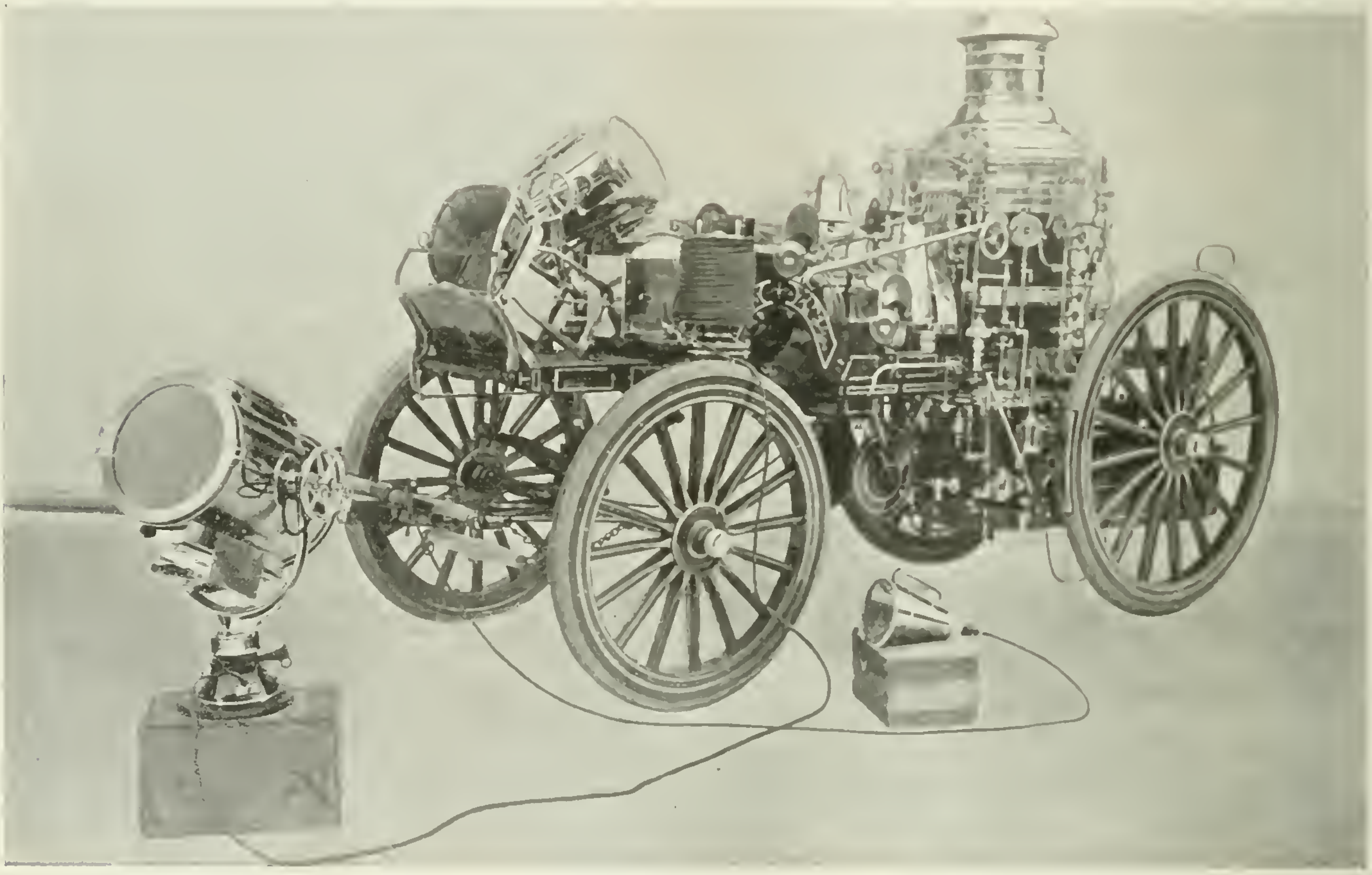
ELECTRIC BELL FLOOR TREAD.

finished and lacquered. The plates are securely fastened to an insulating strip, through the center of which is drilled a hole for admitting the conducting cord, and binding attachments are provided one on either side for connections, as shown. A heavy felt is firmly cemented to one side, and the whole forms a broad, thin, flat pad, always in position for operation either under or over carpet or rug.

The device may be used either under or over a carpet or rug or on a polished floor. It is not necessary to make any holes in the rug, and there are no projecting floor plugs to break or pull out. With a sufficient length of conducting cord, it may be readily shifted to any convenient spot under the table and is operated by a slight pressure of the foot.

Electric Light Fire Engines.

For some time past the New York Fire Department, under the initiative of Chief Croker, has been experimenting successfully with searchlights as an aid in fighting fire. The attention of our readers has already been called to this work, and we are now able to illustrate the latest development in the same direction. The department has now equipped two engines at the Marion Street station with an improved equipment, each carrying two lights, one with a Mangin mirror and the other with a silvered copper reflector, both having the same diameter of 16 inches. Both types have automatic lamps, with horizontal feed carbons, and they are identical in construction. The cases and stands are nickel plated. The mirror light is used for long distances, and is fitted with a 30 deg. divergent lens, so arranged that the beam may be spread vertically or horizontally, as required. The reflector light throws a spreading beam for use at a short range. Each engine carries an extra standard, which can be placed on the street or at any point where the light is wanted. Either of the lights on the engine can be unshipped and placed on this standard, and the light is immediately available for use. The current required by the two searchlights is about 70 amperes, and is generated by a very compact plant carried by each engine. In addition, as will be noted, there is a very handy form of portable incandescent lamp reflector.



Electric Searchlight on Fire Engine.

These new searchlight fire engines were given their first trial at practical fire fighting on the evening of April 1. Chief Croker reports that they are much better than the earlier examples. They give a more powerful and steady light, are more to be depended on, and the men find them much easier to manipulate.

The accompanying cut shows the apparatus. The engines were built by the La France Engine Company, Elmira, N. Y. The electric plants were constructed by the Bullock Electric Manufacturing Company, and the searchlights were from the works of Charles J. Bogue, 213 Center Street, New York.

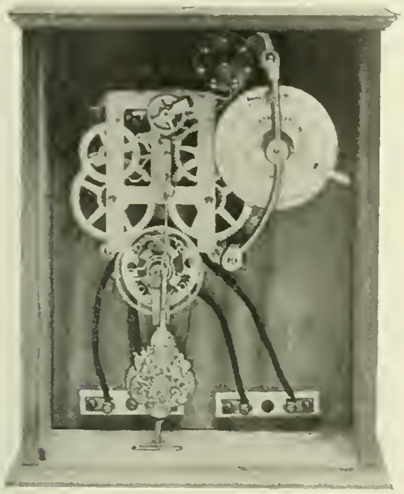
Monmouth, Ill., Model Telephone Exchange.

Monmouth, Ill., has one of the best constructed and equipped telephone exchanges in the independent field. It was installed and constructed by the well-known telephone contractors, Jones & Winter, of Chicago, Ill., who have not spared expense in making it a model plant. There are several miles of underground conduit. All wires are cabled that will admit of the same, and the pole lines are of large heavy Norway pines. The apparatus and equipment, consisting of switchboards, terminals, protective devices and instruments are of the well-known make of the Sterling Electric Company, of Lafayette, Ind. The construction and installment of this exchange, although of the highest grade, was so speedy that it enabled them to give service to a portion of their patrons about May 15. They began operation with 300 subscribers, but, like other independent telephone plants which are properly constructed, the demand for service is coming so fast that they will be unable to supply the wants of the constantly increasing number of subscribers.

Automatic Electric Time Switch.

An automatic electric time switch has been introduced by Jerome Redding & Co., of 48 Hanover Street, Boston, intended for lighting and extinguishing lamps, etc., and for other purposes where it is desired to start and stop electrical apparatus at given times, such as signs, motors, etc.

It is adapted for use in stores to light up the lamps in show-windows; in apartment houses, to light the lamps in the halls on the approach of darkness, and extinguish them at the proper time in the evening, and in all other places where it is desired to light or extinguish lamps, or turn on or turn off the current for any purpose, at more or less frequent intervals. It is also valuable as the main service switch in large buildings to turn off the current at night. It is applicable to the control of the current where flat contracts are made to operate motors, electric heaters, and other apparatus during certain hours of each day, not only for the purpose of securing the exact and automatic turning on and off of the current at the proper times, but also to prevent the use of the same beyond the time agreed upon and paid for.


THE TIME SWITCH.

Three sizes are made. No. 1 for currents up to 15 amperes; No. 2 for currents from 15 to 75 amperes; No. 3 for currents from 75 to 250 amperes. The No. 1 operates a 15-ampere switch, and is for small currents exclusively. The Nos. 2 and 3 operate knife switches of the proper size and capacity. The cut shows the No. 1 time switch. The instrument is provided with an accurate eight-day clock movement, and a time dial to show the exact time of day, and to operate the switch.

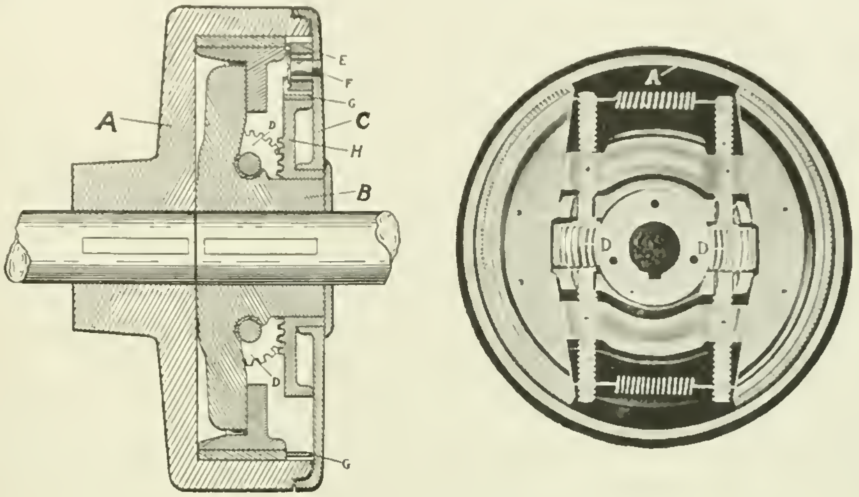
The dial carries two brass arms, one of which controls the opening and the other the closing of the circuit. These arms can be set at any time desired, and when so set are carried around with the dial, and at the designated time operate the switch to open and close the circuit, as desired. The fixed pointer at the top of the dial indicates the correct time of day. As shown in the cut, the movable arms are set to close the circuit at 5.30 p. m. and open it at 11.30 p. m. The fixed pointer shows the correct time to be 8 a. m. The clock can be made to operate the switch at more frequent intervals by placing additional arms on the dial. The day-wheel shown at the top of the cut is for cutting out Sundays and holidays. Each of the seven studs shown on the wheel represent a day of the week. By removing any of these studs the operation of the switch is prevented on the days represented by the studs removed.

The 15-ampere switch is operated by the large gear under the clock movement, and is seen in the cut directly back of the gear.

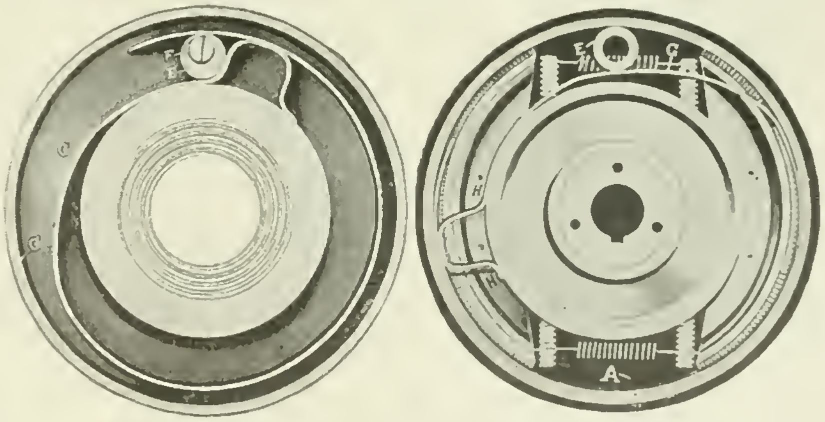
Automatic Self-Adjusting Friction Clutch.

In a paper read before the recent meeting of the New England Cotton Manufacturers' Association, Mr. T. H. Smith, of Jamestown, N. Y., read an article descriptive of a new type of friction clutch known as the "Phillips Automatic Self-Adjusting Friction Clutch," which employs a novel system of mechanism. The construction of the clutch is illustrated in Figs. 1, 2, 3 and 4. Referring to Fig. 1 *A* is a hub keyed to a driving shaft, and in this case provided with an overhanging flange for a belt. A second member of the clutch consists of the driven part, *B*, keyed to the driven shaft, which receives a screw or scroll plate *H*, and carries the gears *D*. Referring to Fig. 2, it will be seen that these gears carry right and left-hand screws which operate wedges having inclined edges in contact with the inclined surfaces of two friction shoes. The springs shown in Fig. 2 are to retract the friction blocks when the clutch is released. The third member (Fig. 1) consists of a starting plate *C*, which revolves independently of the hub and scroll plate. Attached to this starting plate is a bowl *E* (Figs. 1 and 3), loosely mounted on the stud *F*. The spring *G* (Figs. 3 and 4) plays a principal part in the mechanism, and is fastened to the edge of the scroll plate *H*.

The operation of the clutch is as follows: When the starting plate *C*, which is loose on the hub of the scroll plate as shown in Fig. 1, is moved one-fourth of a turn in the driving direction, either by hand or by power, the bowl *E* (Fig. 3) is carried forward on the inclined spring *G* until, as shown in Fig. 4, it makes a contact with the inside rim of the shell or body of the clutch. The spring is then pressed against the inside of the shell sufficiently hard to frictionally hold the scroll plate, which is then driven at the same speed as the driving portion, *A*, of the clutch. The result of this is that the scroll plate will then turn the gears and the left-hand screws, thereby forcing out the wedges (Fig. 2) against the inner surface of the driving part and thus clutching the two shafts. The motion of the screws continues as long as there is any relative motion between the two parts *A* and *B*, and when this ceases the two shafts are frictionally connected. Should the friction shoes slip upon increase of load, the relative motion of the two parts *A* and *B* is resumed, which again starts up the winding motion and retightens the friction blocks. To release the clutch, the plate *C* is retarded either by hand or by a friction shoe worked from the floor. This retardation disengages the bowl *E* (Fig. 4) from the shell or rim *A*. The bowl then runs into a pocket, as shown in Fig. 3, when the spring *G* is released from contact with the rim. This stops the scroll plate, and the worm gears then revolve around the scroll, thereby releasing the friction blocks and stopping the driven part.



FIGS. 1 AND 2.—AUTOMATIC FRICTION CLUTCH.



FIGS. 3 AND 4.—AUTOMATIC FRICTION CLUTCH.

The driving power of the clutch is limited only by the bursting strain on the shell. For example, a 20-inch clutch makes 38 revolutions to 1 revolution of the gears, the gears revolve 12 times to give a motion of one-fourth inch to the friction box, and the rim of the starting plate travels 131 times faster than the friction boxes. This rate of gearing accounts for the great force exerted on the shell, and for the slight strain that is brought on the worm and gears.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—In the money market call money ruled at about 3 per cent. Time money is quoted at 3½ per cent for short and 4 per cent for three to six months arrangements. Commercial paper is quoted at 3¾@4¼ per cent for prime double names. The stock market developed considerable activity during the week, which, however, fell off towards the close. In the early part of the week there was decided strength in tone and a number of important advances were recorded throughout the list. In the traction list, however, there was weakness, and the principal securities closed with net losses—Brooklyn Rapid Transit, 1⅝ points and Metropolitan Street Railway, 1¾; General Electric made a big jump on reports that the company would declare a dividend of 33 per cent. The quotation reached 250, closing at 246¾, a net gain of 13½ points. The sales aggregated 2100 shares. Western Union was somewhat weaker, closing with a net loss of ¾ point, on sales of 12,490 shares. In outside securities, the closing half?day session of the week saw little in the way of positive closing half-day session of the week saw little in the way of positive developments, the market, as a whole, being devoid of distinct character. The stocks which declined preponderated over those in which advances were shown, but the changes in both cases were inconsequential. Electric Boat was in good demand, gaining 3 points in the common and 4 in the preferred. New York Transportation, with the $10 assessment paid, closed 11 points above the previous week's price on the old stock, and many of the high class industrial issues showed gains. Following are the closing quotations:

NEW YORK.

	June 1.	June 8.		June 1.	June 8.
General Electric	233¼	246¾	Electric Vehicle	11	11
Brooklyn Rapid Transit	81⅝	80	Electric Vehicle, pfd	17	18
Metropolitan Street Ry	173½	171¾	General Carriage	2	2
American Tel. & Cable	99½	100	Illinois Elec. Veh. Tran.	⅞	⅞
Western Union Tel	94¾	94	Hudson River Tel	120	120
American Dist. Tel	—	—	N. E. Elec. Veh. Tran	3	3⅛
Commercial Cable	—	—	N. Y. Elec. Veh. Tran	1	11½
Electric Boat	19	22	Tel. & Tel. Co. of Am	5	5
Electric Boat, pfd	45	51	N. Y. & N. J. Tel	169	170
Electric Lead Reduc'n	3½	3½			

BOSTON.

	June 1.	June 8.		June 1.	June 8.
New England Telephone	—	—	Erie Telephone	58½	57½
Mexican Telephone	2¾	2½	General Electric, pfd	—	—
Westinghouse Electric	64¼	70	Am. Tel. & Tel	173½	173¼
Westinghouse Elec., pfd	—	75	Boston Electric Light	240*	240*

PHILADELPHIA.

	June 1.	June 8.		June 1.	June 8.
Electric Storage Battery	53	58	Philadelphia Electric	5¾	5½
Elec. Storage Batt'y pfd.	60	60	Pa. Electric Vehicle	1	1
Elec. Co. of America	8	8¾	Pa. Elec. Veh. pfd	1	1
General Electric Auto	—	—	Am. Railways	45	45

CHICAGO.

	June 1.	June 8.		June 1.	June 8.
Chicago Edison	173	175	Chicago Telep. Co	260	270
Chicago City Ry	255	250	Union Traction	18¼	18¼
National Carbon	15⅞	16	Union Traction, pfd	58	49
National Carbon, pfd	83	84½	Northwest Elev. com	49	48

* Asked.

AMERICAN TELEPHONE AND TELEGRAPH.—The following financial statement of April 30 has been submitted by the company: Assets.—Construction, equipment and supplies, $16,398,952; telephones, patents, etc., $4,800,689; stocks and bonds, $75,306,150; real estate, $1,653,213; bills and accounts receivable, $5,769,884; cash and deposits, $5,877,742; American Bell Telephone Company, $22,110,400; total, $131,917,030. Liabilities.—Capital stock, $94,237,500; bonds, $15,006,000; profit and loss surplus, $3,961,699; reserves, $2,295,638; bills and accounts payable, $445,982; contingent, $15,970,210; total, $131,917,030. The American Telephone instrument statement for the month ended May 20 shows.

	1901.	1900.	1899.	1898.
Gross output	85,118	54,340	55,302	32,441
Returned	37,744	23,868	21,265	11,948
Net output	47,374	30,472	34,037	20,493
Since Dec. 20:				
Gross output	373,623	290,533	279,627	142,362
Returned	160,348	106,989	76,061	63,645
Net output	213,275	183,544	293,558	78,717
Total outstanding	2,166,091	1,764,049	1,328,808	997,838

CONSOLIDATING OMAHA PROPERTIES.—Plans for consolidating the street railways of Omaha and Council Bluffs, the electric power plants of the two cities, and the Platte River Canal appear to be assuming a definite shape. The new corporation is said to include the Omaha Street Railway Company, the Omaha & Council Bluffs Railway & Bridge Company, the Omaha Thomson-Houston Electric Light Company, the Council Bluffs Electric Light Company, the Omaha Water Company, the Council Bluffs Water Company, the Suburban Railway & Traction Company, and the Platte River Power Canal, and may be capitalized at $20,000,000. The Platte River Power Canal, a franchise for which has been issued by the State, is projected, to be 25 miles long, and to be built across the country from a point 15 miles above the mouth of the Platte River to a terminus with the Missouri River. This canal will divert enough of the water of the Platte River to furnish 30,000 horse-power, to be used in the operation of the railways and water plants. President Frank Murphy, of the Omaha Street Railway Company, has been in New York, conferring with capitalists who are said to be fianancing the deal.

COST OF ABOLISHING THE CABLE.—The recent change of the power system of the Broadway, Columbus and Lexington Avenue cable roads to electricity in New York City, by the Metropolitan Street Railway, has given rise to the question as to how the company would carry this loss on its books. President Vreeland states that as the amount lost was represented by bonds now outstanding on which the company had to pay interest, there was only one way in which it could legitimately appear on the books. The method pursued will be to charge what is known as the capital account with the total amount expended on the cable system (about $16,000,000 for the above-mentioned three lines) and to credit the same account with the amount of salvage (being about $10,000,000), while adding the loss of the difference between the two items ($6,000,000) to the cost of the new motive power. No better illustration of the capacity of electric traction could be offered than the ability that it has of enabling the company to recoup this huge depreciation.

DIVIDENDS.—The directors of the Massachusetts Electric Companies have declared a dividend of $2 per share on the preferred stock, payable July 1. The Nashua Street Railway Company will pay a dividend of $2 per share on July 1. The Union Passenger Railway Company has declared a dividend of $4.75 per share, payable July 1. The West Philadelphia Passenger Railway Company has declared a dividend of $5 per share, payable July 1. The directors of the Commercial Cable Company have declared the regular quarterly dividend of 1¾ per cent, payable July 1. The directors of the Madison Gas & Electric Company have declared the regular semi-annual dividend of 2½ per cent, payable July 20. Directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable July 1.

BOSTON NOTES.—The Northampton & Amherst Street Railway has been authorized by the Massachusetts Railroad Commissioners to issue $100,000 5 per cent 20-year mortgage bonds. The Boston Electric Light Company and the Edison Electric Illuminating Company, of the same city, have been given legal authority to consolidate. Note is made of the listing on the Boston Stock Exchange of $3,600,000 common and $1,250,000 preferred stock of the Seattle Electric Company

CENTRAL UNION TELEPHONE.—The decline of 9 points from 49 to 40 in the price of Central Union Telephone stock is explained in a circular to stockholders, which sets forth the necessity of various expenditures essential to furthering the company's immediate needs. The company, it is stated, will be assessed $5,000,000.

NORWICH, N. Y., LIGHTING BONDS.—Lawrence, Barnum & Company offer $85,000 Norwich Gas & Electric Company 5 per cent. gold bonds, redeemable after 1911 at 105. The company has averaged for ten years nearly twice the entire interest charge. The mortgage is 68 per cent of the actual cost of the property.

BALLSTON SPA TROLLEYS.—The stockholders of the Ballston, N. Y., Terminal Electric Railroad Company have voted to increase its capital stock from $300,000 to $1,500,000 and its bond issue from $200,000 to $1,200,000 for the purpose of extending the line to Amsterdam, a distance of 21 miles.

GENERAL ELECTRIC.—It is stated that the business now on the books of the General Electric Company is sufficient to keep its plants in full operation for at least two years. The matter of a 33⅓ per cent stock dividend, it is reported, will receive early consideration.

MORTGAGE.—The York Haven Electric Power Company, York, Pa., has given a mortgage to the Security, Title & Trust Company, of York, to secure an issue of $3,000,000 in bonds. Work on the new plant is now in progress.

TELEPHONE BONDS.—American Telephone & Telegraph Company's $15,000,000 collateral trust 4 per cent bonds of 1920 have been transferred from the unlisted to the listed department of the Boston Stock Exchange.

SIEMENS & HALSKE ELECTRICAL COMPANY.—The Siemens & Halske Electrical Company, of Berlin, will issue a loan of 5,000,000 marks at 4½ per cent, the issue price being 100.

TO SUSPEND DIVIDENDS.—It is stated that the San Francisco Gas & Electric Light Company is about to suspend dividends until a floating debt is paid off.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies indicate better trade conditions, owing, primarily, to the warmer weather and better outlook for crops, and reports of improvements come from the East, the Northwest, the South and the Pacific Coast. Iron and steel are quiet in all lines as regards new business; consumption, however, continues at an undiminished rate. The labor situation in many parts of the country is still unsettled, and constitutes a reason for hesitation in some industries, discouraging new operations which satisfactory conditions would otherwise stimulate. The machinists' strike, which is not yet settled, is causing manufacturers to seek no new business beyond July 1. The failures for the week as reported by *Bradstreet's*, number 163, as against 144 the week previous and 184 the corresponding week last year. The failures for the month of May, according to *Dun's Review*, were 873 in number and $7,990,423 in amount, against 947 in May last year for $23,771,151. In the metal market, copper continues firm, and manufacturers in this country are very busy. Quotations are unchanged, Lake being quoted at 16⅞@17 cents; electrolytic in cakes, wire bars and ingots, 16.35@16.45 cents; cathodes, 16.10@16.20 cents, and casting copper, 16.24@16.35 cents.

THE McLOUD RIVER ELECTRICAL COMPANY, of San Francisco, Calif., is now installing four units of Victor turbines with cylinder gate mounted on horizontal shafts, each unit to develop 790 horse-power under 36 ft. working head of water, and running 270 r. p. m. Each unit consists of two 30-inch Victor turbines mounted in a steel flume and discharging into one central draft tube. The flumes are 15 ft. 9 inches long, 9 ft. 6 inches diameter, constructed of heavy steel plate with cast iron heads and covers. The gate work is the draw-rod type, which places all gears on the outside of the flume where they can have attention, and where they can work in oil, doing away with the old style of gate work where the gears run in water, and where they were continually causing trouble. The patents on this style of gate work are completely controlled by the builders of the turbines, the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, U. S. A. The plant is being installed in the northern part of California. The wheels are set on top of concrete arches, the draft-tubes reaching through to the tailwater below. Each unit is equipped with a large rope pulley, and the dynamos are driven by means of rope drive, being located at a higher elevation than the waterwheels. The feeder pipes come through the foundations upon which the generators set, and the whole is a very substantial and complete plant. There are also two exciter wheels, which will develop about 40 horse-power each under 36 ft. head, and the exciters are also driven by means of rope pulleys. The large units are each equipped with a Gies electro-mechanical governor for regulating the speed of same.

RAILWAY CONSTRUCTION SOUTH.—The contract has been awarded for the construction of the Augusta & Aiken Railway, which will run from August, Georgia, through Bath, Warrenville, Langley, Graniteville, to Aiken, South Carolina, a distance of 20 miles, which road has also secured valuable franchises in the city of Augusta. This company will be owned by the North Augusta Electric & Improvement Company, which latter company owns the North Augusta Land Company, North Augusta Development Company, and North Augusta Railway Company. The Board of directors is composed of the following gentlemen: James U. Jackson, J. William Middendorf, R. Lancaster Williams, John Blair MacAfee, Ernest Groesbeck, Alfred S. Elliott, Henry Buist, Walter M. Jackson and Martin Verdry. The road will be built upon private right of way, and will be of standard steam railroad construction, to carry both passengers and freight. Its equipment will include two powerful electric locomotives for freight service. The contract for the complete construction and installation of the road, power plant, and equipment, has been awarded to Mr. John Blair MacAfee, the well known Philadelphia contractor. Mr. Walter Newbold Walmsley will be chief engineer and will be assisted by Mr. G. Edwin Heath and Mr. William Harrison MacAfee, civil engineers, all of whom are associated with Mr. MacAfee.

STEEL RAILS FOR ENGLAND.—Borough Engineer Lord, of the important city of Halifax, Yorkshire, is at present in this country, chiefly with reference to the contract recently placed with the Lorain Steel Company for 4000 tons of steel girder rails and accessories to be furnished the Halifax corporation for use on an extension of that English city's electric traction system. Mr. Lord, it is believed, will make preliminary arrangements while in the United States, with a view to further contracts being placed with American manufacturers for various material equipment, which will be required shortly. He is at present inspecting several of the electrical systems and plants out West, but will return to New York, according to present arrangements, on June 15. While in this city he can be found at the offices of F. Stuart Williamson, consulting engineer, Broad Exchange Building, 25 Broad Street. Mr. Lord returns to Europe on the White Star liner Oceanic, sailing June 19.

CONTRACT FOR FIVE ACCUMULATOR PLANTS.—The Electric Storage Battery Company, Philadelphia, Pa., has recently closed contracts for five chloride accumulator plants to be installed at rotary sub-stations on suburban electric roads about to be built in the vicinity of Pittsburg, Pa., by the same interests which now control the Monongahela Light & Power Company, the Monongahela Street Railway Company, and the Pittsburg & Birmingham Traction Company. Three of these plants will be installed on the Pittsburg & Charleroi road now under construction; one will be located in McKeesport, and the fifth at Springdale, Pa., on the projected Allegheny Valley Street Railway. One of the important objects obtained by these battery installations is to permit current for both railway and lighting work to be taken from the same 60-cycle alternators.

ELECTRICITY IN COPPER WORKS.—The Westinghouse Electric & Manufacturing Company has closed a contract with the Mountain Copper Company to equip the immense works of the company near Keswick, Calif., for operation by electricity. The power contract has been awarded to the Keswick Electric Power Company, which will transmit from its water-power electric-generating station sufficient power to operate the Westinghouse induction motors in the mills and mines. There will be included in the equipment one 500-hp, two 175-hp, one 75-hp, five 50-hp and one 100-hp motors.

BIDS FOR LIGHTING.—The Cuyahoga County Commissioners have opened bids for a lighting plant to illuminate the public buildings. The bids were as follows: R. P. Crawford Heating & Manufacturing Company, $8,335; Lincoln Electric Company, $15,586; Electric Supply & Manufacturing Company, $12,200; Chafer & Becker, $9,400; C. C. Bateson, $9,960; Standard Machinery & Equipment Company, $10,386; John Thompson, $9,500. The bids were referred to George S. Ryder, the engineer who prepared the plans.

MARINE ENGINE COMPANY.—The Marine Engine & Machine Company, Harrison, N. J., is having a new foundry building erected, the American Bridge Company having been awarded the contract for the structural work. The Marine Company is receiving propositions for electric cranes, cupolas and other necessary equipment. The machine shop is operated electrically, and the new departments will also be operated by electricity.

POWER BLOCK.—The Perry-Payne Estate, of Cleveland, is preparing plans for an enormous power block project. There will be a group of seven-story power blocks, embracing two blocks near the center of the city. The promoters expect to realize by the centralization of power supply, and it is proposed to erect a large power station to furnish power for the group of buildings. The buildings will cost about $2,000,000.

CAR MATERIAL FOR GREECE.—The J. G. Brill Company, of Philadelphia, is about to make shipment of 200 tons of car material to Patras, the principal seaport of Greece. The same concern is also completing work on several 21 E electric motor trucks, which are to be forwarded to Dunkirk, France. Four equipments of a similar description will also be sent shortly to Darwen, a town in the vicinity of Liverpool.

MACHINERY FOR MEXICO.—A despatch from Monterey, Mexico, states that the Monterey Steel Works, now being constructed there at a cost of $10,000,000, has just placed an order in the United States and England for more than $1,000,000 worth of machinery for the plant. The machinery is to be delivered by the first of next year. About $700,000 worth of the machinery order went to United States concerns.

THE WAGNER ELECTRIC MANUFACTURING COMPANY announces that it has transferred its special foreign sales office from the Havemeyer Building, New York City, to the factory in St. Louis, thereby enabling more prompt engineering attention to be given to matters arising in its foreign department.

ENGINE.—The Memphis Light & Power Company, Memphis, Tenn., has purchased a 125-hp compound direct-connected engine from the Ball Engine Company, Erie, Pa.

POWER STATION IN SAN FRANCISCO.—The Market Street Railway Company, San Francisco, is making arrangements to build a 3000-hp electric power station near Black Point, to supply much-needed additional power for its car lines. Oil will be used as fuel.

FANS FOR INDIA.—The Robbins & Meyers Company, of Springfield, Ohio, manufacturer of electric fans, has received a second larger order for fans from Calcutta, India. The foreign demand for electric fans is rapidly increasing, according to this company.

ELECTRICAL EXPORTS.—The following are the exports of electrical material from the port of New York for the week ended May 29: Antwerp—41 cases electrical material, $2,412. Argentine Republic—218 packages electrical material, $5,277; 2 packages electrical machinery, $455. Azores—16 packages electrical material, $145. Brazil—178 cases electrical railroad material, $3,836; 36 packages electrical material, $2,521. British Australia—15 packages electrical material, $8,750. British East Indies—30 packages electrical machinery, $3,600; 2 packages electrical material, $25. Bilboa—314 packages electrical material, $39,913. Berlin—2 packages electrical material, $75; 10 packages electrical machinery, $145. Batoum—2 cases electrical machinery, $1,300. Berne—4 packages electrical machinery, $2,800. British Possessions in Africa—235 packages electrical machinery, $40,000; 34 packages electrical material, $1,900. British West Indies—7 packages electrical material, $49. Chili—6 cases electrical material, $176. Charkow—1 case electrical machinery, $300. Cuba—104 cases electrical material, $2,978. Glasgow—2 packages electrical material, $107; 2 reels cable, $95; 54 cases electrical material, $440. Genoa—45 packages electrical material, $2,183. Hull—5 cases electrical machinery, $716. Havre—14 packages electrical material, $1,267; 13 packages electrical material, $1,470. Hamburg—5 packages electrical material, $1,118; 61 packages electrical material, $1,015. Hayti—3 packages electrical material, $106. Ipswich—1 case electrical material, $121. London—549 packages electrical material, $90,459; 163 packages electrical material, $12,578. Liverpool—117 packages electrical machinery, $30,580; 45 packages electrical material, $2,049. Mexico—371 packages electrical material, $2,200. Manchester—8 packages electrical machinery, $1,537; 2 packages electrical material, $95. Milan—79 cases electrical material, $4,235. Naples—57 cases electrical material, $854. Oporto—1 package electrical material, $169. Peru—32 packages electrical material, $1,449. Rotterdam—6 packages electrical machinery, $111; 10 packages electrical material, $51. Santo Domingo—30 packages electrical material, $635. Southampton—2 cases electrical machinery, $560; 1 case electrical material, $37. St. Petersburg—24 cases electrical material, $450. Santander—23 packages electrical material, $340. United States of Colombia—18 cases electrical material, $293. Venezuela—35 cases electrical material, $1,076. Vienna—1 package electrical material, $50; 2 cases electrical machinery, $1,982. The following were the exports of electrical material from the port of New York for the week ended June 5: Antwerp—8 packages electrical material, $833. Argentine Republic—106 packages electrical material, $4,302. British Australia—227 packages electrical material, $11,267; 10 packages electrical machinery, $415. Brazil—156 packages electrical material, $1,921. Bremen—4 packages electrical material, $154. British West Indies—34 packages electrical material, $617. British East Indies—1 case electrical material, $20. Cuba—11 cases electrical material, $701. Central America—41 cases electrical material, $1,201. Chili—9 cases electrical material, $275. Dutch East Indies—1 package electrical material, $21. Dublin—3 packages electrical machinery, $90. Glasgow—52 packages electrical machinery, $5,442; 23 packages electrical material, $943. Hamburg—31 packages electrical material, $1,181. Havre—49 packages electrical material, $2,628. Hull—2 cases electrical material, $163. Halifax—10 cases electrical material, $476. Japan—170 cases electrical material, $14,056; 4 packages electrical machinery, $4,597. Korea—3 cases electrical material, $73. Liverpool—1 package motor machinery, $210; 33 packages electrical machinery, $2,839; 170 packages electrical material, $4,150. London—44 packages electrical material, $8,677; 91 packages electrical material, $2,682. Manchester—5 packages electrical machinery, $190; 3 cases electrical material, $637. Mexico—111 cases electrical machinery, $4,480; 7 cases electrical machinery, $813. Newfoundland—14 cases electrical material, $400. New Zealand—6 packages electrical material, $120. Nova Scotia—2 cases electrical material, $21; 8 packages electrical machinery, $1,042. Peru—6 packages electrical material, $216; 2 packages electrical machinery, $220. U. S. Colombia—27 packages electrical material, $916. Vienna—4 packages electrical machinery, $300. Venezuela—1 package electrical material, $16. Warrington—84 cases electrical material, $1,764.

TROLLEYS IN RUSSIA.—Consul-General Guenther sends the following, dated Frankfort, April 30, 1901: The first electric suburban railroad in Russia was opened for traffic this year. It connects the manufacturing city of Lodz, in Russian Poland, with the neighboring towns of Zgierz and Pabianice, and is 13½ miles in length. The Thomson-Houston motors used were furnished by the Russian Electricity Union. The road is owned by a company of Polish merchants and manufacturers, and was built at a cost of $560,000. The charter provides that the Government shall receive a share of the profits, and shall have the right to purchase after 20 years, and that the road and all equipment shall become the property of the Government at the expiration of 28 years.

DE LAVAL STEAM TURBINES.—The De Laval Steam Turbine Company has been incorporated, with a capital of $1,000,000. The factory, at Trenton, N. J., will consist of a main building 200 by 210 ft., and three or four smaller buildings, all of brick. It is expected that the factory will be ready about July 1. The officers are Daniel Lorrman, president; R. R. Bowker, vice-president, and Francis J. Arend, secretary and treasurer. It will be remembered that Mr. Bowker was formerly president of the old New York Edison Company, one of the most successful central station corporations in America while under his management. The new company's offices will be established at 74 Cortlandt Street, New York City.

BOSTON PNEUMATIC SERVICE.—The American Pneumatic Service Company began the business of carrying parcels to the different districts covered by its service, including the city proper, South Boston, Dorchester, Roxbury, Jamaica Plain and Brookline last week. It is stated by its officials that the business already in hand is very satisfactory, and a large amount of business is being taken on from day to day. Arrangements have been made with the District Messenger Company for the transfer of messages between the pneumatic tube stations by tube instead of by sending them as heretofore by boy, and this service will be immediately put in operation.

THE ANCHOR ELECTRIC COMPANY, of Youngstown, Ohio, has been incorporated by N. L. Norris, R. T. Hamilton, Charles N. Crandall, Fred Keast, H. W. Davis and Thomas Carr, with a capital stock of $35,000. The company will build and operate a plant for the manufacture of incandescent and arc lamps and other electrical machinery and appliances. A ten-year lease has been secured on a piece of property in Youngstown, and a building 48 by 120 ft., plans for which are now being prepared, will be erected as soon as possible. The company expects to commence operations by Aug. 1, in time to get in on fall and winter business

INTERNATIONAL CONSOLIDATION.—It is reported that the differences between the officers of the Bethlehem Steel Company and the representatives of the Vicker's Sons & Maxim Company have been adjusted, and that the consolidation is now assured of the English concern and the Cramp and Bethlehem establishment. The consolidation of these two interests was referred to in these columns April 13, 1901.

MEXICO.—V. U. Braschi & Bro., of Mexico City, are now representing the Stanley Electric Manufacturing Company, the Stanley Instrument Company, the John A. Roebling's Sons Company, the General Incandescent Arc Light Company, and other American concerns. They have recently sold a 50-kw Stanley plant complete, including generator, Pelton wheel, wiring, and all auxiliaries. They have two other plants under negotiation, and report an excellent outlook.

EXETER MACHINE WORKS, of Pittston, Pa., are installing a complete coal handling plant, with the Exeter-Le Grand conveyor, for the Oxford Paper Company, Rumford Falls, Me. They have recently shipped six improved 75-hp hoisting engines to Havana, and are now erecting a complete coal handling system for the New York Gas, Electric Light, Heat & Power Company's new station at Thirty-ninth Street.

STROMBERG-CARLSON FACTORY.—News comes from Chicago that the Stromberg-Carlson Telephone Manufacturing Company has acquired the land and 7-story factory building at the southwest corner of Clinton Street and Jackson Boulevard, that city, for $212,000. It has occupied the factory for some time past, and now wants the whole of the building for its growing business.

SWISS ROADS.—London advices state that American manufacturers have secured the contract for electric engines on the Swiss railway up Mount Zermatt.

General News.

THE TELEPHONE.

CHICAGO, ILL.—The Chicago Telephone Company is about to begin the preparation of plans for a new telephone exchange building, which it will erect in Evanston. It will be of brick and stone construction, the interior being fireproof, and will cost $15,000.

CHICAGO, ILL.—The application of the new United Telegraph, Telephone & Electric Company to the city council of Chicago for an extension of territory, in order that they may supply Chicago as well as Hyde Park with telephones, has not yet been acted upon. The company has offered to instal free telephones beside those of the Chicago Telephone Company, which shall be paid for at the rate of five cents for each call. The officers have also offered to make rates one-half lower than those charged by the Chicago Company. To meet this proposition, President John I. Sabin, of the Chicago Company, has arranged a new system on the "pay-for-what-you-get" plan. The instruments are all "nickel-in-the-slot" machines, and will be placed in any house or office where there is a guarantee that the earnings will be a certain amount each day. The new instruments will be in four classes. The first will be on an individual metallic circuit, and will rent for $5.50 a month. For this forty free calls will be allowed, and additional calls will be at the rate of five cents each. The second will be with two subscribers on the line, with a guarantee of twenty cents each day, the calls to be at the rate of five cents each. The third will be on ten-party lines, five cents a call, and ten cents guaranteed each day; and the fourth, for residences only, where the ten-party system is used, and one call a day is to be guaranteed at the message rate of five cents.

MITCHELL, IND.—The Trustees of Mitchell have granted a franchise to the Hoosier Telephone Company, of Salem, for the erection of a modern telephone exchange. The board also granted L. W. Spencer, of Georgia, the right to build a connecting line with his Georgia and Huron system.

WABASH, IND.—Farmers in the vicinity of Lafontaine, this county, have effected an organization to build a telephone exchange. They purpose to establish a central station at Lafontaine and connect the homes of farmers within a radius of eight or ten miles. It is practically assured that the system will be put in at once.

GREENSBURG, IND.—The workmen in the employ of the Decatur County Telephone Company who have been extending wires in every section of this county quit work because the time required in going to and from their work was not paid for. The community is divided in support of the company and the men, and petitions are being circulated asking patrons to withhold their patronage until the latter yields to the demands of the workmen.

INDIANAPOLIS, IND.—An innovation in telephone service has been inaugurated by a local firm of grocers, which has signed a contract with the Central Union Telephone Company for fifty instruments, to be placed in the homes of customers. The telephones are to be used by the customers in placing orders for groceries, and this service is to be free of charge. But should they desire to make other calls, a fee of one cent is charged each time.

CEDAR RAPIDS, IA.—A telephone company has been organized at Story City, with $10,000 capital, and is installing an exchange.

TOPEKA, KAN.—The Wilson County Telephone Company has been incorporated. Capital, $750.

BOSTON, MASS.—The Erie Telephone system made a net gain of 3564 subscribers in May; net gain since Jan. 1, 8545. Total connected May 31, 150,144; waiting connection, 3374.

WORCESTER, MASS.—All but six of the striking linemen of the Worcester branch of the New England Telephone & Telegraph Company have returned to work at the old wages and hours.

FALL RIVER, MASS.—The annual meeting of the Fall River Automatic Telephone Company was held recently in the company's new exchange building on Bank Street, Fall River, Mass. After the reading of the various reports, all of which were approved by the stockholders, the following board of directors were elected: B. D. Davol, E. B. Jennings, R. P. Borden, C. S. Greene, R. J. Thompson, V. A. Sears, R. F. Haffenreffer, J. W. Coughlin, M. Sweeney, B. D. Davol, treasurer; R. P. Borden, clerk. The company has very nearly completed its plant with its underground system, which is designed for 3000 subscribers, on private lines exclusively. The automatic switchboards, furnished by the Strowger Automatic Telephone Exchange, of Chicago, have arrived and are being connected up. The exchange will open for business in July, and will be the largest automatic telephone exchange, at that date, in the world. The population of Fall River is 104,000.

DETROIT, MICH.—The Citizens' Telephone Company, of Grand Rapids, has increased its capital stock from $550,000 to $1,000,000. The company owns 29 outside exchanges and is preparing to build three more.

SAGINAW, MICH.—The Valley Telephone Company has declared a 20 per cent dividend for the period of 30 months between Oct. 1, 1898, and March 31, 1901.

MURDOCK, MINN.—The Murdock-Carlson Telephone Company has been organized by the election of the following officers: President, C. H. Fredrickson; vice-president, L. H. Lawson; secretary, A. L. Bergstrom; treasurer, John Brandt.

ST. PAUL, MINN.—The Twin City Telephone Company, now engaged in modernizing its plant in St. Paul and Minneapolis, has purchased a site in the latter city on which will be erected a $75,000 exchange. It has a frontage of 66 feet, and will allow the erection of one of the largest telephone exchanges in the Northwest. The company will begin work at once, and expects to be in its new quarters by August at the latest. A switchboard capable of accommodating 6400 subscribers will be installed. In St. Paul improvements are being made, principally among the list contemplated being the laying of conduits. Several miles will be laid.

CHARLOTTE, N. C.—The Bell Telephone Company has completed connections between the Columbia, S. C., system and Blacksburg, Spartanburg, Greenville and Orangeburg.

NEW JERSEY.—The Hudson and Middlesex Telephone and Telegraph Company has been incorporated in the State of New Jersey, capital $15,000, to begin operations "at a point under the Hudson River, in the County of Hudson, at the easterly line of said county, where said lines will connect with lines of telegraph or telephone, or both, without the State of New Jersey, and continuing thence through the counties of Hudson, Essex, Union, Middlesex, Monmouth, Mercer, Ocean, Burlington and Camden, to a point under the Delaware River, at the westerly line of said County of Camden, where said line will connect with the telephone or telegraph, or both, without the State of New Jersey." Incorporators, Bryan S. Klotz, Sylvester M. Cooley and Walter P. Lindsley.

BURTON, OHIO.—The Burton Telephone Company, Burton, has increased its capital stock from $5,000 to $15,000.

FINDLAY, OHIO.—The exchange of the Home Telephone Company has been opened for business and about 900 subscribers have been connected up.

POLAND, OHIO.—The Central Union Telephone Company, at Youngstown has secured a number of subscribers in this place, and will build a toll line and branch exchange.

FAIRVIEW, OHIO.—The Union County Telephone Company of this place has been incorporated by C. E. Miller, B. F. Sheppard and others to operate exchanges in Guernsey, Harrison and Belmont counties.

CLEVELAND, OHIO.—The line built by the United States Telephone Company to Beaver has been connected at that point with a line built by the Pittsburg & Allegheny Telephone Company. This connection not only gives the independent telephone interests through service from Cleveland to Pittsburg, but connects the numerous exchanges in Indiana and Ohio with those in Pennsylvania. Before many months through service will be secured to Baltimore, Newark and other Eastern cities.

CUMBERLAND, TENN.—The Cumberland Telephone & Telegraph Company, of Tennessee, has decided to increase its capital stock 20 per cent, to $7,500,000, part of which will be expended in completing a direct line between Nashville and Louisville.

MARLIN, TEXAS.—The Independent Telephone Company, of Waco, is preparing to extend its system to Marlin; also to put in a local exchange here.

SILVERTON, TEXAS.—At a meeting held here capital stock to the amount of $1,200 was subscribed to build a telephone line from here to Estelline, a distance of sixty-five miles.

DALLAS, TEXAS.—The Kiowa & Comanche Telephone Company has been incorporated. Capital stock, $5,000. Incorporators: F. T. Cook, J. A. Tuipel and J. W. Malone, of Cloud Chief.

SEATTLE, WASH.—The consolidation of the two independent telephone companies of Seattle, is making progress. At a recent meeting of the city council a communication was received from the Automatic Telephone Company reciting that it desired to sell its plant and franchise to the Independent Telephone Company; also, that its special deposit of $3,500 with the city be returned, and that the city council approve of the transfer. The Independent Company sent in a communication stating that under its franchise it had no power to encumber its plant financially, and made a petition to be empowered to purchase a plant instead of erecting one, as required by its franchise. Two ordinances were introduced later authorizing such acts.

MILWAUKEE, WIS.—It is reported that a wireless telegraph system is to be built between this city and Grand Haven, Mich., by the Cleveland and Buffalo steamship line.

MILWAUKEE, WIS.—All independent telephone companies in Wisconsin will hold a meeting at Lacrosse on June 26. The extension of competitive lines to Milwaukee will be considered.

LA CROSSE, WIS.—The Wisconsin Telephone Company's long distance line construction work between here and Eau Claire is rapidly progressing. The company will soon begin a long distance line from this city to Dubuque, Iowa.

WOODLAND, WIS.—The Eureka Telephone Company held its annual meeting at Neosho on May 25. President W. Wegwart and Vice-President J. A. Clason were re-elected. Secretary J. Mertis and Treasurer J. N. McCollow were new elections.

ELCHO, WIS.—The new rural telephone line between Elcho and Enterprise Lake, is proving a great success and will probably be extended considerably this year. The line already connects five large farms and passes through a rich agricultural district that is being rapidly developed.

MILWAUKEE, WIS.—The Milwaukee Citizens' Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are J. W. Murphy, J. M. Clarke and P. J. Schmitt. The company proposes to build exchanges and lines in the State, and to eventually build an exchange in this city to compete with the Bell Company.

RACINE, WIS.—The Citizens' Telephone Company is now an absolute fact and giving service to its patrons. This company was organized by local citizens, there being upwards of four hundred of the most prominent business men as stockholders. The officers are: John B. Simmons, president; E. B. Belden, vice-president; J. C. Breese, secretary; C. R. Carpenter, treasurer, and William Van Middlesworth, general manager. The plant was constructed by Jones & Winter. The main portion of the outside construction is underground work and the service is full metallic. The exchange equipment, terminals, apparatus and telephones was furnished by the Sterling Electric Company, of Lafayette, Ind. The patrons began to receive service some thirty days ago, there being 700 connected up on the opening day. Remote residence districts and farmers' subscribers are cared for by the use of the Sterling selective signal non-interfering party line telephones, with four and eight subscribers upon one metallic circuit. It is fully expected before the close of the year that there will be fifteen hundred subscribers connected.

ELECTRIC LIGHT AND POWER.

ALAMEDA, CAL.—The Alameda municipal electric lighting system is being extended under the direction of Superintendent Weise.

SAN FRANCISCO, CAL.—The last installment of the machinery for the new electric hoist for the C. & C. shaft has arrived in Virginia City, Nev., and the entire electric installation will soon be in operation.

SAN FRANCISCO, CALIF.—The Consolidated California & Virginia mine, Virginia City, Nevada, is being made ready for the installation of the new electric hoisting plant, and most of the machinery has been received.

SAN FRANCISCO, CAL.—The electric hoist at the Yellow Jacket shaft on the Comstock Lode, Nevada, is in successful operation. Similar electric hoisting machinery is being installed at the Belcher and the C. & C. shafts.

SAN FRANCISCO, CAL.—The Renown Water and Power Company was recently incorporated in California, with Wilmington, Del., as the principal place of business. Directors, J. R. Newberry, J. R. Clark, L. W. Foster and L. W. Blinn. Capital stock, $500,000.

STOCKTON, CALIF.—The Mountain Water & Electric Company was recently incorporated, with Stockton as the principal place of business. Directors: J. U. Castle, L. A. Richards, J. P. Spooner, F. R. Clark and W. B. Harrison. Capital stock, $25,000; fully subscribed.

SAN FRANCISCO, CAL.—The Jupiter Light Company was recently incorporated, with Lemoore, Kings County, Cal., as the place of business. Directors, H. L. Jennings, G. Hutton, J. C. Moore, W. H. Battenfield and L. L. Johnson. Capital stock, $50.000; subscribed, $400.

SAN FRANCISCO, CAL.—The Bay Counties Power Company recently made a proposition to the authorities of San Quentin penitentiary, California, to save that institution $15,000 per year if granted the contract to furnish electric light and power for the prison and the jute mill operated by the convicts.

SAN FRANCISCO, CALIF.—The local electric light plant in Red Bluff, Calif., has been sold by James Cross to San Francisco capitalists. It is reported that the purchasers have closed a contract with the Shasta Electric Light & Power Company. Under this contract the local company will be able to supply adjoining localities with light and power.

SAN FRANCISCO, CAL.—The attention of the San Francisco Board of Supervisors has been called to the clause in the city lighting contract that stipulates that companies holding such contracts shall not require their employes to work more than eight hours a day. It is alleged that the San Francisco Gas and Electric Company and the Independent Electric Light and Power Company are violating the eight-hour clause.

SAN FRANCISCO, CAL.—The battleship Ohio, which was recently launched with great eclat in the presence of President McKinley and his Cabinet at the Union Iron Works, San Francisco, will be equipped with four 32-kw and four 500-kw, 80-volt, direct-connected generators, manufactured at the works. There will be in addition electric turret motors, ventilating fan motors and the usual apparatus installed in the latest war ships.

DENVER, COLO.—The Weston Electric Power Company has been incorporated to operate in Lake County. Capital, 50,000. Incorporators, W. P. Garrison, E. R. Reed and J. W. Sonhorn.

DENVER, COLO.—The Boulder Light and Power Company has filed articles of incorporation. The company was incorporated with a capital stock of $100,000. The directors are Charles B. Culbertson, president; Henry Casaday, vice-president; John H. Nicholson, treasurer; Charles C. Bromley, William H. Allison, Edwin J. Temple and Albert A. Reed.

SEAFORD, DEL.—A new water works system and electric light plant will soon be installed here, and bonds to the amount of $25,000 will be issued to pay for the same.

TOCCOA FALLS, GA.—The Toccoa Falls Electric Light & Power Company is completing an electric light system at Toccoa and lights will be turned on soon. The power is developed at Toccoa Falls, two miles distant. E. P. Simpson is in charge.

CHAMPAIGN, ILL.—The Lexington electric light plant has been sold to Lexington capitalists, headed by Mr. James Vandolah and A. H. Scrogin.

RICHMOND, IND.—Work on the new municipal electric light plant has begun. Instead of issuing bonds the Mayor borrowed the necessary money.

BLUFFTON, IND.—The electric headlight on the Clover-Leaf flyer prevented a bad wreck near this city. A cow was lying on the track asleep and the light enabled the engineer, who was running forty miles an hour, to see it in time to prevent a wreck.

FAIRMONT, IND.—Gilbert Larne sold his electric light plant to this city for $18,000 in payments of $150 per month. A new town board repudiated the contract and he sued to collect the money due him. The court not only ruled against him as to a judgment, but declared the contract void on account of exceeding the constitutional indebtedness allowed by cities. He then compromised by accepting $1,400, one-third of the amount due him, taking back his machinery and moving the plant off of the town property within ninety days. A new plant will be erected.

AUGUSTA, ME.—The Kennebunkport Light and Power Company, capital $10,000, has been incorporated. The officers are: President, Ernest P. Libby, of Sanford; treasurer, Andrew J. Robinson, of Sanford.

LANSING, MICH.—The East Jordan Electric Light and Power Company, East Jordan, has been incorporated with a capital of $10,000.

MINNEAPOLIS, MINN.—The Pipestone Electric Light, Heat and Power Company has been incorporated with a capital of $50,000. The incorporators are F. P. Wilson, D. J. McNerney and J. F. Conklin.

ST. LOUIS, MO.—The Board of Public Improvements has denied the application of the Laclede Power Company to pump water direct from the river into the power plant.

ST. LOUIS, MO.—It is reported that a new corporation, the Citizens' Electric Company, is organizing here with a capital stock of $3,000,000, to construct a generating plant and compete with existing electric light companies.

CHARLOTTE, N. C.—James E. Spencer, representing the New York Trust Company, has secured for about $18,000 the Rialto Mills property on the Appomattox River at Petersburg, Va. It is rumored that the Richmond, Va., Passenger & Power Company is interested.

CHATHAM, N. J.—At a borough election it was voted to issue $15,000 electric light bonds.

ALBANY, N. Y.—The Gas and Electric Company of Corning has been incorporated. Capital, $375,000. The directors are Ashley W. Cole, New York city; L. B. Grant, and N. L. Merry, Brooklyn.

ALBANY, N. Y.—The Syracuse Lighting Company, of Syracuse, has been incorporated with a capital stock of $2,500,000. The directors are Charles V. Nellany, of Brooklyn; Harry F. Cues, of Staten Island, and Richard F. McKinley, of New York city.

COXSACKIE, N. Y.—Certificates have been filed with the New York Secretary of State announcing the merger of the Coxsackie Electric Light Company and the Athens Electric Light & Power Company with the Upper Hudson Electric Company. The capital of each of the consolidating companies is $20,000.

ALBANY, N. Y.—The Upper Hudson Electric Company has been incorporated to furnish gas and electricity in towns and villages in Greene County. Capital $100,000. The directors are William O. Turner, of New York city; Eugene Wolfe, of Athens, and N. W. Dalton, of Bath.

NEWBURG, N. Y.—Having just six customers left, the Rhinebeck Gas Company was forced to go out of existence. For years the company did a thriving business, but with the installation of an electric plant a few months ago, electricity superseded gas, and the consumers gradually withdrew from the support of the company.

NORTH TONAWANDA, N. Y.—The Niagara Falls Light and Power Company has just finished a big change in its power service here. Heretofore the voltage furnished over the local lines was but 11,000; by the addition of three large cables, which run through from Niagara Falls to Buffalo, the voltage in the Tonawandas has been doubled, it now being 22,000. Many local mills and factories have already installed the electric power, and others are planning to follow suit in the near future.

CINCINNATI, OHIO.—The Traction Company will furnish power to light all the floats in the night pageants of the coming Fall Festival, which opens in this city Sept. 16 and continues until Sept. 28.

COLUMBUS, OHIO.—It is stated that the sinking fund trustees will probably purchase the $110,000 4 per cent thirty year electric light bonds recently voted.

BOWLING GREEN, OHIO.—George Kerper, president of the Toledo, Bowling Green & Southern Railway Company, was here to find a suitable location for a power house.

DYERSBURG, TENN.—The citizens will hold a meeting to consider the advisability of issuing $50,000 in bonds with which to purchase the local light plant and water works.

HENDERSON, TEX.—A local company has been organized for the purpose of building an electric light plant. The capital has been paid in, and the contract for the machinery has been let.

AMHERST, WIS.—B. E. Dwinell & Co. have been granted a fifteen-year franchise by the village of Amherst to put in an electric light system.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—A controlling interest in the Mobile Street Railway Company has been secured by a party of Atlanta and Mobile capitalists.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has, it is reported, been secured by Isadore Newman, of New Orleans, and others. While the report is not confirmed, it is said that large sums will be utilized in extensions and improvements, and that the new purchasers will assume control at an early date.

WASHINGTON, D. C.—Frederick D. H. Engley, a conductor on the Washington Traction Company's lines, and his brother, Samuel E. Engley, of Hyattsville, Md., whose arrest on charges of forgery revealed an alleged plot for flooding the city with bogus car tickets, has been held in $5,000 for the Grand Jury. Later a cablegram from the police authorities of Glasgow, Scotland, announced that they had recovered the plates from which the bogus tickets floated here were struck and also 40,000 sheets of tickets, aggregating 240,000 tickets.

DES MOINES, IA.—The Des Moines City Railway Company has filed a trust deed for $3,000,000 in favor of the Illinois Trust and Savings Company, of Chicago. This is an increase of $1,000,000 over the bond issue of $2,000,000 of May 1, 1893, in favor of the same company.

WORCESTER, MASS.—The directors of the Worcester Consolidated Street Railway Company have voted to increase the capital stock $1,675,000, for the purpose of covering the floating debt and paying for proposed extensions.

MUSKEGON, MICH.—Muskegon and Ludington are to be connected by an electric line, the Council of the former place having already granted a franchise.

LANSING, MICH.—The Lansing, St. Johns & St. Louis Electric Railway Company has filed a mortgage given to the Detroit Trust Company for $1,750,000 to secure an issue of bonds with which to provide the funds for purchasing the iron and equipping the road.

OMAHA, NEB.—Plans for consolidation of the street railways of Omaha and Council Bluffs, the electric power plants of the two cities and the Platte

River Canal appear to be assuming a definite shape, and it is said the consolidation now hinges only on terms of purchase. The new corporation is said to include the Omaha Street Railway Company, the Omaha & Council Bluffs Railway & Bridge Company, the Omaha Thomson-Houston Electric Light Company, the Council Bluffs Electric Light Company, the Omaha Water Company, the Council Bluffs Water Company, the Suburban Railway & Traction Company and the Platte River Power Canal. The new combination will probably be capitalized at $20,000,000.

GREENSBORO, N. C.—The Greensboro Electric Company has been granted a franchise by the town for the purpose of operating an electric street railway and furnishing electric lights and power to operate the water works. M. D. Barr, of New York, is interested.

AUGUSTA, S. C.—The Augusta & Aiken Railway Company, of North Augusta, has been commissioned to construct a 20-mile electric railway. Alfred S. Elliott, of Wilmington, Del., and others are the incorporators.

NEWARK, N. J.—The Essex Cross Railway, capital $500,000, has been incorporated to build a trolley line in Essex County. The incorporators are John A. Lawrence, Bloomfield; F. M. Eppley, West Orange; George A. Smith, Vailsburg; E. P. Alling, William Franklin, Charles Hathway, Robert Hawksworth, of East Orange.

JOHNSTOWN, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has voted to extend its electric road from Johnstown to Amsterdam.

UTICA, N. Y.—The Cleveland syndicate, which recently purchased the street railroad properties in this city, is reported to have bought the Herkimer, Mohawk, Ilion and Frankfort Street Railroad. The Utica road is expected to be built to Rome and Frankfort.

FAIRPORT, N. Y.—The Fairport Electric Railway Company has been incorporated with a capital of $110,000, to construct an electric road eleven miles long, between Fairport and Rochester. The directors include Charles A. Lux, Daniel E. Lux, of Clyde, and H. D. Brewster, of Syracuse.

BALLSTON, N. Y.—The stockholders of the Ballston Terminal Railroad Company have voted to increase the capital stock from $300,000 to $1,500,000, and consent is given to execute a mortgage for $1,200,000. The object of the extension of capital is to complete the road to the northern termini and fully equip it.

ALBANY, N. Y.—The Golden Bridge Electric Railway Company has been incorporated with a capital of $100,000, to construct an electric road between North Salem, Westchester County, N. Y., to Ridgebury, Conn. The directors are E. B. Brady, of Golden Bridge; F. W. Siebert, of Waterbury, Conn.; William H. J. Howe, of North Salem, and John Brophy, of Ridgefield, Conn.

WATERTOWN, N. Y.—Papers of incorporation of the Watertown & Carthage Traction Company have been filed here. The company is capitalized at $200,000. The directors and principal stockholders of the proposed company are: Arthur S. Fairchild, John W. Horner, Jr., New York; Ernest S. Emanuel, Brooklyn; J. T. Hollister, Rutherford, N. J.; Clyde Notman, Short Hills, N. J.; John N. Carlisle, F. M. Hugo, L. L. Luther and Mason N. Swan, Watertown.

CLEVELAND, OHIO.—The Masillon, Wouster & Mansfield Railway Company has been incorporated by T. K. Dissette, C. V. Hard, Frank W. Kirk, A. M. Parrish, and Robert C. Mitchell.

DAYTON, OHIO.—Valentine Winters, president of the Dayton & Western Traction Company, has secured consents of property owners for an extension of the road from Eaton to Richmond, Ind.

SHELBY, OHIO.—The Citizens' Street Railway Company, of Mansfield, which is building an extension from Mansfield to Shelby, is securing right of way to extend the line on to Plymouth, six miles north.

CLEVELAND, OHIO.—The Columbus, Delaware and Marion Railway Company has filed a trust deed for $1,000,000 in favor of the Western Reserve Trust Company, covering bonds issued for the building of the road.

RAVENNA, OHIO.—The County Commissioners have granted a twenty-five year franchise to J. A. Blackburn and George W. Taylor for an electric railway from Garrettsville to the Trumbull County line.

CLEVELAND, OHIO.—The directors of the Cleveland City Railway Company have decided to purchase new machinery to increase the capacity of the company's central power house. Plans for the extension are being prepared.

LANCASTER, OHIO.—The Columbus, Winchester & Lancaster Traction Company has been granted a franchise to build its line on the city streets. This completed the entire right of way for the road from Columbus to Lancaster.

COLUMBUS, OHIO.—General Axline, president of the Urbana, Mechanicsburg & Columbus Railway Company, states that his road will be built despite the steps taken for a rival road by the Columbus, London & Springfield Railway Company.

TIFFIN, OHIO.—The county commissioners have granted franchises to the Kerlin Brothers, of Toledo, and to the Toledo, Tiffin & Sandusky, rival companies, which propose building lines from this city to Fremont, Port Clinton and Sandusky.

CINCINNATI, OHIO.—Powell Crossley, president of the Cincinnati & Cleveland Railroad Company, has made application to the county commissioners for a franchise along the Springboro pike and the Dayton pike from Cincinnati to Dayton.

CLEVELAND, OHIO.—The Salem, Lisbon & East Liverpool Traction Company has been incorporated by H. W. Jones, E. N. Hait, Chas. H. Taylor, George H. Billman and H. H. Poppleton, all of this city. The temporary capital stock is $10,000.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company has secured all right of way and has decided on the route of its extension from Wellington to Ashland and Mansfield. The new line will be known as the Cleveland, Ashland & Southern Railway.

CLEVELAND, OHIO.—M. J. Mandelbaum, vice-president of the Southern Ohio Traction Company, has closed a deal for the purchase of the Hamilton and Lindenwald Electric Transit Company. The price is said to have been $225,000. The road runs through Hamilton to Lindenwald.

NORWALK, OHIO. The Norwalk, Ashland & Southern Electric Railway Company has made application for a franchise to enter this city. The company has secured a private right of way from Norwalk to New London, Herford, Savannah and Ashland. The promoters are Ashland people.

COLUMBUS, OHIO.—The Board of Public Works has refused to allow the franchise of the Columbus, Delaware & Northern Railway on Summit and other streets, to be turned over to the Columbus, London & Springfield Railway Company, which is now in control of the former company.

MARIETTA, OHIO.—The Ohio River Bridge & Ferry Company has been incorporated by B. G. Davies, Harry B. Hoyt, Theron M. Ripley and others of this place to build a bridge and ferry across the Ohio River at this point and to operate an electric road across the same. Capital stock, $100,000.

CLEVELAND, OHIO.—The properties of the Cleveland and Chagrin Falls Railway Company and the Chagrin Falls and Eastern Railway Company passed into the hands of stockholders of the Cleveland and Eastern Railroad Company on May 25, and in the future the three roads will be conducted as one system.

CANTON, OHIO.—The Akron-Canton Railway Company has purchased a site for its power house near Berlin, a short distance from this city. It is stated that the company will also install equipment for illuminating purposes and will make a proposition to furnish lights in Canton and neighboring villages.

STEUBENVILLE, OHIO.—An application for a charter for the Steubenville, Mingoe and Ohio Valley Traction Company has been made in New Jersey, and the capital stock will be increased from $150,000 to $350,000. Extensive improvements will be made to the company's system, and the line will be extended to Brilliant.

KENTON, OHIO.—The county commissioners have granted the Findlay & Southern Electric Railroad Company a franchise for a road touching the county line near Foest, passing through Kenton and thence to the Union County line by way of Mt. Victory. It is stated that the road will be eventually extended from Columbus to Toledo.

TOLEDO, OHIO.—The Toledo, Fremont and Norwalk Railway has been appraised by the county auditor as follows: Rolling stock per mile, $550; tools, per mile, $30; main track per mile, $1,500; siding per mile, $500. The Toledo & Maumee Valley Railroad, which is an older road, was appraised as follows: Rolling stock per mile, $2,500; buildings, $3,000; tools per mile, $250; main track per mile, $3,750; siding per mile, $2,500.

CINCINNATI, OHIO.—Indications are that a large contract for the improvement of the lines of the Cincinnati Traction Company will be placed with the North American Construction Company, of Chicago. The improvements include the changing of the Sycamore cable line to electricity, the relaying of much track on other lines, and the construction of a number of extensions. About 34 miles of track will be laid and the contract will call for the expenditure of about $500,000.

YOUNGSTOWN, OHIO.—The Youngstown-Sharon Street Railway Company has awarded the contract for all the steel rails to be used in the construction of the line between Sharon and Newcastle, a distance of twenty-one miles. It is the intention to expend about $2,500,000 in Western Pennsylvania and Ohio on the new trolley system. The road, when completed, will connect Sharon and Cleveland, taking in intermediate points. New York and Chicago capitalists are furnishing most of the money to build the lines.

CINCINNATI, OHIO.—The Cincinnati & Northwestern Railroad Company (steam) which was recently acquired by the Southern Ohio Traction Company has made application to the council of College Hill to erect poles and string wires along its private right of way. This indicates that the upper end of the road will be operated by the Southern Ohio Company with both steam and electricity. Between Cumminsville and College Hill double tracks are being laid, one of which will be used for steam cars and the other for electric.

COLUMBUS, OHIO.—The Findlay & Marion Electric Railway Company has been incorporated by ex-Governor Jones and J. H. Ruhlman, of Youngstown; M. A. Smalley and C. E. Schwartzbaugh, of Toledo; Judge Smalley, of Upper Sandusky; Wm. E. Schofield, of Marion; P. B. Morrison, Hon. David Joy and Jason Blackford, of Findlay. The company has been organized with the above as directors and with the following officers: W. E. Schofield, president; A. W. Jones, vice-president; P. B. Morrison, treasurer and Jason Blackford, secretary. The temporary capital stock is $10,000.

CLEVELAND, OHIO. The Southern Ohio Traction Company is projecting several feeder lines for its system in southern Ohio. Will Christy and M. J. Mandelbaum, of Cleveland, and F. J. Sloat, O. V. Parish and Peter Schwab, of Hamilton, directors of the Southern Ohio Company, have incorporated the Hamilton, Oxford & Western Electric Railway Company and the Cincinnati, Venice & Western Electric Railway Company. The former road will extend from Hamilton to Connorsville, Ind. The second line will extend from Cincinnati through northern Hamilton County and southern Butler county and will probably connect with the first mentioned road.

SANDWICH, ONT.—The Council for the township of Sandwich, West, Ont., has passed a by-law granting a franchise to run a line of the South Essex Electric Railway through the township.

CORNWALL, ONT.—The Electric Street Railway Company, of Cornwall, has purchased the property of the Cornwall Milling Company, and is fitting it up as a power house for the operation of its road.

ALLENTOWN, PA. The Lehigh and Carbon Electric Railway Company, composed of Allentown and Easton capitalists, has secured the right of way for a twenty-mile trolley line from Allentown to Palmerton, Carbon County.

WILLIAMSPORT, PA.—A trolley line will be built between this city and Lock Haven, a distance of twenty-four miles. The line will pass through a populous farming community. Among the incorporators are State Senator J. Henry Cochran and ex-Attorney General H. C. McCormick, of this city, and Judge Charles Mayer, of Lock Haven. The company has been capitalized at $150,000. Senator Cochran has been elected president.

PENNSYLVANIA.—The Senate broke all local speed records last week, when it passed the bill amending the passenger railway act of 1889, to permit the construction of a passenger railway in any street not occupied at present and the bill providing for the erection of elevated and underground railways. These bills were introduced Wednesday, after it became known that P. A. B. Widener and William L. Elkins, the Philadelphia street railway magnates, had sailed for Europe. Representatives of the Philadelphia traction interests came here, and pleaded in vain either for the defeat of the measures or their postponement. The extraordinary speed at which they have been rushed through the Senate has aroused widespread interest. Ten minutes after their introduction they were reported favorably from committee, and they passed first, second and third readings without the loss of a moment's time, all amendments being rejected.

THE AUTOMOBILE.

THE NEWARK MOTOR VEHICLE COMPANY, of Newark, N. J., has been incorporated. Capital, $100,000. Incorporators: Frank K. Irving, Millard S. Muchmore and Henry C. Kees.

THE HIDLEY AUTOMOBILE COMPANY, of Troy, N. Y., has been incorporated. Capital, $50,000. Directors: Eugene Bryan, J. B. Holmes and N. R. Holmes, of Troy.

THE TRANSCONTINENTAL AUTOMOBILE RIDE.—Alexander B. Winton and Charles B. Shanks, who left San Francisco May 20 for New York, found the sandy deserts of Nevada insurmountable obstacles to their gasoline automobile and abandoned the expedition. Winton hopes to try it again in a horseless vehicle built for sand.

NEW YORK CITY.—An improvement in the stage service on Fifth Avenue is in sight, according to an announcement made by H. Sanderson, president of the New York Electric Vehicle Transportation Company. Automobile stages are to replace the horse vehicles as fast as they are procurable after Aug. 1 next, when the company is to begin running the electric stages over routes aggregating twenty-two miles, the whole system being an extension of the Fifth Avenue stage line. Twelve automobile stages capable of making ten miles an hour, exclusive of stops, are to be put in operation on Aug. 1, Mr. Sanderson said, and the number will be added to as fast as may be. The vehicles will be equipped with the new Exide batteries. The new stages are to seat thirty-four passengers and are to be built with room enough in the aisle for persons to walk between the two rows of seated passengers high enough inside for a six-foot man to walk upright in a silk hat.

NEW INDUSTRIAL COMPANIES.

THE PENNSYLVANIA ELECTRIC VEHICLE COMPANY, of Carlisle, Pa., has been incorporated at Wilmington, Del., with a capital of $2,500,000.

JEFFERSON CITY, MO.—Evidence of incorporation was filed by the Western Electric Company, of Illinois, on June 1. Capital stock, $8,000,000; capital in Missouri, $100,000. Gerard Swope, of St. Louis, represents the company in Missouri.

ST. LOUIS, MO.—Articles of incorporation have been filed by the National Power Company, which will manufacture power-producing machinery. The capital stock is $30,000, held by John Ott, Christian Neuman, Charles Kroemecke, Geo. M. Hillenbrand and Geo. Weinheimer.

GARL ELECTRIC COMPANY, Akron, Ohio, has but recently incorporated, and T. H. Lyder, secretary and treasurer, writes us that the organization is not yet quite completed. Within the past few days it has moved into new and very commodious quarters, and is rapidly putting things in shape for early production on a large scale of its well-known telephone apparatus, etc.

LEGAL.

ELECTRIC VEHICLE & TRANSPORTATION.—An order has just been signed, returnable next Tuesday, directing the officers of the New York Electric Vehicle & Transportation Company to show cause why they should not be enjoined from enforcing the $10 assessment made upon the stock of that company. The action has been moved by a Mr. Benjamin Meyer.

CROSSING TROLLEY TRACKS.—A warning to those who have occasion to drive over suburban electric railroad tracks is contained in a decision rendered by Judge Stockbridge in Baltimore. In giving judgment for a railroad company, in an action against the company to recover for damages done by one of its cars striking a carriage, the Judge found that there was contributory negligence on the part of the driver of the carriage in attempting to cross the tracks. He held that there is a distinction between the degrees of care to be exercised in the operation of electric cars in the populous portions of the city and in sparsely settled sections, such as that where the accident occurred. As the car was running on a private right-of-way and the tracks are built as are those of steam railroads, the rule applicable to the case is similar to that governing the crossing of steam railroad tracks. Before crossing such tracks, the one who wishes to have a valid claim for damages must "stop, look, and listen."

PERSONAL.

MR. HARRY TUCKER CRISSEY, secretary of the E. G. Bernard Company, Troy, N. Y., was married June 4 to Miss Josephine Austin Bacon, of Loudenville, N. Y.

MR. ARTHUR V. ABBOTT, chief engineer of the Chicago Telephone Company, lectured recently before the Armour Institute of Technology, of Chicago, on wireless telegraphy.

MR. JAMES BURKE, electrical engineer of the Bergmann Elektricatats Werke (formerly of Herrick & Burke, New York), arrived last week on the "Deutschland" for a short visit in the United States.

MR. S. P. GRACE, of the engineering staff of the Erie Telephone system, with headquarters at Detroit, delivered a course of lectures on telephone engineering recently before the engineering department of the University of Michigan.

MR. WM. POWELL MASON, prominent in Boston financial and business circles, died recently in Vienna. He was a director of the Merchants' National Bank, the Edison Electric Illuminating Company and a number of cotton manufacturing companies.

MR. EMERSON McMILLIN, the banker of this city, who formerly lived in Columbus, Ohio, and has long been actively interested in electrical properties, has promised to defray the expenses of a week in the country for a thousand poor children of Columbus and other towns embraced in the Columbus district of the Epworth League.

MR. A. J. MACDONALD, of Montreal, has just been appointed general superintendent of the street railway system of the City of Mexico. Mr. Macdonald, who is about thirty years of age, is at present in charge of the centre division of the Montreal Street Railway system, in the employment of which he began as a conductor.

MR. FRED SCHOENENBERGER, superintendent of the electrical department of the Oerlikon Works, Switzerland, sailed for Europe this week, after a visit of several months in this country. During part of his stay Mr. Schoenenberger was at the Bullock works at Norwood in connection with the arrangement whereby the American firm will have the benefit of the designing department of the Oerlikon works.

JUDGE JAMES M. THOMAS, president of the Independent Telephone Association of the United States, general manager of the United States Telephone Company, and one of the leading figures in the independent field, has, according to a press despatch, been offered the presidency of the Knickerbocker Telephone Company and the Telephone, Telegraph & Cable Company, of New York, which were recently formed with a capitalization of $55,000,000 by the consolidation of independent interests in New York. The companies are building exchanges in New York and Boston. The proposition made Judge Thomas is a most flattering one, but whether or not he will accept has not yet been decided. Judge Thomas has recently spent considerable time in New York, assisting in the formation of the companies.

MR. T. A. EDISON has lately predicted a general adoption of the plan of building houses with "poured" cement, of which he is producing large quantities at his crushing plants. The New York *Times* says. "Mr. Edison's forecast of cheap houses built of cement and rubble by means of boxes, into which tier after tier is 'poured' and allowed to harden, is somewhat fantastical. The method is an old one, and it has been tried with success in certain climates, but there is no proof that it is suited to a land like ours, where heavy rains disintegrate such walls in summer and snowfalls alternate with thaws in the winter. Our architects have already introduced a modification of this style for country houses, consisting of wire lathing covered with plaster. This leaves an air chamber in the thickness of the wall and prevents 'sweating,' and, while much cheaper, is much warmer. Whether it will be as durable as solid walls remains to be seen. A combination of steel structure and solid concrete is another thing. That is merely a modification of iron architecture. After all, the economic question remains. Can such walls be made durable and capable of supporting the weight of several stories, and at the same time cheaper than wood and stone? The cost of materials and the cost of labor are at present greater for buildings of this kind. Simple four-square buildings of one story and attic might be cheap, but a villa of any complexity introduces so many elements that the cost increases unduly."

Trade Notes.

OIL FILTERS.—Four Cross oil filters are installed in the power house at the Pan-American by the Burt Manufacturing Company, of Akron, Ohio.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has removed its Cleveland, Ohio, office to larger quarters in the New England Building, from No. 1310 in that building to 1007. Mr. C. S. Powell is in charge of the Cleveland territory.

THE WESTON ELECTRICAL INSTRUMENT COMPANY announces the removal of its office and works to its new manufacturing plant at Waverly Park, N. J. The nearest telegraph office is Newark, N. J., and telegrams addressed to the company at Waverly Park are received at Newark and forwarded by telephone.

A POCKET CALCULATOR.—An aluminum pocket calculator is being marketed by C. Francis Jenkins, 1325 F Street, N. W., Washington, D. C., at a very low price—35 cents. The instrument is made of frosted aluminum in two parts, a back piece and a revolvable disk. The back and the disk are marked with identical scales, the scale on the disk just inside the other. The whole is about as thick as two visiting cards, and of a size readily carried in the vest pocket.

THE MAXWELL M. MEYER ELECTRIC COMPANY, 2369 Second Avenue, New York, has issued Bulletins No. 10 and 11, one being entitled, "Direct-Current Motors and Dynamos," and the other "Dynamos for Plating and Electrolytic Processes." Recent shipments of motors and dynamos have been made to Calcutta, India; Rangoon, British Burmah; Forest Hill, Conn.; Newark, N. J., and Valley Field, Canada. Among recent sales in New York City are motors or dynamos to the Eagle Iron Works, Ceylon Coffee Company, General Electric Water Company and Hotel Kennesaw.

DURHAM TELEPHONES.—The Durham Telephone Manufacturing Company, Durham, N. C., describes and illustrates its complete line of telephone apparatus in a forty-eight-page pamphlet of recent issue.

WILLYOUNG INSTRUMENTS.—Elmer G. Willyoung, 11 Frankfort Street, New York, is mailing to the trade a list of his catalogues. The different classes of instruments manufactured by him are also mentioned.

FALCON ARC LAMPS.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York,, has issued a card illustrating its plain direct-current arc lamps. The principal features of the lamps are pointed out.

HOLOPHANE GLASS.—The Holophane Glass Company, 15 East Thirty-second Street, New York, in a recently issued catalogue describes and illustrates Holophane glass globes, which are extensively used in electric lighting.

SEAMLESS TUBING.—The Benedict & Burnham Manufacturing Company, in a pamphlet of recent issue, describes the properties and uses of "Benedict-Nickel" seamless tubing, which is one of the products of this well known company.

TO BANISH WORRY.—Mr. Stephen L. Coles, of the Shaughnessy Agency, 5 Beekman Street, New York, has an excellent recipe for relieving business men of part of their worry. On a card just issued he points out how this can be done.

FUSE WIRE.—The lines of tested fuse wire and links manufactured by the Chicago Fuse Wire & Manufacturing Company, Chicago, are listed in Catalogue No. 12, issued by the company. The catalogue has been prepared with great care, with the idea to facilitate ordering, particularly where special sizes are required.

UNDERWRITERS' APPROVAL.—Mr. Harvey Hubbell, Bridgeport, Conn., informs us that the Underwriters' laboratory of Chicago has approved of his pendant chain pull socket. This action places the device in the category of standard approved goods. This pendant pull socket was described and illustrated in this column March 30, 1901.

THE CENTURY MOTOR VEHICLE COMPANY announces that its works are now running smoothly and on full time. Only a few of its men went out in the machinist's strike, but, the company informs us, they have all returned to work and its factory is now running full-handed in all departments. It is now able to fill its orders with reasonable promptness.

SPEED REGULATION OF WATER POWER PLANTS.—We have received from Mr. Allan V. Garratt, chief engineer of the Lombard Water-Wheel Governor Company, Boston, Mass., a copy of a pamphlet containing a reprint of an article from *Cassier's Magazine*, entitled "Speed Regulation of Water Power Plants, the Practical Side of the Problem." The subject is very fully considered.

BOILER CLEANER.—The Ford automatic boiler cleaner is described and illustrated in a pamphlet recently brought out by the Ford Automatic Boiler Cleaner Company, Carleton Building, St. Louis, Mo. Besides describing the operation of this device, the pamphlet contains a good deal of general engineering information, and fac similes of many testimonial letters telling of the satisfaction given by these cleaners.

THE AMERICAN BATTERY COMPANY, 172 South Clinton Street, Chicago, states that it has equipped 218 central energy telephone exchanges with its storage cells. It will have a battery in operation at the Buffalo Exposition, being part of the power equipment of the American Electric Telephone Company's exhibit. Its June 1st catalogue and revised price list of cells is now ready for distribution.

FAN TESTS.—The Emerson Electric Manufacturing Company is sending out a circular, showing the result of tests recently made by the company on various makes of alternating-current desk fans. Two illustrations are given, one showing the actual velocity of wind, not taking current consumption into consideration, and the other showing comparative efficiencies when taking current consumption into consideration.

LIGHTNING ARRESTERS.—The Garton-Daniels Company, Keokuk, Ia., has issued two neat pamphlets. One illustrates the various types of Garton lightning arresters for use on electric railways, light and power circuits, either alternating or direct currents, the other is a story of the experience of a certain street railway company in Chicago with Garton arresters. Street railway managers should read this story, as it contains some interesting facts.

FORT WAYNE APPARATUS.—The Fort Wayne Electric Works recently issued three illustrated bulletins, describing "Wood" measuring instruments; "Wood" open series arc lamps, shunt type, for direct constant current circuits, and the "Wood" constant current dynamos, for arc lighting, with improved regulator. Other recent publications of the same company are pamphlets on "Wood" primary fuse boxes, and the "Wood" cut-out for arc circuits.

PUMPING MACHINERY. The Jeanesville Iron Works Company, Jeanesville, Pa., describes its new line of pumping machinery in Advance Sheets No. 10 and 11, just issued. The Jeanesville triplex electric pump is illustrated and the principal features described; diagrammatic illustrations show its construction. A large modern mine pumping engine is described and illustrated in Sheet 11. Those interested in this line of apparatus can secure a copy of the sheets on application.

THE GOULD STORAGE BATTERY.—At the recent conversazione of the American Institute of Electrical Engineers, the Gould storage battery exhibit excited considerable interest, chiefly on account of the method of manufacturing the plates, which method gives a much increased active surface. This battery is fully described and well illustrated in a catalogue just issued by the Gould Storage Battery Company, Depew, N. Y. Tables give the dimensions, capacities, etc., of the cells of various sizes.

HYDRAULIC JACKS constitute the subject of a very complete catalogue (No. 61) recently issued by the Watson-Stillman Company, 204 East Forty-third Street, New York. This is a new edition of old catalogue No. 54, and contains new sizes of jacks. Jacks for a great variety of uses are illustrated and briefly described. The Watson-Stillman Company has been making hydraulic jacks for fifty years, and this fact alone is a testimonial far more impressive than any number of testimonial letters could be.

APPLICATIONS OF TELEPHERAGE.—The United Telepherage Company is rapidly introducing its telepherage system throughout the country. In two illustrated circulars of recent issue examples of practical applications of the system are shown. In one case the automatic electric conveyor system in operation at the works of the Yale & Towne Manufacturing Company, Stamford, Conn., is described and illustrated, and in the other the subject is the telepherage system in operation in a glass works in St. Louis.

FANS.—The advent of the fan season is heralded by the catalogues of manufacturers. The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued an artistically designed catalogue of its 1901 fan motors and ceiling fans for alternating current. The various styles are illustrated by means of excellent half-tone cuts, and the features of each are comprehensively set forth. A telegraph code is given at the back, which will facilitate ordering by telegraph.

POWER DEVELOPMENT CONTRACTS.—Work has been begun upon the Cape Fear power plant at Buckhorn Falls, N. C. The contract for the electrical equipment has been awarded to the General Electric Company and for turbines to the S. Morgan Smith Company, of York, Pa. The contract for the insulation has been awarded to the R. Thomas & Sons Company, East Liverpool, Ohio, and for the transmission lines, which will be 36 miles long, to Mr. John Blair MacAfee, of Philadelphia. Messrs. W. A. Smethurst and Rodney D. Allen will be the engineers representing Mr. MacAfee in the construction of the transmission line.

GRAPHITE PRODUCTIONS.—In an artificially designed pamphlet, just issued, the Joseph Dixon Crucible Company, Jersey City, N. J., gives an interesting description of its graphite productions. The two centre pages show the company's plants; the graphite works at Ticonderoga and the main plants at Jersey City. Views of the graphite mines and cedar mills are also shown. The various graphite articles manufactured by the company, a great variety of pencils, and packages of graphite for different purposes are also illustrated. The front cover of the catalogue is an artistic piece of designing and printing, and shows a masterly handling of *chiaroscuro*.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JUNE 4, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

675,373. GRADUATED RESISTANCE COIL; F. Comminge, Pittsburg, Pa. App. filed March 29, 1901. One or more cylindrical layers of insulating material, each wound around with resistance wire, the terminals of the wire leading to the rheostat contacts.

675,377. SIGNALING DEVICE FOR TELEPHONE SWITCHBOARDS; H. C. Dodge, Cleveland, Ohio. App. filed Dec. 21, 1900. The drop is mechanically restored to its normal position by the plug as it enters the jack.

675,380. PRINTING TELEGRAPH; R. A. Fowden, Philadelphia, Pa. App. filed Nov. 2, 1899. These improvements relate to the various features of a printing telegraph outfit.

675,383. AUTOMATIC ELECTRIC CUT OUT; F. D. Greenstreet, Holborn, and E. J. Selby, Birmingham, Eng. App. filed June 12, 1900. A fusible wire passes through the center of two carbons in line with each other and in contact at their meeting ends; when the wire is fused, springs throw the carbons out of line, thus entirely covering the circuit.

675,398. ADJUSTABLE PROTECTING DEVICE FOR ELECTRIC LAMPS; E. J. McAllister, A. D. Page and L. C. Werner, Newark, N. J. App. filed Feb. 28, 1901. A sheet-metal guard is clamped around the socket and rests in contact with the lamp just above the neck.

675,413. PROCESS OF COATING FIBROUS MATERIAL WITH METAL; J. H. Robertson, Brooklyn, N. Y. App. filed Jan. 6, 1900. (See Current News and Notes.)

675,419. GALVANIC BATTERY CELL; C. T. Sittig, Gross-Lichterfelde, Germany. App. filed May 11, 1899. (Cee Current News and Notes.)

675,427. ELECTRIC HEATER FOR ELECTRIC GLOWER LAMPS; J. Van Vleck and W. N. Stevens, New York, N. Y. App. filed April 27, 1900. (See Current News and Notes.)

675,455. PROCESS OF MANUFACTURING LEAD SALTS BY ELECTROLYSIS; J. B. Tibbits, Hoosick, N. Y. App. filed March 6, 1894. (See Current News and Notes.)

675,459. APPARATUS FOR THE ELECTROLYTIC PRODUCTION OF PIGMENTS; J. A. Yunck, Hoosick, N. Y. App. filed Dec. 16, 1898. (See page 1014.)

675,460. PROCESS OF MANUFACTURING WHITE LEAD BY ELECTROLYSIS; J. A. Yunck, Hoosick, N. Y. App. filed Feb. 25, 1899. (See page 1014.)

675,467. TELEPHONE SPEAKING TUBE OR LIKE RECEIVER; H. A. Cutmore, Lee, England. App. filed March 31, 1900. A flexible structure for attachment to the instrument to exclude outside sound from the ear.

675,495. WRITING TELEGRAPH; A. Pollak and J. Virag, Budapest, Austria-Hungary. App. filed June 28, 1900. The method of telegraphically controlling a writing receiver adapted to trace a continuous line, which consists in mechanically imposing upon the circuit for each character of the message to be transmitted a definite and predetermined number of current impulses adapted to actuate said receiver to trace the message in script characters.

675,496. WRITING TELEGRAPH; A. Pollak and J. Virag, Budapest, Austria-Hungary. App. filed June 28, 1900. This patent contains apparatus claims for carrying out the method described in the previous patent.

675,517. CONTROLLER FOR ELECTRIC MOTORS; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed Aug. 28, 1900. In a car controller the handle of the regulator switch is connected with the reverse switch in such a way that by special movement of the handle, the reverse switch is unlocked.

675,518. ARMATURE VENTILATION; F. A. Merrick, Johnstown, Pa. App. filed Oct. 25, 1900. Relates to the shape of a spacing block inserted between the plates.

675,522. TROLLEY POLE; C. Nicholson, Springfield, Mass. App. filed Sept. 5, 1900. A pole in telescoping sections with automatic devices for opening and closing it.

675,527. MAGNETIC BRUSH; J. B. Righter, Elroy, Wis. App. filed Sept. 12, 1900. Magnetic pins representing the bristles are attached to magnetic plates in the back of the brush.

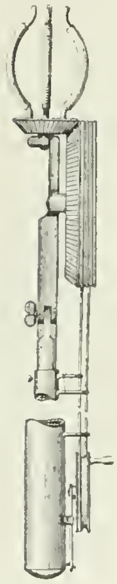
675,532. SYSTEM OF ELECTRICAL DISTRIBUTION; L. B. Stillwell, New York, N. Y. App. filed Feb. 14, 1901. (See Current News and Notes.)

675,555. ELECTROLYTIC PRODUCTION OF WHITE LEAD; E. D. Chaplin, Winchester, Mass., and H. G. Halloran, Boston, Mass. App. filed July 5, 1900. (See Current News and Notes.)

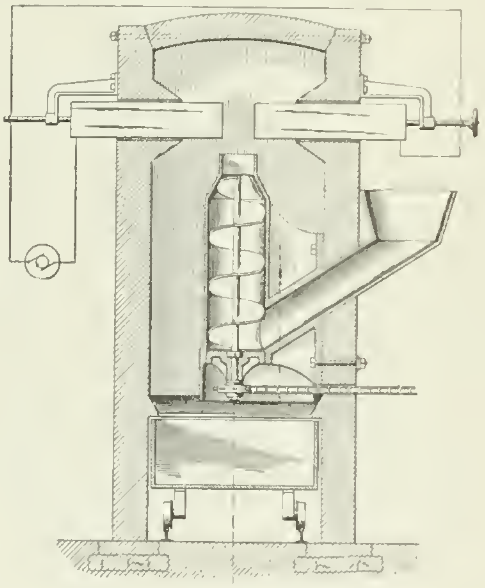
675,586. ELECTRICAL STORAGE BATTERY; W. J. Buckley, Chicago, Ill. App. filed July 5, 1900. (See Current News and Notes.)

675,587. SECONDARY BATTERY; W. J. Buckley, Chicago, Ill. App. filed Feb. 2, 1900. (See Current News and Notes.)

675,588. STORAGE BATTERY; W. J. Buckley, Chicago, Ill. App. filed Oct. 9, 1899. (See Current News and Notes.)



675,640.—Apparatus for Removing Electric Light Bulbs.



675,646.—Process of Producing Calcium Carbid.

675,599. ELECTRIC ARC LAMP; D. Higham, Winthrop Highlands, Mass. App. filed Nov. 21, 1900. In connection with a series coil and an auxiliary coil means are provided for causing the magnetomotive force of the latter coil to vary at a rate different from the rate of variation of current in the arc.

675,600. STORAGE BATTERY; G. W. Hough, Evanston, Ill. App. filed Dec. 20, 1900. (See Current News and Notes.)

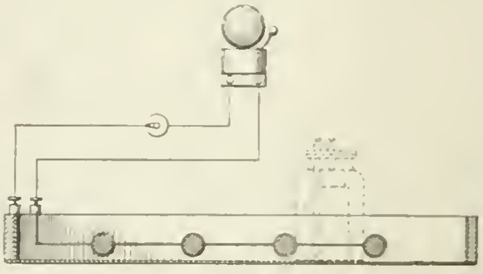
675,614. ELECTRIC SWITCH; J. M. Anderson, Boston, Mass. App. filed Jan. 17, 1900. A form of quick acting switch.

675,615. INSULATOR; J. M. Anderson and A. Anderson, Boston, Mass. App. filed Jan. 31, 1901. Details of an insulator for supporting a rail.

675,636. ROTARY POLISHING MACHINE; J. McCabey, Providence, R. I. App. filed April 4, 1901. In a polishing machine the combination of two sets of polishing devices running in opposite directions and arranged to operate at the same time on a cable, with a space between the sets to allow a dressing to be applied to the cable after being partly polished and before finishing.

675,640. APPARATUS FOR REMOVING ELECTRIC LIGHT BULBS; F. H. Renard, Wilkesbarre, Pa. App. filed Jan. 2, 1901. A rod on the end of which is gearing and a grip adapted to take hold of the lamp bulb; the bulb can thus be rotated to remove it from the socket by means of a belt extending from the gearing to a pulley near the handle.

675,646. PROCESS OF PRODUCING CALCIUM CARBID; J. Zimmerman and I. S. Prenner, Chicago, Ill. App. filed March 13, 1899. A feature of the invention is the provision for feeding the mixture through the furnace from below, so that as it is fed to the arc it completely fills the space and utilizes the entire heat of the arc.



675,708.—Battery Tray.

675,653. ELECTRIC BELL MECHANISM; W. E. Foster, Carnegie, Pa. App. filed Dec. 8, 1899. The hammer is lifted from the gong by a solenoid and is carried against it by gravity, means being provided for lifting the hammer slightly away from the gong after it has struck it.

675,662. RETAINING LOOP FOR PLATING RACKS; S. Lowe, Waterbury, Conn. App. filed Nov. 15, 1900. A wire rack for the support of articles while being electro-plated.

675,667. ELECTRIC BRAKE FOR RAILWAY CARS; F. C. Newell, Wilkinsburg, Pa. App. filed March 26, 1900. A brake switch adapted to connect the motor or motors to act as generators in a local braking circuit regardless of the position of the handle of the running controller.

675,668. ELECTRIC BRAKE; F. C. Newell, Wilkinsburg, Pa. App. filed April 28, 1900. A modification of the preceding patent.

675,675. ARMATURE AND MAGNET ADJUSTING DEVICE FOR RELAYS OR OTHER ELECTRIC INSTRUMENTS; U. S. Rogers, New York, N. Y. App. filed March 5, 1901. Details.

675,685. EXTENSION BELL FOR TELEPHONES; V. J. Van Horn, Keokuk, Iowa. App. filed April 12, 1900. The bell or signal on the extension line is operated by a mechanical action of the main signal bell.

675,690. CONTACT PLUG; C. Wagner, New York, N. Y. App. filed Feb. 28, 1901. Details.

675,708. BATTERY TRAY; J. R. Blackwell, New York, N. Y. App. filed Feb. 15, 1901. The tray contains electrodes connected in an alarm circuit, so that in case a cell resting in the tray becomes broken, the solution will act upon the electrodes in the tray and send in an alarm.

675,738. COMBINATION WATER-TIGHT JUNCTION BOX, RECEPTACLE, AND FIXTURE; A. E. Jahl, New York, N. Y. App. filed March 9, 1901. Details.

675,749. ELECTROLYTIC CELL; A. Merry, Liscard, Eng., and J. H. Noble, Liverpool, Eng. App. filed Nov. 19, 1900. (See Current News and Notes.)

675,755. APPARATUS FOR INDICATING THE PRESENCE OF DANGEROUS GASES; H. G. Prested, London, Eng. App. filed Oct. 15, 1900. A porous vessel exposed to the dangerous gases allows passage of the gas inward more rapidly than passage outward of the air contained in the vessel, as the gas and air tend to diffuse, and thus a flexible diaphragm closing a passage from the vessel becomes more or less bulged and makes an electrical contact whereby an alarm is operated.

675,784. SECONDARY BATTERY; C. L. R. E. Menges, The Hague, Netherlands. App. filed Dec. 23, 1897. (See Current News and Notes.)

675,846. MOTOR; A. Benson, Chicago, Ill. App. filed Nov. 4, 1899. The object is to provide means whereby an electric motor may be utilized for starting an engine, and the latter utilized for driving the motor as a dynamo and storing electricity for use in either starting the engine or assisting the latter in the work it has to do.

675,847. MOTOR; A. Benson, Chicago, Ill. App. filed Nov. 4, 1899. A modification of the preceding patent.

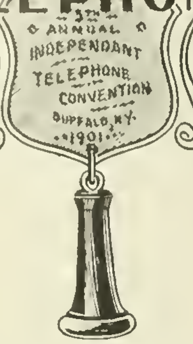
675,848. MOTOR; A. Benson, Chicago, Ill. App. filed Jan. 31, 1901. An explosive engine for automobiles adapted to be started in either direction or stopped and reversed without turning the crank shaft by hand and as readily and with the same degree of certainty as can be done with a steam engine.

675,865. AUTOMATIC CIRCUIT BREAKER; C. E. Starr, Camden, N. J. App. filed Nov. 22, 1899. A circuit breaker, consisting of a box having an open side, contact devices mounted therein, a lid adapted to close the open side of said box and hinged at one edge to one side thereof, said lid forming the switch-carrying arm of the circuit breaker, tension devices situated within said box and bearing against the inner face of said lid, and locking devices for said arm adapted to be actuated by an abnormal current in the line to release said lid.

675,871. SAFETY ALARM DEVICE; L. Da Rozir, Boston, Mass. App. filed April 23, 1900. A weight carried by an arm is removably attached to a shaft in such a manner that centrifugal action will cause the weight to close a circuit.

11,913. (Re-issue.) TRANSMITTING ELECTRICAL IMPULSES AND SIGNALS AND APPARATUS THEREFOR; G. Marconi, London, Eng. App. filed April 1, 1901. (See page 1022.)

INDEPENDENT TELEPHONE CONVENTION



THE Independent Telephone Association of America held its fifth annual convention at Buffalo, N. Y., on June 11, 12 and 13. The headquarters were established at the Iroquois Hotel, and the meetings were held at the Convention Hall, about a mile distant. The attendance was in all probability the largest that has ever graced a telephone convention in America; at any rate, one would have to go back to the earliest years of the industry, around 1880, to find a meeting that would approach it for numbers and enthusiasm. A list of those in attendance appears elsewhere.

At noon the convention was called to order by Judge J. M. Thomas, president, who introduced Mr. Conrad Diehl, Mayor of Buffalo. Mr. Diehl made a brief and pithy address of welcome, greeting the delegates not merely on the ground that they had come as a body to the Pan-American city, but because they represented a principle of vast importance in all industries, viz., "competition is the life of trade." From the competition which they offered in their line it was only reasonable to suppose that the public would be the beneficiaries. Certainly the telephone was almost as necessary now as the air we breathe and the food we live on. In the all-important matters of sickness the telephone in forbidding delay showed its value, and so in all other directions. Out of their efforts, therefore, and from the competition created, must come, he hoped, a betterment in price and a betterment in service. As to the Pan-American Exposition, which was doubtless one of the reasons for their presence, he might point to it as a striking illustration of what they were interested in—the modern uses of electricity, all of which were exemplified. Buffalo itself was worth study in its elevators, lighting, street cars and even its telephones, all deriving the power for their operation from the distant cataract at Niagara Falls.

PRESIDENT'S ADDRESS.

Judge Thomas then delivered his presidential address, essentially as follows:

The past year has been one fraught with important events in the telephone world, and the great work that has been accomplished is the highest commendation that can be offered to the great army of workers in the field. Having been in close touch with all the great independent organizations of the country and knowing their present status, I do not hesitate to say that all doubt of the permanency of the independent telephone movement has passed. Doubters have become its advocates, while the voice of the false prophet is no longer heard in the land, and his writings have been placed in the archives of oblivion, bearing the inscription above its portals, "Failure."

The work in the Middle West, North and South, the greatest fields of activity in telephone development, is to be followed by very active development in the extreme Eastern and Western sections of the United States, and in a short time the organizations, now nearing perfection in these sections, will show a development that will be highly gratifying to those of us who for several years have labored in the fields now more fully developed.

In speaking of the conventions held by this organization I have heard several gentlemen who have attended them say that the general tone resembles more political conventions than conventions of allied business interests. I have always agreed with that statement with a limitation that they have been somewhat like political conventions would be with the politics eliminated. Like public conventions, we have never lost sight of the principles of progress and fair dealing with the people, and being so different from meetings of the men who control the Bell companies, this impression has found lodgment in some minds. But this spirit, being the surest sign of the fundamental principles of progress, we desire that it shall always be the keynote of all conventions of the organization.

There has been much inquiry, not only on the part of those who have control of this field of investment, but also by those desiring to enter, as to the underlying principles that actuate the development of this movement. To fully and properly answer that inquiry requires a careful study of the entire history of telephony and would require more time than those of us who are actually engaged in construction and operation have been able to give to the subject; but a glance over certain events and certain policies will be of interest and profit to persons seeking the knowledge desired by the prudent man before investing in the building of telephone properties.

The telephone being one of the greatest utilities discovered and put into practical use by man, and being entirely new, and the only means of reproducing articulate speech at a distant point, gave the inventors a right to protection for seventeen years under the United States statutes, which rights the inventors could keep or sell to others if they so desired.

Bell's invention, the first put into practical use, and which at one time was a useful and satisfactory transmitter, being what we generally term a magneto telephone, gave place to a more effective instrument, the product of the minds of several inventors but brought into perfection by that great inventor, Thomas A. Edison, who discovered the fact that carbon electrodes held in constant contact but so arranged as to admit of variable pressure in conformity with sound waves, the result of articulate speech, thus regulating the flow of an electric current through them produced by a battery in connection therewith, gave a fuller and more perfect transmitter than Bell's invention.

After this discovery Bell's invention was fast supplanted as a transmitter by the more effective microphone, but its use as a receiver in connection with the microphone has been universal. For the purposes of this investigation the great volumes of records and briefs in litigation between inventors, or their assigns, will be of very little service, and, therefore, we pass to such facts as will enable us to more fully understand the history leading up to the beginning of the independent telephone movement.

The first, or fundamental, Bell patent expired in March, 1893, and the second Bell or magneto telephone patent expired in January, 1894, and between these dates we find the work of establishing independent systems began. Nov. 17, 1891, the Berliner patent was issued on an application filed June 4, 1877. The claims of this patent were intended to be broad enough to cover all constant-contact battery transmitters, and these were believed to be all battery transmitters of commercial value.

In May, 1893, the Edison carbon transmitter patent was issued on an application also filed in the year 1877, and it should be remembered that both the Berliner and Edison patents were owned by the American Bell Telephone Company. This patent was for the use of carbon electrodes in a battery transmitter. No other material has been found as a practical substitute for carbon.

These two patents were for seventeen years from the date of their issue, and if either or both of them had been found valid it would have continued the Bell Telephone monopoly to the year 1908 or 1910.

When the Berliner patent was issued, Milo G. Kellogg obtained a certified copy of the record of the application in the Patent Office, and after a careful study of the same for several months, became convinced that the patent was invalid for several reasons, and would not be sustained by the courts, if intelligently litigated. He also realized that unless its validity was attacked in some unusual manner it would remain as a menace to prevent any extensive competing use of battery transmitters, and when it came to be litigated, if such a case should arise, the defense was likely to be weak and ineffective, and the patent, therefore, likely to be sustained, and thus the Bell monopoly would continue to the end of the term of the patent. He then conceived the idea that the question was one of great public importance, and that the patent, having, as he believed, been improperly granted, the Government itself should begin a suit to test its validity, on the basis of annulling or revoking it. It was certain that a patent could be revoked on the ground of fraud, but it had not been adjudicated whether a patent could be revoked on grounds of invalidity. The proper channel for bringing a suit to annul or revoke a patent was through the Attorney General in the name of the United States against the party or his assigns claiming the right of monopoly under the patent.

He prepared a brief of about 150 pages, giving the various grounds on which he believed the patent was invalid, and in November, 1892, presented the same to the Attorney General. After the matter had been considered, and with the approval of President Harrison, a bill was filed by the Attorney General in 1893, in the name of the United States against the American Bell Telephone Company. The first decision in the case was by Judge Carpenter, who declared the patent invalid for two reasons, but did not pass on the other grounds of invalidity which were raised. These two reasons were, first, fraud in obtaining the patent, and, second, the fact that a patent had been granted to Berliner on the same invention in the year 1880. The case was carried to the United States Circuit Court of Appeals, which held that the only ground on which the patent could be canceled or annulled was that of fraud, and that the other claims of the bill could only be set up as defense in a suit brought by the owner against an infringer. This court found that no fraud had been proved, and that, therefore, the patent could not be ordered canceled. The Supreme Court, on appeal, took the same view of the case.

After the decision of Judge Carpenter in the Circuit Court, the few companies which had begun to manufacture and build exchanges took new courage and many others entered the field, and this new impetus assured our present great success in spite of all that has been done to discourage us.

After the decision of the Supreme Court in the Government case, the testimony was completed in the infringement cases which the American Bell Telephone Company had in the meantime (Aug. 5, 1895), brought against the National Telephone Manufacturing Company and the Century Telephone Company. The defenses in these cases included the same grounds of invalidity set up in the Government case except that of fraud, and the decision of Judge Brown, recently handed down, practically sustains all the defenses except one.

The Edison patent on the use of carbon in the transmitter was no doubt valid; but the question arose concerning it as to the effect on its life of Section 4887 of the Revised Statutes. The application for this patent was filed before Edison had taken out any foreign patents on the invention, but the patent itself was issued after he had taken out foreign patents, and, in fact, after such foreign patents had already expired. With one interpretation of the meaning of Section 4887, the foreign patent would limit the life of the United States patent, and the patent had already expired at the time of its issue. The interpretation of this section had already been raised in regard to other patents, but had never been passed upon by the Supreme Court, and it was uncertain what the decision there would be. There was pending before that court a suit known as the Bate Refrigerator Company vs. Ferdinand Sulsberger et al., in which this particular question was involved. This case was one of minor importance, but on the outcome of the same depended the question as to whether the Edison carbon patent, owned by the Bell Company and some important electric light patents owned by the General Electric Company, should extend for seventeen years or had already expired. When this comparatively unimportant Bate Refrigerator case came to a hearing before the Supreme Court, the side which was favorable to the Bell Company's contention was most ably and elaborately presented, Mr. Storrow, chief counsel for the American Bell Telephone Company, and other noted lawyers presenting very able briefs on the subject. The other side was also well represented, especially by Mr. Wetmore, of New York. There was, however, nothing to show that there was practically anything more at stake than the contest between the Bates Refrigerator Company and Sulzberger. At the hearing, however, a request was made and granted that Mr. Charles H. Aldrich, formerly solicitor general, be permitted to file a brief in the case on behalf of Milo G. Kellogg as "one whose interests as an inventor of telephone appliances, and as a stockholder in companies operating telephone exchanges and manufacturing electric light and other apparatus, would, in his opinion, be disastrously affected by an interpretation favorable to complainant of Section 4887, Revised Statutes." Mr. Aldrich's brief thus filed pointed out to the court the great interest involved in the suit, and the legal grounds for an interpretation of the section which would, in fact, limit and make the Edison patents ineffective. The Supreme Court decided the case in favor of defendant, holding that under Section 4887, United States Revised Statutes, the expiration of a foreign patent limited the grant under our laws to that time, and, as far as the statutes then stood, the Edison carbon patent became a dead issue.

However, while this Bate case was pending before the Supreme Court several bills to amend Section 4887 were introduced in Congress, the effect of which, if passed, would be to give life to the Edison patent for seventeen years from the date of its issue. The real animus and source of the instigation of these bills was not apparent. The fact of their existence and the real motive and effect of the same came to Mr. Aldrich's knowledge, and he prepared a memorial to Congress on the subject, entitled "The American Bell Telephone Monopoly and the Pending Legislation in Its Interest." A copy of this memorial was sent to every member of Congress. The effect of the same was that the real motive for the proposed legislation was exposed and thus the bills were defeated.

But to show how adroitly the affairs of the American Bell Telephone Company were managed we must now consider a few facts which were the result of the thought of great minds employed to prolong the monopoly. Edison having applied for foreign patents, and they recognizing the danger of limiting his rights under Section 4887, Revised Statutes, should their efforts fail to repeal or annul it, the Berliner application for a patent was, by shrewd manipulation, kept pending in the Patent Office for fourteen years, and he, so far as we have discovered, made no application in a foreign country under the statutes of which the patent in this country would be limited, but only in such countries the laws of which would not bring it under our court's interpretation of Section 4887, in view of the danger growing out of the Edison foreign patents. After the Berliner caveat and application had passed to the ownership of the American Bell Telephone Company, which did not claim a constant-contact telephone which would reproduce speech, but a make-and-break transmitter which would reproduce musical sounds, this able corps of experts in the pay of the company managed, after this delay of fourteen years, to obtain a patent by amendment, claiming just the invention that Mr. Berliner had disclaimed in his caveat and original application.

After the decision in the United States Supreme Court in the Government case, through the efforts of J. B. Leatherbee, treasurer of the National Telephone Manufacturing Company, Edward P. Payson, of Boston, a very able and conscientious lawyer, proceeded with the arduous task of completing the proofs to sustain the defenses set up in his answer to the bill of complaint in the case of the American Bell Telephone Company against the National Telephone Manufacturing Company.

Mr. Payson gave to this case a great portion of his time and his best thought from the time of his retainer in 1895 to the time the case was fully submitted to the court, November, 1899. Judge R. S. Taylor, having been selected by the Government as one of the counsel in its suit and being very familiar with the questions involved, was retained to file a brief and make an oral argument in the case against the National Telephone Manufacturing Company on behalf of the defense. Feb. 27 last Judge Brown, of the United States Circuit Court, District of Massachusetts, handed down his decision after considering the case from November, 1899, to that time, and from his rescript, indicating his deep study of the questions involved in this important case, the impartial words of the learned Judge clearly indicate his conviction as to the deep-laid scheme to prolong a monopoly.

We certainly should appreciate the efforts of these men who have so ably resisted the efforts of the representatives of the American Bell Telephone Company to retain that which had by law passed to the people, and no voice should be heard except in highest commendation of their work. Their intelligent and arduous labors have defeated the skill and cunning of those who were employed to try to deceive our patent officials and our courts. I feel at this time it is not only the duty but the pleasure of this organization to make public acknowledgment of their services.

This combined effort has resulted in the decision of Judge Brown, in which he holds: First, that at the date of the application, June 4, 1877, Berliner had not made the invention covered by the patent issued to the American Bell Telephone Company on Nov. 17, 1891. Second, that the invention designated in the patent is radically different from the invention described in the application. Third, that the invention was previously patented by Berliner. Fourth, that Edison was the prior inventor. Judge Brown agrees with the well-known position of all telephone inventors that Berliner, so far as his claim to a microphone is concerned, invented nothing.

These facts, together with the policy of the Bell companies in dealing with the people, has been the chief incentive to invest in this field. The people were anxious for relief from their arbitrary methods, and have always welcomed an independent company.

Having proven our legal right to give telephone service by good and efficient methods, and having demonstrated our ability to compete with the old companies, it becomes now a question of working together for one common end, and it is important that at this meeting we consider such questions as will lead us to unity of action. The present year will add much to our present strength by placing a large amount of money at our disposal.

At the close of the address, on motion of Mr. H. D. Critchfield, general counsel of the Cuyahoga and U. S. Telephone companies of Cleveland, it was unanimously agreed to adopt the suggestion of the president and extend the thanks and grateful acknowledgment of the association to those who had so faithfully, honestly and enthusiastically guarded their interests in this great litigation.

The meeting then adjourned until 10 a. m. Wednesday.

WEDNESDAY MORNING SESSION.

The session on Wednesday morning opened at 10 a. m., when a paper was read by the Hon. S. P. Sheerin, of the New Long-Distance Telephone Company, of Indianapolis, on "Village Exchanges and Farmers' Lines."

SHEERIN ON VILLAGE AND FARMERS' TELEPHONY.

The telephone—which, after all, has only had its development in the last six or seven years—is a greater boon to farmers than to any other class of people. The great drawbacks of country life are its isolation, its meagre opportunities for social intercourse and its still fewer opportunities for protection. When we add to these the disadvantages of being out of touch with the market, and out of reach of the great news pulse of the country, the sum of the country life's shortcomings is complete. The telephone changes all this. No man can fully estimate its benefit to the farmer. It brings his ear close to the market tickers of the world; brings the weather report to his door, in time to protect his crop and cattle, and travels, what would be to him and his horses, weary miles, in the ordinary transaction of his every-day business.

It is, I am afraid, a slight reflection on the usual good sense of the average farmer, who has progressed, in other respects, out of the cheap way of doing things, to find him insisting upon putting up cheap, grounded telephone lines, on native poles, three or four hundred feet apart—marring the landscape, and furnishing temptations to profanity by those who have to use them. A poorly constructed and badly managed country telephone line is many hundred times worse than no telephone at all. There was a time when those things served their purpose as educators, but that time has passed.

The country telephone line (and all other telephone lines which go along the country road) should be considered as part and parcel of the road itself. They should not be considered as tenants of the road, or as something that is there by sufferance, or by the permission—grudgingly given—of those who, for the time, do not appreciate its advantages; but it should be regarded as a part of the road itself.

I look forward to the time when telephone lines will be regarded as such sacred property, that men and boys will no more think of interfering with a country telephone line than they do now of throwing stones at windows or killing song birds as they pass along.

In order, however, to be entitled to this high regard of the public the telephone must, by its outward appearance command the respect of the people. Telephone lines should be substantially and neatly constructed. They should be of the very best material—good, heavy, well-shaped poles (no pole shorter than 25 ft., nor smaller than 6 inches in diameter at the top); cross-arms should be of regular length, and the wire put on in a thoroughly mechanical manner. I have an impression that, as time goes on, and our high regard for the telephone increases, we may get along with shorter poles, and put out wires as near to the ground as electrical conditions will permit. My thought is, that we will not have to use very high poles anywhere, except at road crossings, and it is barely possible that we may reach a condition where it will be found easier to go under cross-roads than over them. Wherever it is possible I think that not more than one line of poles should occupy the same side of the road. It will be entirely possible to build a line, sufficiently strong and symmetrical, to take on all the lines that should go along any particular roadway.

Of course, it goes without the saying that all lines should be iron or copper metallic, and, as nearly as possible, the maintenance of the whole line should be under the control of one head—without reference to how many persons or companies may be interested in the pole line. One of the great troubles of the country telephone line—as, indeed, it is one of the drawbacks we all have in cities—is the trees. In the cities we are able to escape this annoyance very largely by the use of cable, but, of course, it would be impossible to do this in the country. Not taking into account the great additional cost of that sort of construction there are electrical considerations that make a continuously long cable line an impossibility. The trees on the country roads should give way to the telephone.

I am an advocate of trees, and believe that we should cultivate our forestry in every possible way, consistent with the discharge of our other obligations. But as it was necessary to trim away the original forests to make the roads, so I would trim away the trees along the side of the roads, which interfere with that part of the road which belongs to the telephone. Trees along highways, near residences, can just as well be set back 25 or 30 ft. They have no business on the highway or overlapping the highway, when they interfere with the uses of the highway.

The telephone is a proper use of the highway. In many respects it is the most important use. Being a comparatively new thing, it may take legislatures and courts a little while to appreciate all this, but just as surely as our American legislation and jurisprudence has found a way to clear all other obstacles from the path of material progress, so they will find a way to order the trees along the highways, set back out of the way of the telephone.

In my judgment, village exchanges should be encouraged everywhere, and these village exchanges should have direct communication with the county seat exchanges and the exchanges in other towns of the county; and these exchanges, in turn, should be connected with the long-distance exchanges of the several States.

With all due respect to the manufacturers—and I think the manufacturers are entitled to a great deal of credit for the development of the telephone business—I cannot help the feeling that they are very largely responsible for a great lot of shoddy, inefficient and wholly abominable telephone equipment in the country. They go upon the theory that the farmer wants something cheap, and that the way to catch him is to present a very low-priced article, without very much reference to how long it will last or what service it may give him in the meantime. This is little short of criminal, and cannot be too strongly condemned.

This association, and all other people largely interested in the telephone business, who want to escape responsibility for bad service by other people, as well as by themselves, should set their faces firmly against the manufacturers who make specially "Cheap John" equipment for farmers' lines.

The battlefield of the great telephone war, which has been raging in this country for the past five years—with the victories always on the same side—has been largely transferred from the cities to the country. The Bell companies, in the days of their monopoly—and, in fact, until quite recently—positively refused to furnish service to the farmer upon any terms. Now they have changed their minds about that, and seem to have concluded that the farmer and the villager are not such bad fellows after all. But their repentance has come too late.

When the first independent telephone exchange was constructed in Indiana, my State, the Central Union Telephone Company had been paying, for 12 years, on a capital of $6,300,000 (three-fifths of which was pure water) annual dividends, ranging from 4 to 6 per cent. They had no bonded indebtedness and no floating indebtedness, that was reported. When the fight with the independents began they ceased paying dividends—the last one being paid in 1895. In 1897 they borrowed $2,500,000; in 1899 they borrowed $6,000,000—two and a half of which was set aside to pay the holders of the first mortgage of two and a half millions. They now have, in addition to this $6,000,000 mortgage (according to recent publications), a floating indebtedness of $1,250,000. Now, let me tell you what all this has resulted in. The Central Union now has (as shown by their own figures) 22,000 telephones in the State. The real number is smaller than this, but we can afford to be generous, and I propose to give them all they claim. The independent telephone interests have, in the State of Indiana, by actual count, 52,469 telephones. I know you will excuse me if I repeat those figures. *After a "war expenditure" of $7,250,000, begun upon the independent movement when there were less than 3000 independent telephones in the State, the Central Union now has, for its expenditure, 22,000 telephones, and the independent movement has* 52,469. The total population of Indiana (according to the census of 1900), is 2,516,000. There are 92 counties in the State, and there are 27 of these, in which the Central Union (or any other Bell company) has no exchange, large or small. The population of these 27 counties aggregates 491,000, and the aggregate number of independent telephones in these 27 counties is 14,262. The total number of Central Union and other Bell company telephones, used at toll stations only, in these 27 counties, is 197. Of the millions invested in independent telephony in Indiana, less than $100,000 had come from outside the State.

The independent movement gives opportunity for self-helpfulness and intelligent co-operation. That which a man can do for himself is most likely to be quickest done. The flexibility of the independent plan is its greatest recommendation. There is no honest local movement that cannot find a warm welcome and a happy home in it. It will not do to say that good service cannot be given by the independents. Every unprejudiced man will say that the most indifferent independent service in the country to-day is very much better than the average Bell service was when the independent movement began.

Mr. J. B. Ware, of the People's Telephone Company, Detroit, Mich., in the discussion on Mr. Sheerin's paper, pointed out, among other things, the distinction that existed in farmers' telephoning that had not been recognized. Some farmers used their telephones for business purposes, and they were desirous of having individual lines, as any one must who was in commerce and surrounded by competitors. But a great bulk of farming telephony rested on mere sociability, and he had been very much surprised to hear an experienced man say that usually the farmers would rather have six on a line than not. In fact, if some one in a farming district had six on a line he could go into the same territory and beat him out simply by putting, if possible, 20 on a line. Merely for the sociability of the thing, the farmer wanted to have as many on a line as possible. Farmers had built their own lines, connecting up their own systems with cheap instruments and switches, some one farmer allowing the central to be established in his house, and the farmers were getting their service for nothing. It was difficult to build up a toll line business with that set of conditions to be faced; they were really a menace to telephone development at the hands of some of the independent companies. In Michigan $12 was the limit for farmers' service, and some rates were even lower. But, in the long run, in two or five years, the farming communities would outgrow these cruder conditions and themselves demand more separate lines, or lines with at best only two or three on each. That meant that the present pole lines with 6-pin cross-arms would be inadequate, as they would soon be compelled to furnish a large number of additional circuits. They ought even now to be putting in poles to carry 10-pin cross-arms, as the proper equipment for the near future. This change was the salvation of the telephone industry in Michigan and elsewhere, and the consequent higher rates would not be fought, because the farmer was a reasonable man, willing to allow a fair return on any investment. He was glad to note the frank admission by Mr. Sheerin, that the farmers had proved of immense value to the independent movement. The Bell people, or some of them, had reached the point of understanding this, but he had heard that the $100,000 president of the Bell Central Union Company was dead opposed to farmers' lines, and had even caused them to be taken down. There was in his opinion no way for the Bell licensee companies to drive out the independents except by getting the farmers away from them, and he did not believe this could be done. In large portions of Michigan the success of the independents was due to the fact that the farmers had been connected into the local exchanges. The ideal farmers' exchange was that which in turn was part of the system of the village or city exchange, building up from party lines to the trunk lines to the city exchange. In conclusion, Mr. Ware claimed very emphatically that the independents were now giving much better service than the standard achieved by their old rivals. Even the apparatus was now generally superior, as well as the quality of construction.

A member, with reference to the mention of the Central Union System, then read an item from the Chicago *Record-Herald*, of June 11, in which Mr. Sabin's circular to Central Union stockholders was quoted, telling them that several millions must be raised at once to put the plant in good condition for competition.

Mr. Fisher called attention to a decision by Judge Phillips in Ohio, ruling that telegraph and telephone companies, lighting and street railway companies, etc., having proper franchises, or the city or community itself could remove trees, or parts of them which were an interference with the reasonable use of the highway for purposes of traffic and commerce. The case was that of Keith against the Little Consolidated Street Railway, of Cleveland, where the company had to get eight trees out of the way, whose limbs were in the way of the wires. Judge Phillips threw the Keith case out of court.

Mr. T. J. Fricker, of the Ashtabula Telephone Company, made a long and very humorous address on the general relations of independent companies to the farmers, and in opening quoted an analogous case with a similar decision from the courts of Michigan, holding that public service companies had the right to cut every branch and every tree that interfered with carrying out the objects for which their franchises had been granted. He was himself engaged also in rural electric railway work, and quoted a case in his own experience where, because of the high voltage of the trolley lines, the position of some of the telephone circuits had to be changed. One man had interfered, and had spirited away their poles, but under threat of arrest by the constable he had restored the missing poles to the very spot from which they had been taken outside his property. He then paid a handsome eulogy to Judge Thomas for his work, and held that but for the sustaining power of the association and its protection many an independent company would long since have been wiped out of existence. As to the general success of the movement it was evident. In Ashtabula they began, for example, with 125 subscribers, and now had 900, and could not take care of the rapid growth. The great, vital thing now needed was the extension of the long-distance lines

As to farmers' lines a few years ago, even to the independents, the phrase had no meaning. Now that branch was highly important, and must be adequately dealt with by the superintendents, who should see to it that the Bell companies did not supply a service of that kind, and thus compel many a country business man who could not afford it, to put in two telephones. Another point was the telephone girl, in whose behalf he addressed some earnest remarks to his fellow members. It was no use putting in a fine plant and then fall down in operation. If the girls were properly cared for and treated the service would be good.

DEVELOPMENT EAST OF THE ALLEGHENIES.

Mr Charles E. Wilson, of the Keystone Telephone Company, of Philadelphia, who had been asked for a paper on "Independent Telephone Development East of the Alleghenies," apologized for inability to prepare it, owing to work on his new exchange, which will be in operation by October. He invited the convention to Philadelphia next year, and volunteered some very generous hospitality. As to the exchange, their conduit and cable system had been laid out for a capacity of 30,000, all underground connections, and there would be two main buildings, ready in 90 days. Some 4000 contracts for five years had been signed up, and they were still coming in at the rate of 75 or 80 a day. They had been advertising in the local papers some $2,000 a month, but, although that had been stopped, the names were coming in just as freely. The switchboards would be Kellogg. The telephones would be manufactured under contract, according to the specifications of their own engineers. Their rates would be $80 for single business lines and $52 for two-party lines; residence $48 for single lines and $36 for two-party lines, nothing higher than two being used. The old Bell business rate had been $160 unlimited service; all other service on the measured basis, and in the suburbs four and six on a line. In January the Bell people had 10,025 subscribers in a population of 1,320,000. In reply to an inquiry, Mr. Wilson stated that they had got along very well with the Pennsylvania Railroad, although that still had a long Bell contract. They had had a little trouble with the Reading system, but they had found the way of quietly bringing them to time.

Senator C. W. Kline, of Hazelton, Pa., president of the Interstate Telephone & Telegraph Company, of Pennsylvania, then read a brief paper on the subject assigned to Mr. Wilson. Mr. Kline said that under the splendid management of Mr. S. E. Wayland, superb plants had been installed in Scranton and Wilkesbarre, covering the Lackawanna and Wyoming Valleys, with an easy possibility of 30,000 telephones in sight, and 7000 now at work. Allentown, the center of the Lehigh Telephone Company's system, has a splendid system, with a possibility of 5000 telephones, with about 1800 installed. Reading is being built. Easton is working up the lower Lehigh. The Overland of Lehighton reaches out its tentacles for everything in sight. The Anthracite, of Hazleton, embraces everything in lower Luzerne, Upper Carbon and Northern Schuylkill counties. The Standard, of Bucks and Montgomery, is now being rebuilt by Mr. G. S. W. Brubaker, covering all that section. The United Telephone companies embracé Norristown, West Chester, Lancaster, Lebanon, all of the Schuylkill, Northumberland, Montour and Columbia counties, and the north and west branches of the Susquehanna. Harrisburg is building, and Columbia. York connected with Carlisle via Chambersboro is extending its lines in every direction in York and Lancaster counties, and is connected west to the Alleghanies. As to New York State, he remarked that fine plants had been installed at Rochester and Albany. The United Telephone Company, of Pennsylvania, covered the southern portion of New York State. The Maryland Telephone & Telegraph Company had a splendid plant at Baltimore, and the chain of independent companies stretched south along the Atlantic to the Gulf of Mexico. He predicted that in a very short time the independents would have in the territory east of the Alleghanies more telephones than the Bell would have in the same State both east and west of that range.

As to toll lines, Mr. Kline said that they were "short" on those, and "long" on local exchanges. But already the Interstate Telephone & Telegraph Company had built lines in the eastern portion of Pennsylvania connecting up that entire region with some 14,000 telephones, and it had its terminal at Trenton, N. J., thence reaching over the lines of the State Telephone Company, of New Jersey, up to Jersey City, which meant New York. The Interstate Company was also ready and willing to reach out across the Alleghanies and make the chain of service complete between east and west. There were at present too many companies in the field ambitious to control the situation as to toll lines, but in due time they would have to poll their interests and bury their differences. From the independent standpoint, the situation east of the Alleghanies was all right, and with 50,000 instruments they meant to take the "right of line" in the movement, and stay there.

Mr. C. E. Stinson, of the Rochester Telephone Company, N. Y., then continued the same topic and gave with considerable interesting detail an account of the systems in Rochester, which was described and illustrated in the Electrical World and Engineer, in the issue of Feb. 23, 1901. They had at present some 3600 telephones in service in a population of 160,000. The Bell people claimed 2200. On their anniversary of opening in May no fewer than 15,000 people had visited his exchange, showing the popular interest. He had about 160 miles of pole line, and had everything covered within a radius of eight miles of Rochester. With them, farmers' lines were different from what they had been hearing about, and brought $40 to $50, five-year contracts, payable quarterly in advance. Their pay also to the girls was high, averaging $5.44 per week. Mr. Stinson replied to a number of inquiries, and closed by inviting the association to visit Rochester.

The morning being far advanced, the remaining business on the programme was carried over, and the meeting adjourned to meet at 10 a. m. Thursday. A group photograph was then taken outside the Convention Hall, and the association as a body spent the afternoon on a trip down to Niagara Falls.

THURSDAY'S SESSION.

The Thursday morning session opened with the reading of a paper by Mr. L. W. Stanton, switchboard manager of the Cuyahoga Telephone Company, Cleveland, on "Exchange Service," accompanied by a number of load diagrams.

STANTON ON EXCHANGE SERVICE.

This subject may be divided into three important branches: Reliability, promptness, good transmission. Any of these, if not up to its highest state of perfection, mars the general result.

For good transmission as well as apparatus we must depend upon the manufacturer. The independent telephone interests are to-day in greater danger on account of some of the inferior apparatus that is being thrown upon the market than they have ever been from the old monopoly. Some of the apparatus that is being sold to-day by the independent manufacturers is a curse to independent telephony. It only half works. It is unreliable, it does not give good local service, not to mention the poor results obtained when used for long-distance lines. Every telephone that is installed to-day should be one over which conversations between New York and Chicago can be carried without difficulty, for it is only a matter of a short time till every telephone in this broad land will be connected by a network of long-distance lines to every city, village, town and hamlet. The continued use of inferior apparatus will mean unreliable service, poor transmission, expensive maintenance and a final discarding of the original installation at a great loss, and, worst of all, dissatisfied subscribers. I feel sorry for the independent interests when I see this inferior apparatus being installed in exchanges that are being newly equipped for it means a loss of prestige. It is true, it is difficult for the independent telephone companies to select the best apparatus, for, as a rule, their experience has been limited to the use of apparatus that was furnished them a few years ago. Another reason is the unparalleled strides that have been made in telephone manufacturing within the last few years. They have been accustomed to the old magneto drop board, which is undoubtedly a thing of the past in exchanges of any size. It is the opinion of the writer that in any exchange of over 100 subscribers, where suitable arrangements can be made for current, the only thing to install is a central energy lamp signal board with double supervision. This style of board saves an operator a great many moves, such as restoring line signals, and cutting in on subscriber's line to inquire if party answered, or if they are through talking, for with double supervision she can tell at a glance whether the called-for party has answered, or if the conversation is finished.

Wherever an exchange requires three or more operators a multiple board should be installed, for when transfers are used they impede the service and add permanently to the operating expense. On a large transfer board, you almost double your work, for nearly every call has to be trunked to a second operator, while with a multiple board each operator handles her subscribers' calls direct, without asistance. Another distinct advantage of the multiple board is: One operator in the evening and on Sundays can sit at one position and answer all calls through the multiple. In this way, with double supervision, she has control of the entire board.

I do not doubt that some of you are of a different opinion, but I will endeavor to show why this class of apparatus is superior. It gives better service. It is cheaper to operate. First, because it requires fewer operators. Second, because it dispenses with hundreds of local batteries scattered over miles of territory. Third, it does away with an expensive piece of mechanism, the generator, with its cog-gears, shunts, commutators, etc., which are a constant source of wear and tear. Fourth, in eliminating the generator and batteries, the number of inspectors can be reduced, which is no small item.

The following figures will give some idea of the saving in the cost of current for an exchange of 1000 subscribers. Taking the cheapest form of battery, which is the dry cell, at 15 cents each, and using two cells per telephone, which is modern practice, it gives a cost of 30 cents per telephone. Allowing the battery a life of one year, which is more than the average, we have a cost of $300 per year, or $25 per month for the 1000 telephones.

In one of our central energy exchanges of something over 1000 subscribers I find the average cost of all current for operating line signals, supervisory signals, and all current used for talking, amounts approximately to $6.50 per month, which is about one-fourth of the cost for current for operating the same size system with local batteries, to say nothing of the additional cost of labor for renewal and maintenance.

From a number of monthly reports of trouble covering both common battery and magneto type exchanges, I find that the number of cases of trouble at the subscriber's instrument is from two to four times as great for local battery plants as it is for common battery plants. With one of the latest types of central energy telephones the trouble at the subscriber's station is reduced to a minimum. There is practically nothing left but the transmitter, receiver and signal bells, and these, as they are made to-day by some of our best manufacturers, almost eliminate the possibility of trouble. This coupled with accurate and scientifically constructed apparatus at the central office gives the ideal system, and it is only with an ideal system we can give ideal service. It is often remarked that it requires better line construction for common battery plants, which is true to a certain extent, but any good line will work well with common battery, and in some cases this system is worked on a common return.

Telephone men are beginning to realize the importance of good line construction, especially when they see the great difference in the expense of maintenance between well and poorly constructed lines. The Bell Telephone Company's plant in St. Louis, in whose employ the writer spent several months in different departments, during the building of their new common battery exchange, offers a good example of first-class construction. In building this exchange they were extremely particular that every detail be carried out in the best possible manner. It seemed at the time that it was a waste of money, but I have since realized that it was money well invested. The entire system was put in so that it would stand the test of time. The interior wiring was protected in every possible way. Telephones were placed on the wall in the most substantial manner. Cable work and line construction was unequaled. As a result, the number of cases of trouble per telephone is less than that of any other telephone exchange in the country. The parent company has awarded them the credit of giving better service than that given by any other licensee company, and in the face of the strongest competition, I understand their financial showing is very good, which would not be possible with slighted details and poor construction.

The telephone business stands to-day on a higher plane than ever before. The independent movement has forced the Bell Company to put forth their best efforts, and this in turn has stimulated the independent companies, but telephony is yet far from its ideal goal. Look through the operating rooms of some of the large Bell and independent companies and notice the number of idle operators, while on the same boards there are operators that have more calls than they can properly handle. Few telephone men seem to have realized the importance of equalizing the load among the operators, that is, placing enough lines in front of each operator to properly load each position. I submit some charts, giving the peg count curves which convey the meaning more readily and show where thousands of dollars can be saved in the cost of operating, by reducing the force, besides giving more efficient service.

The operating force of a large exchange is one of its most important factors. If the operators are well disciplined and courteous, the subscribers are quick to notice and show their appreciation. Even a second or two is noticeable to a subscriber when awaiting an answer from central, and on hearing the operator call "number" in a brisk, clear tone, with a rising inflection, it conveys the idea of discipline. But if the operator answers with a falling inflection and uncertain voice, it gives the opposite impression; in fact, the operating force is nearer to the telephone public and wields a greater influence among the telephone's users than any other class of individuals connected with the company. It is through the operators that we dispense the little courtesies that make our service popular. A few weeks ago I was examining an independent telephone exchange which was exceptional, inasmuch as it had over 100 subscribers, but through the carelessness and neglect of the manager, who lived in another town, in maintaining the telephones and outside construction the subscription list had been reduced to 25, and those 25 I am told remained on account of the courteous treatment they received from the operator, who was certainly exceedingly kind and obliging to the subscribers. On the same day I visited this exchange I was in another small city, and while talking over the telephone situation with one of the citizens there he assured me that the chief operator of the Bell company at that place had done more than any other 20 causes combined to make the Bell company unpopular. These two cases just cited certainly show the importance of courteous operators. I remember an instance where I reprimanded an operator who had formerly been with the Bell company for speaking crossly to a subscriber. Her answer was, "Why, Mr. Stanton, you ought to hear how cross the Bell operators are, and you would not think we were cross."

I prefer not to employ Bell operators. As a general thing, they have some undesirable traits which become more prominent when they try to show their importance to the "new company"—as they term it. There is always an army of applicants besieging a telephone company for employment, and if you are any judge of human nature you will not be long in choosing a list of girls, who, with proper training and appreciation of their efforts, will make a very efficient corps of operators. There are few managers who realize the great advantage derived from the proper training of their operators. As a general thing, an operator after being employed is given a seat at the switchboard beside one of the old operators, and is told to watch the other operators and learn what she can, and in a short time she commences to answer a few calls, and from that time on she is supposed to be an operator. As a matter of fact, she is far from being one. She should become thoroughly familiar with all the rules, and should have their meaning explained to her. She should be taught how to handle the plugs with the left hand as well as the right. Until she can use her left hand as easily and naturally as her right she is only half an operator. She should be taught how to answer two and three calls at the same time without interference. It is only in this way that an operator can answer quickly and handle the number of calls that she should. Walk through almost any operating room, especially that of an independent exchange, and notice the number of wooden arms and mallets that are in use. Notice the number of false moves and untrained voices, and you will realize that the company is spending unnecessary money. By wooden arms I mean that the operators do not use the left arm any more than if it was wooden. By mallets, I mean that they are driving the plugs in by the heel of the hand, breaking the tinsel of the cords, causing a cut-out, which means unsatisfactory service, besides the expense of replacing the broken cords. By false motions, I mean that the plug is picked up with one hand and passed to the other instead of being inserted with the hand with which it was picked up. These are only a few points in which operators should be trained

The operating room should be conducted on a merit basis, and promotions be made according to the efficiency and courtesy of the operators. During each month competitive tests should be made to determine the speed and courtesy of operators in answering subscribers, and those having the highest general average as regards speed in responding to calls, courteous treatment of subscribers, obedience to rules, promptness in reporting for duty and regularity of attendance, etc., should receive some sort of promotion. Those who through these tests prove to be unqualified for the position of operator should be discharged. A form of promotion which I have found to work well is to give the operator having the highest general average the most desirable hours, and those least efficient the night hours. Another reward of merit which works well is to recognize an operator's ability by giving her a small raise in wages. I do not believe in giving an operator a large raise in wages at one time, but to encourage them and to show that their efforts are appreciated by giving them an increase of, say, $1 at a time. This may seem like a small amount, but a girl will appreciate this raise as much as a man would an increase of $5 or $10, and by giving a small raise at each time you can reward their efforts more frequenly and thus get better results. Another method which I find works admirably is to arrange each operator's merit standing, showing who is first, second, third, and so on, leaving a copy in their recreation room. This starts a friendly rivalry among the operators, which produces results that cannot fail to make our service popular.

Every large operating room should be presided over by an A1 telephone man, who is thoroughly acquainted with every detail of the business, and who realizes the necessity of prompt action in the trouble department and the proper disciplining of the operating force. Last, but not least, he should have the faculty of dealing with the telephone public.

Mr. Stanton then explained a large number of peg count curves which accompanied his paper, compiled from independent exchanges. He said that a girl could easily take care of 2000 calls a day. In Chicago, the Bell exchange count from tests over a series of five years, showed a possible 528 calls per hour. The figures from leading Bell exchanges showed that one-eighth of the number of calls in the 24 hours gives the peak of the load. The result would be something like 4000 calls per 24 hours. Of course, with the old magneto board it took six times as long as with modern multiple boards, especially when modern plants included intermediate boards. He knew of only one independent intermediate board, namely, that of Mr. Curtis at Sandusky.

Mr. Curtis remarked that his operators were averaging 300 calls per hour, and he was giving a 2½-second service, and not 4 or 5.

Mr. Stanton said it was absurd to put only 100 subscribers in front of each operator.

Mr. Judson, of Minneapolis, said that ordinary peg count would not apply to his case where he had four or five operators for four hours loaded to death, although at other hours they had an easy time. They were stock and produce exchange operators. In Minneapolis they also had an information bureau, giving news of baseball and football games, etc. About 4 or 5 in the afternoon, in their sporty community, the inquiries poured in. Ordinarily when the rush was over daily he "lifted" some of the operators after the close of the stock exchange. The average during the 10 hours of business was 1400 calls.

Mr. Stanton instanced, as to distributing business, the case of Marshall Field in Chicago. There were 20 trunks leading from the private exchange to central, and those trunks were busy every minute. Now, one operator could not handle them all, so they were distributed throughout the exchange. He then described the method used in the Bell exchange in St. Louis, where at 6 p. m. the operators drew back from their positions and half the force went off. In short, the exchange closed up part of its system just as a business man closed up his store. The board was in the shape of a curve, and it could be noted that the business was bunched at the ends, where the operators seemed to be as busy as usual. To put the case in a nutshell, profitable exchange operation depends upon equalizing the load and giving every operator a full and equal amount of work.

Mr. Dougherty asked that in some way steps be taken to impress on members the value of such work as shown by Mr. Stanton.

Mr. Judson suggested that instructions be given as to methods of taking peg counts and compiling the curves.

Mr. Fisher admitted the value of peg counts, but asserted that it did not always mean good service. He had been the victim of a large Bell exchange taking peg counts, and it had been not merely 4 seconds per call, but 10 minutes.

A paper was then read by Hon. E. B. Fisher, Citizens' Telephone Company, of Grand Rapids, Mich., on the subject of "Bell Methods."

FISHER ON BELL METHODS.

I do not expect or hope to say anything startling or novel. Most of you already know all that I shall mention this morning—have had experiences and observations similar to those mentioned; but to recall them may induce the presentation of other and really new experiences, and may prove an encouragement or a suggestion to those just entering or about to enter the independent telephone field. The man or corporation that should ignore competitors, that fails to study their mutual conditions, and profit from them, could not expect to succeed in competitive enterprises and efforts. The man or corporation that maliciously or falsely discusses a competitor and its business in the hope that thereby its own business may be benefited makes a grievous mistake, and in the end loses more than is expected to be gained. With these two thoughts as premises, I enter upon a discussion of Bell methods. I could not, under any circumstances, consider such topic in the spirit of criticism only, and were I expected to do so should certainly decline the assignment. The gentlemen who have been conducting the business in the various constituents of what we know as the Bell Company are our neighbors and friends. Many of them have been in the telephone business for years, some for quite 20 years. They have extended experience, they are competent, successful business men, and we can learn much by observing their methods, and undoubtedly can find many examples in their conduct of business from which to profit.

One of the most serious criticisms I have had occasion to suggest as to independent telephone companies is their lack of system, their lack of carefully analyzing conditions and experiences and their making systematic deductions therefrom. They have engaged in the telephone business, in too many cases, much as the original Bell corporation did, and have been learning from sad personal experiences, rather than from profitable observation of what had already been "threshed out" in the evolution of the Bell system. It is highly essential, now that the independent systems are becoming larger, more complex, and intimately related with each other, that thorough system shall obtain; that first-class construction shall be the rule rather than the exception; that uniformity of practice in the manner of toll service, in the division of revenue arising therefrom shall obtain; that those conducting the business shall exchange experiences, thus enabling all to learn of mistakes and avoid them, and to secure the advantages of improvements that may be devised. The exchanges of the Bell company throughout the country have for years enjoyed the interchange of opinion and experience, and through the manifest advantages of such interchange, have avoided many difficulties and secured many betterments. We can and should copy this feature. We should meet each other frequently, individually and collectively, should keep in touch with each other by correspondence as well as over the wires—when we hear of a good thing, let our neighbors know of it; when we discover perils or uncomfortable conditions, warn our friends. The Bell, in a sense, although composed of many subordinate companies, have been one family. We can retain our individuality, maintain our ambitions to be the first in our chosen sphere of action, and still remember that we are a part of a family. Some have been inclined to suggest that our friends of the Bell company had too much system. As the business develops it begins to appear that too much system is less expensive and less foolish than too little. If the managers and operators of independent plants shall more carefully and fully analyze the cost of conducting their business in the different departments and the results therefrom, many errors will be avoided and the ledger balance on the right side will unquestionably grow. In systemizing business, we have much to learn from Bell methods. We should gain this knowledge and improve on it.

It is undoubtedly true that the conduct of a monopoly often results in somewhat of arrogance on the part of those who are at the head of such monopoly, or who hold responsible positions in the management of its business. Such people naturally come to feel that they can do about as they please, and if patrons or the public are not delighted therewith, what odds. I have heard gentlemen, who are listeners to this paper, more than once offer the suggestion that they would not care for the service of certain Bell employees who had applied for positions, because they were too "cranky." We can see for ourselves how natural it was that crankiness grew upon many officials and managers of Bell plants. They were not obliged to consult the wishes or desires of the public to secure their business and profits. One could take telephone service on their terms or let it alone. That was all there was of it.

This spirit of crankiness, so natural under the circumstances which engendered it, is the exponent of general conditions which produced other peculiar manifestations often noted the past few years. We should carefully consider these manifestations which are intended or expected to affect our own business, and, by interchange of observations or experiences, help each other and counsel or warn those who are about to engage in the independent telephone business. I well remember when, a little more than six years ago, we began canvassing in Grand Rapids, Mich., to secure the moneys with which to build the plant of the Citizens Company and for patrons of the same, the many stories which were afloat among our people as to our business. It was confidently asserted by representatives of the Bell company in our city and State that we never would build a telephone plant, indeed, that we had no intention of so doing, and were only trying to make money by being bought out. We were, in effect, it was intimated, intending blackmail. It was said that we could not build, could not get material, could not properly combine the material when we got it, could not find apparatus that was not infringing, could not get a switchboard that would work; would not know enough to set poles, string wire thereon and make them stand up. Even after we had actually begun to install telephones, those who had given us contracts were prompted to bet that we never would give service. There were infringement suits which may have been really expected to put a quietus on our enterprise, but these did not any of them succeed—it scarcely seems possible that some of them could have been expected to.

We have been giving service for more than five years, and the company which was then organized with but $100,000, authorized capital, has grown until it has to-day in service more than one-half as many telephones as the Bell had in the entire State of Michigan but five years ago, and has an authorized capital well toward one-half what the Michigan Telephone Company then had. And yet to-day similar predictions and commentaries upon like enterprises, even in Michigan, as well as other States, are indulged in by our neighbors. Officials of the Erie Company have informed the public through the press within a few weeks that the new independent plant will never be built in Detroit; that the People's Company in that city never will give service. When, in your respective localities, the Bell resorts to such methods to dissuade the public from patronizing them, to persuade them that you are not intending genuine business, you can comfort yourself with the fact that you are not singular in this experience, and you can point to results in other localities and say to your friends, "It is an old story, and no truer here than it has been elsewhere."

If you get started with service and you find that your patrons receive circular letters suggesting that the Bell is owner of letters patent "steen hundred thousand and steen," and that all who use the independent apparatus infringe such letter patents and are liable to prosecution for using the same, do not flatter yourself that in this method the Bell company is distinguishing you beyond other independent companies. Such things have been done repeatedly. You have yet to hear of a subscriber who has been so prosecuted, and you can very safely guarantee your patrons against any damage that may be awarded by any court under such suits, and that you will pay all costs for defense. If you should find that the Bell company, which has frequently informed the people in your community that its former rates were the lowest they could afford to make for its service in your locality, has, upon the development of your competition, resorted to free service, or much less than cost rates in an effort to destroy you, do not be fearful that such practice can really damage your company; do not imagine that you are enduring an experience novel in the telephone business. No, not for a minute, when the Bell resorts to this method attempt to meet competition by establishing like rates, or lower rates, for your own service. Begin the education of your people, take them into your confidence, tell them the truth about your business and its results; insist upon a fair profit, upon reasonable returns on the actual investment, after giving good service, and you will find the people ready to pay your price rather than to get absolutely free service from the competitor. Do not resort to other tactics because there can be but one result from such procedure. This Bell method is a "war measure," pure and simple, and if it could succeed would be followed by such advance in rates as would fully compensate that company for the temporary concession of free service or less-than-cost rates. This fact has but to be stated to intelligent business men to be apparent to them, and to influence their action. This method, which has been practiced by the Bell subordinate companies in considerable regions of the country, so far as I know, never yet has succeeded in taking away the patronage of an independent company honestly striving to give good service at a reasonable rate. The company which shall reduce its rates below a reasonable point in a struggle with the Bell company is doomed the moment it shall do so.

What do you think of party-line service? One of the methods of the Bell company, in its efforts to meet the lower rates of independent telephone companies, has been to introduce, quite largely, party-line service with important reductions in rates for such service. Has it been successful where you have observed it? Is it a serious menace as a competitor? Of course, we know that the new president of the Central Union and the Chicago Telephone companies, who still retains his position at the head of the Pacific Coast Company—all Bell—is a staunch advocate of this sort of service. He is a gentleman of extended experience and wide observation in telephony, and for that reason his opinion is not to be lightly dismissed or treated with indifference. We are this morning discussing Bell methods in the hope that we may learn from them and profit from either accepting or avoiding their example. My own observation has been that party-line service is largely "a snare and a delusion," where given in city exchanges, and is not a competition that we need fear. It is evident that no devices have yet been invented which will permit more than two parties to use the same line at the same time, so when any pair on a party line holds the line, others must wait. Should this sort of service be generally used, the difficulty of securing your own line and of getting connections with other parties on similar lines is manifestly very greatly increased. We all know how impatient the average telephone user is to get service the moment it is wished—you have known subscribers ready to swear that the girl kept them waiting two minutes for a connection when it was not to exceed 20 seconds. I do not believe that you will be compelled to resort to party line service to meet this method of the Bell competition. The B. W. C. service, which was expected to work wonders three or four years ago, is not very generally popular.

No discussion of recent Bell methods would be useful if we did not consider minute rates for toll service. What is your observation on this topic? The high authority from the Pacific Coast who is trying to stifle competitors in the Central Union territory and to prevent it in Chicago, who is indeed regarded as a possible head of the American Telephone & Telegraph Company, is the father of the minute-rate service. He sets great store by his scheme, and has secured its adoption in considerable territory outside of that which he controls. We, in the Michigan territory, find it one of our competitions, and have not quite made up our minds as to its present and probable effects. However, on general terms, it is fair to state that it is causing considerable friction and dissatisfaction. The average telephone user is ready to affirm that he has not used the service so long as he has been charged for. He considers himself a victim of overcharge, and believes that the minute-rate is intended to thus increase the fees of the telephone company which he was inclined to believe were already quite large enough. If the average business man, on a long-distance connection, can actually accomplish his conversation in a single minute, it strikes me that at the price for one minute's connection, the line cannot earn enough, for we all know that quite as much time heretofore has been spent in getting two parties to talking as is occupied with their conversation. Now, if the time for securing connections cannot be reduced and the time of using is reduced, with theoretical reduction of pay, service would be less profitable to the companies than on the three or the five-minute basis. If the average subscriber is expected to use the line on a three or five-minute basis, why not make rates upon that theory? That would be fair to both companies and patron, and secure the desired revenue, even if but one minute should actually be used. The purpose of this paper, as before intimated, is to set you to talking about your mutual experiences and to induce discussion rather than to state conclusions.

In Michigan our neighbors have taken a new departure within the last few weeks. Formerly, they refused to admit that any other apparatus than the Bell could be successfully used in telephone service. The sub-companies of the parent company were supposed to have a hard and fast contract forbidding the use of any other apparatus, and forbidding connections with any other apparatus. Latterly the Michigan telephone companies have been attempting to secure, in a few instances, toll line alliances with companies formerly built and still continued, as far as exchanges are concerned, as independent companies. The Michigan company has said, in effect, to such companies: Keep your local exchanges, even your own toll lines; take control of the exchange business in your locality, but enter into a contract for toll connection outside your territory through the Bell system. It will give you equal percentages on originating business to those you have heretofore enjoyed, and provide you with more extended and superior toll line facilities. This late Bell method is insidious, and it is not strange that in some cases it is successful. Where such a contract is made exclusive—and, of course, they try to make it exclusive if possible—it subtracts by so much from the efficiency of adjoining or neighboring independent service. So anxious has the Michigan Telephone Company become in this matter, I believe it is true that it has been willing to make arrangements in some cases for a divided toll service where it was impossible to secure an exclusive contract. This Bell method is one of the most threatening efforts yet made, and yet has its silver lining. The strong independent companies, with considerable toll line facilities which have been growing, have not been influenced by such propositions. Only the smaller and weaker companies have made such contracts with the Bell company. Of course, no other independent company has been willing to parallel the lines of a neighboring independent company, no matter how inferior might be such neighboring plant, or how imperfect its service. Now that sort of territory will be provided with up-to-date independent plants. This recent manifestation would seem to indicate that the parent company must have consented to an abandonment of the exclusive feature of its contract with subordinate companies.

I believe that the Bell habit of ignoring the farmers—the small villages and the country—has been an error. I think that in this department of telephone service, a proper development of party lines may be made with great advantage to the communities served and at fair profits to the investor. There are regions in Michigan—and probably each of you could repeat the same tale—where the Bell is beginning to compete with independents in their own field in this regard. I say their own field, because the independents were the first to deliberately provide this sort of service. This Bell method of following a good example may prove a formidable competition, and may materially strengthen their smaller exchanges and their situation if they shall first enter new territory with this sort of service.

There was a time when I think it was actually believed by the average general manager or prominent official connected with the Bell telephone companies that an independent company could not possibly secure intelligent, experienced employees. They thought that we would be compelled to go through the process of evolution which was so tedious and so costly in the earlier days of the Bell company; that their employees would remain with them. They even thought in some localities that an independent company would not get exchange operators, and in some instances employed superfluous help simply to keep them from entering the service of independent competitors. Some know more to-day on this topic than they did a few years ago. A large number of the brightest men in telephony have found employment in the independent field, and there is scarcely one in this Convention Hall who has not had frequent opportunity to secure many more of the most important employees of the Bell company than he has had places for. We have been surprised at times at the seeming lack of loyalty to their employers by those who have been so long on Bell payrolls. Perhaps a little analysis of Bell methods may explain this situation and furnish a warning for ourselves. The rewards among the employees of the Bell heretofore have not been great either in salary or opportunities. They have been made to feel more like machines than human beings. In many cases they have not had their inventive tendencies encouraged by proper compensation for what they produced; indeed, they have been compelled to part with their inventions on the theory that their brains as well as their labor, belonged to their employer, or because there was but one market for their invention and devices. That market could set its own price upon what it bought. Such conditions are not conducive to loyalty, or to inducing energetic service. The independents, if they shall copy Bell methods in this respect, will make a grievous mistake.

If you should wake up some fine morning and hear that you have sold, or are about to sell, your telephone plant to the Bell company do not consider that the transaction is necessarily closed. If you hear similar reports as to actual or impending sales of other independent companies in your own or other States, be not disturbed thereat, nor convinced that the news is reliable. There have been some such sales, but vastly more rumors of those which never have occurred and do not seem likely to. There have been methods in these rumors. For some reason, some interest, evidently not independent, has believed it desirable to circulate such reports, probably in the hope that other independent interests might be disquieted or discouraged, and yield more readily to apparently advantageous offers. These methods have been relied upon to produce serious effects. Keep yourself and your neighbors advised of the strength and growth of the independent movement, of the strength of their own situation in competition, and fewer such rumors will be verified hereafter.

In nothing that I have said thus far have I given many of you real news. As I said to one of my friends, I felt that it was impossible to do so, and was almost ashamed for having tried to prepare and read such a paper; but if it shall refresh your memory, if it shall induce you to give other experiences and observations of your own; if it shall attract, through publication in our annual reports or otherwise, the attention of any who are about to engage in the telephone business, and shall hearten and strengthen them in their enterprise and efforts, it may accomplish some of the good earnestly desired and intended in the preparation of the paper. As stated at the outset, it is not in criticism or derogation of the Bell company that is offered. That corporation has the right to resort to any efforts within the bounds of fact, it may choose to make, and we have equal right to discuss its methods and by considering them, minimize their effect, if not entirely to overcome them.

In reply to an inquiry from Mr. Critchfield, the speaker said that only three small companies in Michigan had been inveigled from their "independent" allegiance. One had a grounded iron wire service, in parts of two counties; one was an exchange of about 25 members, and one had about 116 subscribers.

Invitation was read to visit the independent exchange of Mr. Stinson, at Rochester.

A request was read from Mr. John Rohrer, president of the Business Men's Central Council, of Buffalo, asking for information as to the cost of equipping an up-to-date exchange in that city.

It was announced that Dir.-Gen. Buchanan, of the Pan-American Exposition, would meet the members at 3 p. m. in the Electricity Building.

Messrs. Black, Ware and Kline were appointed a committee to audit the books of the association.

Mr. Fisher referred to the statement of Mr. Kline that Washington was the only Eastern city without an independent telephone franchise. As that city was under Congress, he urged every member to influence their representatives to change this.

Mr. Kline explained that but for the delay on the River and Harbor bill at the last session of Congress, Mr. Webb, who had already done such good work with his exchanges at Pittsburg and Baltimore, would have had a franchise for Washington. It wasn't votes he wanted, but the chance for voting. He alluded to the good work that had been done, and carried a rising vote of thanks to President Thomas for his able leadership.

By tremendous acclamation, a vote was carried condemning bitterly the service of the steamboat company that had transported the members to Niagara and back on Wednesday afternoon.

CRITCHFIELD ON LEGISLATION AND LITIGATION.

Mr. H. D. Critchfield, general counsel of the Cuyahoga and United States Telephone companies, of Cleveland, delivered an eloquent address on "Legislation and Litigation," in spite of the fact that he had been sick at Hot Springs, Ark., and was barely convalescent. He said that he should have opposed an open discussion of these points, as furnishing information to their adversaries. He then referred briefly to the subject of right of way, and said that, broadly stated, the legislature had no power to give them the right to put poles and lines on the highway unless subject to the limitations which are always upheld for the protection of property. If damage was done, it must be judicially determined, and it was well to be as diplomatic as possible in getting their rights of way. Each year it was getting more difficult to secure rights of way for nothing.

As to taxation, he held that valuing the property at 60 per cent, as was done, was unfair to the telephone people. It was three or four times as much as was paid by railroads, electric light companies. Action should be taken to correct and equalize this wherever necessary. As to litigation, he said, in regard to the Berliner case that its settlement was due to the work of the association and its officers. There had been an idea that the money raised was to provide good salaries for certain officials. But not one single, solitary dollar had ever been paid that way, except to an earlier treasurer, who took care to pay his own salary. The officers had done their work, had traveled at their own expense, and had brought them to the point where their cause was universally recognized as legitimate.

Mr. Critchfield then spoke of the new Bell president as one of the ablest men in the country, and said that his intention was to so change the policy of the company that connections should be made between Bell and independent companies where the independents had the best of the position. There could be only one result of this again. He did not under-estimate the strength of the Bell system, and the fight was getting hotter. The Bell people were in better shape to give them a run for their money than ever. But the independents were also in better shape to sustain attacks which would be insidious, but injurious none the less. All they had to do was to stand together. The man who sold his property instead of standing shoulder to shoulder, was unworthy of any confidence whatever, placed in him by his fellow men. Besides, the stockholders in the 4000 independent companies by their political and social affiliations ought to be able in every way to dictate the telephone situation in the United States.

He then moved the following resolution, which was unanimously carried:

Be it Resolved, by the Independent Telephone Association of the United States, in Convention assembled at Buffalo, N. Y., June 11, 12 and 13, 1901, That the thanks of this Association and of all persons whomsoever interested in the welfare of the independent telephone movement of the United States, is due to the officers of this association for their faithful, intelligent and untiring efforts to promote the welfare of independent telephony; and,

Be it Further Resolved, That thanks are especially due to Hon. R. S. Taylor, E. P. Payson, and others enthusiastically associated for the work done in the litigation recently decided by Judge Brown n the United States District Court for the Northern District of Massachusetts, involving the validity of the so-called Berliner patent, and that the successful conduct of this litigation is fully appreciated by this Convention.

Be it Further Resolved, That the secretary be and is hereby instructed to prepare and forward to the persons herein named copies of this resolution.

Mr. C. T. Bash, Home Telephone Company, of Fort Wayne, Ind., in commenting on Mr. Critchfield's address, said that they now had 2146 independent subscribers there, although for 2½ years past every quarter the Bell company had been sending receipted bills to the 500 subscribers, or less, on their system, who paid not a cent. As to needed legislation, he instanced a case in Fort Wayne recently, where when the Wayne Hotel was on fire, the telephone line in an adjoining building was found to have been cut and thus warning could not be sent promptly through the exchange. There should be legislation to protect their circuits just as much as there was to insure the railroads against malice, etc. Mr. Bash then poked fun at the Central Union, but the laugh was turned on him when he spoke of Mr. Sabin being at the head of the Philistines who were submerged in the Red Sea.

Invitations to hold the next meeting at Milwaukee, Philadelphia, Rochester, Mansfield, Ohio; Louisville, etc., were referred to the advisory board.

A committee of three, being appointed by Mr. Young, in the chair, to select a ticket for the ensuing year, the following ticket was reported and adopted very enthusiastically: President, J. M. Thomas, of Chillicothe, Ohio; first vice-president, H. C. Young, of Columbia, Pa.; second vice-president, C. E. Stinson, Rochester, N. Y.; third vice-president, W. H. Durin, of Cedar Rapids, Iowa; secretary and treasurer S. P. Sheerin, of Indianapolis; first assistant secretary, J. B. Ware, of Detroit; second assistant secretary, C. E. Wilson, Philadelphia; third assistant secretary, J. B. Lee, of Pittsburg, Pa.

Thanks were tendered to *Telephony* for organizing a special train from Chicago, and to the Buffalo press, especially the *Courier*, for its efforts in behalf of independent telephony.

Mr. Dougherty advocated the compilation of a complete list of independent telephone companies. No action was taken.

Mayor Diehl was thanked for the free use of the city Convention Hall.

The auditing committee reported finding the accounts of the association in satisfactory shape.

The Convention then adjourned.

LIST OF ATTENDANTS.

The following are the names of the delegates and members. The names of those representing manufacturers, supply houses, press, etc., will be found elsewhere:

Western Penn. Telephone Company.—J. B. Painter, Independence, Pa.

Cortland (N. Y.) Home Telephone Company.—H. L. Smith, W. Martin, W. H. Jones.

Morrow Co. Telephone Company, Mt. Gilead, Ohio.—A. A. Whitney.

Cuyahoga Telephone Company, Cleveland, Ohio.—J. J. Fitzgerald, M. Davis, L. W. Stanton.

U. S. Telephone Company, Cleveland, Ohio.—T. Gilmore, W. L. Cary, Jr., K. V. Murry, C. J. Ross, H. D. Critchfield, J. M. Thomas.

Federal Telephone Company, Cleveland.—J. Pierce, W. B. Woodbury, R. R. Fralich, N. Coen, M. E. Zuber, O. Miller, O. F. French, H. K. Taylor, R. W. Judd, G. S. Duperow, R. C. Enwright.

Eastern Telephone & Telegraph Company, Camden, N. J.—G. W. Burleigh.

Wellsburg (W. Va.) Telephone Company.—W. K. Cummings.

Juniata & Susquehanna Telephone Company.—A. G. Scholl.

Interstate Telephone & Telegraph Company.—J. P. Helfenstein.

Tuscarawas County Telephone Company, Cleveland.—G. J. Hoffman.

Ottawa County Telephone Company, Oak Harbor, Ohio.—F. W. Gradolph.

Morrison Telephone Company, Greenfield, Ind.—G. Morrison.

Ontario Telephone Company, Toronto, Can.—J. B. Ford.

Queen City Telephone Company, Buffalo, N. Y.—H. H. Littell.

Louisville (Ky.) Home Telephone Company.—W. G. Patten.

U. S. Telephone Company, Dunkirk, Ohio.—E. S. Anderson.

Bremen Telephone Company, Bremen, Ind.—C. E. Koontz.

Johnson Co. Telephone Company, Iowa City, Ia.—J. D. Goss, A. T. Presson.

Mansfield (Ohio) Telephone Company.—T. F. Black, L. C. Mengab.

Cedar Rapids (Ia.) Telephone Company.—W. H. Durin.

Columbia (Pa.) Telephone Company.—H. C. Young.

Portsmouth (Ohio) Telephone Company.—T. W. Human, H. S. Gowe.

Bowling Green (Ohio) Telephone Company.—W. R. Barkdull.

York (Pa.) Telephone Company.—G. W. Rudy, W. Hughes.

National Telephone & Telegraph Company, Fort Wayne, Ind.—G. F. Trier, G. W. Beers.

Zanesville (Ohio) Telephone & Telegraph Company.—J. B. Rhodes, S. M. Branger.

Inland Telephone Company, New Knoxville, Ohio.—W. H. Fledderjohn.

Inland Telephone Company, De Graff, Ohio.—E. Fledderjohn.

People's Telephone Company, Akron, Ohio.—S. M. Strong.

Galion Telephone Company, Galion, Ohio.—J. T. Belanger, B. W. Blyth, C. T. Crim.

Cattaraugus Telephone Company, Franklinsville, N. Y.—V. Hayden.

Interstate Telephone Company, Philadelphia.—A. M. Worstall.

Burlington Co. Telephone Company, Mt. Holly, N. J.—H. E. Woodman.

Twin City Telephone Company, Minneapolis, Minn.—C. H. Judson.

Citizen's Telephone Company, Ashland, Ky.—W. B. Seaton.

Federal Telephone Company, Pittsburg, Pa.—Fred De Land.

Sandusky (Ohio) Telephone Company.—C. C. Curtis.

Columbian County Telephone Company, Lisbon, Ohio.—W. Morron.

Southern Telephone Company, Nashville, Tenn.—F. F. Sapp.

Kent Home Telephone Company, Kent, Ohio.—W. H. Butler, A. B. McLery.

People's Telephone Company, Shelby, Ohio.—C. L. Howk.

Marysville (Ohio) Telephone Company.—N. E. Liggett, G. T. Suvern.

Upper Sandusky (Ohio) Telephone Company.—C. D. Juvenall.

Madison Clark Telephone Company, London, Ohio.—F. W. Pierce.

Rochester (N. Y.) Telephone Company.—C. O. Harris, W. F. Babcock, C. E. Stinson.

Valley Telephone Company, Bay City, Mich.—H. A. Price, B. L. Carson.

Anderson (Ind.) Telephone Company.—C. D. McConchay.

Lafayette Telephone Company, Lafayette, Ind.—H. A. Taylor.

Youngstown Telephone Company, Youngstown, Ohio.—S. Weil, C. Y. McVey.

Tippecanoe Telephone Company, Romney, Ind.—Dr. A. D. Pyke.

Massillon (Ohio) Telephone Company.—W. S. Holloway.

Ottawa Co. Telephone Company, Elmore, Ohio.—J. G. Steinkemp.

Knoxville (Ia.) Electric Company.—J. S. Bellamy.

Home Telephone Company, Wabash, Ind.—J. Hipskind, R. F. Blount.

Fair Telephone Company, Chrisman, Ill.—G. W. Fair.

Louisiana & Texas Long-Distance Telephone Company, Thibadaux, La.—T. H. Lancaster.

Elk Telephone & Telegraph Company, St. Marys, Pa.—A. H. Blasdell.

Jefferson & Warren Telephone Company, Orangeville, Ohio.—E. U. Hyde, C. S. Fenton.

Putnam Telephone Company, Ottawa, Ohio.—J. F. Risser.

Black River Telephone Company, Lorain, Ohio.—C. D. Gott.

Ada Telephone Exchange Company, Ada, Ohio.—H. A. Clark.

Harrison County Telephone Company, Cadiz, Ohio.—A. J. Vernier.

Connersville (Ind.) Telephone Company.—L. A. Frazee.

Home Telephone Company, Fort Wayne, Ind.—C. S. Bash.

Citizens' Telephone Company, Grand Rapids, Mich.—E. B. Fisher.

New Long-Distance Telephone Company, Indianapolis, Ind.—S. P. Sheerin.

Keystone Telephone Company, Philadelphia, Pa.—C. E. Wilson.

Interstate Telephone & Telegraph Company, Hazelton, Pa.—C. W. Kline.

People's Telephone Company, Detroit, Mich.—J. B. Ware.

Ashtabula (Ohio) Telephone Company.—T. J. Fricker.

Lima (Ohio) Telephone & Telegraph Company.—G. H. Metheany.

Hubbard City (Tex.) Telephone Company.—H. McFarlan.

Telephone Company of America, Washington, D. C.—R. B. Hazlett.

Registered, but not giving other indications of connection with the industry, were: J. B. Lee, Pittsburg; C. L. Fisher, Findlay; J. S. C. Edwards, Johnstown, N. Y.; E. C. Taylor, J. C. Firmin and J. D. Snyder, all of Findlay, Ohio; T. M. Knierin, Toledo, Ohio; E. Hendrickson, Macedene, N. Y.; H. A. Coit, St. Louis, Mo.; W. F. Adely, Boston, Mass.; I. H. Moulton, La Cross, Wis.; H. W. Fox, Indianapolis; A. A. Geiger and R. Mitchell, Bluffton, Ohio; E. L. House and C. M. Grauel, Painesville, Ohio; Claude R. Stoops, Nappanee, Ind.; H. E. Inks, Ligonier, Ind.; R. B. Watrous, Milwaukee; A. L. Lawrence, Cleveland; A. M. Taylor, Cleveland.

CONVENTION NOTES.

Pan American.—A visit of the delegates was paid to the Pan-American Exposition on Thursday afternoon, when they were received in Electricity Building by Director-General Buchanan and Professor G. F. Sever, superintendent of electrical exhibits. A cordial official welcome was extended to them, and they spent some time in examining the telephone exhibits, especially the superb displays of the Kellogg, Stromberg-Carlson and American Electric Telephone companies—not even forgetting the working Bell exhibit, and those of the makers of conduit and cable. Many calls were paid to the booth of the Electrical World and Engineer, which adjoins the telephone section. Of course, in the evening all were delighted with the electrical display created by the genius of Mr. Luther Stieringer, who in reality has furnished a second Pan-American, viz., that for the night, an even more lovely one than that of the daylight and sunshine. In reality, it is only at night that the Howard Tower realizes itself and dominates the scene. Many of the telephone visitors were greatly interested in the signal corps display in the Government Building, and in the operative exhibit there, in the Patent Office section, of the Palmer fac-simile long distance telegraph.

Electrical World and Engineer had its headquarters at the Exposition, and was represented at the Convention by Messrs. T. C. Martin and J. R. Cravath, of the editorial staff, and President J. M. Wakeman, J. V. S. Church and E. T. Walker, of the business department.

The Electrical Press, in addition to the staff of this journal, was represented by W. F. Collins, C. T. Child, W. E. Keily, M. H. Murch, Jr., N. Hall, G. A. Babtiste, R. Howland, P. E. Rotchka, F. L. Perry, E. Taylor, S. H. Goddard, H. B. McNeal, W. J. Barr, W. H. Goontz and others not registered.

Mr. A. V. Abbott, the well-known electrical engineer, who was until lately with the Chicago Telephone Company, was an interested attendant at the convention. Since giving up his Bell connection, Mr. Abbott has already been engaged in connection with several electrical enterprises, some of which deal with power transmission and electric railway work.

Mr. F. C. Manning, secretary of the Sumter Telephone Manufacturing Company, tells an interesting story of how his company resurrected the telephone service in Jacksonville, Fla., after the disastrous fire last May. The fire extended over an area of three miles long by one mile wide in the heart of the city, thus demoralizing the entire service. It occurred on Friday, May 3. The following day Mr. Manning received a telegram from Mr. W. N. Shine, general manager of the Jacksonville Telephone Company, asking him to ship a switchboard immediately. So promptly did the Sumter Telephone Manufacturing Company respond that on Tuesday 100 telephones were in operation, and in less than two weeks all the telephones which had not been burned up were in use through switchboards located in different sections of the city and connected up by trunks. The first switchboard was erected in a little booth used as a fruit-stand, and the 100 telephones were connected up by cutting a hundred-wire cable in front of the booth and distributing it in the switchboard. Who shall say the South is not exemplifying the "strenuous life" after such a performance as this? The Jacksonville Telephone Company is now re-equipping its entire system, and will shortly be giving even better service than it did before the fire.

Mr. W. J. Johnston, the veteran electrical publisher and now proprietor of *Mining and Metallurgy*, dropped in from the Pan-American Exposition and was greeted by a great many old friends.

EXHIBIT NOTES.

Mr. Otto M. Knoblock attended in behalf of the important interests of the Miller-Knoblock Manufacturing Company, of South Bend, Ind.

Mr. S. J. Lumbridge represented the Utica Fire Alarm Company, of Utica, N. Y.

The Union Switchboard Company, of Erie, Pa., who has a very ingenious and effective board on a novel plan, was represented by Mr. John J. Miller.

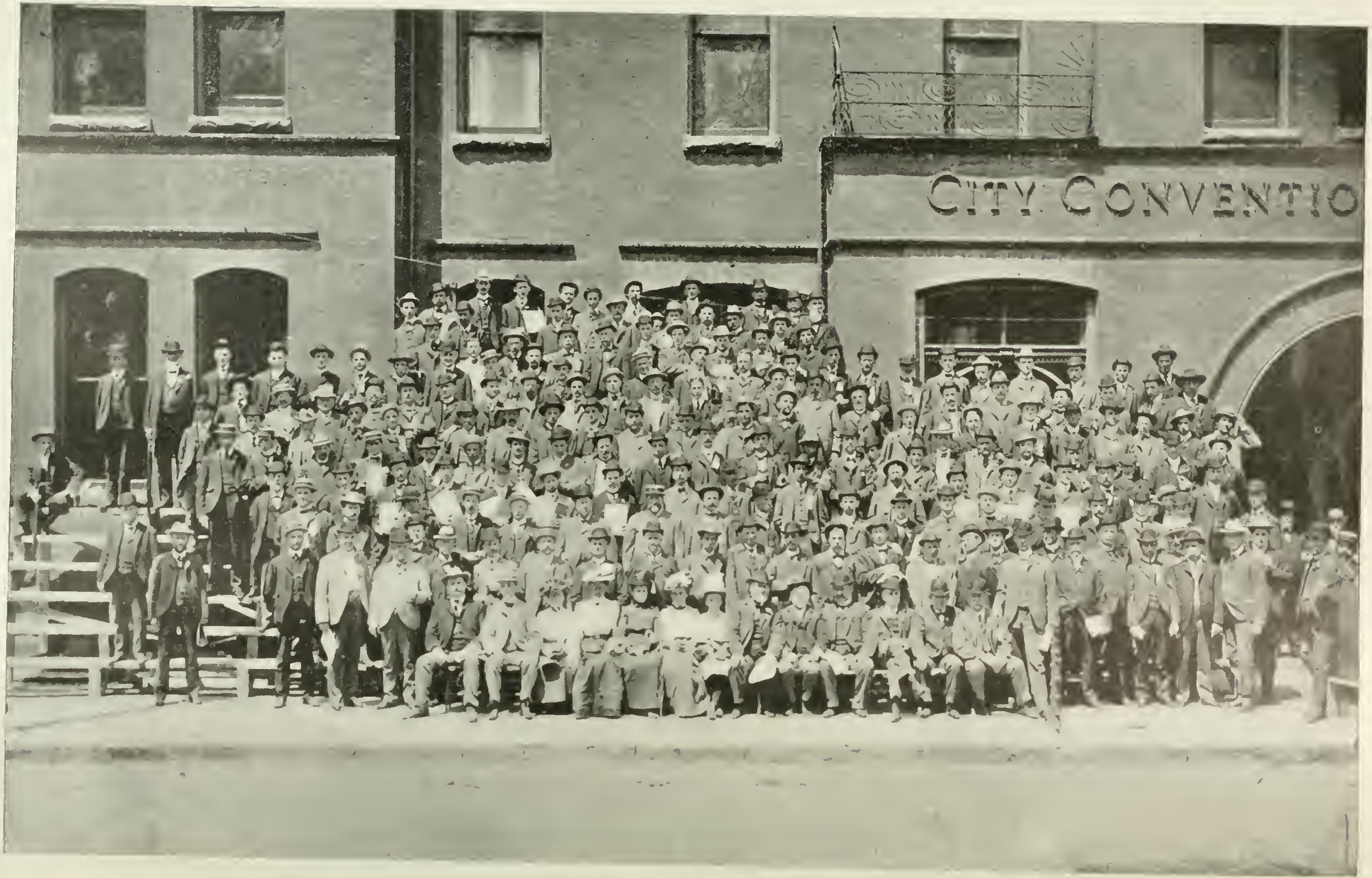
Erner, Hopkins Company, of Columbus, Ohio, was represented by Mr. W. A. Hopkins.

The American Electric Telephone Company.—Located in the most accessible position of Electricity Building is the beautiful pavilion of the American Electric Telephone Company, Chicago. The exhibit is at the northeast corner of the building. The design is Colonial, with Corinthian columns. In it is displayed a complete collection of the American Electric Company's telephone devices and apparatus. Among the large number shown may be mentioned their standard power board, furnished with its central energy system. On the board are mounted ammeters, voltmeters and necessary switches and cut-outs. Adjoining the power board is seen a 1.5-kw "Roth" dynamotor transforming from 500 volts 3 amperes to 60 volts and 25 amperes. A current interrupter is also shown, giving a pulsating current of 500 volts at 900 revolutions. Then there is a 100-line Bell type switchboard, a 300-line metallic cross-connecting board, a hundred-line "American Express," finished in a most elaborate manner. Five 100-line Burns combined heat coil lightning arrester, and terminal heads, are placed in the center of the wall and attract much attention from telephone engineers and managers. In a handsome show case facing the main aisle is displayed a complete line of the smaller parts and accessories entering into the construction or operation of telephones or switchboards, comprising a desk set. A number of the new American receivers show the great advance made in this necessary adjunct. Multiple apparatus is displayed in sections, showing the mechanical construction and design for magneto call, common battery and central energy systems. Favorable comment was made by the delegates on the American "Samson" 5-bar generator with new self-contained switchhook. A line of individual lightning arresters and cable protectors are extensively displayed, including everything latest and best in this line. The line of listening and ringing keys is shown in several styles and designs. Three different patterns in desk sets are shown in elaborate finish and beautiful design. Favorably displayed on the wall is one of the handsomest lines of magneto call centralized calling and central battery telephones ever produced. The types and designs comprise 26 separate and distinct patterns. The new No. 34 central energy telephone received more than passing attention on account of its beautiful design and finish. Aside from the technical features of the exhibit the chaste and elegant design and execution of the pavilion was the subject of much deserved praise and admiration. This artistic place was done under the supervision of Mr. S. J. Bear, general Western agent, who also designed and executed the American exhibit at Omaha. Mr. Bear is in charge of the exhibit extending to all callers a cordial invitation for its inspection. The staff of this well-known company, in addition to President P. C. Burns and General Manager J. G. Johnson, consisted of P. J. Eubanks, Ohio representative; J. J Speed, of the home office; C. E. Kammeyer, advertising department, and the necessary clerical force. Owing to the very large increase in orders at the factories the erection of the large central energy multiple switchboard has been delayed and could not be completed in time for the inspection of the visiting delegates.

National India Rubber Company, Bristol, R. I., was represented by Mr. P. F. Lyons.

The Durham Telephone Manufacturing Company, of Durham, N. C., was represented by its general manager, C. E. Egan, formerly general manager of the Interstate Telephone & Telegraph Company, operating in Maryland, Virginia and North Carolina. He was kept busy explaining a new pay station telephone device his company is just putting out. This differs from most pay station or prepayment devices in that the coin can be given back to the calling subscriber in case the desired connection is not secured. In an ordinary prepayment telephone there is often an annoying delay while the calling subscriber puts in his coin before the central office completes connection. With the Egan device this delay is done away with by having the calling subscriber drop the coin in the slot before the central office can be called. Normally, the generator circuit is open, and no calling can be done without putting in the coin, which closes the circuit. If the connection is completed and conversation secured the hanging up of the receiver knocks the coin down into the strong box. If, however, the connection is not given, the central office so informs the caller and closes a circuit so that when the subscriber presses a button to complete another part of the circuit the coin is thrown out into the open receiver in front of the telephone. Now that prepayment systems and other methods calculated to do more justice to both stockholders and public are coming in, Mr. Egan's device is of particular interest.

The Mayberry-Holmes party-line system is a recent arrival in the telephone field, and was exhibited in Parlor 72 at the Iroquois. This system allows the putting of as many subscribers on the line as may seem desirable. Calling central on one instrument locks the hooks on all the other instruments on the line, and displays a busy sign. When a subscriber on a party line of this kind is called none of the other bells ring, and all other instruments on that line are locked out, and have busy signals displayed. The system can be



GROUP OF INDEPENDENT TELEPHONE CONVENTION, BUFFALO, N. Y., JUNE 12, 1901, OUTSIDE CITY CONVENTION HALL.
(OFFICERS ON BENCH IN FOREGROUND.)

applied to any standard telephone. It is the property of Dr. F. E. Mayberry and Watson M. Holmes, of West Medford, Mass., both of whom were at the convention.

The Couch & Seely Company, 26 Binford Street, Boston, Mass., had a very complete line of its representative products in Parlor 72 at the Iroquois. E. B. Seely and A. F. Boardman were in attendance. The latter gentleman was one of the respondents in the famous Berliner case. Among the things attracting special attention in the display was a listening and ringing key, unusually perfect as to details, with which the operator can listen, ring and ring back, using the same key and with a very simple movement. Two styles of intercommunicating call-box were shown. One of these was a key-box in which the contact is established and ringing done by the same key and only one key will stay depressed at a time, making confusion of calls impossible. The other was a plug box. The neat outdoor outfit used extensively on electric railway interurban lines and for a police patrol box attracted considerable attention. In this instrument the shutting of the door cuts out the instrument so that it is only in circuit when the door is open. The common battery wall instrument for ordinary subscribers' use is a very compact and neat little instrument designed expressly for common battery service. The hotel set made by this company which is used in the Essex Hotel at Boston was shown alongside the regular set used in the Iroquois Hotel, and the contrast was striking, as the Couch & Seely set was only about a quarter the size of the other.

Roth Brothers & Co., of Chicago, who are doing such an extensive business these days in small motor-generator sets for telephone exchanges had G. A. Roth, of the firm, looking after their interests. This firm came up from a small beginning a few years ago, but is making friends everywhere by its square dealing and the satisfaction its machines are giving, so that its history has been one of constant growth. A motor-generator set of Roth make was on exhibition in the American Electric Telephone Company's booth at the Pan-American Exposition.

General Electric Company does not usually manifest much interest in a telephone convention, but since the miniature lamp signal has become such an important factor in switchboard construction the lamp department is beginning to respond actively to the demand, and F. W. Willcox, of the Edison Miniature Lamp Department, Harrison, N. J., was present, learning the needs of the telephone men, and showing his company's miniature lamp product. He carried a complete exhibit in his vest pocket. Mr. Willcox was on several occasions the center of an animated discussion of the features of lamp-signal work.

The Automatic Telephone Meter Company, of 620 Atlantic Avenue, Boston, Mass., had a working exhibit of its new automatic meter system in Parlor 72, at the Iroquois Hotel. A small switchboard and two subscribers' instruments connected thereto with automatic meters at each subscriber's instrument, showed the working of the meter. This meter is a counter which registers only when the called subscriber removes his telephone from the hook to answer. The operator has nothing to do with registering the calls, nor is any time lost by the process, the operation as far as operator and subscriber are concerned being the same as if no meter were on the circuit. Mr. Charles H. Viggars explained the system to visitors at the parlor.

The Electrical Appliance Company kept open house at Parlor 222 of the Iroquois Hotel, where some of the telephone specialties of the company were shown. A. L. Millard and S. A. Densmore represented the company.

The Clark Automatic Telephone Switchboard Company, of Providence, R. I., received many visitors at its handsome space in Electricity Building at the Pan-American Exposition during convention. J. L. Putnam, chief electrical engineer of the company, came on from Providence to attend the convention, and L. A. Stillings and F. Ingrham were also present. The Clark is an automatic switchboard system, which does not require any central office operator, and it is adapted to factory and small town exchanges up to 150 subscribers' stations.

The American Battery Company, of Chicago, which does an extensive storage battery business among telephone companies, had its interests ably looked after by its secretary, C. S. Kaufmann.

F. Bissell & Co., of Toledo, Ohio, had the following gentlemen in attendance: W. S. Bissell, M. S. Walker and C. H. Hamilton.

The Central Electric Company, of Chicago, had Allen S. Pearl looking after its interests.

The American Electrical Works, Providence, R. I., was represented by W. J. Watson, of New York, and E. H. Hammond, of Chicago.

The American Miniature & Decorative Lamp Company, of New York, recognized its growing importance in the telephone field by sending H. J Jaeger as its representative.

The Stromberg-Carlson Telephone Manufacturing Company was, of course, out in force, having a representation in proportion to its size and volume of business. A. Stromberg, C. W. Stiger, H. Shafer, E. L. Brown, William Davis, Paul M. Krahmer, P. J. Hertz and S. Curtis were on hand to look after the company's interests both at the convention and at the company's large space in Electricity Building at the Pan-American Exposition. Unfortunately, they were delayed about getting the material for the principal part of the Exposition exhibit which will be very large and comprehensive, and will include a large switchboard installation. Their space, however, appeared to good advantage, and with the choice selections from their stock of apparatus which were on exhibition, in lieu of the more permanent exhibit that is to come later, a handsome showing was made. This company operates a free telephone service on the Exposition grounds for the benefit of the officers and service bureaus of the Exposition. The central office is located in the company's space. The service is of great utility, and is highly appreciated.

W. J. Murdock & Co., of Chelsea, Mass., represented by Mr. Murdock himself, distributed a souvenir button and receiver, advertising the "solid" receiver, almost large enough for regular service.

The American Electric Fuse Company, of Chicago, was well represented by President Jones, "who pays the freight"; James A. Kenny and Price A. Allison. They were generously profuse in courtesies to the delegates.

The Columbia Telephone Manufacturing Company, 194 South Clinton Street, Chicago, made its debut at this convention. Although a new company, its representative, J. G. Nolan, who is the leading spirit and inventor of the specialties that were exhibited at the Iroquois parlors, is one of the oldest and best known men in the independent telephone business. The leading feature of the display was a switchboard which had the subscribers' circuits terminating on a plug and tip, and having jacks on the ends of cords, thereby reversing the usual arrangement and making what Mr. Nolan calls an "anti-dust" switchboard.

The Williams Electric Company, of Cleveland, Ohio, represented by J. A. Williams, president and general manager, and J. A. Stratton, displayed some of that company's more notable products in one of the parlors of the hotel.

The Hipwell Manufacturing Company, 831 North Avenue, Allegheny, Pa., exhibited its line of high grade long-distance telephones in the parlors of the hotel. H. H. Hipwell and T. Hipwell did the honors.

The Lambert Schmidt Telephone Manufacturing Company, 325 Broadway, New York, occupied Parlor 80 at the Iroquois Hotel, with a very neat and complete exhibit which attracted much favorable comment. The appliance that was most noticed was a new portable switchboard for army use and other places, or purposes requiring a portable switchboard or very rapid connections. A 6-drop and a 10-drop board of this kind was shown. Instead of cords and plugs connections are made by means of cam keys similar to ringing keys. There are three rows of cams on the 10-drop board, and each line has a terminal on three cams. If No. 1 and No. 2, for example, should wish to talk, the cams 1 and 2 in the first row would be thrown. The cams on the next row would be used should other parties wish communication, and so on until all are occupied. A small semi-portable board using plugs and jacks was also shown, this not possessing, however, the rapidity of operation and portability of the cam board. The intercommunicating instruments of this company are also exceptionally neat. They are made in several types, and are fitted all with automatic flyback switch, which returns to "off" when the receiver is hung up. These were shown in both wall and desk forms. The switch is operated with a thumbscrew and provided with numbers, as on a cyclometer barrel. Only the thumbscrew is outside of the case. All these designs are provided with head microtelephone of very strong, handsome design, or regular transmitter and receiver. One decidedly new kind of telephone designed expressly for the convention was in operation in the parlors. Attempts to call on this telephone were responded to by the flying open of the battery box, when it was found that the battery was charged with cigars. Lambert Schmidt, president; W. W. Bostwick, Jr., and Mr. Schwartz were in attendance.

The Electric Storage Battery Company, of Philadelphia, had its interests looked after by Otto C. Cathoff.

The Eureka Telephone Company, of Chicago, was represented by that well-known telephone man, I. J. Kusel.

The Varley Duplex Magnet Company had C. L. Hibbard, of Chicago, in attendance.

The Valentine-Clark Company, of Chicago, was represented by E. L. Clark.

The Holtzer Cabot Electric Company, Brooklyn, Mass., showed some of its specialties in Parlor 222, of the Iroquois Hotel. The stick fast butterfly souvenir the Holtzer-Cabot people threw around was much in evidence not only at the convention and hotels, but at the Pan-American, and especially on the midway. C. W. Holtzer, T. W. Ness and W. H. Holland, of Brookline, and E. R. Harding, of Chicago, were there.

The International Specialty Company was represented by G. Hallett Johnson, of Chicago.

The India Rubber & Gutta Percha Insulating Company had for representative Dr. W. M. Habirshaw, who met many old and new friends.

The Laclede Battery Company, of Kokomo, Ind., was represented by J. F. Kerbin.

The McRoy Clay Works, Brazil, Ind., had "the genial and convivial Kirk" on hand everywhere at the convention, although in nowise associated with exercises of the conventicle.

The National Conduit & Cable Company sent J. B. Honan to represent it.

The Monarch Fire Appliance Company, of New York, had C. H. Barney and H. J. Doyle at the convention, and these gentlemen were naturally much gratified that "Kilfyre" tubes have just been adopted for the protection of all the switchboards at the Pan-American Exposition. General Barney was one of the oldest telephone men present, and with other old-timers, recalled memories of the Bell Niagara meeting 20 years ago.

The North Electric Company, of Cleveland, gave away souvenir good-luck pieces through Mr. S. S. Sapp, its energetic representative. George W. Conover, Chicago agent, was also present. The convention hall was also strikingly decorated with some of their literature.

The National Automatic Telephone Company, of 153 West Jackson Boulevard, Chicago, entertained in its regular space in Electricity Building at the Pan-American. J. A. Russell came to look after the company's interests and explain to interested delegates the working of the National automatic system, which is in use in a surprisingly large number of exchanges.

J. Edward Ogden & Co. were represented by Paul H. Schapfer, of New York.

The Okonite Company had its interests looked after by George T. Manson, of New York.

The Phoenix Electric Telephone Company was represented by D. P. Scott.

John A. Roebling's Sons Company, Trenton, N. J., sent W. G. Quigley, of the home office; W. N. Slughiff, of Chicago, and W. T. Bowman, of Cleveland. Mr. G. W. Swann, their Exposition representative, was also very much in evidence, and distributed pliers.

Mr. Charles A. Rolfe, of the Rolfe Electric Company, of Chicago, was present.

The Sterling Electric Company had W. E. Doolittle and F. B. Cook in attendance, and could not have been more thoroughly represented had there been many more, so well are these faces known in the independent field. They report the factory crowded with orders.

The Standard Underground Cable Company turned out a large force from various quarters, as usual, consisting of T. E. Hughes, of Philadelphia; J. R. Wiley, of Chicago; C. L. Wiley, of New York, and A. V. Sauerman, of Boston.

Charles G. Stevens, dealer in electrical specialties at Chicago, was present.

The Williams-Abbott Company, of Cleveland, of which H. C. Dodge is general manager, was looked after by Mr. Dodge and L. Sands.

The American Vitrified Conduit Company was represented by Mr. Barnard.

The Chase Shawmut Company, of Boston, was represented by H. P. Moore, who gave away samples of the Boston cable clip.

The S. B. Condit, Jr., & Co., of Boston, is introducing the Cameron system of cable-placing machines and hangers, and Mr. Condit was talking up this system among the telephone construction men present and calling attention to the saving of time by this process.

The Eureka Electric Company, of Buffalo, had George B. Pratt in attendance.

The Kellogg Switchboard & Supply Company was out in force and much in evidence, both downtown at the Convention, where its numerous representatives were seen, and at the Electricity Building at the Pan-American. At the latter place, a magnificent booth, the work of weeks, was just completed in time for convention visitors, and there some excellent samples of the company's switchboard work on a large scale were found. In an annex to the booth in another part of the building, subscribers' instruments were shown. Mr. Milo G. Kellogg, the company's leading spirit, was, of course, in attendance, and among his corps of assistants at the Convention and Exposition were F. J. Dommerque, Charles L. Meyers, Paul Bossitt, Mr. Platt, of New York, and A. E. Barker, of Cleveland. A handsome card case was given as a souvenir to telephone men visiting the booth Thursday afternoon.

Wagner Electric Company, of Muncie, Ind., were represented by Mr. McDonald.

G. F. Atkinson Company, of Jersey City, N. J., was represented by H. F. Atkinson.

Central Construction Company, Wauseon, Ohio, were represented by E. L. Barber.

Phoenix Telephone Company were well represented by Mr. J. H. Scofield.

American Toll Telephone Company, of Cleveland, represented by Messrs. W. A. Foss and E. F. Kaneen, distributed a very pretty and effective pamphlet as to their ingenious automatic pay station apparatus. The various types of machines for different services and rates, etc., were illustrated, and the *modus operandi* explained, the details being given as to the single, two and three-slot boxes. The wall set and the cabinet type were also illustrated and described in a full and clear manner. Other apparatus brought to notice in the pamphlet were the call register to record outgoing calls, the instruction card holder and the cigar rest

T. W. Warner, of Muncie, Ind., well known in the telephone field as the maker of the Warner central office pole changer ringing outfits for use with both dry and wet batteries, was at the Independent Telephone Convention, and had an exhibit in the booth of the American Electric Telephone Company at the Pan-American Exposition In his latest form of ringer for central offices a small make-and-break pole changer is operated constantly by a type R R cell of Edison-Lalande battery. This pole changer changes from direct to alternating the current supplied by a battery of 40 to 60 cells of open circuit type, and this alternating current does the ringing The pole changer is of good workmanship, and is mounted in a glass case on top of the cabinet containing the batteries. This neat little outfit comprises a complete power plant for ringing purposes in the telephone exchange. As the capacity of a battery cell is so large in amperage there is no difficulty in regard to sufficient current supply This ringing apparatus is now in use in over 1200 exchanges in the United States, and though originally designed and sold to independent exchanges only, its excellence for its purpose has led Bell exchanges to purchase a large number of them. Ordinarily 40 cells of common dry battery are sufficient, but room for 60 is provided. If other than dry batteries are used the generator alone is provided and the batteries are placed in another room.

Mr. Vinton A. Sears represented the Eastern Automatic Telephone Company. Besides being vice-president of this company, which controls Eastern territory for the Strowger system, he is a director in the automatic telephone companies of both New Bedford and Fall River, Mass.

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THE INSTITUTE LIBRARY.

A very interesting development has occurred in connection with the library of the American Institute of Electrical Engineers. It appears that at the time the Latimer Clark Library was being offered for sale, Mr. Andrew Carnegie was advised of the fact through more than one channel, and intended to buy it and present it to the Institute, as the proper repository or trustee in this country. Dr. Wheeler, however, with swift generosity, determined that delay should not let the opportunity slip away, bought the library by cable direct from the Clark heirs. This notable exhibition of disinterested professional spirit pleased Mr. Carnegie hugely, and he forthwith offered to give the Institute a sum equal to that of the price of the library, so that the Institute could house, catalogue and round it out progressively. Mr. Carnegie, in thus seconding the noble gift of Dr. Wheeler, has in a manner that cannot be too highly commended, paid over to the Institute a sum of about $7,000 for this use. The gift, while not so conspicuous as many of his other "grants in aid" of literature, is likely to be as beneficial as any of them.

We feel sure that actions like those of Dr. Wheeler and of Mr. Carnegie—who began his wonderful career in the field of telegraphy—must stimulate to supplemental gifts the general body of the Institute membership. They will doubtless be glad to learn that Mr. Carnegie has expressed his great pleasure at the work the Institute is doing for the profession it represents, and that he has conveyed to his representatives the desire that consulting and constructing electrical engagements in regard to any of his various enterprises shall be entrusted only to Institute members in good standing. Whatever may be the low opinion of his friend, Mr. Schwab, as to the value of education, it is evident that Mr. Carnegie rates highly professional status and accomplishments based on expert technical knowledge.

TELEPHONIC RECONSTRUCTION.

For seventeen years the Bell telephone system enjoyed a monopoly that was probably the most thorough thing of the kind ever known in this country. Such undisturbed possession should certainly have left it strongly entrenched, not perhaps in the affections of the people, but in the creation of a system, the establishment of its network of exchanges and circuits, and the forestalling of competition. In many parts of the country such is actually the case, but the report made by President Sabin from the Central Union Bell territory reveals an extraordinary condition of exactly the opposite nature. There have been two or three years of active competition, and the Bell system in that prosperous, progressive region is already seriously in the minority. More than that, it is bankrupt. It is not paying dividends, the stock is selling at less than 40 cents on the dollar, and now President Sabin says he needs $5,000,000 to put the system in proper shape. If this be true, and no reason exists for questioning the statements made in our issue this week by Mr. Sabin, what a hollow shell and sad wreck the Central Union system must be! He has a task before him that no man living can envy.

The only inference to be drawn from Mr. Sabin's confession of what he finds is that the profits of the telephone business have been over-rated, and that to neglect the costly work of necessary maintenance and reconstruction is suicidal. In the evidence given by Mr. Bethell, of the New York Telephone Company, before the Industrial

Commission last week, it is clearly shown that to change from overhead to underground wires and from individual battery to common battery, has already cost that company millions of dollars. But if they had not spent it, where would they be? For one thing, they would assuredly be an "easy mark" for any active opposition, and that is just what the Central Union is now discovering itself to have become. On the other hand, those independent companies which have gone in for low rates, large dividends, and lax repairs have a large score piling up ahead of them, which they will have to pay just as much as their Bell opponents. The amounts of money that will have to go into telephonic reconstruction and expansion the next five years are enormous, and difficult to overestimate.

Dielectric Losses in Condensers.

Mr. Steinmetz's article, published this week, contains some very interesting conclusions. It would seem that the condensers which he has been testing are among the most efficient electric storage devices known, since they waste only about the one two-hundredth part of the power which they temporarily store, as measured in volt-amperes. It is also shown that in the case of the condensers tested, the power factor (average about 0.005) is practically independent of the frequency. This means also that the power expended increases directly with the frequency and in the same proportion as the apparent power. In other words, as the frequency increases, so does the apparent power, or the power stored cyclically in the condenser, and so does the power wasted in the dielectric. The power per cycle is, therefore, constant for a given constant sinusoidal impressed voltage. And just as the hysteretic loss of iron is known to be constant per cycle for a given range of magnetic induction, whereby the hysteretic loss is in direct proportion to the frequency, so the dielectric hysteresis appears to be a definite quantity per cycle and to increase in proportion to the frequency. Moreover, the loss of power increases as the square of the e. m. f. applied to the condenser, just as in the case of power thermally lost in a resistance. This is different from the case of magnetic hysteresis, which varies approximately with the .6 power of the flux density, indicating that the physical natures of magnetic electrostatic hysteresis are probably fundamentally dissimilar.

The subject of the virtual dielectric resistance or virtual dielectric conductance, is of great practical importance in subterranean cables for the transmission of power. It is quite possible that a cable having a relatively large virtual dielectric resistance or relatively large power factor might have a relatively low conductor resistance, and yet waste a comparatively large amount of power in the course of a year in its dielectric, just as though it had a greatly reduced cross-section of conductor and expended the heat under load in the metal. In other words, a small conductor cable with a low power factor, in connection with a high-tension alternating-current system, might be as expensive in power and coal as a large conductor cable with a large power factor. Much discussion has recently been directed to this subject in London, where it was announced that the power factor of a certain five-mile length of cable in commercial service was as large as 12½ per cent. It seems, however, that this result was exaggerated by errors in the wattmeter employed for the measurement, since it is known that small power factors are liable to relatively large errors in their measurement, and that the actual power factor of the cable was approximately 3.4 per cent. This only shows that the time may come when the limit to high potentials shall be determined more by the dielectric losses than by their conductor losses or by the limitations of insulating materials to withstand electric stresses.

Induction Motors and Their Kin

It is a good thing sometimes to realize that induction motors, by whatever theory they may be treated, are in their essential particulars very much like other motors, that they obey the same fundamental laws and can be considered in the same straightforward way. The little motor due to Fischer-Hinnen and described in this issue is such a capital example of the derivation of an induction motor from a direct-current form that we cannot forbear calling particular attention to it. It does not seem to represent any revolutionary improvement in induction motor practice, but it should prove convenient for certain cases of small motor work. Its principal interest lies in the fact that it is derived directly from an ingenious but obsolete direct-current motor that came to grief through the use of brushes, which obviously are avoided in Fischer-Hinnen's design. A motor having windings only upon the armature is an old device that might have proved useful in small machines had it not been afflicted with irremediable sparking. Now realizing that, barring sparking, such a structure could readily be used, it was a clever flank movement to introduce the working current into the armature by induction, while retaining the field displacement necessary to give a direct starting torque. The duplex construction of the field magnets and armature attains the same end in directing the torque, as was reached by taking the original direct current motor, feeding it with alternating currents and displacing the brushes—a scheme which was really Fischer-Hinnen's starting point, it appears, and which we have here carried back a step further.

Induction motors are really much closer to ordinary direct-current motors, both in theory and practice, than is generally understood. Take, for example, the definition of the properties of an induction motor in terms of slip, as evolved in the course of the common rotary pole theory. One finds a very pretty set of relations between current, torque, output and efficiency, that seem at first sight quite peculiar to induction motors, and a most valuable deduction from the fundamental rotary pole treatment. But if one assumes as the "synchronous speed" of a shunt motor that speed at which the counter e. m. f. equals the impressed e. m. f.—the latter being assumed constant, as in the former case—one can derive a set of motor equations in terms of slip fully as interesting and valuable as those obtained for the induction motor. For instance, in each case the armature loss is to a very close degree of approximation directly proportional to the slip, when taken in terms of the output. That is, if an armature of either kind has a slip of 5 per cent, there is 5 per cent loss of motor efficiency to be charged to the armature. And, in fact, one could at a pinch evolve a fairly complete working theory of the shunt motor in terms of an hypothetical constant rotary field. Such an exploit would have little value outside of academic circles, except that it would serve to emphasize the fact that induction motors are not so far removed from other motors as has sometimes been supposed.

Laying theory aside, the fact is that the modern polyphase induction motor is, as a hard-working every-day machine, to be regarded as belonging in the same category as other motors. It has both immunities and troubles of its own, but by and large it will stand more hard knocks than almost any machine with which we are acquainted. Even the single-phase motor—to which class Fischer-Hinnen's machine belongs—is coming to be looked at with more tolerance and less suspicion than in the past. There have recently been recorded some very creditable performances from such motors, and there are still not a few instances in which only single-phase current is available, and in which self-starting single-phase motors obviously prove a real boon.

Magnetic Units

It is important that the action of the recent International Electrical Congress, held at Paris in 1900, should receive the widest recognition among engineers in connection with the two magnetic units which they officially christened. The action of the Paris Congress of 1900 was in one respect very different from that of prior electrical congresses, because whenever the prior electrical congresses christened a unit, they also created it, whereas the Paris congress of 1900 christened two units without creating them. In other words, they christened the offspring of their predecessors.

The British Association originally called into existence a system of units which has since been adopted all over the scientific world; namely, the C. G. S. system, in which the unit of length is the centimeter, the unit of mass the gramme, and the unit of time the mean solar second. When the electrical units were evaluated in this system they were found to possess awkward dimensions, that is to say, the units were either too large or too small for practical use. For example, it required a hundred million of the electromagnetic units of e. m. f. to approximate to the e. m. f. of an ordinary voltaic cell. It likewise required some thousands of millions of the electromagnetic units of resistance to equal the resistance of a mile of ordinary telegraph wire. At that time those were the two most important electrical units, and, therefore, the most important quantities to make suitable for practical electricians. Consequently, the first electrical congress was determined to modify the units so as to give units of e. m. f. and resistance which would conveniently fit voltaic cells and miles of wire, respectively. In order to produce units in the required sizes, the congress virtually created a new system of units belonging to the what may be called the Q. E. S. system, in which the unit of length is the quadrant of the earth or 10,000 kilometers, the unit of mass the eleventh-gramme or 10^{-11} gramme, and the unit of time the mean solar second. The ratios of the various units in this system to the corresponding units in the C. G. S. system, were all decimals, or powers of 10, but varying powers of 10. Thus the practical or Q. E. S. unit of resistance or ohm was 10^9 C. G. S. units, the Q. E. S. unit of current capacity or ampere 10^{-1} C. G. S. units, and so on.

The practical or Q. E. S. units had not long been in existence before it was found that the simple sizes of the volt and ohm could not be retained in other units, as, for example, the unit of capacity, which in the Q. E. S. system was about a million times too large for ordinary work, so that the practical condenser had to be called a micro-farad instead of a farad. Moreover, the rising pressures employed in modern electric power transmission would probably make a unit of e. m. f. a thousand times as large as a volt, quite as convenient as the volt itself, or a unit of current a hundred times greater than the ampere, just as convenient as the ampere itself. All this goes to show that it was a blunder to have attempted adapting the C. G. S. system for practical work, by creating a new or Q. E. S. system as a medium of exchange. The correct step would undoubtedly have been to christen the units of the C. G S. system, and adopt in connection therewith a coherent system of multiples and sub-multiples like milli, mega and micro, so that just as the micro-farad serves as the practical unit of capacity, while retaining its reference to the farad as origin, so the values required for practical purposes in the various units of resistance, current, etc., should have been readily found and described in terms of C. G. S. units and of their multiple prefixes. Of course, it is easy now to look back and see what might have been done, but considered from the standpoint of the workers in the early international congresses, there can be nothing but praise for their endeavors, however much we may at the present time, regret their course of action.

As time has gone by, the C. G. S. system and the Q. E. S. system have been driven side by side like a pair of unmatched horses. The C. G. S. system could not be dropped, because it was the fundamental scientific system embracing all sciences of which electromagnetics were but a part. The Q. E. S. system could not be dropped, because the electrical units were all christened in this system and had come into extensive use. Every electrical engineer is compelled to learn both systems, and to practice one while he theorizes in the other. Every successive electrical congress that introduced a new unit necessarily defined that unit in the Q. E. S. system in order to be consistent with the acts of prior congresses, and yet the connection between the two systems was perplexing, artificial and difficult to remember. Matters continued, however, in this ill-assorted scheme until magnetics required practical recognition. The natural course to follow in the naming of magnetic units was to create and christen Q. E. S. magnetic units. The values of these units was, of course, known in advance, but their existence had never been officially recognized. The difficulty arose, however, that magnetic densities involved the introduction of a unit of area, in such a manner, for example, as lines-of-force-per-unit-of-area. In order to be consistent, and to keep the electromagnetic equations clear of meaningless coefficients, it would be necessary in the Q. E. S. system to express magnetic densities as Q. E. S. units of flux-per-square-earth-quadrant, just as the C. G. S. system naturally introduces C. G. S. units of flux-per-square-centimeter. Here the inadaptability of the Q. E. S. system became apparent, because no practical man would express lengths in quadrants or areas in square quadrants, and the Q. E. S. system may be said to have failed to be extended by virtue of its own weight of inadaptability.

Nevertheless, the dilemma existed that both the C. G. S. unit of flux and the C. G. S. unit of magnetic density were in extended use among electrical engineers, either without any authorized names or with misleading names. With this evidence in view the Paris congress of 1900 adopted the name "maxwell" for the C. G. S. unit of flux in place of the common but ambiguous phrase "line of force"; and the name "gauss" for the C. G. S. unit of flux density, as representing a maxwell-per-square-centimeter, or a line-of-force-per-square-centimeter. It is important that these terms should be used by engineers as far as possible, because they are brief, consistent and definite; while they mark a return towards the simple C. G. S. system and a renunciation of the hopeless Q. E. S. system in the magnetic department. For the first time, in 1900, an electrical congress gave names to C. G. S. units already existing, and did not burden the literature of magnetics and the memories of students with the creation of new units in the perplexing Q. E. S. system. It is, therefore, officially correct to speak of a bipolar dynamo armature, for example, as revolving in a flux of, say, 2,000,000 maxwells, or 2 megamaxwells, and of having a density in the armature teeth of, say, 15,000 gausses or 15 kilogausses. No small incentive to the immediate general use of these terms in this country should be that the American Institute of Electrical Engineers originated and advocated the plan to name the magnetic units. The action taken at Paris was on a proposal submitted by the American body, and the successful issue was largely due to the able and determined advocacy of the A. I. E. E. programme by American delegates to the congress—notably, Messrs. Kennelly and Mailloux.

Telephony in New York City.

A hearing was given at Washington on June 15 before the Industrial Commission on the subject of telephony, when Mr. U. N. Bethell, general manager of the New York Telephone Company, appeared as a witness and made a long and interesting statement in regard to the telephone conditions in New York City. The hearing lasted not less than five hours and the members of the Commission showed themselves deeply interested in the points which were brought to their consideration.

Mr. Bethell divided telephonic development in New York City into two periods, one of about sixteen years, from 1877 to 1894, and the second from 1894 to 1901. At the end of the first period the Bell system, then operated by the Metropolitan Telephone & Telegraph Company, which has since become the New York Telephone Company, had reached a total of 11,600 subscribers. In the second period 51,000 additional subscribers had been secured, making a total at the present time of about 62,600. Of the number no fewer than 37,500 had been added in the last three years, and it was Mr. Bethell's belief that at the end of the current year the system would include in the Boroughs of Manhattan and the Bronx not far short of 75,000 stations.

As to rates, telephonic development might also be divided in New York City into two periods which would coincide with those already given. The first period was that of the flat rate system. During part of the time the rate had been from $60 to $120 a year, with overhead wires and grounded circuits. The latter part of the period had seen the substitution of underground wires and metallic circuits, and the cost had necessarily gone up to rates ranging between $120 and $240 a year. There had never been, however, a period when all the rates were on the higher scale noted, because the second development, that of the measured message rate system, overlapped the earlier. In throwing out its overhead system the company had sacrificed a plant worth not less than $1,500,000, and within the last few years, carrying out its progressive development, the company, in substituting a common battery system for that with the battery at every subscriber's station, had replaced equipment sufficient to serve no fewer than 30,000 stations. This again wiped out an enormous amount of investment, but had been done readily with the aim of improving the service to the subscriber. The notable gain in enrolled subscribers was due, therefore, to three conditions: improved efficiency, the reduction in rates and the growing recognition of the value of the telephone by the public.

As to the average cost of telephone service to the public under the message rate, Mr. Bethell stated that even including the $240 stations, of which there are now somewhat less than 1400, the cost or yield per year per station was only $85. This did not include pay stations, of which the company had now installed some 4000 in New York. The cost per Manhattan message at these stations was 10 cents, of which the company received 8 cents. Forming part of the general system there are over 1200 private branch exchanges in the city connecting with the central exchanges through independent boards and ranging in capacity from 2 up to 180 stations. Mr. Bethell explained the details of the message rate system, showing how subscribers were able to increase the amount of telephone traffic done with a diminishing scale of cost upon it, down to only three cents per message.

As to rapidity in operating, he stated that an investigation of the records carefully compiled for years past, and particularly with reference to the last 18 months, showed that the average time between the subscriber's call and the operator's answer was only from three to five seconds; in only one month had it gone over five seconds, and then for but a fraction of a second. The message rate business had seen its highest development in New York City as a scientific plan of charging, and had been indorsed and approved by a committee of the New York State Legislature, by a Parliamentary Committee of the English House of Commons, by the Danish and German Parliaments, by the officers directing the municipal system of Amsterdam; by the Swiss Government, and by the General Telephone Company at Stockholm, Sweden, which operates under the message rate, while the competing government system does a business at the flat rate only. The best results, however, were obtained in the United States, and the satisfaction which they yielded in New York City was apparently shown by the fact that efforts to deal with telephony by legislative measures had virtually ceased. In bygone years, several bodies and individual citizens, prompted in most cases by the best of motives, had sought to reduce the flat rate, but since the flat rate had virtually passed out of existence attempts at legislative remedial measures had ceased, so that so far as Mr. Bethell was aware, during the last two years not a single association nor a single subscriber had gone to the New York State Legislature seeking to regulate or change the company's system of charging for its service.

On the point of dissatisfaction, Mr. Bethell said that there were generally two causes for it; one was an erroneous idea as to the profits and the other was misinformation as to conditions elsewhere, especially abroad. With respect to the profits of the business, Mr. Bethell pointed out that a legislative committee in New York State, reporting in 1888, had placed on record the fact that the abandonment of the overhead plant of the New York system would entail a loss equal to three-fifths of its net earnings from the date of its organization; that is, three-fifths of the surplus would be wiped out to take care of that particular depreciation in its property. The committee then presented figures, which, taking thus loss into account, showed that the net earnings on the investment for the seven years covered by the report amounted to only 0.66 per cent per year. From 1888 there followed a long period of reconstruction, during which no dividends were paid. Since 1896, said Mr Bethell, dividends had been paid at the rate of 6 per cent per annum. Even more significant was the fact that the percentage of cost of operation to earnings had averaged about 65 per cent; for the first four months of 1901, being 65.3 This indicated a conservative management, and with any high percentage the business would not be profitable, nor would it be possible to get capital raised to meet the public demands for an extension of the business.

Mr. Bethell went into the matter of wages and care of employees and showed that the company had not only dealt liberally with its staff, but had taken every means to ensure the comfort and health of those engaged in its different exchanges It was, however, particularly in regard to foreign telephone work that misinformation was rife and was difficult to correct. There was extreme difficulty in comparing the results from different places, for the reason that no common denominator could be found. Mr. Bethell, from the results of his own numerous trips abroad to study telephonic conditions, was able to present a large mass of information in regard to England, France, Belgium, Germany, Switzerland, Holland, Austria-Hungary, Sweden, Norway, etc. In regard to these countries he pointed out that in France, Belgium, Germany, Switzerland and Austria-Hungary the telephone service was in the hands of the government. In Holland, as at Amsterdam and Rotterdam, the telephone system was handled by the municipality. In England the system was handled by private enterprise, but was handicapped by government royalties and interference, and by municipal obstruction, as at Glasgow and in London. In the Scandinavian countries, the rapid development of the art had been due to private initiative, as it was not subject to government restrictions until recently. The order of development and progress ran closely along this line. The telephonic systems were best under private ownership, as in this country, and worst under government and municipal ownership. The development at Amsterdam, for example, was the smallest amongst European and American cities of over 200,000, excepting Brussels and Budapest—government plants—and the two Russian cities of Moscow and Warsaw. As to the results of government ownership, Mr. Bethell pointed out that the last figures from Switzerland showed telephone receipts of 5,035,056 francs and expenditures of 6,274,015 francs. In all these cases, however, Mr. Bethell did not find fault with the technical bureaus, but attributed the poor showing to the political conditions which always surround such work even in the best governed countries.

Another Large Gift to the A. I. E. E. Library.

Mr. Andrew Carnegie has donated to the American Institute of Electrical Engineers the sum of $6,880.28, to be expended in housing, cataloging and completing the Latimer Clark collection of electrical books recently presented to the Institute by Dr. S. S. Wheeler.

It was the original intention of Mr. Carnegie to purchase the Latimer Clark collection for the Institute Upon being informed, however, that Dr. Wheeler, feeling that delay might cause the library to be lost to the Institute, had stepped in and purchased it direct from the Latimer Clark heirs, Mr. Carnegie very generously offered to donated a sum equal to that paid by Dr. Wheeler, in order that the library might be properly housed and cataloged and rendered more complete.

The Largest Electrically Operated Dry Dock in the World.

WHILE it seems almost incredible that the port of New York, the most important of the Western Hemisphere, should have been until very recently without proper commercial dry dock facilities for the accommodation of large transatlantic steamers, it is nevertheless a fact. Heretofore it has been found necessary, in case any accident happened to the hull of one of the recently constructed floating monsters on its westward passage, to take it to one of the ports outside of New York for repairs, or in emergencies obtain permission to dock at the Navy Yard.

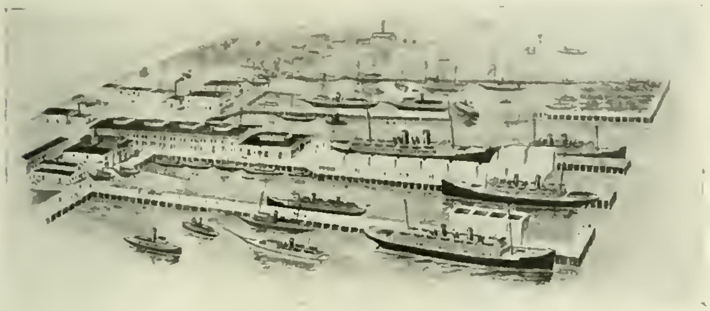

FIG. 1.—GENERAL VIEW OF DOCKS.

This reproach, however, no longer rests upon the port of New York, for there has recently been completed what is claimed to be the largest and most efficient floating dry dock in the world. It was designed by and constructed for the Morse Iron Works & Dry Dock Company, and is located near the new 40-ft. channel, now being dredged along the South Brooklyn shore. The dry dock itself is situated at the foot of Fifty-sixth Street, the property of the company extending from Fifty-fifth to Fifty-eighth Streets, and including land under water reaching some 2000 ft. into the harbor. A view of the company's property, comprising the dry dock, several basins, a marine railway, large ship building, repair and machine shops, the transformer house, etc., is shown in Figs. 1 and 3.

The floating dry dock, which at present consists of five sections, or pontoons, each 80 ft. in length, has a total length of nearly 500 ft., which includes the 4-ft. spaces between the pontoons and the 36-ft. extensions at each end. When completed, the dry dock will be between 700 and 800 ft. in length, capable of accommodating with ease the largest ship afloat. The pontoons are 120 ft. in width, and the combined lifting capacity of the pontoons at present installed is 15,000 tons.

Aside from the fact the dock is the largest and most powerful floating dry dock in the world, it is remarkable on account of the novel methods employed for the operation of its pumps and the kind of machinery installed. The power used is electricity, the motors being of the induction type, and the pumps are of the centrifugal pattern. An idea of the efficiency of the arrangement may be gathered from the fact that it is possible to dry dock an 8000-ton ship in about 40 minutes time. Recently the Mt. Vernon, a 649-ton ship, was lifted in 25 minutes, and it took only 51 minutes to dock the California, a 9000-ton vessel, shown in one of the illustrations (Fig. 2.)

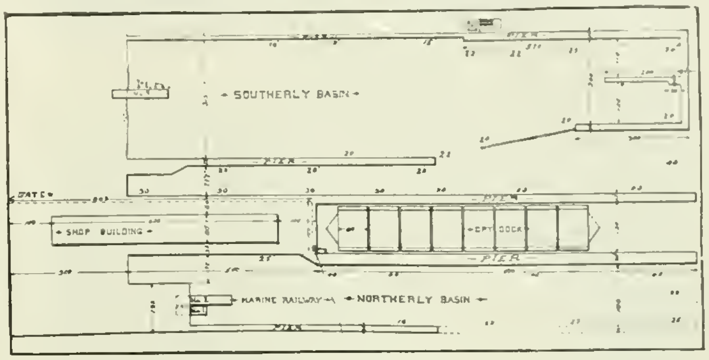

FIG. 3.—PLAN OF PROPERTY AND PIERS.

As will be seen from the illustrations, each pontoon or section has the shape of a V. As stated above, each section is 80 ft. long by 120 ft. wide, and has a depth of 15½ ft. at the center. The two wings at each side measure 56 ft. from the bottom of the pontoon to the top platform, on which the motors and handwheels for the inlet valves are located. The sections are built of the best Southern pine, and a complete system of stiffening bulkheads is used, there

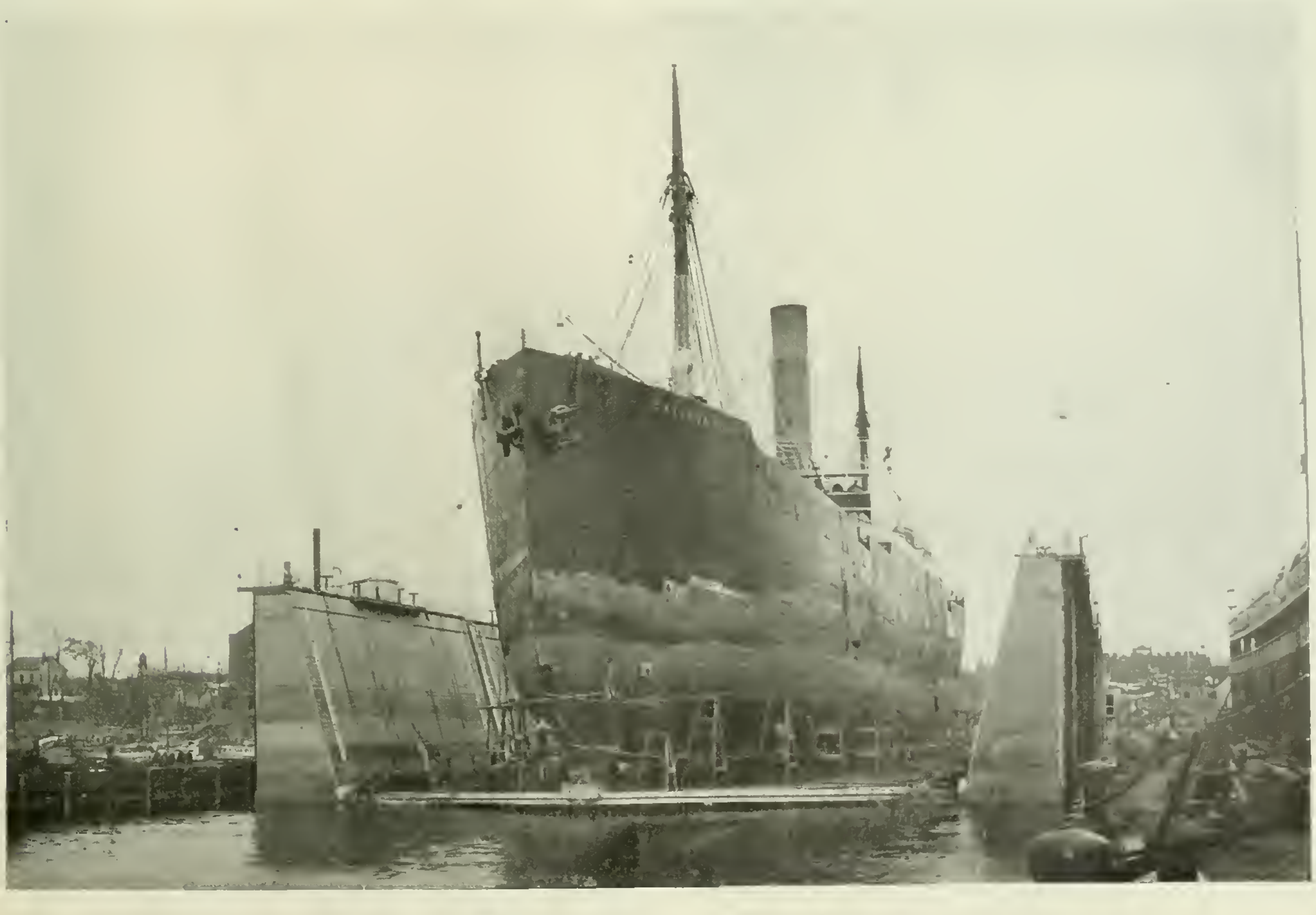

FIG. 2.—STEAMSHIP ON ELECTRIC DRY DOCK, SOUTH BROOKLYN, N. Y.

being seven running longitudinally, or fore and aft, through each pontoon. Each section is provided with a number of inlet gates below the water line, and sufficient ballast is carried to insure its sinking when the gates are opened.

On the floor of each wing is situated a centrifugal pump, manufactured especially for this dock, by the Prindle Pump Company. Each pump is supplied with three suction pipes, two extending towards the two end chambers and one to draw the water out of the central one. There are in all six compartments, three on each side of the main central bulkhead; but in case of a breakdown, the two sets of compartments may be connected by means of sluice valves, and either pump can accomplish the entire task of pumping out the pontoon. This sectional arrangement makes it possible to dock a vessel which is considerably listed, by tilting the dock, which has hitherto been found to be an impossibility. After the pontoon has assumed the same angle as the listed vessel, the latter is secured on the dock, which is then made to assume a level position. The pumps have a capacity of 5000 to 6000 gallons of water per minute and all suction pipes are 20 inches in diameter.

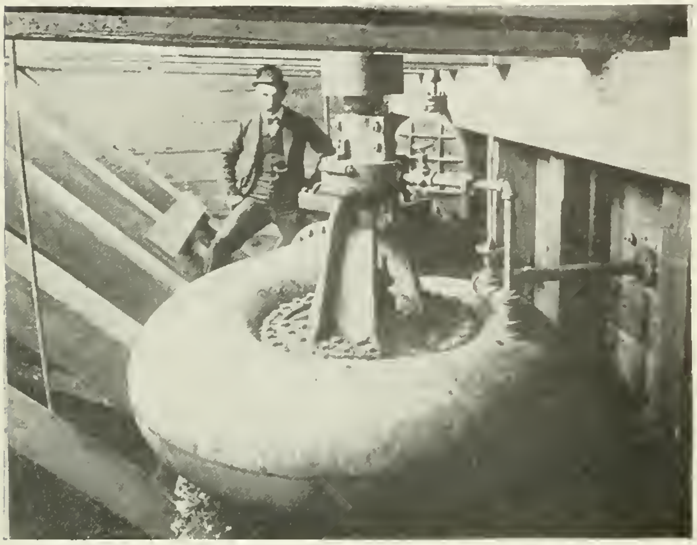

FIG. 4.—CENTRIFUGAL PUMP DRIVEN BY INDUCTION MOTOR.

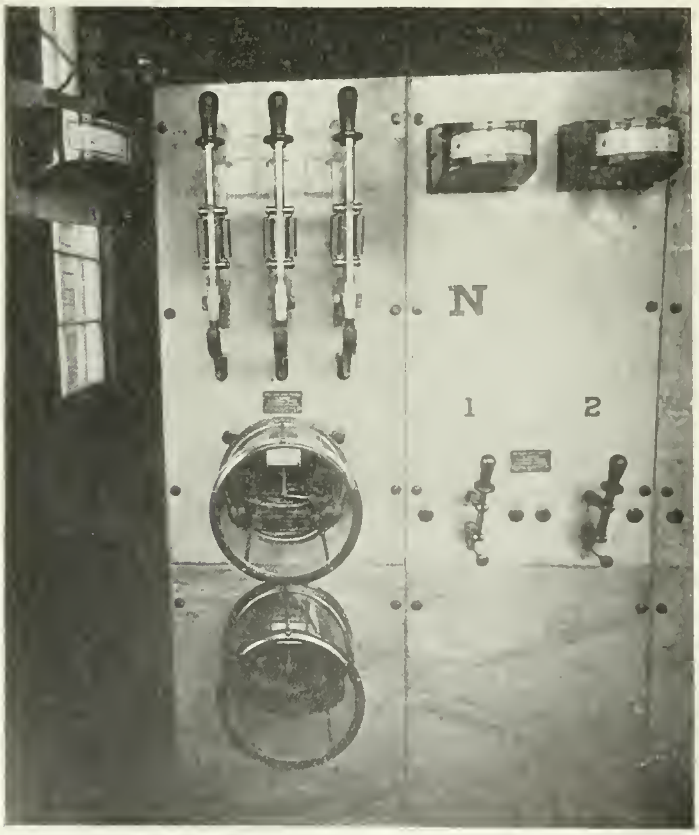

FIG. 5.—MAIN SWITCHBOARD PANEL.

Each pump is connected by means of a vertical shaft to a 75-hp General Electric induction motor, which is carefully housed in at the top of the pontoon, more than 50 ft. above the pump. Three-phase current at 6600 volts and 25 cycles to operate these motors is supplied to the company by the Edison Electric Illuminating Company, of Brooklyn. It is led to three 300-kw General Electric air-blast transformers, connected up in delta, located in a transformer house, where it is transformed down to 240 volts. A 2-hp induction motor is directly connected to a Buffalo Forge Company's blower, which supplies the air for cooling the transformers. A duplicate set of three conductor cables has been installed to guard against a breakdown.

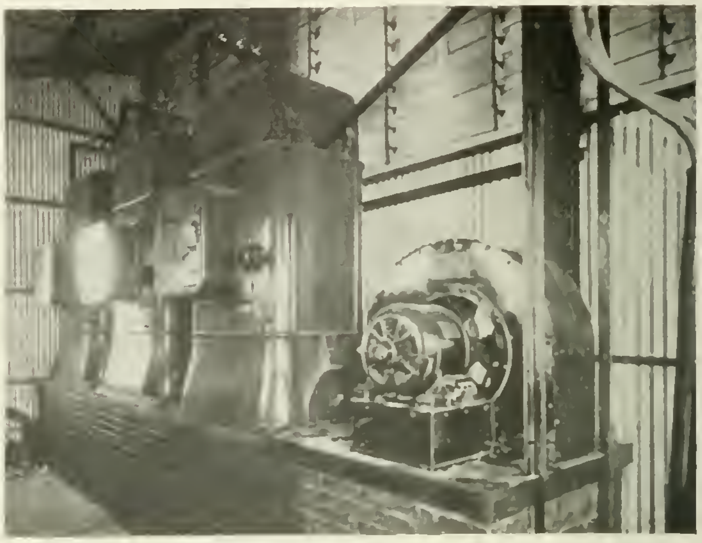

FIG. 6.—AIR COOLED TRANSFORMERS.

From the transformers the current is led to the switchboard, consisting of 6 panels, 5 of which are for the control of the motors. On one panel are mounted the polyphase wattmeters, one for the starting bus, at 140 volts, and one for the main bus, at 240 volts, as well as three 3000-ampere single-pole quick-break knife switches for controlling the board. The voltmeter is mounted on a swinging bracket. On each of the five motor panels, each of which controls two 75-hp induction motors, are mounted two three-pole double-throw oil switches, and two Thomson alternating-current ammeters, reading from 0 to 350 amperes. The wattmeter panel and one of the motor panels are shown in Fig. 5.

On the back of the board are two sets of bus-bars, the lower ones being the starting and the upper ones the main busses. There are also two G. E. circuit breakers which control the starting busses. The main wattmeters are supplied with current transformers, which can carry a normal load of 2300 amperes and an overload of 3500 amperes for 30 minutes, the ratio being 140 to 1. The transformers for the starting wattmeters are designed for a normal load of 1200 amperes and a 30-minute overload of 2000 amperes, the ratio being 80 to 1. The motors on the pontoons are controlled entirely from this

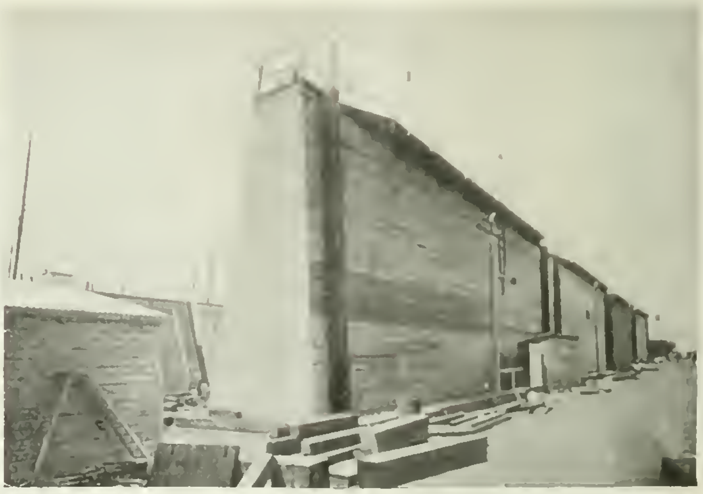

FIG. 7.—VIEW SHOWING METHOD OF SUPPORTING CABLES.

board, and after the motors have attained their proper speed, which the operator judges from the noise in the transformers ceasing, he throws them from the starting busses onto the main busses. The motors drive the pumps at a speed of 250 r. p. m.

The Edison Company also furnishes two-phase, 60-cycle, 2500-volt current for the lighting of the dock, which is done by means of arc lamps, located on the top platforms. The current is led to these lamps by means of flexible cables, supported in elevator loop fashion, as shown in the illustration.

The mode of procedure followed in docking a vessel is as follows: The inlet gates are opened and the pontoon sunk to a depth which will allow the vessel to be backed in between the wings, with the necessary clearance between her keel and the keel blocks. As soon as everything is in position, the pumps are started simultaneously, in case the vessel has no appreciable list, om the switch-board in the transformer house. As the wat pumped out the pontoons will rise, lifting the vessel clear out water. One advantage of this sectional building of a dock is nly so much of the dock need be used as is desired. For exan a vessel that is only 150 ft. long would simply require the pun g out of the first two sections.

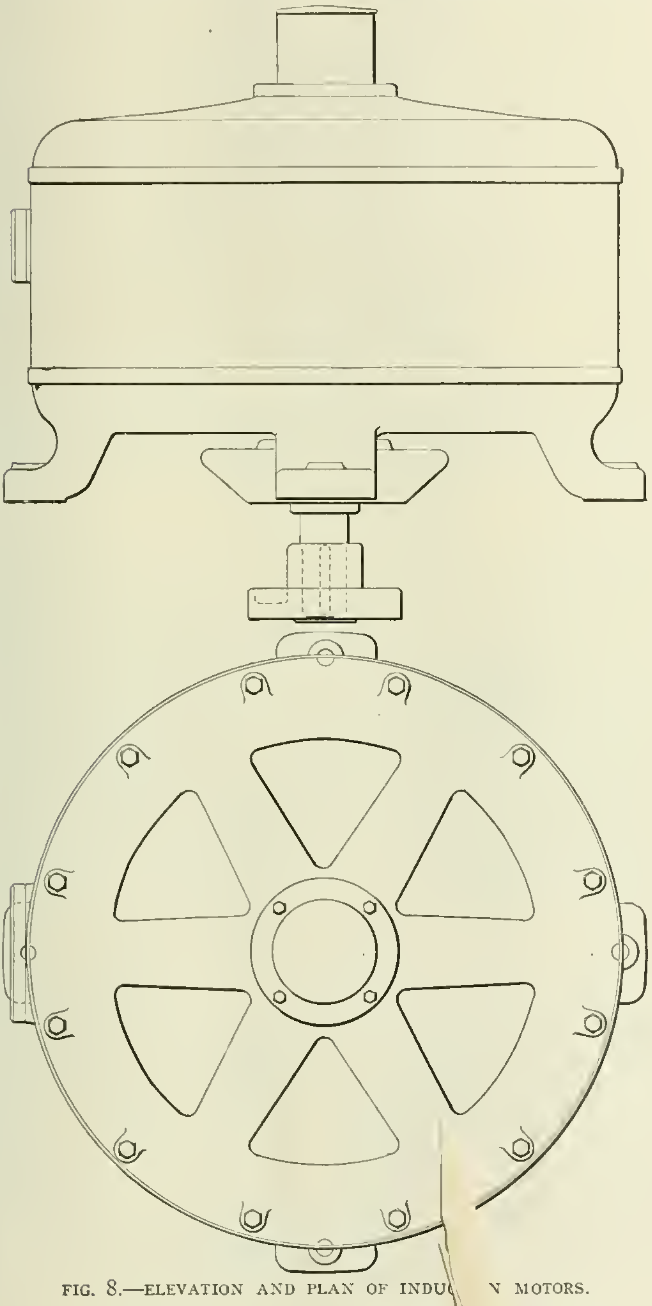

FIG. 8.—ELEVATION AND PLAN OF INDU N MOTORS.

It should be stated that the electrical method employed here is one which has never been used before, and has been found to be extremely flexible and efficient. Great credit is due to the various companies who have combined forces to make this plant a success, and special mention should be made of Mr. E. L. Etheridge, the Morse Company's electrical engineer, who has devised many important features. Mr. E. P. Morse is president and treasurer and Mr. Charles G. Street secretary of this enterprising and growing establishment.

Some Notes on Dielectric Losses

By Charles Proteus Steinmetz.

In the following are given the results of some determinations of the loss of power in electrostatic condensers on an alternating-current circuit, and at various frequencies and voltages. The condensers consisted of tinfoil and paraffined paper, filled with paraffine by the application of heat and vacuum, so as to exclude the air as far as possible.[1]

Anticipating a loss of power of a fraction of 1 per cent of the volt-amperes apparent input, I did not consider it feasible to measure directly the power by wattmeter, for the following reasons:

1. Even with a voltage and a current greatly overloading the wattmeter, the reading of the instrument is at or below the lower end of the scale, being only about ½ per cent of the volt-amperes impressed upon the instrument.

2. The inductance of the potential coil and the capacity of its series resistance cannot be determined with such accuracy as to derive the phase angle of the potential circuit of the instrument with sufficient closeness to avoid an excessive instrument error when testing a circuit of about 89.7° per cent phase displacement.

Therefore, I devised the following method, which proved very satisfactory:

1. An inductance coil of extremely low power factor (from ⅓ to ¾ per cent, according to the frequency), and of a reactance equal to the capacity reactance of the condensers, was shunted thereon, so that the lagging current of the inductance and the leading current of the condensers compensated, and a small resultant current of practically no-phase displacement remained. Then the wattmeter could be used to read very accurately the total power consumed in the condensers and inductance coil. The power consumed in the inductance coil was determined by measuring volts and amperes with direct current passing therein, and subtracting from the wattmeter readings.

2. The test was repeated with the inductance coil in series with the condensers. In this case the wattless leading voltage of the inductance and the lagging voltage of the condensers compensated, and the small resultant voltage is practically in phase with the current.

In either case a non-inductive resistance, very large compared with the capacity reactance of the condenser, was inserted in series, to eliminate higher harmonics of current,[2] and a smooth core armature alternator was used, giving practically a sine wave.

Since the correctness of this method depends upon the absence of other losses in the inductance coil than ohmic losses, the coil was built without iron to exclude hysteresis losses, was of very large diameter, and of well stranded cable to exclude eddy currents in the conductors—the absence of eddy currents being checked by tests.[3]

From 7 to 35 blocks of condenser were used, and the tests extended over a range of voltage from 220 to 980, for parallel as well as series connection of condenser and inductance coil. The average results of tests are given in the accompanying table per block of condenser. They are essentially:

1. With a sine wave of impressed e. m. f. the current in the condenser is directly proportional to the impressed e. m. f. and to the frequency; that is, the capacity of the condenser on an alternating current circuit is constant, within the range of tests.

2. The loss of power in the condenser is, within the range of tests, proportional to the square of the impressed e. m. f.; that is, the power factor of the condenser, at constant frequency, is constant and independent of the impressed voltage. (If anything, the loss rather appears proportional to a little higher power of the e. m. f. than the second.)

3. The power factor of the condenser does not seem to vary with the frequency; that is, the efficiency of the condenser appears to be independent of the frequency: or in other words, the loss of energy per cycle is proportional to the square of the electrostatic field

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[1] The condensers were standard 500-volt General Electric condensers, taken from stock, and after each set of tests returned thereto, so that the tests with different frequencies are not directly comparable.

[2] With no resistance in series to the condenser, even with an almost perfect sine wave of e. m. f., it is quite common to find the condenser current several times larger than corresponds to the capacity, since very high harmonics, which are too small to be detected in the e. m. f. wave, may produce excessive currents in the condenser. For instance, a 19th harmonic of e. m. f. of 2 per cent, with a transformer of 4 per cent inductance, gives in the condenser a 19th harmonic of current of over one-half the amplitude of the fundamental.

[3] For this purpose two stranded conductors were wound in multiple, connected in series for the condenser tests and in opposition for the check tests. In the latter case the eddy currents in the conductor obviously are the same, but since, due to the absence of an external field, the coil is practically non-inductive, the loss could be measured with alternating current by wattmeter, and checked with the ohmic loss determined by direct current.

strength, but independent of the frequency, as far as can be seen, considering that different lots of condensers were used in the different tests and the loss of power varied considerably in different sets of condensers.

4. The power factor of well-made condensers is extremely low, averaging about .005, or the efficiency is about 99.5.

Let $n =$ frequency.
$I =$ current, and $W =$ loss of power, per block of condensers, at difference of potential E.

We then have

$$I = a\, n\, E\, 10^{-5}$$
$$W = h\, n\, E^2\, 10^{-9}$$

$$\text{Power factor } f = \frac{h}{a}\, 10^{-3}$$

n	57.	77.3	93.9	114.	133.	Avg.
a	15.61	15.59	15.55	15.57	15.60	15.59
k	58.5	86.	105.	102.5	67.5	83.9
f (per cent)	.375	.551	.675	.659	.433	.539

The efficiency, therefore, varied between 99.625 per cent and 99.325 per cent, and the condenser is thus one of the most efficient pieces of apparatus known.

As regard the existence of a true dielectric hysteresis, while I believe such a phenomenon exists, I am under the impression that at least a very large part of the observed loss is not due to hysteresis, but is due to traces of air which are still occluded in the dielectric of the condenser; and caused by mechanical motion of the air molecules under the influence of the alternating electrostatic stress.

◆

Self-Starting Single-Phase Motor without Brushes.

By J. Fischer-Hinnen.

If one considers the field of an ordinary direct-current machine, shown in Fig. 1, as composed of insulated pieces of sheet iron, and the brushes moved out of the neutral zone and connected with an alternating-current source, then this motor, although it has no magnet coils of its own, will start to revolve in the direction in which the brushes were moved out of the neutral zone. As will be seen, no magnet coils are necessary if there are a sufficient number of armature coils, since the requisite field will be produced by the ampere-turns of the armature wires between *ab* and *cd*, and the maximum turning moment is obtained when the brushes are placed in the position indicated by *ac*, close to the pole-tips.

Such a motor possesses all the properties of an ordinary series direct-current motor—that is, large starting torque, the dependence of the speed on the load, and the property of regulating the speed. By choosing the proper proportions, a cos may be obtained which is far in excess of the cos which may be obtained with an ordinary asynchronous single-phase motor, but the objection to its practical application is the large amount of sparkling at the collector.

This fact induced me to effect the current distribution in the armature required for starting, not by means of any special position of the brushes, but by means of induction, doing away entirely with the brushes. Although I applied for a patent on this over five years ago (Swiss patent No. 13,651, of Dec. 17, 1896), I had only an opportunity recently to build a small motor of this type, and a description of the same may be of interest, as no details of the motor have ever been published.

"Figs. 2*a* and 2*b* show diagrammatically the connections of a bipolar motor. Accurately speaking, it consists of two separate motors with a common armature winding. To simplify the conception, the armature is assumed in Fig. 2 as a short-circuited armature, although the torque is thereby reduced to a certain extent. A phase armature (that is, one in which the phases are kept separate) would be better adapted for this purpose."

The magnet poles are turned with respect to each other through an angle of 45 degs., or in general through $\frac{90}{p}$, in which p is the number of poles. Instead of this the armatures might be turned through the same number of degrees, as is shown, for example, in Fig. 3.

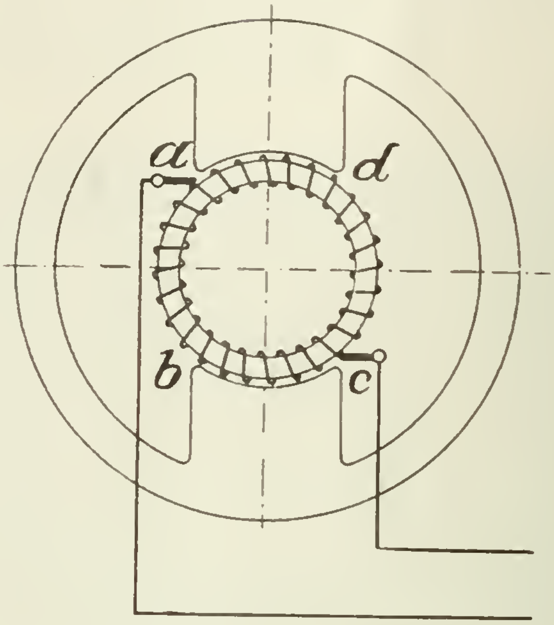


FIG. 1.—FIELD OF DIRECT-CURRENT MACHINE.

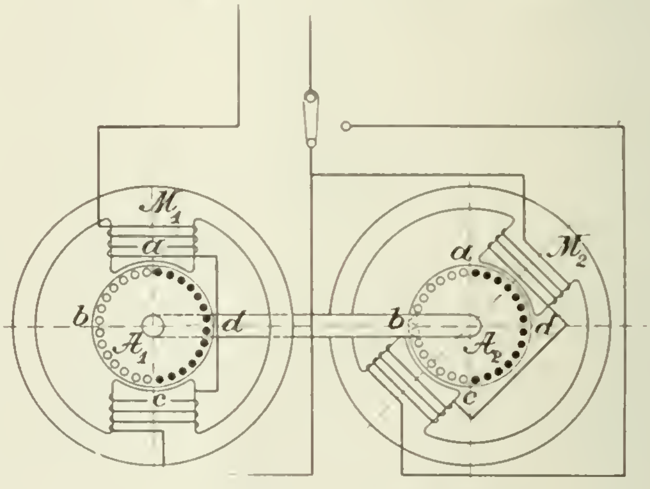


FIG. 2A.—DIAGRAM OF CONNECTIONS.

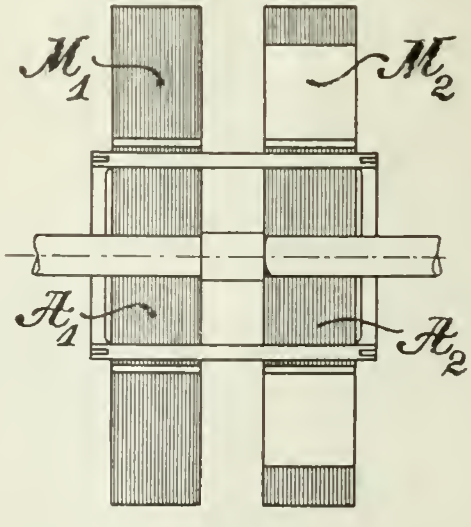


FIG. 2B.—DIAGRAM OF CONNECTIONS.

The starting of the motor is accomplished by first sending the current through one of the two windings, while the other is switched out by hand. If we assume, for example, that the magnet winding M is switched in, then this winding acts with respect to the armature winding A, as the primary of a transformer does to the secondary; that is, the current is produced in the armature A_1, the magnetic axis of which coincides with that of the field M_1. The same current distribution also takes place in armature A_2, as the two armatures have a common winding. The wires located between *a b* and *c d* therefore produce lines of force which pass through the field M_2 and create a turning moment in the wires *a d* and *b c* of about the same phase. When the motor has attained a certain speed the winding M_2 is switched in. The motor then becomes an ordinary asynchronous machine, and has a nearly constant speed at any load.

I wish to take this opportunity to point out an interesting peculiarity of the motor. If the field M_1 is switched in first, the motor will turn to the right and keep on turning in this direction after the winding M_2 has been switched in. If, however, one proceeds in the reverse order by first sending the current through the winding M_2, and only through M_1 after the motor has started, the motor will run in the opposite direction. It is therefore possible to make the motor revolve in either direction.

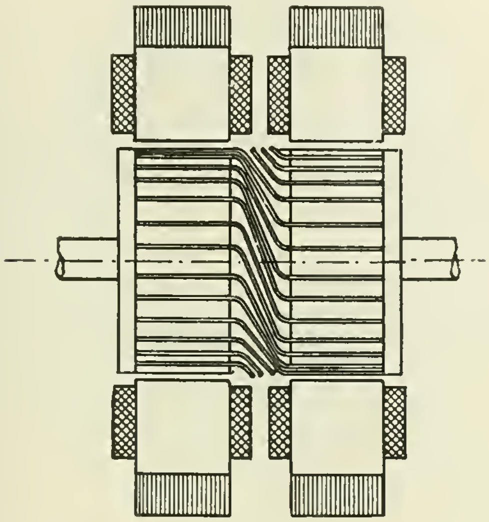


FIG. 3.

On account of its low cost the motor is well adapted for domestic purposes, such as the operation of sewing machines, fans, etc. For heavier work it is perhaps better to employ two separate motors with collector rings, and use rotating magnets, so as to reduce the number of rings. Besides, the same principle might, under certain conditions, be utilized for alternating-current arc lamps, wattmeters, etc., by using a disk armature instead of the ordinary armature in order to reduce the friction.

In this case the field necessary for starting is obtained by tilting the magnet poles. The same thing could be accomplished, however, by choking the secondary field in a certain direction, as shown in Fig. 4, by short circuiting the winding M_2 at two points, *e* and *f*, situated opposite each other and moved $\frac{90}{p}$ degs., with respect to the magnetic axis of the field M_1. The effect in this case will probably not be as perfect, because a small stray field will be present, the direction *e f*, which will cause an uneven turning moment.

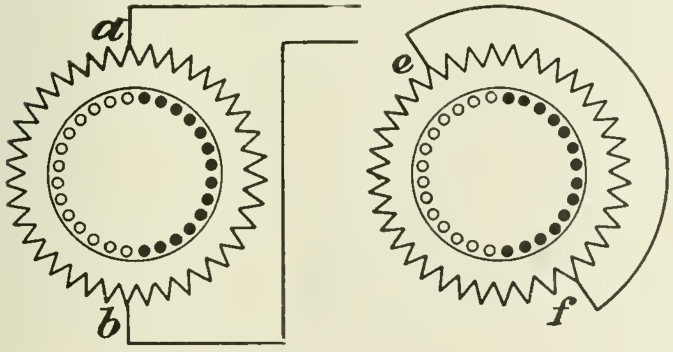


FIG. 4.

But whatever method may be chosen, it is of importance that the slots be entirely closed. When using the method shown in Fig. 2 the pole tips must be well rounded and the number of armature teeth must be so chosen that no sparking can be produced.

Los Angeles Transmission Plants.

LOS ANGELES is now the most important power transmission center in the West. To be sure, it will soon be called on to divide its honors in this respect with San Francisco and Oakland, but at the present time it probably stands at the head as being the chief city in a district which has done more pioneer transmission work than any other in the United States. This is not said to the discredit of the transmission work done at many other Western points, which have all played an important part in the development of the art of long-distance electric transmission.

There are two companies operating long-distance transmission lines into Los Angeles, the Edison Electric Company (purchaser of the Southern California Power Company) and the San Gabriel Electric Company. There are also three other companies operating long-distance transmission lines within a radius of 80 miles of Los Angeles, the Redlands Electric Light & Power Company, the San Bernardino Electric Company and the United Electric Gas & Power Company, of Santa Monica, so that there is a belt 100 miles long east and west and 30 miles wide north and south in Southern California, which is pretty thoroughly covered with high-tension lines. At times a number of these plants in this district have been operated in parallel with each other, thereby securing the maximum reliability and immunity from breakdowns for all concerned. Of this more will be said later.

The present article will deal mainly with the two large transmission plants supplying Los Angeles. Descriptions of them have previously appeared in the technical press, but results of operations of plants of this kind have not ceased to be of value. Both of these companies have distributed systems in Los Angeles for light and power, and also help feed the Los Angeles Railway. Both also have steam auxiliary plants at Los Angeles as the water-power plants are not sufficient to carry all the load at lowest water.

THE SAN GABRIEL ELECTRIC COMPANY

operates a 16,000-volt, 23-mile transmission line from a water-power plant near the entrance to the San Gabriel Cañon, about one mile north of Azusa, Calif. It has also recently acquired an old power plant in the San Antonio Cañon, 44 miles from Los Angeles, which will be run in connection with the San Gabriel plant.

The transmission line from the San Gabriel Cañon to Los Angeles consists of two three-phase circuits of No. 5 B. & S. medium hard-drawn copper wire on glass insulators. The Provo No. 1 type of insulator made by the Hemingray Glass Company, with an outer petticoat about 7 inches in diameter, has proved the most successful. A glass insulator previously used, having a diameter of 5½ inches, did not give satisfactory results. Most of the short circuits on the line are caused by birds. Formerly the lines have been patroled once a month, but hereafter a man will go over them once a week in connection with his attendance on some sub-stations for electric lighting acquired by the purchase of the San Antonio Electric Light & Power Company. With the newly acquired lines the company will hereafter have 100 miles of high-tension line. It has been claimed by advocates of porcelain insulators that glass will stand little mechanical abuse. The San Gabriel management points to the fact that on the old San Antonio 10,000-volt line some glass insulators were found with the petticoats entirely shot off, which had caused no short circuit. It is the practice now to coat all cross-arms and pins with a coat of asphaltum ⅛ inch thick. This is done by dipping the cross-arm with the pins on just to the point to which the insulator comes on the pin.

The power house at Azusa has four 300-kw, two-phase Westinghouse generators direct connected to Tuthill waterwheels. The exciters are belt-driven from the generator shaft. The frequency is 50, as in all transmission plants in this region. Two men are kept on duty at this power house in 12-hour shifts, making four men to operate the power house 24 hours. On the ditch and pipe line one man is employed in summer and three in winter.

At the sub-station in Los Angeles, which is close to the heart of the city, five classes of service are given—2400-volt, two-phase, a. c., power service; 24,000-volt, two-phase, a. c., lighting service; 110-volt, three-wire, d. c., lighting service; 500-volt, d. c., power service; a. c. constant-current arc lighting.

To supply so many classes of service, which were necessitated by the conditions when the company started, naturally requires a great variety of apparatus, and has given rise to a number of ingenious combinations.

Adjoining the sub-station is a steam plant which is used as an auxiliary at time of low water during the summer. In the steam plant rope-driven two-phase Westinghouse alternators are installed. Four men run the sub-station 24 hours, working 8-hour shifts, and four men a day are kept on duty at the steam plant, where steam is kept up all the time as an emergency precaution. Los Angeles crude oil is used for fuel as in all Southern California plants.

Direct current service is supplied by rotary converters. There is one 400-kw, 250-volt rotary for the three-wire system; two 250-kw rotaries for either 500-volt power or three-wire system. and one 250-kw, 500-volt rotary. The 250-volt rotaries when working on the three-wire system are connected on what is commonly known as the Hartford method, which consists in connecting the direct-current terminals of the rotary converter to the outside wires of the three-wire system, and connecting the neutral wire to the middle points of the secondary transformer coils which supply the rotary. During the day when the lighting load is light, two of the 250-kw rotaries are connected in series to supply 500-volt direct current for the Los Angeles Railway along with the 500-volt rotary. There is also a sub-station at Pasadena where there is a 500-volt, 400-kw rotary supplying the Los Angeles & Pasadena Electric Railway.

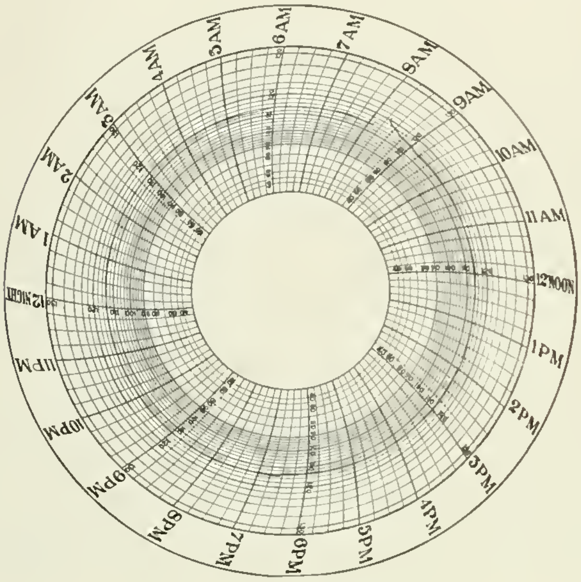


FIG. 1.—VOLTMETER CHART.

All the circuit breakers at the Los Angeles sub-station are provided with auxiliary contacts, whereby in case they open from any cause the supply circuit is connected to a water rheostat to prevent a sudden throwing off of the load. This, of course, is to improve the regulation. The regulation on the lighting mains is excellent, as shown by the Bristol recording voltmeter charts shown in Figs. 1, 2 and 3. These are from an instrument connected to the lighting mains. The writer had the pleasure of looking over a large number of these in the office of General Manager Balch, and those shown are fair samples of the whole lot. The lighting service is supplied over the same transmission line as the railway and power service, but, of course, the percentage of fluctuating load to the total load is small. Lombard governors are used at the water-power plant. The sub-station switchboard attendants watch the voltage closely, and if any radical changes are to be made the power house is notified by telephone.

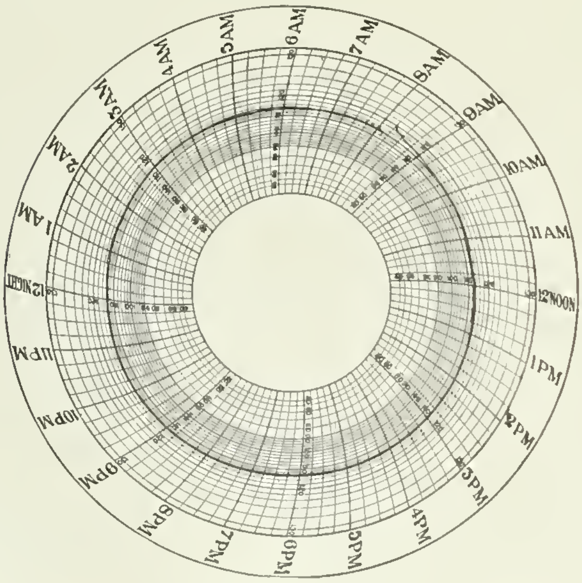


FIG. 2.—VOLTMETER CHART.

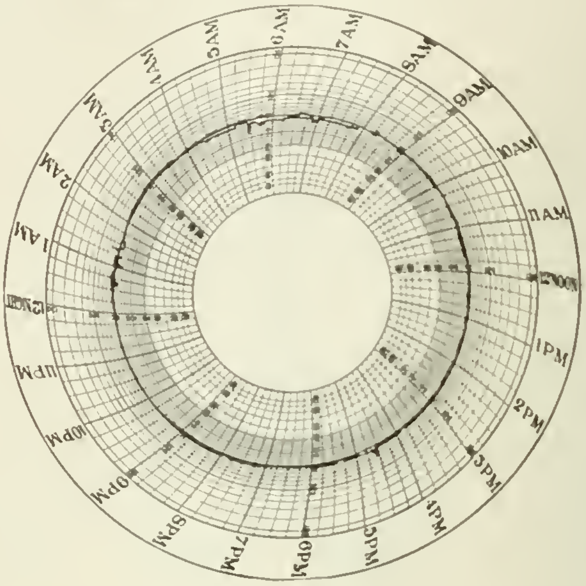


FIG. 3.—VOLTMETER CHART.

There are no fuses on any of the lines or transformers at the power house. At the sub-station the direct-current circuits are provided with circuit breakers, and the alternating circuits are fused with aluminum wire enclosed in a tube. When the high-tension transmission lines short circuit it usually is burned off. If it does not burn off it is found by trial on which of the two lines the short exists and the other line is used alone. The underground three-wire network of the city is divided into two parts, north and south, the north set of mains being connected to the south set of mains. If a short occurs on either set of mains too heavy to be burned off only one-half the service will be shut down thereby. The lighting of the city is done by series a. c. arcs supplied from constant potential transformers. Manhattan regulators keep the current constant at 6.6 amperes. Sixty lamps are run in series with 80 volts per lamp. By using constant potential transformers for this arc-lighting service the same transformers are utilized during the day on 2400-volt power service.

Besides the four kinds of city light and power service enumerated an important part of the company's business is that of supplying power for irrigation pumping. Last summer 30 to 40 pumps of 30 to 40 horse-power were in operation. The present summer a load of 2500 horse-power is anticipated. These farmers' pumping plants are supplied from the 16,000-volt line. At a pumping station two transformers are placed, stepping down from 16,000 volts, three-phase, to two-phase for the pump motor. The rate for irrigation pumping is 1¾ cents per horse-power hour. The pumps are cut off from 5 to 9 p. m. to accommodate the lighting peak. The 2400-volt power circuit supplies five brickyards, which stop at 3 p. m., so that this also is a good thing for the load factor.

A load curve for 24 hours is shown in Fig. 4. This is from a winter day. In the summer the irrigation pumping fills up the hollows and makes the remarkably good load factor even better. The power supply to the Los Angeles Railway is cut off during the lighting peak, as the railway company has its own plant from which it can get power. The power factor of the apparent load averages 80 per cent.

This company gives special attention to checking up consumers' meters to prevent loss of revenue through slow meters so common in many places. It is the aim to check each consumer's meter in place with a stop watch every six months. Five trials of this kind are made for each meter to try the accuracy on different loads.

The following are the rates for various classes of service:

REGULAR SCHEDULE OF POWER RATES, JAN. 1, 1900.

Minimum Bill, $2.00 per month.

Discount.		Kilowatt-hours.			Net.
20 %	when consumption is between	25,000	and	124,000	12
40 %	" " "	125,000	"	249,000	9
46⅔%	" " "	250,000	"	499,000	8
53⅔%	" " "	500,000	"	749,000	7
60 %	" " "	750,000	"	999,000	6
66⅔%	" " "	1,000,000	"	1,999,000	5
73⅓%	" " "	2,000,000	"	over	4

REGULAR SCHEDULE OF ARC RATES, JAN. 1, 1900.

Each arc burning from sunset to 9 o'clock week nights, and until 10.30 o'clock Saturday nights; no light Sundays, per week	$1.25
Burning from sunset until 9 o'clock, each night	1.50
Burning from sunset until 10 o'clock, each night	1.75
Burning from sunset until 11 o'clock, each night	2.00
Burning from sunset until midnigt, each night	2.25
Burning from sunset until 1 o'clock each night	2.50
Burning from sunset until sunrise, each night	3.00
Burning from sunrise until sunset, each day	2.00
Burning for 24 hours each day	5.00

REGULAR SCHEDULE OF INCANDESCENT LIGHTING RATES, JAN. 1, 1900.

Base Rate, 15 cents per 1000 watt-hours.

					Net.
When monthly bill is less than	$2.00	no discount.			
" " " between	2.10	and	$3.90	6⅔%	14c
" " " "	4.05	"	9.90	13⅓%	13c
" " " "	10.05	"	29.85	20 %	12c
" " " "	30.00	"	49.95	26⅔%	11c
" " " "	50.10	"	99.90	33⅓%	10c
" " " "	100.05	"	199.95	46⅔%	8c
" " " "	199.95	"	over	60 %	6c
Minimum bill, $1.00 per month,	300.00	"	over		5c

Minimum bill on arcs on meter, $4.00 per lamp per month.

The Company is under the general management of A. C. Balch, to whom and to Superintendent E. A. Beck the writer is indebted for much information and many courtesies shown. Mr. Balch reports the plant to be in excellent financial condition, with well satisfied stockholders. Enlargements are soon to be made.

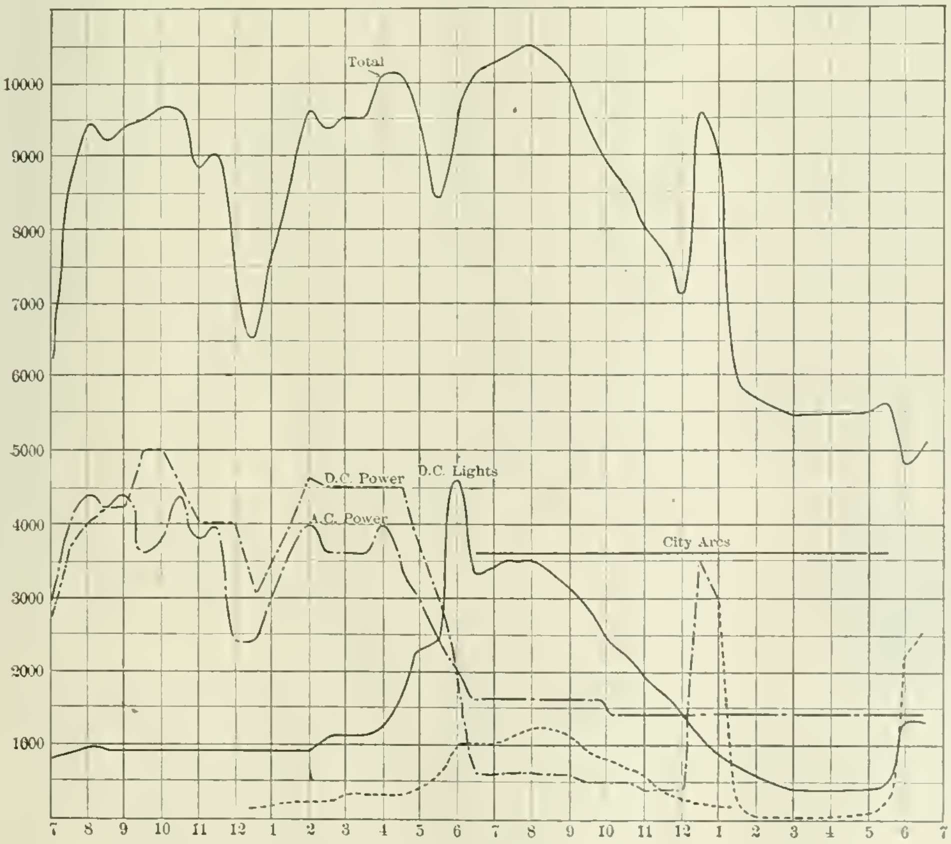


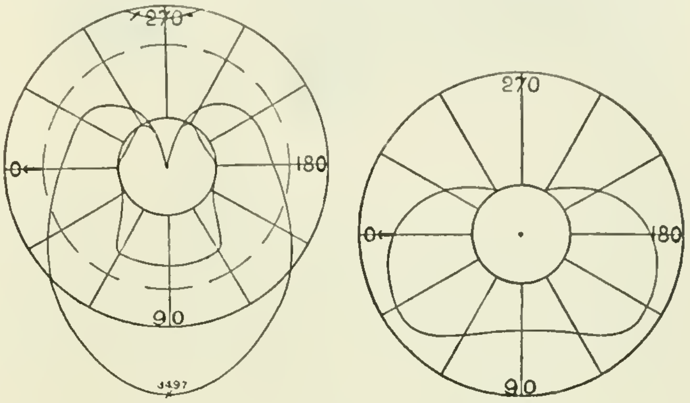
FIG. 4.—LOAD CURVES FOR FEBRUARY 13, 1901.

Elements of Illumination XXVII.

By Dr. Louis Bell.

In spite of the trouble from dust, alluded to in the last paper, the holophane globes have come into considerable use for street lighting in some European cities, notably Munich, where several thousand have been used on Welsbach street lamps for several years past. The net result is reported to be exceedingly good, although the amount of labor involved must be, from an American standpoint, very considerable. Breakage in this case is reported at about 10 per cent per annum.

If this device could be successfully applied to arc lamps for street lighting, a very valuable redistribution of the light might be effected, but certain obstacles seem to be interposed on account of the shifting of the arc as the carbons are consumed. With a focusing form of lamp this trouble would be averted, but such lamps have never yet come into considerable use.



FIGS. 1 AND 2.—DISTRIBUTION CURVES.

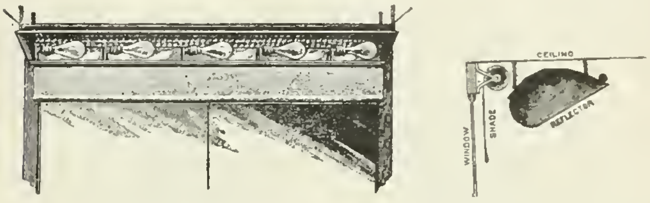
Tests of holophane globes on incandescent lamps show in a thoroughly typical manner the effect of their peculiar structure in diffusing and redistributing the light. For example, Fig. 1 exhibits the distribution produced by a holophane of the "stalactite" shape designed to throw the light downward. It does this very effectively, giving less of a spotted effect than any of the reflecting devices and at the same time diffusing the light from the bare filament very thoroughly. The light absorbed by this stalactite was only 14.6 per cent, which is considerably less than would be lost by any equally effective device for diffusion alone, to say nothing of the matter of redistribution. And this figure for absorption is probably increased by the deflection of so much light downwards, since similar shades designed to throw more light laterally give materially smaller absorption.

From a considerable number of tests the holophane shades appear to average about 12 per cent absorption when clean. That is, they actually transmit very nearly as much light as clear glass globes that have no value in redistributing or diffusing the light. As to their great usefulness in indoor work there is little doubt. For street lighting they are capable of immensely improving the distribution of the light, but the matter of keeping them clean is serious. Their greatest chance for practical usefulness would be in connection with arc lamps if the details of such an application should be thoroughly worked out.

Fig. 2 shows the distribution curve from a holophane stalactite designed to produce a more general distribution than Fig. 1, the absorption in this instance being only 10.8 per cent. The principle employed in these shades would readily lend itself to the distribution of light in special directions for special purposes, but the variety of work in which light has to be directed is so great that special problems are best treated by the use of reflectors which are comparatively cheap and can readily be adapted to any required form.

There is a vast amount of illumination which may properly be classed with scenic illumination, although it may be purely utilitarian. It is at all events directed illumination rather than that intended for the general lighting of an area. In this category fall the lighting schemes for shop windows, picture galleries, exhibits of various kinds and the thousand and one cases in which some particular object must be strongly lighted.

Of these cases many may be sufficiently well treated by placing strong lights near the objects and far enough at one side to be out of the field of view, but, as a rule, the use of reflectors is desirable.

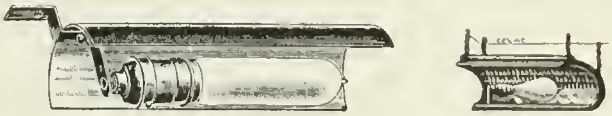


FIGS. 3 AND 4.—WINDOW REFLECTORS.

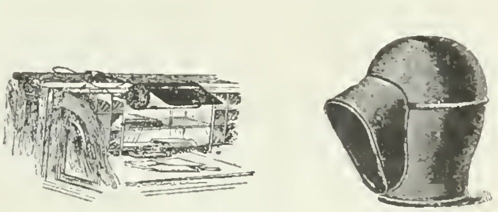
Reflectors for such work are made in various shapes and of various materials, most commonly of brightly planished tin or of silvered glass built upon strips to the required shape. The simpler forms are made often of one piece of silvered glass, sometimes ribbed or corrugated to produce a certain amount of diffusion. Similar reflectors are sometimes used in connection with groups of lights placed near high ceilings. Such services are quite useful in certain cases of ceiling and cornice lighting.

The general principle to be followed in any sort of display lighting is to place the lights so as to throw a strong light upon the objects to be brought into prominence without being themselves visible. The most useful direction of illumination is usually found to be downwards.

A good typical example is the illumination of a show window. This is accomplished far more readily by means of incandescent lamps than by any other radients, since these can be safely placed in almost any position. Such windows are usually high and embrace a space rather deep from front to rear. Fig. 3 shows a common and very effective plan of their illumination. At the top of the window close to the ceiling is arranged a long reflector with its working surface bearing backward and downward. In the reflector are located such a number of incandescents as may be necessary, turned sidewise, lengthwise of the reflector, as shown in Fig. 3, which gives a view of the arrangement looking towards the window from the inside. The lights should be 9 inches to a foot from socket to socket, and the reflectors should extend clear across the window. Fig. 4 gives an end view of the reflector, showing its shape, relation to the window and the method of suspension. The lamps in this instance are wired to a flexible cord. Ordinarily, 16-cp lamps are used for such work, but with specially high or deep windows 32-cp lamps are useful. Rarely, colored lights give a desirable effect, and in such case it is almost necessary to use 32-cp lamps to attain anything like sufficient brilliancy.



FIGS. 5 AND 6.—REFLECTORS.



FIGS. 7 AND 8.—DESK REFLECTORS AND PULPIT HOOD.

A similar scheme of illumination may be effective applied even to show cases. For this purpose a little reflector of polished metal, taking a lamp with a long and narrow bulb, as shown in Fig. 5, is extremely useful.

In cornice lighting, reflectors like Fig. 3 and Fig. 5 can be very advantageously employed, and indeed something of the kind should always be used when the cornice can be gotten at to keep the reflectors clean. No form of interior lighting gives a more beautiful effect, and by the adroit use of reflectors a fair degree of economy can be attained.

Picture galleries are lighted on much the same principle as show windows, and with similar apparatus. As a rule, the light should come strongly down upon the pictures at an angle of from 30 to 45 degs. away from the perpendicular. Generally several rows of pictures can be illuminated by a single long reflector, and the reflectors have to be hung from the ceiling far enough away from the wall and high enough to bring the light downward at a proper angle. In a few instances a small reflector may have to be carried out on a bracket from just above some especial picture in order to throw upon it sufficient light. As to the amount of light required in such situations, there can be laid down no very definite rule, but, as a rule, the lamps should be at least as closely set along the reflector as in the case of window lighting. The gross amount of light should be not far from 1 candle-power per square foot of vertical wall surface. The diffused light will take care amply of the general illumination. In case of very dark tones in the hangings even the lighting just mentioned may well be increased. With a generally light tone in finish and pictures, such a condition, for example, as might be found in an exhibition of engravings or water colors materially less than 1 candle-power per square foot would be found to serve the purpose.

For all such work ordinary clear bulb 16-cp incandescents are the main reliance, other sizes and kinds of lamps being only useful now and then. In some respects arc lamps would be very useful in display lighting, but they are too bulky to put behind any ordinary reflectors, and hence, in spite of the advantage of a clear white light, are seldom applicable. Ordinary incandescents of fairly high efficiency give a near enough approach to the proper color for all ordinary purposes. It is generally considered inadvisable to use gas light in any form for the illumination of picture galleries on account of the effect of the gas and its products of combustion upon the pigments. In one case within the author's ken all the high lights in some valuable sketches were turned black by the effects of illuminating gas. They had been put in with lead white, and the traces of sulphuretted hydrogen in the gas had in course of time done their work In some instances an interposed glass ceiling to separate the gas jets from the gallery proper have been used with good effect, but there is small excuse for using anything but incandescent lamps in such places.

Frequently the use of reflectors is a great convenience in bringing into strong light some particular spot, and small reflectors on the general lines already shown are exceedingly convenient. Fig. 6 shows one along the same lines as Fig. 3, but arranged to take a single lamp. This would serve admirably to light up a single machine, or a dark corner in an office, such as exists far too often.

Such lighting should, however, be done rather cautiously, since, for example, a brilliantly lighted desk in a dark corner is apt to affect the eyes very seriously, as has already been suggested. For this reason some of the special desk reflectors like that shown in Fig. 7 should be used if at all, with bulb or containing shade very heavily ground to soften and diffuse the light, and with plenty of general illumination about the vicinity. This is but following out the general rule that strong level illumination should never be used alone, but always in connection with plenty of diffused light. With this proviso desk lights, like Fig. 7, are some times very useful.

Probably the most objectionable arrangement in use from a hygenic standpoint is the pulpit hood, such as is shown in Fig. 8. It is enameled white inside and contrived to throw a brilliant beam of light on the book while leaving everything about in darkness or the semi-obscurity that popular parlance associates with religious functions. It comes as near to being a bad eye machine as anything misplaced ingenuity has yet devised.

If it be really necessary for the stimulation of reverence or somnolence or the proper and righteous conduct of the service that the occupant of the pulpit should be in a dark corner then the pulpit light should be shaded in the least obnoxious way possible. Giving the hood an interior coating of deep cream colored enamel and providing it with an incandescent lamp of 8 or 10 candle-power with a lightly ground bulb, would cut down and soften the illumination while still giving all that is necessary or desirable. In a brightly lighted hall the intense spot from a hooded reflector is less troublesome, but it had still better be softened in some such manner as has just been suggested.

Storage Battery Auxiliaries—III.

By Lamar Lyndon.

DIFFERENTIAL BOOSTER.

The differential booster is used on power and railway circuits where the load fluctuates widely and suddenly. There are several varieties of this type of booster, and many patents have been issued covering the different methods of varying the e. m. f. of the machine. Some of these patents appear to be identical with each other and lead to doubt as to the efficiency of the United States Patent Office.

The first booster patent issued was granted to C. O. Mailloux, June 24, 1890, under serial number 430,868. This patent covers the booster system shown diagrammatically in Fig. 6, and, in connection therewith, as a modification of the basic patent, a differential booster.

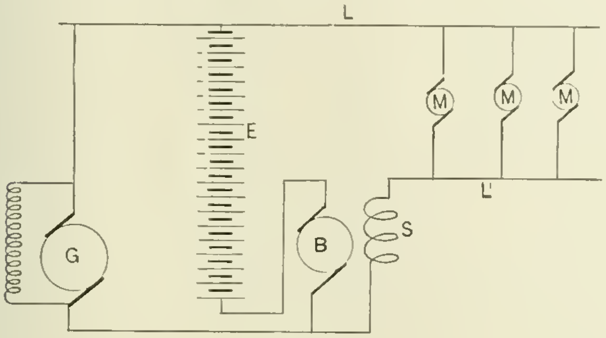


FIG. 6.

The original patent contemplates a battery E in series with a booster armature B. This series is connected across the mains L, L^1, the generator G being the source of supply. The total current supplied to the line passes through the series field s on the booster. It is evident that within the limits of saturation the e. m. f. of the booster will vary directly as the external load. This e. m. f. is opposed to the generator e. m. f., and tends to discharge the battery. When the load is light the e. m. f. is low and the generator e. m. f. overcomes it and the battery e. m .f. sends a charging current into the battery. At normal load the series field produces an e. m. f., which, added to the battery e. m. f., balances the generator e. m. f. and current flows neither into nor out of the battery. A load greater than normal raises the booster e. m. f., causing it to discharge the battery at a rate proportional to the external load.

The differential booster which appears in this same patent is as shown in Fig. 7. In this the shunt coil f opposes the series coil s, tending to produce an e. m. f. in the same direction as the generator e. m. f., and to send current into the battery. At normal load the series and shunt coils balance each other and the e. m. f. of the booster is zero, and current flows neither into nor out of the battery. A heavy load causes the series to overpower the shunt field, and the e. m. f. of the booster is in such a direction as to discharge the battery. A load lighter than normal allows the shunt to overpower the series field, and the booster e. m. f. is added to the generator e. m. f., causing a charging current to flow into the battery.

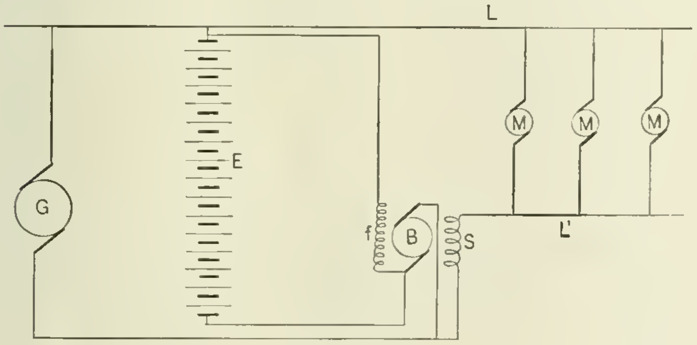


FIG. 7.

Patent No. 589,186, granted to Meredith & Hunt, on Aug. 31, 1897, appears to be identical in every respect with the differential booster system patented by Mailloux in 1890.

Patent No. 651,664, granted A. S. Hubbard on June 12, 1900, and assigned by him to the Gould Storage Battery Company, of New York, describes a booster system which is as shown in Fig. 8 G is the supply generator, E a battery, B the booster armature connected in series with the battery, the two being connected across the mains, L and L^1. M is the armature of a counter e. m. f. generator connected in series with the field, f, of the booster, the two being also connected across the mains L L^1. A rheostat R is included in the circuit.

S is the field of the counter e. m. f. generator, and carries a current proportional to the total external load, the proportion being regulated by means of the adjustable resistance, r, which is in parallel with S. The operation of this system is as follows:

The e. m. f. of the booster is in opposition to that of the generator. The e. m. f. of the counter e. m. f. generator opposes the current glow through shunt field f of booster. The e. m. f. of counter e. m. f. generator varies directly as the external load, thus causing the booster e. m. f. to vary inversely as the external load.

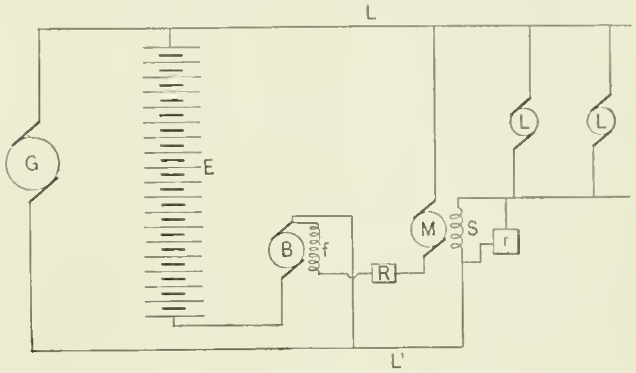


FIG. 8.

At normal load the battery e. m. f. plus booster e. m. f. balance the generator e. m. f. Decrease in load causes a higher booster e. m. f and a proportional charging current, while a load greater than normal reduces the booster e. m. f. and permits the batteries to discharge at a rate proportional to the excess of load up to a given point, which point is the magnetic saturation of the field magnets of M. This system was designed with a view to limiting the discharge of the battery, and in case of the load exceeding the normal capacity of both generator and battery, to cause the generator to operate at an overload rate and assist the battery.

The differential booster commonly used is a modification of that of Mailloux, and was patented May 16, 1899, under serial No. 625,-098, by J. B. Entz. This system is explained by Fig. 9.

G is the generator, B the booster armature, E a battery, f the shunt field of the booster connected across the battery terminals, S_1 and S_2 series fields, L, L^1 the mains and M, M, the external load.

As shown, S_1 is in series with the generator and carries all current supplied, and at the rate at which the generator furnishes current. S_2 carries all current supplied to the external circuit, which, at any time, is equal to the algebraic sum of the generator and battery currents, when the generator and charging currents are taken as positive and discharging current as negative.

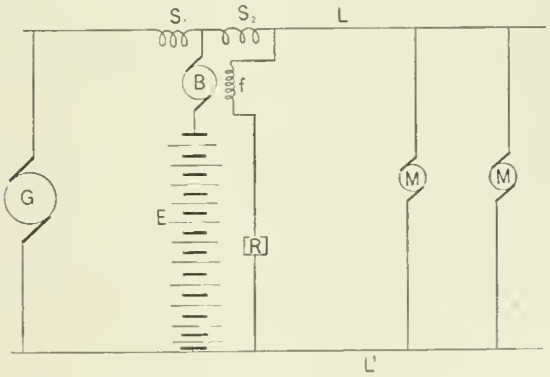


FIG. 9.

S_1 and S_2 act together to produce a m. m. f. opposed to that produced by the shunt field. As the object of this system is to maintain a constant load on the generator, S_1 may be considered as constant. The field then due to $f - S_1$ is constant. If at normal load $(f - S_1) - S_2 = O$, the booster e. m. f. will be zero, and there is neither charge nor discharge. As S_2 varies directly with the external load, an increase or decrease will result in a booster e. m. f. acting to discharge or to charge the battery. The action is, in fact, the same as that of Mailloux's differential booster, considering $(f - S_1)$ as the equivalent of the opposing shunt field of Mailloux's system.

The reason of the application of S_1 lies in the fact that any considerable variation in the battery e. m. f. will disturb the equilibrium of the system unless this compensating coil is used. If the e. m. f. of the battery be lower than normal, it will not discharge rapidly enough to relieve the generator of overload fluctuations unless the booster e. m. f. be increased, and the generator will therefore have to supply a current greater than its normal capacity. If, however, a current greater than normal flows through the coil S_1 the value of $(f - S_1)$ is reduced, and S_2 still further overpowers the resultant of those two and causes a higher booster e. m. f. tending to discharge the battery, and thus bringing down the generator load to normal. Should the battery e. m. f. be above that it ordinarily has the reverse operation will take place; the battery tending to discharge too rapidly will be brought down and the generator allowed to take its share of the load, because of the booster e. m. f. being lowered by decreased current in S_1 due to light load on the generator.

This system is entirely automatic with the exception of occasional variations in the strength of shunt field f effected by means of rheostat R to compensate for changes in the battery e. m. f. It is adopted for systems supplying both light and power, where the lighting mains are connected to L and L_1 between the booster and the generator forming a non-fluctuating load.

The fluctuating load must be connected to the mains *after* they pass through their proper booster connections.

In the compound booster system, it will be remembered, power can be taken from either side of the booster connections.

As in the case of the compound booster, the battery may be made to help the generator carry the peak of the load as well as take up the fluctuations. This booster will operate satisfactorily with a compound-wound generator as the source of supply. In calculating the size and windings of this booster the following analytical discussion is necessary:

At normal load and normal battery voltage there should be neither charge nor discharge, and the booster voltage should be zero. Let the maximum voltage of battery equal 2.3 N, N being the number of cells in series. The normal voltage equal 2 N. The voltage due to the shunt coil should be *not less* than $(2.3\,N - 2\,N) = .3\,N$.

Let E_M = Maximum generator voltage.
E_A = battery voltage.
V = booster e. m. f. due to shunt coil.
I_x = generator current.
R = battery circuit resistance, including booster armature.
t_1 = number of turns in coil S_1.
t_2 = number of turns in coil S_2.
I_0 = current in external load.
K = volts produced per ampere-turn on booster field.
h = volts drop in generator voltage per ampere of generator current.

If I_x be first assumed as equal to the average generator current, then $E_M - I_x\,h$ = normal voltage at booster and battery terminals = E_0. If the generator is compounded to give a constant e. m. f., $h = 0$. If it be overcompounded h is negative and $E_0 = E_M + I_x\,h$.

In order that booster voltage shall be zero when I_0 = average generator current.

$$I_x\,(t_1 + t_2)\,K = V \;\therefore\; t_1 + t_2 = \frac{V}{I_x\,K} \qquad (16)$$

As the load increases, the voltage due to the series coils must exceed V by an amount equal to the drop due to resistance of battery circuit, or

$$K\,(I_x\,t_1 + I_0\,t_2) = V + R\,(I_0 - I_x) \qquad (17)$$

the current supplied by the battery being $I_0 - I_x$. As I_x is to remain constant, the increase of series m. m. f. must be supplied by coil S_2. Then $K\,t_2\,(I_0 - I_x) = R\,(I_0 - I_x)$, or $t_2 = \dfrac{R}{K}$ (18)

From these equations, the windings of the three coils are determined. In using the factor K a constant permeability and straight line characteristic are assumed. This is sufficiently true for practical purposes. Remembering that the shunt coil voltage varies with variation in E_A, if connected across the battery terminals, V becomes

$$\frac{V\,E_A - V\,R\,I_0 + V\,R\,I_x}{E_N} \qquad (19)$$

in which E_N is the normal voltage of E_A.

With the shunt coil connected across the line, the equation of e. m. f.'s is

$$I_x\,t_1\,K + I_0\,t_2\,K - V - E_0 + E_A + R\,I_x - R\,I_0 + I_x\,h = 0 \qquad (20)$$

But $t_2\,K = R$ (equation 18). Therefore,

$$I_x = \frac{V + E_M - E_A}{t_1\,K + R + h} \qquad (21)$$

This shows I_x to be constant with a given value of E_A whatever the load variation.

If, however, the shunt coil be connected across the battery equation (20) becomes

$$I_x\,t_1\,K + I_0\,t_2\,K - \frac{V\,E_A}{E_N} - \frac{V\,R\,I_0}{E_N} + \frac{V\,R\,I_x}{E_N}$$
$$+ I_x\,h - E_0 + E_A + R\,I_x - R\,I_0 = 0 \qquad (22)$$

whence

$$I_x = \frac{E_0 + \dfrac{V\,E_A}{E_N} - E_A + I_0\,\dfrac{V\,R}{E_N}}{t_1\,K + R + \dfrac{V\,R}{E_N} + h} \qquad (23)$$

With a given value of E_A, all the terms of this equation are constant, except I_0, showing that I_x varies with I_0. The factor $\dfrac{V\,R}{E_N}$ is, however, small. When battery voltage is normal, $E_N = E_A$, and

$$I_x = \frac{V + I_0\,\dfrac{V\,R}{E_A}}{t_1\,K + R + \dfrac{V\,R}{E_A} + h} \qquad (23)$$

Consider now the concrete case of a railway circuit having the following characteristics:

$E_M = 500$ volts $= 2\,N$.
$n = \dfrac{500}{2} = 250$ cells.
$V = 3\,N = 250 \times 3 = 75$ volts, say, 76.
$I_x = 100$ amperes average.
$I_0 = 400$ amperes maximum.
$R = 0.2$ ohm.
$K = .02$ volts per ampere turn.
$h = 0 \;\therefore\; E_M = E_0$.

Computations based on normal battery e. m. f.

$E_A = 500$ volts.

$$t_1 + t_2 = \frac{76}{100 \times .02} = 38 \text{ turns.}$$

$$t_2 = \frac{.2}{.02} = 10 \text{ turns} \;\therefore\; t_1 = 28 \text{ turns.}$$

As, in practice, the battery is connected across the line, V is practically constant. Therefore, with E_A normal there will be no variation in I_x, whatever the load. If the line potential varies appreciably, equation (23) should be used, substituting line changes for battery changes.

I_x maximum occurs when E_A is minimum.

$I_x = \dfrac{500 + 76 - 475}{.56 + .2} = 132.9$ amperes. I_x is minimum when E_A is a maximum.

$$I_x = \frac{500 + 76 - 575}{.76} = 1.3 \text{ amperes.}$$

Therefore, t_1 must be large enough to carry 133 amperes; t_2 and armature must carry 400 — 1.3, or practically 400 amperes. These extremes are only reached when the battery is used for carrying the peak of the load as well as compensating for fluctuations.

When used for regulation only, the battery voltage will vary but little, and the booster need not be so large as the foregoing figures would seem to require. Proper attention to the rheostat can prevent I_x from reaching the maximum value given, though the minimum value cannot be increased without increasing V, which would increase the size of the booster.

If the shunt coil be made to give a lower voltage on normal operation, than the figure assumed by using a rheostat, t_1 will be reduced; and while the regulation will be the same as that given when E_A is at its normal voltage, it will not be so good when E_A varies from normal. For good regulation with variation of E_A, T_1 must be large, which requires that V_2 be large. Therefore, the full value of V or $V_{max} = .3\,N$, should be the normal working shunt voltage. Increasing V improves regulation, but increases the size of the booster, the size of machine required varying with the regulation necessary.

This type of booster is commonly installed with a switch to short circuit S_1 and S_2, and allow the shunt coil only to act when a rapid battery charge is desired. The size of booster necessary in the case just considered would be $400 \times 76 = 30.4$ kw considering shunt voltage only.

The series coils always oppose the shunt coils, and do not add materially to the capacity required of the machines, though the magnet limbs must be long enough to accommodate them. Since the maximum demand seldom comes and only lasts a few moments, 70 per cent of the calculated capacity is large enough to make the machine in the present case equal 22 kilowatts.

If $V = 76$ when $E_A = 475$—which would be the case if the battery should discharge down to minimum and the rheostat receive no attention—the booster voltage on maximum external load $= 76 - (28 \times .02 \times 133) - (400 \times 10 \times .02) = 78.48$ volts, or the amperes through the booster are 267. The product of these, or 19.9 kilowatts, is the maximum of the product of volts multiplied by amperes at any instant, and fixes the size of the motor required to drive if the booster is used only.

Street Railway Standards.

The committee on standards of the American Street Railway Association held a meeting at Niagara Falls, N. Y., on June 3. The object of the meeting was to map out the preliminary work of the committee. An abundance of material, which had been gathered by the secretary, was placed before the committee for consideration. It was apparent, from the data in the hands of the committee, that both street railway operators and manufacturers of street railway appliances are much interested in the work of standardizing street railway equipment. It was decided that the best results could be obtained by apportioning the work among the members of the committee, each member to act as a sub-committee on certain parts of the work assigned to him, with power to incur reasonable expense in the preparation of plans and specifications, and to report at the next meeting of the committee. The following assignments were made: To consider two forms of rail, the "T"-rail and a grooved girder rail, each with a modified form of head. To consider two forms of wheels, one a cast chilled wheel, with either spokes or plate center, the other a steel tired wheel, with either spokes or plate center, tread and flange of wheel to conform to the rail to be recommended. To consider the wearing parts of trucks, the center-bearing swing bolster for double trucks to be recommended. To consider a standard for axles, journals, journal brasses, oil-boxes and brake-heads, such as will fit the trucks of different makers.—Mr. N. H. Heft, Meriden, Conn.

To consider electric motors with a view to standardizing all parts of the motor, including suspension, lead wires with connector boxes and ventilation.—Mr. W. J. Hield, Minneapolis, Minn.

To consider single truck and double-truck car bodies, including open cars, for city and suburban service, in order to determine wherein such cars can be standardized to meet the requirements of various conditions of operation, with due regard to proper ventilation.—Mr. John R. Graham, Boston, Mass.

To consider the standardizing of overhead material as far as practicable along the following lines: Trolley wire, trolley wheels, trolley ears, trolley hangers, span wires, pull-off wires, section insulators, cut-outs, overhead frogs and switches, lightning arresters and all parts that go to make up the overhead system.—Mr. C. F. Holmes, Kansas City, Mo.

Mr. T. E. Crossman, 1829 Park Row Building, New York, is secretary of the committee, and will be glad, on behalf of the committee, to receive communications bearing on the above-named subjects from many interested persons.

Berliner on Telephone Transmitters and Exchanges.

A very interesting article is contributed by Mr. Emile Berliner to the *Saturday Evening Post* on "Ideas Worth Millions." In regard to the telephone he gives some very striking reminiscences as follows:

The invention of the constant-contact telephone transmitter which made long-distance telephony possible and rendered short-distance talk clear and intelligible was the result of something of the same kind. I had for years been studying the science of electricity and the physics of sound when Mr. Bell's patent was issued in 1876, and it occurred to me at once that the knowledge I had absorbed in my studies might be very profitably applied to improving the telephone.

At that time I was engaged in commercial pursuits in Washington, and my experiments and studies were more in the nature of a recreation than anything else. I paid frequent visits to the central office of the Fire Department, the electrical superintendent of which, Mr. Richardson, was a particular friend of mine. He had a dummy telegraph instrument on which he had taught me telegraphy, and on this particular evening I was working the instrument as usual, when he said:

"You don't press hard enough, Berliner."

"Does that make any difference?"

"Certainly; it makes all the difference in the world in the strength and clearness of the message at the other end. That is why women do not make good and effective operators as a rule. They are not strong enough—their touch is too light. They do not give thorough contact."

That was a revelation to me. Under Mr. Bell's invention the voice had to vibrate a diaphragm against a magnet and the volume of electricity thus produced was not sufficient to transmit sound waves sufficiently strong. That night, before I went to sleep, I had set up the movable diaphragm used in the telephone to-day, which keeps in constant contact, but with varying pressure, with the transmitting end of the telephone wire, simply pressing back and forth as the sound waves produced by the voice diminish or strengthen.

Another case illustrating this point occurred not so many years afterward. Upon the completion of my invention of the constant contact sound transmitter, the Bell telephone people engaged my services as expert to aid in perfecting the telephone, which was still in a crude state. Mr. Blake had just invented his form of transmitter and the instrument was placed in my hands for final development. It secured a very much clearer transmission than had been possible before, but one of its troubles was that the carbon button used would rapidly wear holes at the contact. The material was so soft that it kept us busy replacing or refacing the carbon buttons. These buttons were made from the ordinary long soft carbons used in arc lights, which had only just appeared in the market. They were made by sawing the long carbons into thin circular buttons. We conducted all sorts of experiments with a view to securing a hardening of this carbon, but for a long time we failed in effecting any improvement. It was well known that the hardest carbon in the world was that which is deposited in gas retorts. This carbon deposit had always proved a serious source of trouble since the manufacture of coal gas was invented, because it has to be cleaned out from time to time, and this is a difficult job.

It occurred to me to have a little iron cage built, into which I put a lot of our soft carbon buttons. This cage I asked the gas people in Boston to put into their retort on the next occasion when they were ready for a charge. I left it there during six charges; then, when I took it out, I found my carbons all shriveled and shrunken. The intense heat had half burned them up. They were all rough, and for a little while I thought there was another failure. In a contemplative mood I began to rub one of the roughened buttons on a piece of emery paper to see what polishing might do for it. Soon I had rubbed away entirely the spongy rough surface and got down to the original button. Examining this closely, I found to my great surprise that the carbon itself was practically unchanged except that it had become tremendously hardened. A closer inspection showed that not alone had the carbon in the gas deposited itself on the surface of the buttons, but that it had also penetrated the pores of my carbon, filling them up absolutely and making the buttons as hard as any one could desire. That was in the year 1879.

By exposing to fewer gas charges we thereafter produced a carbon button that was at once hard and smooth, and to this day this process is employed. Nothing has ever been found that hardens carbon buttons for telephone use better or more economically.

As to the telephone exchange idea, he says:

One inventor may have something that, as it stands, appears to show only a comparatively small field of usefulness, but which, worked out under given conditions, will become a gold mine. The telephone again illustrates this. None of the men who worked at this idea originally had any conception of its possibilities. For some time after the apparatus was perfected by Mr. Bell, and even after Mr. Edison, Mr. Blake and myself had made our improvements, nobody appreciated the vast possibilities of the telephone. It was declared useful only as a means of communication between two points on a private line; between a man's office and his factory, his place of business and his home.

It was only when there was applied to it the central office idea that the telephone became important and really valuable. None of the men originally concerned with the invention thought of it immediately in connection with a central office. This idea grew out of the working of what was known as the Law Telegraph Company, of New York, and the credit of applying the idea undoubtedly belongs to the late Gardiner G. Hubbard and to Mr. Theodore N. Vail. Mr. Vail was general manager of the Bell Company. Mr. Hubbard from the first was the main factor in the initial development of the scheme.

The Law Telegraph Company was an institution organized for the benefit of the lawyers of New York. There was a central office, out of which ran private lines to the offices of the lawyers who subscribed. When one lawyer wanted to communicate with another, his operator called up the central office and the latter's line was connected by the usual plug system with the line of the man he desired to telegraph to. In other words, they did exactly what is now done in the telephone central office, only using the telegraph keys and skilled operators instead of telephone transmitters and receivers. To-day there are more patents on central office appliances than on the telephone instruments proper.

Necessities of the Central Union Telephone System.

Mr. J. I. Sabin, who has recently been elected president of the Central Union (Bell) Telephone Company, has issued the subjoined startling circular to his stockholders. On its appearance the stock dropped in Chicago from 53 to 34. The document is as follows:

After two months' investigation—the last month in charge as president—I find that it is imperatively necessary that at least $3,000,000 be provided without delay—that is, one-half immediately, and one-half before the close of the present year, 1901; with a call for another $1,000,000 during the first half of the year 1902 and one more for the same amount during the last half of 1902, making a total of $5,000,000. (This sum in addition to the net income during the period named.)

The issue of bonds under present mortgages has reached its limit. The net revenue will not allow extensions rapidly enough, and while there have been a great many proposed modes of getting the money, in my opinion, the most practical is one of the following three:

1. For you to agree to a voluntary assessment of $20 per share immediately, $20 per share before Dec. 31, 1901, and $20 per share during 1902.

Or 2. For you to agree to loan the company the same funds, at the same time, at 4 per cent interest.

Or 3. For you to agree to purchase your share of the unissued capital stock of this company, at par. The amount is $3,000,000.

And if the great majority, practically, all of the stockholders, will not agree to one of these three propositions, nearly all new work must stop, and that simply means going backward instead of forward.

There is no use crying over spilled milk, or abusing one another for things not accomplished. The people of the States of Illinois, Indiana, Ohio and Iowa want telephone service. Will you supply it, or must some one else?

Are you doing it with less than 70,000 stations?

No. When you have 300,000 exchange stations then you have a good start, not before.

When you have 150,000 exchange stations, at proper rates, you will have a plant upon which you can earn something, with which to build up the second 150,000. Your territory needs 300,000 stations.

With your present 70,000 stations, the great majority of them at insufficient rates, thousands of them absolutely without charge, you cannot build up anything—except opposition.

You are not satisfying the public, because your system does not reach far enough. There are scores of villages and small towns, taken as a whole, that should have over 50,000 telephones, and in which the Central Union Telephone Company has not one single instrument.

The opposition are not satisfying the public.

The property is yours, not mine.

Do you want to build it up to its proper standard?

Time is the very essence of value to your property.

What you want done must be done now. Later on, and a very little later at that, will be too late.

Will you agree to No. 1?

Will you agree to No. 2?

Will you agree to No. 3?

I am sure 70 per cent of our stockholders will agree to either 1, 2 or 3.

What will you agree to do?

It is stated that 51 per cent of the capital stock of the Central Union Telephone Company is owned by the American Telephone & Telegraph Company. They are also carrying over $1,000,000 of the company's temporary loan.

Electrolytic Manufacture of Metal Papers.

Some 35 years ago a keen rivalry arose between certain British manufacturers as to which could produce the largest and thinnest sheet of iron, the competition beginning with a letter inscribed by the Sligo Iron Works upon a sheet containing 270 square centimeters, and weighing but 4.469 grams, and reaching its climax in the plate produced by the Hope Company of Tipton, having an area of 1425 square centimeters and a weight of 11.529 grams, the weight being thus about 8 milligrams per square centimeter, and the thickness perhaps one-quarter that of the thinnest tissue paper. These sheets were, of course, useless save as illustrating the manipulative skill of the makers, and since the malleability of a metal is closely related to its purity, as showing the high grade of their material.

Shortly thereafter, in 1873, Wood described his electrolytic method for the production of foils by deposition of the metal upon a base from which it could be stripped. By this means sheets far thinner than any process of hammering or rolling could possibly yield were readily produced, and in 1879 Professor Egleston, of Columbia College, exhibited before the American Institute of Mining Engineers a piece of gold leaf produced by Alex. E. Outerbridge, of the Philadelphia Mint, and probably the thinnest piece of metal which has ever been handled alone. This sheet was 5.7 mm. square, and so light as to be without appreciable effect upon a balance. Its thickness was estimated to be less than .00015 mm.—1-100 of the wave length of green light, or 1-15,000 of the thickness of ordinary printing paper. By transmitted light it was of a pale yellow color, or where double, light green, and was perfectly transparent so that the finest print could be read through it with ease. The method employed by Outerbridge consisted in rolling a sheet of copper to a thickness of 1-200 mm., and after careful cleaning and burnishing electropating upon it the thin film of gold. Several days floating, copper side down, in dilute nitric acid, sufficed to remove the copper, leaving the gold film, which was then floated upon glass and dried.

Such films possess merely a scientific interest, and are comparable to the attached transparent coatings of metals or of oxides produced at about the same time by Professor Wright, of New Haven, through the medium of the vacuum discharge. Heavier electro-deposits, either detached as leaf or foil or backed by paper, and often patterned by electro-deposition upon an engraved base, find application in many directions, and have been the subject of numerous patents, especially during the past 10 years. Most of these relate to improvements in the treatment of the cathode to facilitate the removal of the deposit, for the solution method of Outerbridge is obviously inapplicable to a commercial process, and the slightest local adhesion will mar or deface the foil. This treatment may consist in exposing the cathode, before plating, to the fumes of smoke or the vapors of iodine, in washing it over with a solution of soap, wax, or fatty matter, in coating it lightly with oil or graphite. Or if the cathode be of nickel, it may be slightly oxidized, but in general treatment with sulphide solutions has been found most satisfactory.

The most recent development in this line is covered by a patent issued June 11 to Carl Endrumeit, of Berlin, describing a continuous process for the production of "metal papers" or paper-backed foils. An endless belt of metal moves past a rotary polishing roller which removes stains or irregularities, then over a tank containing a dilute solution of potassium trisulphide with which the polished face of the belt is moistened by means of a cylindrical brush. This forms upon the surface a layer of sulphide, imperceptible to the eye, yet sufficient to prevent too close adherence of the metal afterward deposited. After wiping and rinsing, the belt dips into the first plating vat, and receives, over the sulphide, a thin coating of nickel, then into a second vat where this film is reinforced by a heavier deposit of copper. After further brushing and rinsing a coating of glue is evenly applied to the layer of copper, a strip of paper is fed upon it from a roll, and belt, deposit and paper pass together through rubber compressing rolls and a drying chamber. The deposited film adheres far more strongly to the paper backing than to the polished and treated metal belt, so that the finished metal-faced paper is readily stripped and wound, while the belt passes again to the polishing roll and the electroplating vats.

A polished cathode-belt yields a paper with a brilliant nickeled surface, and by the addition of mercaptans or other sulphur compounds to the glue, the backing adheres so strongly that the product is thoroughly serviceable and very attractive. If the paper be intended for wrapping articles for sale, appropriate letters or designs are readily produced in it by engraving the cathode, the finest details being reproduced in reverse in the face of the paper.

Canal Operation by Electricity.

The Miami & Erie Canal Transportation Company, which controls the lease by T. N. Fordyce on the Miami & Erie Canal, has been reorganized and has passed into the hands of a strong syndicate of Cleveland capitalists, all of whom are prominent in electric railway enterprises. At a recent meeting of the company directors were chosen as follows: H. A. Everett, E. W. Moore, M. J. Mandelbaum, F. T. Pomeroy, E. G. Tillotson, L. J. Wolf, R. A. Harmon, W. H. Lamprecht, F. N. Wilcox, H. B. McGraw and C. W. Collister, all of Cleveland; Will Christy and J. R. Nutt, of Akron; D. J. Ryan, Toledo; T. N. Fordyce, of Detroit. Officers: W. H. Lamprecht, president; W. S. Hayden, secretary, and Otto Miller, treasurer. The company is capitalized at $3,000,000, and at the meeting mentioned it was found that the stock had been oversubscribed to the extent of nearly 35 per cent. The character of the organization indicates that it is far from being the visionary project that it has sometimes been considered. The franchise gives it the use of the canal from Cincinnati to Toledo and, contrary to the impression which has been freely published, it is strictly a freight "proposition." There is no intention, nor would it be possible, to operate passenger cars on the tracks, which will be built on the bank of the canal. Under the terms of the grant, the speed of the boats, which are to be propelled by electric motors, is restricted to four miles an hour. The bridges over the canal give only a four foot clearance, so that it will be necessary to design a special electric locomotive. Boats will be towed in strings of four, and perhaps six boats, with a carrying capacity of 75 tons each. It is believed that two men will be sufficient to operate a string of boats; an operator on the electric locomotive and a helmsman on the first boat. As a freight carrying enterprise, it is claimed that the canal furnishes a most attractive investment. The cost of operation will be small, as the power required to operate boats at such a slow speed is very slight. It is believed it will not even be necessary to build power houses, since sufficient current can be obtained from the railway power stations along the route. The canal passes through more than a hundred prosperous villages and towns, and numerous manufacturing establishments are located by preference along its banks. This would dispense with the expense of hauling freight. The canal is crossed by numerous east and west trunk railroads, thus giving connection with all parts of the country. Manufacturers and merchants in towns along the route are much interested in the project, in view of the fact that it is claimed that the canal freight rates will be much lower than those made by the railroads. Boats will be operated through the various towns at regular intervals, and it is believed that the canal can be kept clear of ice, so that it can be operated all the year around. Work of dredging, building tracks and strengthening locks has already been started near Hamilton, and it is stated that the section between Cincinnati and Dayton will be in operation this year. T. N. Fordyce has been appointed general manager of the company, and Warren M. Bicknell, at present auditor of the Southern Ohio Traction Company, will be traffic manager of the new company. F. A. Lytle, of the Standard Construction Company of Detroit, is the engineer, with headquarters at Cincinnati.

CURRENT NEWS AND NOTES.

TELEPHONY IN RUSSIA.—It is stated that the municipal council of St. Petersburg is about to send an electrical expert to this country to study the development of the telephone system. St. Petersburg has a new plant under consideration.

ACCIDENT RECORDS.—From returns compiled in France, it would appear that accidents from horses are by far the most numerous. The proportions are roughly as follows: The horse, 82 per cent; steam railways, 9 per cent; automobiles, 3 per cent; bicycles, 7 per cent.

ELECTRICITY IN MINES.—A special dispatch from Pittsburg of June 16 says: "The explosion and loss of life at the Port Royal mine may cause a conflict between mine owners generally and the State Mine Inspectors. After the Port Royal accident Mine Inspector Isaac Roby inspected the Grindstone mine near Brownsville, close to the Bragnal mine, in which there was much loss of life last year. Roby says the Grindstone mine is gaseous, and he ordered the electric mining machines taken out, asserting that sparks from them were liable to set the gas off. The owners appealed to Chief Mine Inspector Roderick, who will decide the question. If electric mining machines are officially declared dangerous and ordered out of the mines it will mean a loss of millions to the mine owners.

CURING LUPUS.—A special dispatch from London of June 15 says: "The large subscriptions flowing into the London Hospital to carry on the experiment in the use of electric light to cure cases of lupus have caused a little controversy between the surgeons in charge of that work and those using the Roentgen rays for the same purpose at the London Skin Hospital. It seems that the latter experiments have been going on for some time and cost less, because the apparatus used to concentrate the Finsen rays of electric light in the other system is expensive and a long time is required at each exposure. But the use of the Roentgen rays is always attended with some danger to the patient, and the results at the London Hospital, where experiments have been going on under the direct patronage of Queen Alexandra, are, on the whole, much more satisfactory."

RIVER PROFILES.—An interesting and valuable publication of the Department of Hydrography of the United States Geological Survey on the Profiles of Rivers in the United States, by Henry Gannett, has just been published and is now available for distribution. It embodies within a hundred pages the leading facts of about one hundred and fifty of the most important rivers and streams of the country, noting their length, drainage area, the location of water power in their courses, their peculiarities of flow and the nature of their drainage basins. The rivers selected are those which are the largest in size and bear most directly upon the varied interests of the country, such as the Connecticut, Hudson, Susquehanna, Ohio, Potomac, Mississippi, Missouri, Platte, Colorado, Sacramento, Columbia and others. The figures for the tables showing height above sea level and fall per mile were collected from various sources. Some were obtained from the report of the Chief Engineer of the United States Army, some from railroad companies when their lines cross the streams and some from the atlas sheets of the United States Geological Survey. In the case of such rivers as the Connecticut, Susquehanna, Mississippi and Colorado, where the surrounding country is, in part or whole, of peculiar physiographic interest, very excellent and vivid descriptions of its leading physical characteristics are given which add to the interest and render it valuable from an educational standpoint in geographic and physiographic instruction. The pamphlet is the result of much careful work and is the first attempt to collect and compile this information in its present form.

UNIVERSITY OF ILLINOIS ANNUAL.—The current volume of *Technology*, published annually by the Association of Engineering Societies of the University of Illinois, contains five papers on electrical subjects, following being the titles: "Regulation and Adjustment of Arc Lamps," by M. E. Chester; "Electrically Operated Railway Signals," by F. J. Postel; "An Inexpensive Mirror Galvanometer," by A. P. Carman; "Regulation of Alternators Under Variable Loads," by G. W. Redfield; "Commercial Electric Meters," by G. R. Radley.

ELECTRICAL POWER DISTRIBUTION.—At the recent Milwaukee meeting of the American Society of Mechanical Engineers, Prof. W. S. Aldrich read a paper on "The Requirements of Electricity in Manufacturing Work," in which are set forth principles based upon actual experience. The subject is treated under the heads of general considerations, economics of electricity in manufacturing, influence of electric transmission upon factory building, influence of electric transmission upon workshop expansion, influence of the electric drive upon the arrangement of machinery, changing from the old to the new system of driving, application of the electric drive, selection of equipment, losses in factory transmission, efficiency of electric transmission and operation, and testing of factory installations.

WIRELESS TELEGRAPHY IN CANADA.—It is not unlikely that experiments in marine signaling, by means of the Marconi system of wireless telegraphy, will be made in Canada this summer. The only point at which it would be of utility to incoming ocean steamers is at Belle Isle, which, however, has not yet been connected with the Government coast telegraph system. It is expected that the land line will be completed along the Labrador coast to Chateau Bay by the first of July next. From that point to Belle Isle, the connection will have to be made by cable across the strait, a distance of 28 miles. The cable has been purchased and will be laid some time during the summer, but by the time it would be available steamers would probably be abandoning the Belle Isle route for the season. Experts have grave doubts as to whether a cable can be maintained across the Strait of Belle Isle, on account of the danger of its being cut by grounding icebergs during the winter and early spring. It may be therefore that tests of the practicability of the Marconi system will be made between Belle Island and the mainland.

A MARCONI PATENT.—In a patent issued June 11 to Guglielmo Marconi a new type of wireless telegraph ærial wire is described. As illustrated, there are two conductors, one concentric with the other. At the transmitting end one of the sparking balls of the induction coil is connected with the outer conductor and the other ball connected, through an adjustable inductance, to the inner conductor, the latter being grounded. At the receiving end one terminal of the coherer primary circuit is connected with the outer conductor and the other terminal connected through an inductance with the inner conductor, which latter is also grounded. (In the Marconi system the ærial circuit is, by means of a transformer, in inductive relation with the coherer circuit.) The specifications state that communication of signals may be greatly facilitated by this employment at each station of two ærial conductors insulated from each other; and that advantageous results are attained by the inclusion of the inductancies referred to, which are capable of wide variations of self-induction, thereby enabling the resonance of the inductances at the transmitting and receiving stations to be harmonized, and the receiving apparatus caused to respond readily to the oscillations sent from the transmitting station.

GOVERNMENT CONTROL OF TELEGRAPH AND TELEPHONES IN CANADA.—The Ottawa Board of Trade has made a practical departure that must bring the question of governmental cable, telegraph and telephone services to the attention of business men in all parts of the British Empire. A circular letter has been drafted and will be forwarded to boards of trade and chambers of commerce throughout the United Kingdom and the colonies, urging the importance of the establishment of State-owned cables connecting the mother country with other parts of the empire. The proposal requires that not only the connecting transmarine cables shall be under Government control, but that land telegraphs, in the several British possessions, shall be State-owned. Canada is the only important part of the empire in which the telegraph service is in private hands, and the circular alludes to the report that the transfer of the Canadian telegraph lines to the Post Office Department, and the laying of a State-owned cable across the Atlantic, are now under consideration of the Dominion Government. The question of establishing the telephone service under management will also soon come up for consideration by the Government.

STORAGE BATTERY CHARGING.—A patent issued June 11 to H. F. Parshall , of London, describes a means whereby a current of variable e. m. f. suitable for charging storage batteries may be attained, the e. m. f. as the charge proceeds being increased in order to compensate for the increased e. m. f. of the battery. This object is attained by making use of a rotary converter having a series winding arranged so as to act in opposition to the shunt winding, the converter being supplied from an inductive alternating current source. If, for example, the current supplied by the rotary converter tends to diminish, the demagnetizing effect of the series winding is decreased, thereby causing a resultant increase in field strength of the converter. This increased excitation advances the phase of the current supplied to the converter which, by reacting upon the inductive supply circuit, increases the e. m. f. of the converter, thereby correspondingly increasing the direct current e. m. f. The converter thus has a tendency toward constant current regulation rather than toward constant potential regulation. As illustrated, there are two rotary converters. One of these supplies the main current for charging, and the other is an auxiliary rotary in series with the storage battery. The direct-current terminals of the auxiliary, or booster rotary converter, are supplied with current derived indirectly from alternating current supply mains through the medium of transformers. These transformers are especially constructed so as to have considerable leakage between the primary and secondary wires, the transformer circuit thereby being given the necessary inductance.

FREQUENCY EQUALIZATION ON ALTERNATING-CURRENT CIRCUITS.—In the operation of alternating-current systems to which synchronous motors and rotary converters are connected, considerable difficulty arises owing to momentary fluctuations of frequency in the system. The speed of such machines frequently surges backward and forward with considerable violence, this phenomenon being known as "hunting," and if one machine commences to hunt it transmits this tendency to other machines, and the action of each machine magnifies or increases the hunting of the other. Fluctuations in the frequency may also be due to variations in the angular velocity of the prime mover, in which case synchronous machines are often caused to hunt in unison with such periodic fluctuations, or to be started hunting with periods of their own. To overcome the difficulties mentioned is the object of a patent granted June 11 to Ernst J. Berg To this end use is made of an induction machine of high inertia, the machine being so chosen that its inertia bears a fairly large ratio to the inertia of the machines connected to the alternating-current system. The induction machine has preferably a very low armature resistance so as to have close speed regulation; and on its shaft is also mounted a fly-wheel of comparatively large inertia. The close speed regulation renders it more sensitive in its action and causes it to respond more powerfully to small variations of frequency, while the fly-wheel has a tendency to cause the machine to run at a uniform speed. When, therefore, fluctuations in frequency occur in the system the induction machine does not respond to these by adjusting its speed thereto, but, on the contrary, has a tendency toward uniform rate of rotation. The result is that when the frequency drops, due to hunting or other irregularities, the induction machine is left running at a speed greater than that corresponding to the new value of frequency, thus acting as a generator and momentarily supplying additional driving power to the system and so opposing the drop in frequency. On the other hand, when the frequency rises momentarily the torque of the machine is thereby enormously increased owing to the drag due to the inertia of the moving parts. It therefore acts as a powerful brake and tends to prevent increase in frequency. When the frequency of the machine is constant it acts normally as a motor.

TWELVE HOURS UNDER WATER.—The submarine boat Narval concluded a twelve-hour submersion test at Cherbourg, France, on June 15, with the object of ascertaining the effects upon the crew. The test proved that the strain is too much. The confinement and lack of fresh air produced nausea and exhaustion after a few hours. The tension was so intense that the men were unnerved.

A GERMAN TECHNICAL BUREAU.—Deputy Consul-General Hanauer writes from Frankfort, May 18, 1901: "Steps are being taken for the creation of a federal bureau of technics in Germany. On the executive committee having charge of this plan are members of the leading chemical works, the German association for protecting the trades, the Technical Association of Germany, the Association of German Engineers, the Union of German Patent Lawyers, the Central Bureau for Scientific Investigation, the Institute for Fermentation, the German Tobacco Association, leading electrical companies, and others.

NIAGARA POWER IN TORONTO.—It is reported that power from Niagara Falls will soon be delivered in the city of Toronto under the auspices of the Toronto Railway Company, the Toronto Electric Light Company, and possibly the Gas Company. The Toronto Street Railway will take 10,000 horse-power per year, and the Toronto Electric Light Company, for itself and customers, about 5000 horse-power. The rate for this power, delivered at the borders of the city, will be $25 per horse-power per annum. This rate is for power for an entire day of 24 hours.

A NEW STORAGE BATTERY.—A Rochester, N. Y., dispatch states that Mr. Walter Scott Strowger, the inventor of the Strowger automatic telephone switch, has invented a storage battery which he claims is superior to anything now on the market, or promised. The dispatch adds that Mr. Strowger stands ready to take the Empire State Express from Rochester to New York by the use of his battery. The dispatch also states that Mr. Strowger has discovered a new gas similar in illuminating power to acetylene, but without the latter's dangerous qualities. The bi-products, it is stated, are more valuable than the gas itself.

WEATHER SERVICE IN THE PHILIPPINES.—The Jesuit fathers of Manila maintained a meteorological observatory for many years. Since 1894 Father Algue has made a special study of the typhoons of the region. His extensive report on the subject is now in course of publication as a Congressional document (Senate document No. 138, Fifty-sixth Congress, first session). Early in 1900 a Philippine Weather Service (independent of the United States Weather Bureau for the present) was organized, and it is now in operation. Some 20 telegraphic stations are equipped and in correspondence with the central office at Manila. The storm warnings already issued have been very valuable to merchant shipping, and to the vessels of our navy. The new cables laid by the United States Government are very serviceable in this respect.

GAS ENGINE EFFICIENCY TESTS.—In a paper read at the recent Milwaukee meeting of the American Society of Mechanical Engineers, Mr. C. H. Robinson gives the results of efficiency tests of a 125-hp Westinghouse gas engine. The average thermal efficiency of the engine was 20.05, the highest being 23.24 per cent; the figures correspond to 171.66 and 226.13 B. T. U. per ihp per minute, respectively. The mechanical efficiencies corresponding to these tests were 79.39 and 89.05 per cent, respectively. The gas consumption per indicated horse-power became as low as 9.7 cubic feet, and per brake horse-power, 11.29 per cent, the averages for the tests with respect to these two items being 10.62 and 13.69 per cent, respectively. Tests were made to determine the distribution of heat in the engine. At the lowest horse-power of the series the percentages equivalent to indicated horse-power, the exhaust and the jacket, were 10, 32 and 58 respectively. At the highest horse-power (164 indicated) these figures became 26, 44 and 30 per cent.

BLUE-PRINTING BY ELECTRIC LIGHT.—Mr. H. G. Reist in a paper read at the recent Milwaukee meeting of the American Society of Mechanical Engineers gave an account of the arrangements employed in the General Electric works at Schenectady for blue-printing by electric light. The carriages supporting blue-printing frames are run under a metal hood a little larger in size than the printing frame, each containing two 5-ampere, 110-volt enclosed arc lamps. The lamps in turn are supported on a small trolley arrangement and are enclosed in white opal globes. The time required for printing is three or four times as long as with bright sunlight. The cost of making prints by electric light is smaller than by sunlight, owing to the fact that the labor employed in carrying out the former method can be utilized during the entire office hours, both summer and winter, and during cloudy days. Another advantage is that with the electric equipment blue prints may be put into the shop almost immediately after the completion of the tracing, regardless of the time of day.

FIELD MAGNET SHIELDS.—A patent granted June 11 to Percy H. Thomas relates to the protection of the coils of electrical apparatus from damage caused by sudden changes in static potential. The conducting shield is placed between the coil to be protected and any object having comparatively large electrostatic capacity, and is electrically connected to the terminal or lead through which the dangerous change in potential is transmitted to the coil. The entire bound charge will then appear on the shield, and thus entirely relieve the coil and protect its insulation from the strains to which it would otherwise be subjected. The illustrations show the device applied to a transformer, to an armature winding and to a magnet core such as may be used in arc lamps, in telegraph or telephone instruments or any other relations where such coils are ordinarily used. As applied to a transformer, the shield is placed between the primary and core, or between the primary and secondary windings, or both, and is electrically connected to one side of the primary mains.

LONDON UNDERGROUND.—A cable dispatch from London of June 1 says: The *Times* this morning has a practical and insistent editorial article on London's great need of electrical improvements, and the obstacles in the way of progress in that particular. These obstacles may all be expressed in the two familiar words "British conservatism," but they may be specifically reduced to muddled and antiquated laws, the ignorance and stupidity of concealment, the timidity of the Briton in the face of new ideas, and the long-established English custom of compensating oneself for discomfort by grumbling. Some time the Metropolitan & District Railway will be equipped with electricity, the new deep tunnels will be built, and the town will be properly lighted. The latest opponent of rapid transit is St. Paul's Cathedral. The Dean and Chapter of that venerable institution object to the new projected "tube" from Piccadilly to the city for fear that it will undermine the cathedral's concrete foundation. They declare that the spire of the famous Church of St. Mary-le-Bow in Cheapside, in which the Bow bells ring, is 23 inches out of the perpendicular because of the excavations for the existing twopenny tube, the only modern means of transit in London.

FLEECING SENDERS OF CABLE MESSAGES.—The subjoined is from the Philadelphia *Record*. It does not at all coincide with our own experience. In sending cablegrams from all over Europe we have never been fleeced in this way anywhere: "Americans who go abroad must expect to be robbed right and left," said a young man who recently returned from a brief European tour. "One expects to be held up for all sorts of tips, but when the beggars follow you home you can't help feeling a sort of admiration for their ingenuity. I went over on one of the Red Star line boats, and the first thing I did on landing at Antwerp was to go to the cable office and send a message to my mother, announcing my safe arrival. I paid the toll and thought no more about it until I got home, when, among my mail, I found a letter from the Antwerp operator, addressed in care of my mother, saying that through an error he had not charged me enough for my cablegram sent on such and such a date; that he had been obliged to pay the difference out of his own pocket, and as his salary was very small and he had a large family, and all that sort of thing, he felt sure I would reimburse him. The amount was a trifling one, and I did send him a foreign money order. I have since learned from experienced travelers that I had been made the victim of a systematic form of robbery, and that scarcely a cablegram is sent from the other side unless it is of a business nature, that is not followed by some such plea from the European operator."

ARMY AUTOMOBILES.—The British Government has instituted a prize competition for the best type of automobile for military purposes. Three prizes are offered: A first prize of $2,500, a second prize of $1,250, and a third prize of $100. The details of the competition are given in a notice in our advertising columns.

RAILROAD TERMINAL ELECTRIC SERVICE.—Construction is to be started this fall on a $3,000,000 passenger station in Chicago, which will replace the Van Buren Street structure now used by the Lake Shore, Rock Island and Nickel Plate railroad. All trains will be hauled into and out of the city by electric locomotives. Steam traction on the Rock Island road will end at Blue Island, and the trains of the Lake Shore and the Nickel Plate railroads will drop their locomotives at Englewood.

FRENCH CABLE PLANS.—A special cable dispatch from London of June 8 says: There is considerable energy in the latest French effort to secure the establishment of French telegraphic and cable service all over the world, free from English supervision. A bill now before the Chamber of Deputies approves the convention of last March of the Government with the French Cable Company for the laying of a number of lines. Recent events in the East and in South Africa have awakened France to a lively sense of the possibility that some day she might be without the means of quick communication with her colonies and the rest of the world. The original report of this week's Tien-Tsin incident seems to have strengthened the case. The British are accused of coloring facts to suit their own convenience.

THREE-PHASE ELECTRIC RAILWAY SYSTEM.—A patent granted June 11 to George Westinghouse, Jr., relates to the organization of circuits and conductors of a three-phase electric railway system. A continuous wire or cable supports two conductors, representing the two legs of a three-phase system. The supporting conductor may be connected to earth at intervals, and thus form part of the earth circuit and third leg of the system. Or the supporting conductor may, if desired, constitute in itself the third leg of the conducting system, in the latter case, of course, being entirely insulated; or it may be employed merely as a guard to the two conductors which it supports. If in case of a sectional railway it should be desired in any instance to make a more complete ground connection when the car is passing along a section, the supporting conductor may be connected with an electromagnetic contact device whereby, when a car is upon the corresponding section, a ground circuit from the supporting conductor will be completed.

BRITISH PACIFIC CABLE.—According to a recent consular report from Victoria, a surveying party has located the landing site of the British Pacific telegraph cable (which is to connect the Dominion of Canada with the Australian Confederation) on Kelp Bay, near Banfield Creek, 7 miles from the entrance to Barclay Sound, and something over 100 miles from Victoria. The location is described as admirably adapted for the purpose—a good harbor, 12 fathoms of water close to the shore, so that vessels of 10,000 tons can find safe anchorage. The harbor is landlocked, and has a bottom of ooze that it is said will furnish good protection for the wire. Work has already begun in England on the cable. It is to be 5834.5 miles in length, the longest yet constructed, and will be transported and laid in one ship, which is now being specially built for the purpose. The cable will run from Vancouver Island to Fanning Island, a distance of 3337 miles, before a landing is effected; thence to the Fiji Islands, thence to Norfolk Island, and thence to Queensland. The first installment of cable, including the sections from Queensland to Norfolk, Fiji, and Fanning Islands, is expected to leave England in January, 1902. The second and longest portion is to leave in August, 1902, go direct to Vancouver Island, and be laid from Barclay Sound to Fanning Island. According to the contract, the whole cable is to be laid and working by Jan. 1, 1903. Unforeseen disaster excepted, those engaged in the work believe this great enterprise, which will cost $10,000,000, will be completed at the date promised.

A MASSACHUSETTS MUNICIPAL PLANT.—Massachusetts makes another interesting contribution to the stock of public knowledge regarding municipal lighting plants, in the report from the manager of such a plant in the city of Taunton. It appears, according to the *New York Evening Post*, that the plant is nearly worn out, that the buildings are in danger of tumbling into a river during any heavy storm, that the machinery is out of date, and that the power needed to run it cannot be secured with the material on hand. In other words, the city must now build practically a new plant, or else go out of the lighting business. What renders this report the more striking is the fact that this Taunton experiment has for years been held up as an example of the successful municipalization of "public utilities"—a plant which not only furnished light for the street lamps and the city offices, but also for the offices and residences of citizens, and at the same time was "operated at a profit." The truth was that no account had been taken of the steady depreciation of the plant, and of the approaching necessity for large expenditures to keep it running. The Boston *Advertiser* says that there is nothing exceptional in this experience; that other cities which have been showing bookkeeping "profits" have not been keeping their plants "up-to-date," and are already beginning, or will soon begin, to feel the effects. It maintains that the only way to figure out the municipal lighting plants in Massachusetts as profit-making institutions is by ignoring the item of "depreciation of plant," which no private company would ever think of doing.

LETTERS TO THE EDITORS.

Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—In a popular article on "Wireless Telegraphy," by a well-known physicist, that appeared in the current number of one of the best magazines, there is one point brought out that appears to me to lack the support of facts. The article states, in substance, that the electromagnetic radiation goes out in straight lines, similar to the light of a candle, and consequently conducting bodies intervening will screen off the effects from the receiver. Owing to the curvature of the earth and the fact that saltwater is an excellent conductor it will not be possible to signal a greater distance than that at which an air line connecting the tops of the vertical wires would be tangent to the earth.

The first point mentioned, that the radiation is in straight lines, is the one that, to me, appears to be doubtful, and as all that follows in the above hinges on that statement (there is no question but that the radiation will not penetrate the water) we can turn our attention to a consideration of it. The greatest distance that Mr. Marconi has sent a message, so far as I know, is 200 miles, from the Isle of Wight to Lizard Head. A simple calculation will show that in order to have the air line connecting the tops of his vertical wires he would have to use poles about 6280 ft. high. The ones he actually used, I believe, were but 150 ft. in height. Of course, the base of these poles may have been a hundred feet or more above sea level, but allowing for that we still have an enormous discrepancy.

If this radiation does not go through, it must go around, and the theory, proposed by several writers, that the function of the earth connection is to supply a conductor between the two stations along which the waves could slide, seems to fit the case. It is very fortunate that such is, apparently, the case, as otherwise long-distance signaling would be out of the question.

Accepting this theory, for the lack of a better one, the problem of the practical telegrapher resolves itself into one of producing more intense radiation and in inventing a better detector to make transatlantic work a reality.

The coherer at present is probably as sensitive as it can well be used in practice, and improvements in the receiving station can best be made in the arrangement of the vertical wires and auxiliary apparatus. S. M. Kintner.

Allegheny, Pa.

The Automobile Club's Endurance Test.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the proposed test of the Automobile Club of America from New York to Buffalo next fall there seems to be some misunderstanding on the part of the press, as to the facts in relation to the Technical Committee of the Automobile Club, in relation to this matter. The Technical Committee prepared all the general rules and regulations for this test, and turned them over to the Board of Governors, who have approved them. The committee then decided, as five out of the eight members of the committee were manufacturers and would practically have entries in the test, that in order to avoid criticism it would be wiser to request the club to put the actual charge of running the test under the supervision of a special committee, free from any manufacturers' interest, in order to avoid criticism on the part of any manufacturer, who was or was not represented on the committee. In compliance with the request of the Technical Committee, made at the suggestion of the Technical Committee, and at the special request of the chairman thereof, the Board of Governors have appointed a committee of three to take charge of it, who are entirely disinterested from any manufacturers' interest. This committee is composed of Messrs. W. M. Power, W. E. Scarritt and Harlan W. Whipple.

New York City. C. J. Field,
Chairman Technical and Contest Committee.

DIGEST
OF
Current Electrical Literature.

Dynamos. Motors and Transformers.

Polyphase Working.—Eborall.—A communication in which he makes some corrections in the report of his last lecture (which was abstracted in the Digest last week). The current densities given apply to the stator conductors only. In these the full-load current density will be between 1100 and 1500 amperes per square inch for the usual standard motors. The peripheral speed of rotors will not exceed 6000 ft. per minute with standard motors. The ampere-wires per inch of stator core at full load will lie between 300 and 450 for standard motors between 5 and 100 horse-power. These figures must, of course, be used in conjunction with the other data given, and are only to be taken as a guide when getting out the preliminary design. The flux densities quoted do not apply to hole-wound motors, only to slot-wound machines. Satisfactory power factors and good starting performances can be attained with induction motors only when the air-gap length, and consequently the magnetic leakage, is small. These small air-gaps may be a source of weakness in polyphase traction motors unless the bearings are carefully and frequently inspected. Naturally the shafts and bearing supports must also be specially stiff for work of this kind. Earthing the middle points of the star-connected generators and step-down transformers was mentioned by him as being common practice, as is also the modification of this method of working, namely, the use of a fourth wire of small section instead of the earth connection. The object is, of course, either to help balance the system, the neutral wire carrying only the out-of-balance current, or to work the lighting load at a smaller pressure than the motor load, or to make use of both these advantages. In factory installations, for instance, it is frequently convenient and economical to work in this way, running lights at 200 volts and motors at 350 volts.—Lond. *Elec.*, May 3.

Converters.—Colles.—A continuation of his very long and well illustrated serial on rotary transformers, their history, theory and characteristics. This part deals with the inductorium which is defined "as a self-contained" induction coil or series of coils, one of whose sides is connected to a commutator, adapting it to mediate between alternating or polyphase and continuous currents. By 'self-contained' is meant that it is not acted on by external magnetic fields, and it is hence, in general, stationary." He gives a review of the development of this type.—*Frank. Inst.*, June.

references.

Calculation of the Stray Coefficient of Induction Motors.—Jonas.—A mathematical article in which he develops a formula for the stray coefficient of an induction motor, the stray coefficient of the stator and that of the rotor being each defined as the ratio of the e. m. f. of the stray field to that of the air field. He has used his formula in the predetermination of induction motors and found good agreement between calculation and measurement. Three numerical examples are given.—*Elek. Zeit.*, May 30.

Windings of Drum Armatures.—Burnie.—An article on the winding of closed coil drum armatures. The winding formulæ commonly used for drum armatures are so numerous and so different that it is very difficult to memorize them all. It is possible, however, to get all these formulæ from one single expression obtained by considering the total number of conductors passed over in all the winding steps from a starting point until one arrives again at the same point. The article is, however, too mathematical to be abstracted.—Lond. *Elec.*, May 31.

Lights and Lighting.

Cheap Device for Darkening Incandescent Lamps.—Stern.—An illustrated article in which he suggests a cheap method for decreasing the light given out by an incandescent lamp, as is sometimes desired in hospitals, etc. To obtain normal illumination the ordinary lamp burns at its rated pressure. To obtain less illumination, another lamp is connected in series with the main lamp. The voltage and the candle-power of this auxiliary lamp are so chosen that it burns at normal voltage when in series with the main lamp. He shows how to calculate the best type of auxiliary lamp for this purpose. If the main lamp is a 120-volt 16-cp lamp, the auxiliary lamp ought to be a 60-volt 5-cp lamp. The switch used in connection with this device is very simple.—*Elek. Zeit.*, May 30.

references.

Incandescent Lamp Factory.—An illustrated article on the plant of the Incandescent Electric Lamp Co. in Hammersmith, Great Britain, where the Robertson lamp is made. The different steps of the process of making this lamp are described.—*Lightning*, May 30.

Searchlights.—Perkins.—An illustrated article on the use of the modern searchlight in the navy.—*El'ty*, June 5.

Power.

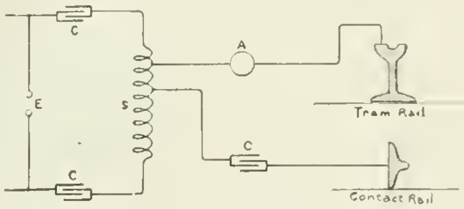
Design of Electric Plants.—B. J. Arnold.—An abstract of a lecture delivered before the Engineering College of the Univ. of Ill. He discusses the choice of location of the power house, the choice of the electric system, speaks of the development of sub-station electric supply, and the best equipment of steam plant. From 15 to 25 per cent in full may be saved by the condensing of the exhaust steam. The efficiencies of the several parts of a steam power plant are stated as follows: Steam boilers, with Illinois coal, from 58 to 65 per cent, and with Pennsylvania coal from 70 to 72 per cent; mechanical efficiency of steam engines from 85 to 92 per cent, according to type and manufacture. He also referred to the planning of switchboards and to the drafting of specifications.—*West. Elec.*, June 1.

Polyphase Equipment of Factories.—Wyld.—An abstract of a paper read before the Birmingham section of the Brit. Inst. Elec. Eng. He gives some information about polyphase plants in English factories, and describes at some length the installation of the Patent Shaft & Axletree Co.'s works at Wednesbury, where there is a plant of 420 horse-power, consisting of two three-phase generators at 210 horse-power each, and some 30 motors, varying in size from 50 horse-power to 5 horse-power, the small ones being in use on traveling cranes. Since the plant was started over a year ago, it has worked most successfully, and the economy has been very marked. He also gives a list of examples of polyphase equipments in factories in different countries. He gives information about the kind of factory, the polyphase system used (nearly all use the three-phase system), the frequency, the total horse-power of the generating plant, and the number and size of motors and how employed. He also gives a brief table of polyphase plants in use in the different countries. There are 105 plants, aggregating 68,000 horse-power.—Lond. *Elec.*, May 31.

reference.

British Power Distribution Schemes.—The first part of a series of articles giving maps, with additional descriptions, of electric power distribution and transmission schemes before the British Parliament during the current year.—Lond. *Elec.*, May 31.

Localizing Insulation Faults in Conduit Systems.—A. Z.—An illustrated description of a method devised by Claude and de Villiers of the French Thomson-Houston Company. It is based upon the fact that the solid conductors offer a considerable impedance to high frequency currents. This is said to be the first industrial application of high frequency currents. On an ordinary tram car a high frequency generator is installed, for instance, a Ruhmkorff coil, the secondary terminals of which are connected to a spark-gap *E*, and to two condensers *C C*, which are connected together by solenoid *S*. At each spark the condensers are discharged and an oscillating high frequency current is produced. Two points of the solenoid are connected through a hot-wire ammeter to the frame of the car, i. e., to the tram rails or the earth, the other through a condenser *C* to the conduit. The latter condenser holds off the direct current of the supply, and enables one to localize a fault during the regular service. When the car runs along the line the current indicated by the ammeter is practically zero, as long as the car is at a distance of more than 20 or 30 meters from a fault, as the circuit of the high frequency current, comprising a great length of both conduit and track rails, has a very great apparent resistance. But as soon as the car approaches a fault, the impedance of the circuit is reduced to that of the connecting wires, of a short length of rails, and of the fault, the ammeter indicates an appreciable current which becomes a maximum when the car is over the fault. Unfortunately, only short circuits which are practically dead can be localized by this method, but it is hoped that it will be possible to increase its sensitivity.—*L'Ind. Elec.*, May 25.



LOCALIZING INSULATION FAULTS IN CONDUIT SYSTEM.

Earth Return Currents of Tramways.—An editorial on the earth as an ordinary electrical conductor. The conclusions drawn from the assumption of the earth acting as an electrolyte regarding the damage done to gas and water pipes, are said to be numerically wrong. Long abstracts are given from a paper of Claude (abstracted in the Digest last year), who found that the earth acts to a very large extent as an ordinary conductor, though partially as an electrolyte and that, generally speaking, only a small proportion of the current leaving the track rails enters into neighboring metallic pipes. Reference is also made to a United States official report on electrolysis in the District of Columbia.—Lond. *Elec.*, May 31.

Automobiles in Paris.—Cottrell.—An illustrated description of the electric automobiles of the Compagnie Generale des Voitures, of Paris. The style of cab adopted and now in use has a battery box "containing 43 elements of the Julien type, with Plante modifications. The capacity of a battery is from 37 to 44 miles at a speed of 9 miles per hour, without being absolutely exhausted. The motors are of the Lundell-Johnson type, with four poles, excited in series, and two collectors. The winding is double, on both magnets and fields, so that, by coupling the windings in series or in parallel, different speeds can be obtained. The cabs are lighted by electricity, the internal lighting being afforded by a 5-cp lamp fitted to the center of the roof. The charging station for the batteries is described in detail.—*West. Elec.*, June 8.

Automobile.—An illustrated description of a new two-place "electrolette" of the Krieger type. The battery is of the Fulmen type, and allows a run of at least 65 miles on a single charge. There are two 3-hp motors. The total weight of the automobile is 1700 lbs., of which 800 lbs. are for the battery and 220 lbs. for the motors.—*Sc. Amer.*, June 8.

REFERENCE.

Calculation of the Current Distribution for Electric Railways.—Pforr.—An article in which he starts from the statement that electric railways, consuming unequal quantities of current at different points, and taking off the same from the supply circuit at certain given feeder points, have a certain analogy with a long beam of a bridge resting at given points upon piers. He applies the methods of analytical mechanics for calculating the distribution of the load upon these different pillars, to the case of electric railways and develops a graphical method for determining the distribution of the load.—*Elek. Zeit.*, May 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Monocyclic System in Madrid.—Baswitz.—An illustrated description of the new electric station of the Inglesa of Madrid. He begins with the statement that the use of electric energy, especially for lighting, is not developed as much in any country as it is in Spain, with perhaps the single exception of Switzerland. There are no franchises required in Spain for laying cables, etc., there is therefore great competition. Madrid has 15 different supply companies, of which the Inglesa is one of the principal. The Union Elec. Co., of Berlin (affiliated with the General Electric Co., of this country), has recently installed a new plant for this company. As there is a large area to be supplied, an alternating-current system was necessary and the monocyclic system was chosen, in order to be able to connect motors more readily. There are four monocyclic generators, each giving 450 kilowatts at 125 r. p. m. and inductionless load, the frequency being 50. The voltage in the station varies between 2040 and 2200, according to the load. The sub-stations, cable network, etc., are described. The voltage at the consumer's terminals is 100.—*Elek. Zeit.*, May 23.

Electric Installation of a Coke Plant.—Hartmann.—An illustrated description of the electric installation of the coke plant of the collieries in Orlan-Lazy in Austrian Silesia. The current is used for lighting and power purposes. The steam plant contains three generators running at 145 revolutions, and giving three-phase currents at 370 amperes per phase at 330 volts, the frequency being 42. In the coke plant itself all motors are run at 330 volts, while for transmission to more distant plants the voltage is transformed up to 3000. The incandescent lamps are supplied with 100-volt alternating current from transformers, while the voltage reduction for the arc lamps is made by individual small transformers on the lamp poles.—*Elek. Zeit.*, May 30.

Electric Installation of a Bank Building.—An illustrated article on "Electrical features of the Chicago National Bank." All the current used for light and power is obtained from a supply company. The circuits are carried to a switchboard upon which are mounted one 400-ampere, three-pole switch for lighting and one 300-ampere, two-pole switch for power. All lighting is carried on the Edison three-wire system, with 110 volts between the neutral and the outside wires. The power service is cared for by 220-volt, two-wire circuits. Electric power is used in connection with the heating, ventilating and sewerage systems.—*West. Elec.*, June 1.

ELECTRO-PHYSICS AND MAGNETISM.

A Condenser in Parallel with on Inductive Circuit.—Perreau.—An investigation, by a graphical method, of the case of an alternator supplying current to an inductive circuit and a condenser connected in parallel to this circuit (this is a first approximation of the case of an alternator supplying current to an inductive circuit through underground cables, which represent a certain capacity in parallel). He shows that in order to pass a current of given intensity through a supply network one may, by placing a condenser in parallel, use a lower e. m. f. than required without that, and that a smaller current will then flow in the alternator so that the loss by Joulean heat is smaller. The action of the condenser may be compared with that of a transformer which receives an e. m. f. and a current and gives out a stronger current at a smaller e. m. f.—*L'Eclairage Elec.*, May 4.

Velocity of Electric Waves Along Wires.—Barkla.—An account of experiments in which the Rutherford detector was used in measurements of the velocities along wires of various diameters and materials. He first made experiments with copper wires of different diameters, and found that the wave length decreases very slightly with decreasing diameter, further that the diminution of velocity in the finer wires is greater with higher frequency. The effect of increasing the specific resistance of the material of the wire was shown by comparing the wave lengths, corresponding to the same frequency, along wires of the same diameter, but of different material. The comparison was made between platinum and copper, the specific resistances of which are in the ratio of 7 : 1 approximately. The velocity of electric waves along platinum wire of diameter .0158 cm. was less than the velocity along copper wire of the same diameter by about 0.4 per cent.—*Phil. Mag.*, June.

Mechanical Movements of Wires Produced by Electrical Discharges.—Viol.—When oscillating discharges are sent over wires the wires become luminous under certain conditions and apparently show stationary electric waves. Various investigators have described this phenomenon and have measured the wave lengths, which they have considered true wave lengths due to the capacity and self-induction of the circuit. The present author, however, considers that these luminous effects are merely mechanical vibrations due to the electric spark of a much lower period than those which would arise from true electric oscillations, and that the nodes and ventral segments are rendered visible by a species of negative brush discharge along the vibrating wires.—*Ann. der Physik*, 1901, No. 4; briefly abstracted in *Am. Jour. of Sc.*, June.

Oscillatory Discharges.—Russell.—A communication on the problem of getting an oscillatory discharge from a condenser and of inventing a simple way of altering the period of the oscillations. Mizuno has shown that by simple shunting the condenser by a non-inductive resistance he can vary the frequency of the oscillations throughout a wide range. Further, that if the circuit is non-oscillatory to start with, it can be made oscillatory by shunting the condenser. The only drawback to this method is that the damping factor is always increased and, hence, that the free vibrations die away more rapidly. The present writer suggests another method by which the damping factor can be diminished so that he can actually increase the number of the free oscillations, whilst being able to alter the frequency between wide limits. His method is to wind a secondary coil of wire around the inductive coil and to vary the frequency by altering the resistance between its terminals. As the voltage can be reduced by this means there will be less risk of the resistance coils being broken down through sparking. He gives an outline of the theory of this method. It shows that this method of altering the frequency is perfectly feasible, and if the quantities are properly chosen the damping can be very considerably diminished.—Lond. *Elec.*, May 31.

Magnetic Properties of the Alloys of Cast Iron and Aluminum.—Richardson and Lownds.—A second illustrated paper on this subject. They investigated in what way the hysteresis loss, between given limits of the field strength, is connected with the temperature for a specimen containing 3.64 per cent of aluminum. The hysteresis loss at first diminishes as the temperature rises. It then increases and reaches a maximum value at about 550 degs. C., which temperature is about 80 degs. higher than the temperature of maximum induction. On further heating, it falls off rapidly and becomes negligible at about 700 degs. C. The magnetic properties of the specimen depend largely on its previous history. There is no essential difference between the behavior of this specimen during heating and cooling, except near the temperature of minimum permeability. An abrupt increase in the permeability takes place at 652 deg. C. during heating, followed by an equally abrupt diminution on further heating. This abrupt change in the permeability is more marked with falling than with rising temperatures. Continued heating and cooling diminish the permeability of this specimen, probably due to disintegration. The curve connecting the temperature of minimum permeability and the percentage of aluminum for the three specimens investigated is a straight line. The microscopic examination of the specimens shows the presence of crystals.—*Phil. Mag.*, June.

Hysteresis of Nickel and Cobalt in a Rotating Magnetic Field.—Beattie.—An account of experiments, the results being given in tables and a diagram. The material to be examined, in the form of a thin circular disk, was placed in a wooden box, and this box was suspended between the poles of an electromagnet. When the electromagnet was rotated slowly so as to avoid the production of eddy currents, the suspended system experienced a couple and was in consequence twisted through an angle proportional to the hysteresis loss, the two quantities being connected by a formula which does not contain the speed of rotation. For nickel he found that for an intensity of about 340 c. g. s. units the hysteresis loss reaches a maximum value of nearly 10,000 ergs. per c. c. per cycle. As the intensity is increased from this point to the highest value attained, viz., 475 c. g. s. units, the hysteresis loss rapidly falls off. The latter portion of the curve is sensibly a straight line, and if it were to retain this character over the unexplored region, the hysteresis would disappear entirely at an intensity of 500 c. g. s. units, which is about equal to the saturation intensity of nickel. The curve obtained by him for cobalt shows the same general character, but the maximum hysteresis loss—36,000 ergs per c. c. per cycle—occurs at an intensity of 700 c. g. s. units, and is very much greater than for nickel.—*Phil. Mag.*, June.

REFERENCES.

Conductivity for Heat and Electricity, Heat-Capacity and Thermo-Electric Power of Certain Metals.—Jaeger and Diesselhorst.—The complete report on their work, of which preliminary accounts were noticed before in the Digest. Elaborate mathematical discussions of the sources of errors are given, also full details of the precautions that must be taken in the experiments, and of the corrections that must be applied in the calculations. The numbers given in their former papers have been revised.—*Phys. Techn. Reichsanstalt, Wiss. Abb.*, 3, pp. 269 to 424; briefly noticed in *Science Abstracts*, May.

Conductivity of Hydrogen and Carbonic Acid Gas.—Townsend and Kirby.—An account of a series of experiments on conductivity produced in hydrogen and carbonic acid gas by the motion of negatively charged ions.—*Phil. Mag.*, June.

Terrestrial Magnetism.—The May number of the journal of this name contains the following articles: The conclusion of Exner's summary of the results of recent investigations in atmospheric electricity; a second paper of Bauer on the physical decomposition of the earth's permanent magnetic field, dealing with the composition and characteristics of the uniform magnetic field; a summary of magnetic work at Bombay Observatory in 1897; a paper by Hazard, on the magnetic work of the Norwegian North Polar expedition 1893 to 1896; a summary, by Bauer, of results of recent comparisons of magnetic instruments; an article on Schuster's researches on the solar rotation and the lunar period of the earth's magnetism; and a biographical sketch, with portrait, of William Ellis.—*Terr. Mag.*, May.

Electro-Chemistry and Batteries.

Electro-Chemical Action.—C. J. Reed.—A continuation of his Franklin Inst. paper. He defines the polarization of an electro-chemical cell as electro-chemical fatigue. It is caused by the exhaustion of the re-agents at the loci of the electro-chemical action (terminals of the electrolyte or electrolytic chain), and their consequent displacement by other substances which produce a different and more electrothanic or less electrogenic reaction. When the substance in the very thin molecular layer on the surface of the electrodes is exhausted, polarization sets in, if diffusion does not bring new substances to this layer. Convection is also very important in practice. In all ordinary cases of electrolysis convection is the principal cause of the transportation of matter to and from the electrodes. He states the law of maximum electrogenesis, when two or more independent electrogens in the same electro-chemical system, are equally accessible in parallel to the electro-chemical circuit, they are successively exhausted in their order of maximum electrogenic power, and when two or more independent electrothans in the same system are equally accessible in parallel to the same electro-chemical circuit, they are successively exhausted in their order of minimum electrothanic power. Or, in other words, when several independent electro-chemical reactions in the same system are equally accessible in parallel to the same electro-chemical circuit, they are successively exhausted in their order of maximum evolution or minimum absorption of electrical energy. Polarization occurs at the anode as well as at the cathode. In consequence of the popular belief that polarization can occur only at the cathode, the reagents used at that terminal have received the name "depolarizers," because while they last there is no polarization. In all electro-chemical systems these cathode reagents are "oxidizing agents," or, more broadly speaking, chemical compounds, one or more components of which suffer diminution of chemical valence in an electro-chemical reaction, or they are chemical elements whose valence becomes electro-negative in an electro-chemical raction. The anode reagents are "reducing agents," i. e., substances, whose chemical valence suffers an increase, or whose electro-negative valence becomes zero or positive. He then discusses the speed of electro-chemical action. The speed of continuous electro-chemical action without polarization may generally be materially increased by imparting a rapid mechanical motion to the electrolytes to assist diffusion.—*Jour. Frank. Inst.*, June.

Edison Battery.—An editorial note refuting the extravagant prophecies of newspapers regarding the general replacement of the horse by the Edison battery for traction. Nickel, which is used for the positive plate, is neither low in price nor available in unlimited amounts for commercial use. The present price of nickel is 50 to 60 cents per pound, which restricts the use of nickel for the treatment of steel to high-class work. The Edison battery seems, by its price, restricted to special purposes.—*Eng. News*, June 6.

Equilibrium Between the Different Oxidation States of a Metal.—Abel.—A very long paper giving the results of a research on the equilibrium between the different oxidation states of the same metal in the case of both mercury and copper. Among many other things he found that the electrolysis of solutions of copper sulphate which were in equilibrium with copper did not give that increase of weight of cathode and diminution of weight of anode when small current densities are used, which is required by theory. The amount of deposited copper was always too small. These differences depend on the concentration of the sulphuric acid. It is probable that, with these small current densities, a dissolving action is superimposed on the pure electrolytic action, which is perhaps caused by a reduction of the sulphuric acid due to the electric current and a consequently stronger formation of complex bodies from the cuprous ions, whereby the equilibrium is disturbed and fresh copper must go into solution. The copper voltameter can, however, be made to an exact, if somewhat inconvenient, measuring instrument for small current densities, under the following condition: Separation of anode and cathode, treatment of the copper sulphate solution before the commencement of the measurement with dilute acids, and working in a stream of hydrogen gas. The accuracy of the copper voltameter increases with diminution of temperature.—*Zeit. f. anorgan. Chemie*, v. 26, p. 361; abstracted at some length in *The Elec. Chem. and Met.*, May.

Application of Electrolysis to Organic Compounds.—Hewitt.—A continuation of his serial. He first deals with alcohols. The preparation of alcohols by electrolysis is probably not feasible, neither is the conversion of alcohols into other substances by electrical means likely to be of service in many cases, although the electrolytic production of chloral from ordinary ethyl alcohol is now carried out technically. Electrolysis has been proposed for the purification of alcohol, and the question of using ozone for the ageing of wines has attracted some attention. He also deals with acids and aldehydes and ketones. One aldehyde of technical importance is produced by an electrolytic method, viz., chloral. A still is divided by a diaphragm. In the anode space is a hot concentrated solution of potassium chloride. The anode itself is of carbon, and movable, so as to act as stirrer at the same time. The cathode is of copper. Electrolysis is carried out at 100 degs. C., alcohol being allowed to flow into the anode space where, in contact with the nascent chlorine, it is converted into chloral; 50 grams of chloral are produced per horse-power-hour.—*The Elec. Chem. and Met.*, May.

Electrolytic Purification of Glycerine.—A note stating that crude glycerine containing various sodium and potassium salts, can be purified by electrolysis, whereby these salts are decomposed while the glycerine is not attacked. The cathode consists of mercury lying at the bottom of the electrolytic cell. An amalgam is formed, which is subsequently treated. The nature of the anode depends upon what salts have to be removed, as it is essential that insoluble compounds should be formed. When the electrolysis has been completed, run off the pure glycerine, which will be turbid, but will clarify on standing.—*The Elec. Chem. and Met.*, May.

REFERENCES.

Comparative Data of Storage Batteries. —Nearly three pages of tables of comparative data of a number of batteries, chiefly those exhibited in Paris last year or those which took part in the Automobile Club competition of 1899. Each table gives five facts about three types of cells of the same capacity for each make, the capacities ranging between 25 ampere-hours and 6000 ampere-hours. The three types of cells selected are intended to be normally discharged in 10 hours, 5 hours and 1 hour, respectively. The five facts given are: The weight of electrodes per ampere-hour in grams, the total weight per ampere-hour in grams, the volume per ampere-hour in c. c., the discharge rate in ampere per kgr. of plates, the price per ampere-hour in pence.—*The Elec. Chem. and Met.*, May.

Conductivities of Aqueous Solutions of Alkali Chlorides and Nitrates.—Kohlrausch and Maltby.—The official report of a very exact investigation. The conductivities here determined will serve as standard, since every possible source of error has been allowed for or eliminated. The results are given in tables and diagrams.—*Phys. Tech. Reichsanstalt Wiss. Abh.*, 3, p. 155, 1900; noticed in *Science Abstracts*, May.

Electrolytic Production of Alkalies and Chlorine.—J. B. C. Kershaw.—An illustrated article on the non-diaphragm mercury processes for the production of caustic alkalies and chlorine. He briefly characterizes the Castner cell, and gives some information regarding plants in which this cell is used. The Solvay cell is also described and illustrated. Some notes are given on the plants in which the secret process of the Elektron Co., of Griesheim, is used.—*El'ty*, June 5.

Electro-Chemical Laboratory.—Hutton.—A detailed illustrated description of the electro-chemical laboratory at Owens College, Manchester.—*The Elec. Chem. and Met.*, May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Lux Watt-Hour Meter.—An illustrated description of the Lux meter for direct and alternating currents. It is a motor meter and has a motor, free from iron, the energy of which is consumed by a brake disk rotating between permanent magnets. The motor consists of two solenoids, supplied with the main current, and of an armature in shunt. The meter differs from other meters of the same type, especially in that it has instead of the ordinary drum armature, an armature with open circuit winding, like in the Thomson-Houston arc light machines. The advantages of this feature are pointed out. The meter can be used as well for direct current as for single-phase and polyphase alternating current. The makers guarantee that the errors are below 4 per cent, between 10 and 100 per cent of full load. The motor starts below 1 per cent of full load.—*Zeit. f. Beleucht*, May 10.

REFERENCES.

Watt-Hour Meter.—Holden.—A long illustrated paper read before the Brit. Inst. Elec. Eng., in which he gives a detailed description of his watt-hour meter, which was described and illustrated in the Digest, Sept. 15, 1900.—Lond. *Elec.*, May 24, 31.

Wehnelt Interrupter.—Lampa.—An account of an experimental investigation of the question why the Wehnelt interrupter is less efficient when the smaller electrode is negative than when it is positive His experiments are made with a coherer circuit containing a galvanometer.—*Akad. Wiss. Wien. Sitz. Ber.*, 109, IIa, p. 891, 1900; abstracted in *Science Abstracts*, May.

Caldwell Interrupter.—Ruhmer.—An illustrated communication in which he describes the results of experiments which he has made with a Simon interrupter (known in this country as Caldwell interrupter), and with a new form modified and improved by him.—*Elek. Zeit.*, May 30.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Syntonic Wireless Telegraphy.—Marconi.—The conclusion of his illustrated paper, the first part of which was abstracted in the Digest last week. He can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wire a number of corresponding receivers. Different messages can be sent by each transmitter connected to the same radiating wire simultaneously, and received equally simultaneously by the vertical wire connected to differently tuned receivers. A further improvement has been obtained by the combination of the two systems. In this case the cylinders are connected to the secondary of the transmitting transformer, and the receiver to a properly tuned induction coil, and all circuits must be tuned to the same period. The record distance over which signals have been sent through space without wires, is 186 miles. He gives a list of the commercial wireless telegraphy stations in permanent working order They are all between stations on the seacoast or between such stations and steamers. He has lately tried to ascertain how near a tune transmitter which is radiating waves of a certain frequency, must be to a receiver tuned to a different frequency in order that the said receiver shall be affected. He finds that if he was working with oscillations which differ "very considerably in period," a transmitter capable of sending signals 31 miles to a tuned receiver will not affect a non-tuned one at 50 metres. If the periods of oscillation of the two tunes are more similar to each other, then the non-tuned receiver may be affected even at several kilometers. He finally makes some remarks about Slaby's work (which was described at some length in the Digest). He finds that the information given in Slaby's paper is very incomplete, and he criticizes some special points. He tried Slaby's arrangement without success, perhaps because he worked over too large a distance and used too small a vertical wire. He has come to the conclusion that the days of the non-tuned system of wireless telegraphy are numbered. An account is also given of the discussion which followed.—Lond. *Elec.*, May 31.

Testing Large Transformers.

By JOHN S. PECK.

THE distinction of being the "Largest in the world" belongs at the present time to seven Westinghouse 2250-kw (3000-hp) transformers recently installed by the Cataract Power & Conduit Company, of Buffalo, N. Y.

The transformers are arranged for delta connection on both high-tension and low-tension windings, forming two groups of three each, one transformer being held as a reserve unit. The transformers are placed in a sub-station near Buffalo, for reducing the voltage of the Niagara Falls transmission circuit from 22,000 to 11,000 volts, for distribution through and about the city, as the use of 22,000 volts on the underground system in Buffalo is not considered feasible.

The winding is made up of a number of thin coils, which are placed side by side, the primary and secondary being frequently interlaced in order to insure close regulation with loads of all power factors. Numerous ducts are provided between the coils, permitting a free circulation of oil through all parts of the winding, and precluding the chance of any local heating. The iron laminations lie in a horizontal plane, and are also provided at frequent intervals with ventilating ducts.

The case is of riveted boiler iron, with all seams and rivet heads thoroughly caulked. The case rests upon a cast-iron base, and is provided at the top with a cast-iron cover. Two large manholes in the cover permit an easy inspection of the interior of the transformer and admit of ready access to the terminal blocks.

For cooling the oil, water is circulated through four spirals of brass tubing, which are placed inside the case below the surface of the oil. The four spirals are connected in parallel so that in case one should become disabled it may be cut out.

For indicating the temperature of the transformer, a "Standard" thermometer is fastened in the side of the case so that the end of the thermometer is immersed in the oil. This arrangement not only affords a means of determining the temperature of the oil at all times, but is so arranged that should the temperature at any time exceed a certain predetermined value, a battery circuit will be closed by the thermometer and a gong sounded, thus immediately attracting the notice of the attendant. An oil gauge is also provided to show the height of the oil in the case, and a large valve is placed at the lower end of the case so that the oil may be quickly withdrawn.

The terminals from the different coils are carried to marble terminal blocks placed above the transformer, but below the surface of the oil. The line leads are carried in at the top of the case through suitable bushings to the proper contacts on the terminal boards.

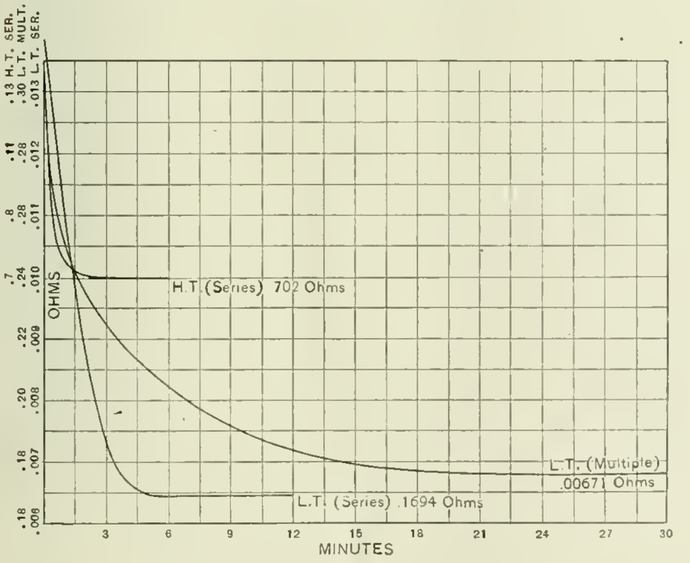


FIG. I.—CURVES.

Although these transformers are intended primarily for use in lowering from 22,000 volts, three-phase, to 11,000 volts, three-phase, they are so arranged that they may be connected for a number of other voltages; thus, the low-tension winding is arranged for either 2200 or 11,000 volts and the high-tension winding for either 11,000 or 22,000 volts. The windings are so arranged that the transformers may be used for the Scott two-phase-three-phase connection, or for three-phase to three-phase transformation with delta connection. A number of taps are brought out from the windings so that voltages approximately 5 per cent higher or lower than those given above may be obtained.

As the e. m. f. of the generators at Niagara Falls is 2200 volts two-phase, the transformers can be used at the power houses as raising transformers, stepping up from 2200 volts, two-phase, to 11,000 or 22,000 volts, three-phase, or they may be used as reducing transformers at any point on the line for lowering from 11,000 or 22,000, three-phase, to 2200 volts, two-phase or three-phase. These different combinations of voltages and phases are easily made by simple changes on the terminal blocks of the transformers.

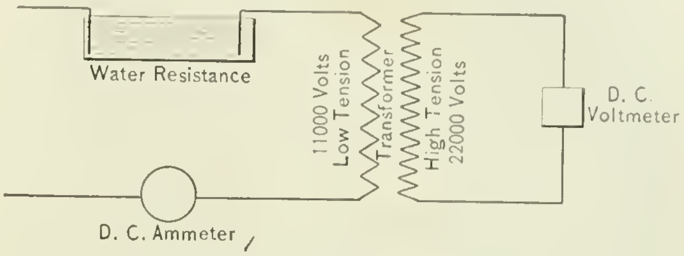


FIG. 2.—DIAGRAM OF CONNECTIONS.

The high guarantees of performance under which these transformers were made were shown by actual tests to have been fulfilled, with very comfortable margins. The table below gives the guaranteed performances, also the values which were actually obtained. In all cases the average obtained from the seven transformers is given:

EFFICIENCY.	Full load.	¾ load.	½ load.	¼ load.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Actual	98.65	98.58	98.33	97.2
Guaranteed	98.40	98.40	98.20	97.0

REGULATION.	Non-Inductive load.	Load having 80 per cent. power factor.
Actual	0.76	1.8
Guaranteed	1.10	3.0

TEMPERATURE.—*Rise of coils as measured by increase in resistance.*

Actual	28.7 per cent.
Guaranteed	40.0 per cent.

All transformers stood the following tests:

(*a*) 45,000 volts applied for one minute between high-tension and low-tension windings and between high-tension winding and core.

(*b*) 22,500 volts applied for one minute between low-tension winding and core.

(*c*) Two and one-fourth times normal voltage applied to the low-tension winding for 30 minutes, giving a maximum of 49,400 volts on the high-tension winding.

In making the resistance measurements of the windings some interesting phenomena were observed. When these measurements are made it is necessary, for reasons which will be explained later, to short circuit one winding while the other is being measured. It was found that resistance measurements taken at different times did not check with each other. This phenomena had been previously observed on large transformers, but never before to such a degree.

On one transformer after the measurements had been completed and it had been standing for several minutes entirely disconnected from the circuit, the testers were greatly surprised to draw a heavy arc upon breaking the short circuiting connection. A consideration of the actions which occur in the transformers under the conditions of measurement, will make clear the reason for these peculiarities.

The resistance was measured by the drop-in-potential method. A direct current was passed through the winding and the drop taken with a voltmeter. From the current and voltage readings the resistance was calculated. A 110-volt storage battery circuit was used, the current in all cases being approximately six amperes. With this current the drop through the windings was in most cases considerably less than one volt, so that it was necessary to insert a high-resistance in series with the winding.

When a direct current is sent through a transformer winding a magnetic field is induced in the iron. Slight variations in current will cause variations in the strength of the magnetic field, which may in turn induce high e. m. f.'s in the transformer winding and endanger the instruments in this circuit. It is chiefly for obviating this danger that one winding is short circuited, for if there is a sudden change in the magnetic field a current will be induced in the short-circuited winding which will in turn oppose the change in the strength of field. The short-circuited winding thus acts as a damper to choke out any sudden variations in magnetic field, with the accompanying high-induced voltage.

When the direct current is passed through the winding the magnetic field which is induced would reach very quickly its maximum value were it not dampened by the short-circuited winding; but on account of this winding the increase in the magnetic field is slow and a considerable length of time is required for the field to reach its maximum value. While the field is thus building up, an e. m. f. is generated in the transformer windings, which e. m. f. is in such a direction that it is added to the e. m. f. due to the resistance of the winding, and the voltmeter reading is higher than it should be on account of the resistance of the winding alone, and the true resistance drop will be obtained only after the field has become stationary.

Fig. 1 shows three curves giving the relation between the apparent resistance of the windings and the time from the instant that the current was sent through the winding. One curve shows the high-tension winding all in series, another the low-tension winding all in series, while a third shows the low-tension winding in multiple. It will be noted that approximately 30 minutes are required before the resistance, with all low-tension coils in multiple, reaches a stationary and true value. With the high-tension coils all in series, the resistance reaches a stationary value in approximately three minutes.

This difference in time depends upon the difference in magnetizing force. With the high-tension coils all in series there are 10 times as many turns as with the low-tension coils all in multiple, and since the same current is used in each case, the ampere-turns are 10 times as great in the first case as in the second, and the iron is more quickly brought to a stationary value.

If the winding is not short circuited it is found that the resistance becomes stationary almost immediately; but in addition to endangering the instruments there is often great difficulty in reading the voltmeter, on account of the rapid variations in voltage due to small though sudden changes in magnetic field. It is, however, possible to open the short-circuited winding for a short time until the magnetic field becomes constant, then to short circuit it and so choke out the rapid oscillations.

From the above it is evident that in measuring the resistance of the transformer care should be taken to ascertain that a constant resistance has been reached.

When the direct-current circuit is opened the field would fall almost instantly to a minimum value were it not checked by the short-circuiting winding, but the current induced in this winding by the dying field prolongs the life of the field so that several minutes are required before it disappears entirely. It was while the field was dying out that the short-circuited connection was opened and the arc drawn.

The iron losses of the transformers were measured by means of a wattmeter in the usual manner. This method of measuring, however, gives the total iron loss and does not separate the hysteresis from the eddy current loss. On account of the large size of these transformers it was desired to separate the iron losses in order to determine whether the ratio which is found to exist between hysteresis and eddy current loss in small test samples is maintained in a large transformer.

In order to make this separation the hysteresis loss was determined by a method devised by Mr. C. F. Scott for measuring the permeability and hysteresis loss on the field ring of one of the 5000-hp Niagara generators. This was, however, the first time the method had been applied to the measurement of the hysteresis loss of transformers.

The connections and instruments used for making the measurements are shown in Fig. 2. In the 11,000-volt winding is shown a direct-current ammeter and water rheostat, the latter being so arranged that very close adjustments of resistance can be made over a wide range. Across the 22,000-volt terminals is a direct-current voltmeter.

If a direct current is sent through the low-tension winding, a magnetic field is induced in the iron. If the current is gradually increased or decreased, the magnetic field will also be increased or decreased. This changing field induces an e. m. f. in the transformer winding which may be measured by the voltmeter across the high-tension winding. If the rate of change in the magnetic field is uniform, there will be a constant e. m. f. generated in the winding, and the voltmeter needle will remain stationary.

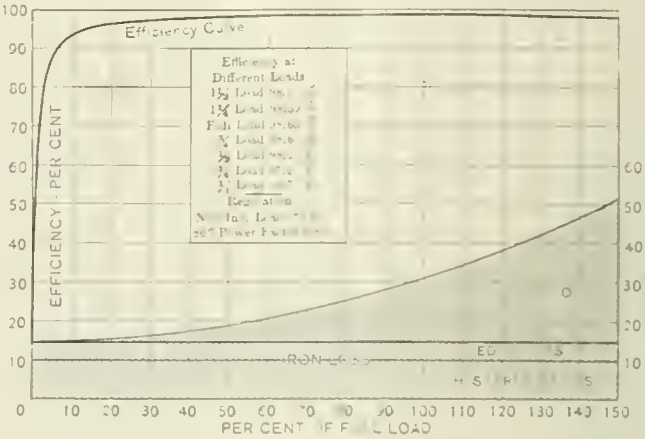


FIG. 3.—EFFICIENCY CURVE.

It was found that a rate of change of approximately 6 C. G. S. lines per square centimeter per second would give a reading of 0.1 volt on the voltmeter. By watching closely the voltmeter needle the resistance could be so changed as to give a constant reading of 0.1 volt. Starting with the iron demagnetized, at the end of one second the induction would be 6 lines per square centimeter, at the end of two seconds 12 lines, at the end of three seconds 18 lines, etc.; so that the time from the start gave a measure of the induction in the iron. The method used in taking the curves was as follows:

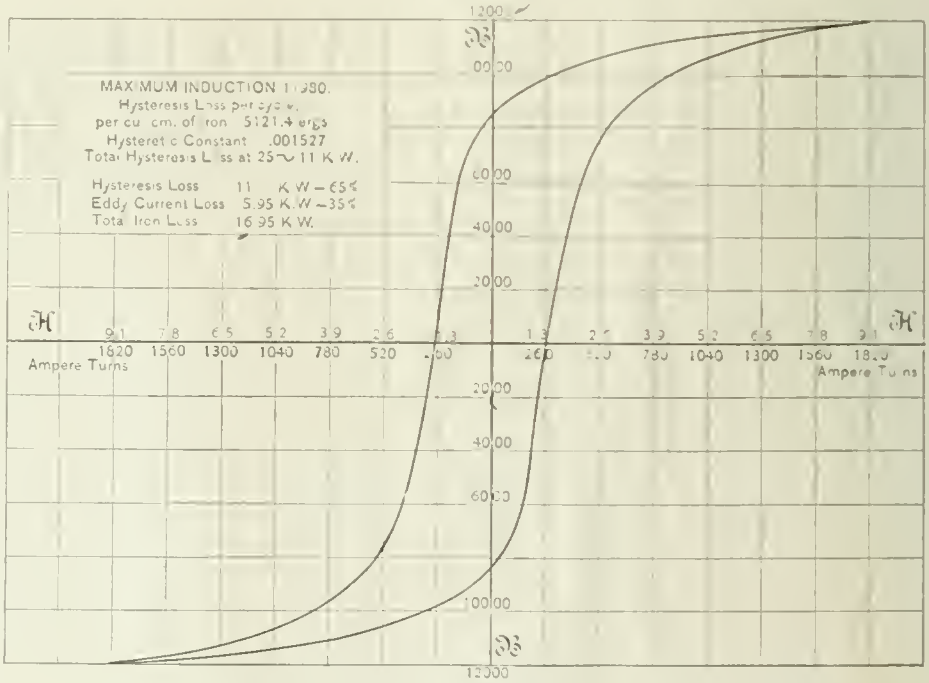
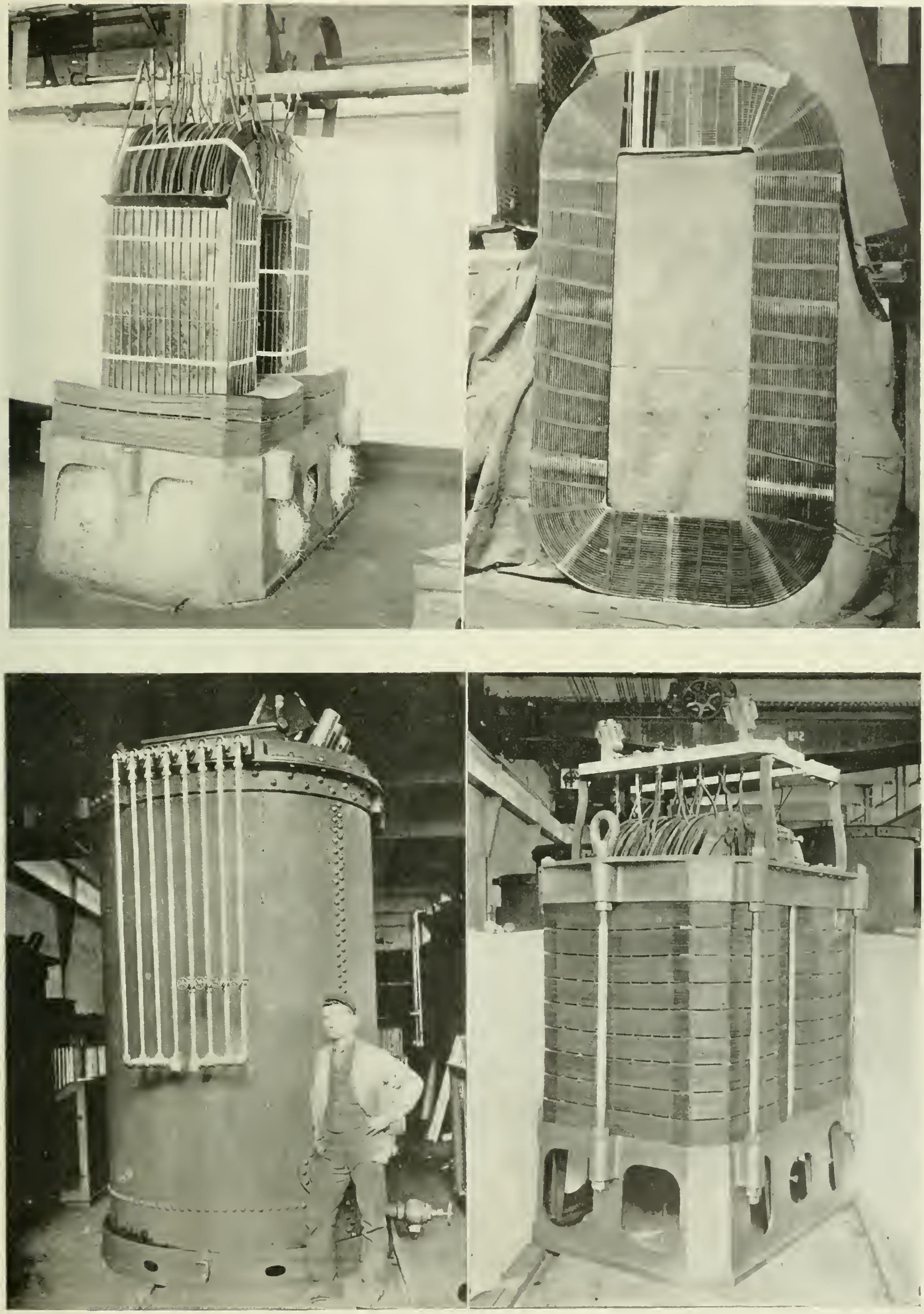


FIG. 4.—HYSTERESIS CURVE.

Starting with zero current the resistance was cut out at such a rate as to give a steady deflection on the voltmeter. When the maximum desired induction was reached the voltmeter was reversed and the current gradually decreased to zero, then the current was reversed and gradually increased to a negative maximum, then the voltmeter again reversed and the current decreasd to zero, thus completing the cycle. Readings were taken of current every five seconds, so that with a deflection of 0.1 volt the points came very close to-



FIGS 5, 6, 7 AND 8.—VIEWS SHOWING TRANSFORMERS IN DIFFERENT STAGES OF ASSEMBLING.

gether on the curve. The instruments were so arranged that a complete cycle could be carried through without a moment's stop at any point.

In taking the readings four men are desirable—one to vary the resistance and so hold the voltmeter constant, one for calling off the time intervals for readings, one for reading the ammeter and one for taking down the readings.

In order to get the iron "into step," the transformer was run through the complete cycle several times before any readings were taken. With this method it was, of course, necessary to locate the horizontal axis after the curve was plotted, but this could be done without difficulty as the loops closed on themselves accurately and were found to be almost perfectly symmetrical about the two axes.

The hysteresis loss per cycle is represented by the area of the loop, and was found to be 3958 ergs per cycle at 10,260 gausses, and 5121 ergs per cycle at 11,980 gausses.

Using the equation $L = K\mathcal{B}^{1.6}$ where L = hysteresis loss in ergs per cycle and $\mathcal{B}$ = maximum induction, it is found that $K = 0.00152$ for a maximum induction of 10,260 gausses, and $K = 0.001527$ for a maximum induction of 11,980 gausses.

Considering the fact that the magnetic circuit is rather wide and that the induction cannot be equally distributed over this section, the hysteresis constant is quite small and lower than is often obtained on small samples of transformer iron.

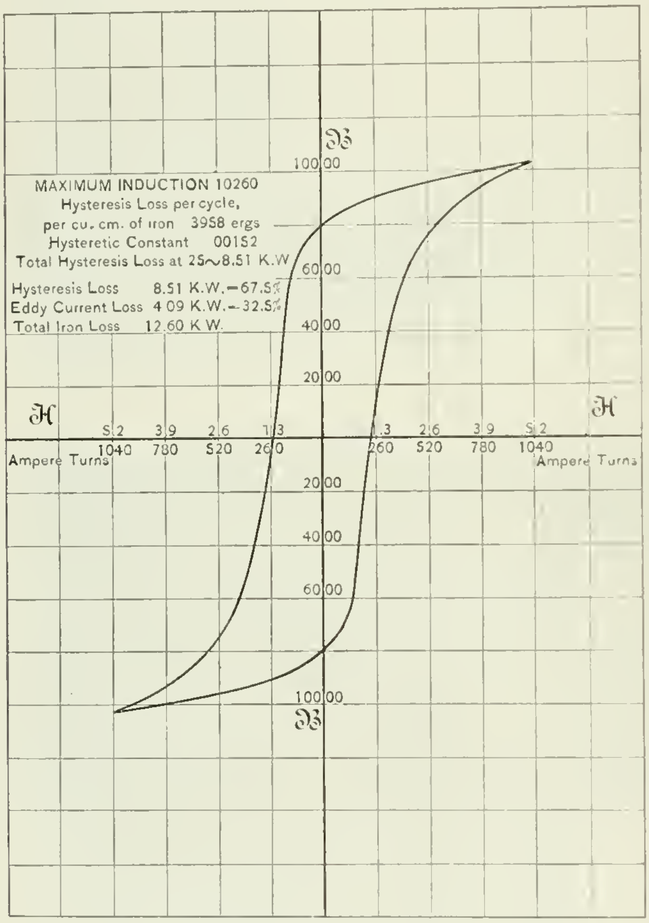


FIG. 9.—HYSTERESIS CURVE.

The eddy current loss is found by deducting the hysteresis loss from the total iron loss. At an induction of 10,260 gausses the eddy current loss is 4.09 kilowatt per transformer, and 5.95 kilowatt at 11,980 gausses. Assuming that this loss varies as the square of the induction, and that it is 4.09 kilowatts at 10,260, it should be $4.09 \times \frac{(11{,}980)^2}{(10{,}260)^2} = 5.56$ kilowatts at 11,980. The measured value 5.9 is approximately 7.5 per cent higher, but this difference may be accounted for by the unequal distribution of the flux in different parts of the circuit.

The simplicity of this method of measuring the hysteresis loss of transformers is apparent. Its chief interest, however, lies in the fact that it is the only practical method yet devised for measuring this loss on a completed transformer.

National Carbon Exhibit at the Pan-American.

The National Carbon Company, of Cleveland, Ohio, has a notable exhibit at the Pan-American Exposition. It consists of a large assortment of its products made wholly or in part from carbon, and is designed to show in a compact arrangement the important position in the industries which the manufacture of carbon has now attained.

The plan of the exhibit is a design in Pompeian villa effect, and the material out of which it is formed is entirely of carbon taken from different shapes and forms in actual use in different industries, and not made up especially for this exhibit. The pillars are solid carbon columns 9 inches in diameter by 80 inches long, capped with 10 x 10-inch solid slabs. Both of these shapes are used in electrolytic and smelting work. The 3-inch electrodes are the well-known forms used in manufacturing aluminum. The exhibit of the smaller forms, such as batteries, specialties and carbon pencils for lighting, is arranged in a series of platforms or steps in a pyramidal form against the wall. It contains over 1000 different shapes. The shapes and sizes range all the way from small globules less than 1-32 of an inch in diameter to the large electrodes used in smelting and which weigh up to 600 pounds each

CARBON EXHIBIT IN ELECTRICITY BUILDING.

Especial attention is called to the different kinds of complete batteries shown, including all the best known and most efficient forms of the wet battery and gravity cell types, and also the most used sizes of the "Columbia" dry cell. The specialties include back plates, diaphragms, granular and globular carbons used in telephone work, and of which a great many forms are shown.

Scattered throughout the exhibit are a large variety of motor and generator brushes. In electric light carbons only a few of the different lengths and sizes are shown.

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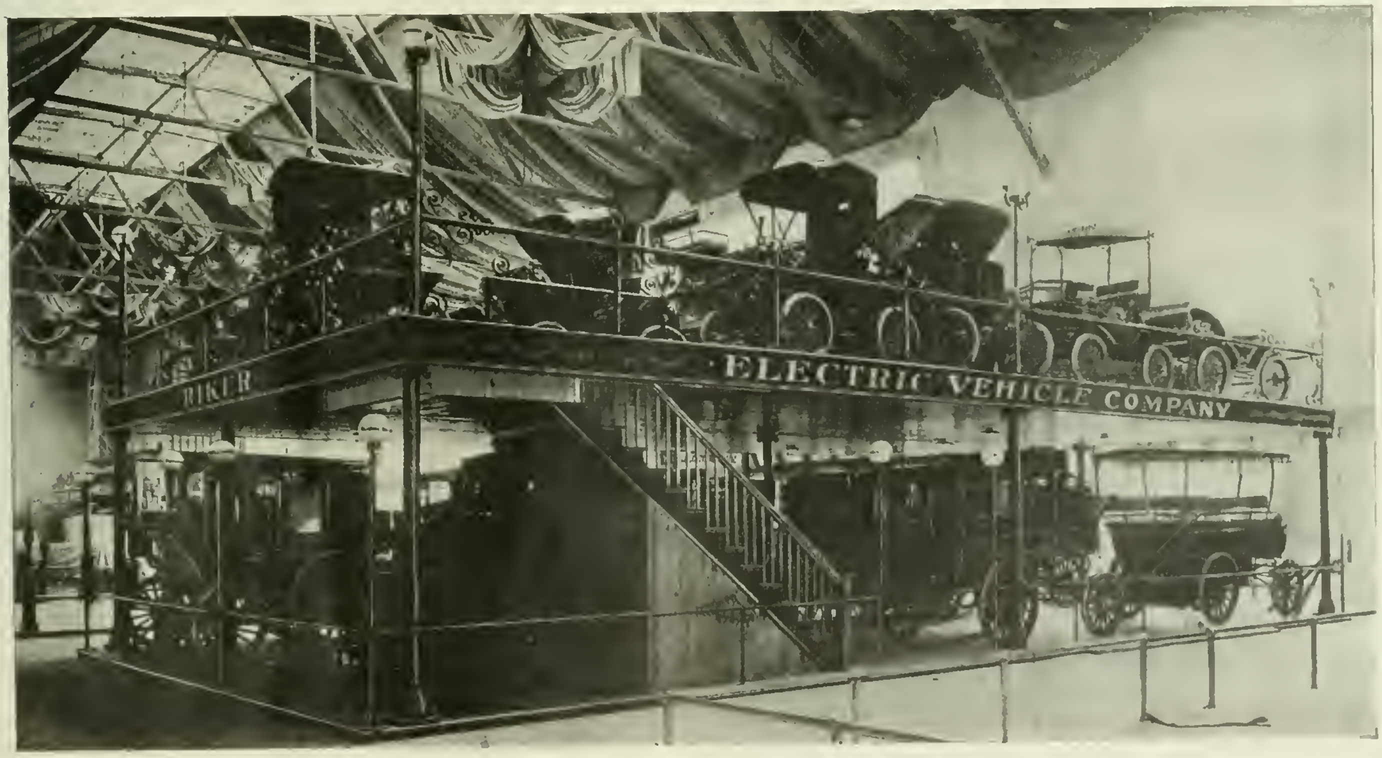
Exhibit at the Telephone Convention.

The Lambert Schmidt Telephone Manufacturing Company had, as noted in these pages already, a very elaborate exhibit for the independent telephone convention at the Iroquois Hotel on June 11, 12 and 13. Their exhibit consisted of two portable army field switchboards, one 40 drop regular type army board, and a 100 drop combined series and bridging switchboards. They showed also army telephone field sets, their regular exchange telephone, consisting of generator call and common battery wall telephone, portable desk telephones, microtelephones, their automatic reset inter-communicating wall and desk sets, many combinations of private line instruments and parts in detail of their cordless adjustable arms, transmitters, receivers, etc. They made a particular feature of showing the inside of both switchboard and telephones, as illustrating the fine workmanship throughout. The two army portable field switchboards attracted considerable attention, being a novelty in this line. These boards are of six and ten drops respectively. No cords or jacks are used. In regard to the ten drop outfit, it may be stated that all the parts are inclosed in a heavy, compact oak case with a door at the front and back. Inside at the front is a hard-rubber panel on which are mounted in the first row 10 drops, second row

10 red ringing cams, third, fourth and fifth rows being composed each of 10 black cross connecting cams, and sixth row three white listening cams, and below a night bell cam. There is one ringing cam for each line and one listening cam for each row of black cams. The cross connections on the first call would be made on the first row of black cams, using the first listening cam to the left; the second cross connection would be made on the second row of black cams, using the second listening cam, etc. The ringing on any line can be made by the individual red ringing cams. The board is provided with their army type hand microtelephone and bridging generator and with binding posts at the top for line connections. The board weighs 63 pounds, is compact and can be shifted at a moment's notice. A strap at the top is used for carrying.

TELEPHONE EXHIBIT.

They exhibited a trick telephone in the shape of a common battery wall instrument. A delegate on being requested to try the telephone would lift the receiver from the hook, when the lid of the ringer box would fly up, showing a bunch of cigars and a notice, "Take one." It is needless to say that the invitation was seldom refused. The company was ably represented by Mr. Lambert Schmidt, president; Mr. Schwartz and Mr. W. W. Bostwick, Jr. They received many congratulations on the high quality of their apparatus.



ELECTRIC VEHICLES AT PAN-AMERICAN EXPOSITION.

Exhibit of the Electric Vehicle Company.

One of the most striking exhibits in Machinery and Transportation Building at the Pan-American Exposition is that of the Electric Vehicle and Riker Motor companies. It stands in the center of the vast hall, and is in full view from the big doorway of Electricity Building, across one of the sunken gardens, so that it has the unusual advantage of being conspicuous in two buildings and two groups at once. Another novelty is that the exhibit is double-decked, several of the vehicles being carried on the upper deck. In all, there are over thirty automobiles of the well-known "Columbia" and "Riker" types in the company's enclosure in the transportation building and several others in practical demonstration about the Exposition grounds. Of the Columbia vehicles on exhibition there are the following: One phaeton, one tricycle carrier, one gasoline runabout, one wagonette, one six-passenger omnibus, one runabout with wooden wheels, one runabout with buggy top and wire wheels, one Victoria with wire wheels, one Victoria with canopy top and wooden wheels, one extension front brougham, one surrey, one cabriolet, one rear-boot Victoria, one delivery wagon. The Riker list includes one piano-box runabout, one Victoria, one phaeton, one spider phaeton, one mail phaeton, one Victoria De Luxe, one delivery wagon, one two-ton truck, one Wilkesbarre bus, one theatre bus, one public hansom, one railway cab, one straight front brougham, one demi-coach, one brake, one gasoline voiturette. A Columbia delivery wagon is under contract to carry the mail between the Buffalo Post Office and the Pan-American grounds, and several vehicles of a smaller type are very much in evidence, as they go around to distribute mail about the Exposition grounds. The pleasure vehicles to be exhibited include runabouts, phaetons, Victorias, surreys and cabriolets. Vehicles of this type are equipped with new long-distance batteries, which have a running capacity of forty miles on one charge. The various types have already been described to the readers of this journal in detail, but seen thus collectively they present many features for new study and comparison, and are a great center of attraction for visitors to the Machinery Hall. Mr. J. M. Hill, who is in active and efficient charge of the exhibit, has encountered an endless demand for information, and has been able several times to assist the management with the loan of vehicles for special necessities and functions.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 3 to 4 per cent. Time money was easier and closed at about the same figures. The rates for mercantile paper are 3¾ a 4¼ for 60 to 90 days' indorsed bills receivable, 4 a 4½ for the highest grade of 4 to 6 months, single names, and 5 a 5½ for others. In the stock market there was limited speculative activity, but prices were strong and advances were scored in the railroad lists. Among the industrial stocks, United States Steel securities were unfavorably affected by the reports that the Pennsylvania Railroad has acquired control of the Pennsylvania Steel Company, but it subsequently recovered. In the traction list, Manhattan showed strength on favorable reports of earnings which will result from the equipment of the line with electric power. This stock closed at a net advance of 5⅝ points. Brooklyn Rapid Transit closed with a net gain of 1½ points, the number of shares sold being 65,370. Metropolitan Street Railway made a net gain of 3¾ points on transactions of 30,600 shares. There was little trading in General Electric, which, however, closed with a net gain of 3¼ points, the closing quotation being 248, ex-dividend. The sales were only 1825 shares. Western Union showed greater strength, and closed with a net gain of 2 points, on sales of 48,300 shares. There were no special features in the outside market; trading was light, with the majority of price changes showing a gain. Copper stocks keep a steady tone; Otis Elevator sold at 32, with no activity. The automobile stocks show declines, with the exception of New York Electric Vehicle Transportation, and New England Electric Vehicle, which remain at about the same price as quoted last week. Following are the closing quotations:

NEW YORK.

	June 8.	June 15.		June 8.	June 15.
General Electric	246¾	248	Electric Vehicle	11	10
Brooklyn Rapid Transit	80	81½	Electric Vehicle, pfd.	18	16
Metropolitan Street Ry.	171¾	175½	General Carriage	2	1⅞
American Tel. & Cable	100	99½	Illinois Elec. Veh. Tran.	⅞	⅞
Western Union Tel.	94	96	Hudson River Tel.	120	120
American Dist. Tel.	—	—	N. E. Elec. Veh. Tran.	3⅛	3⅛
Commercial Cable	—	—	N. Y. Elec. Veh. Tran.	11½	11¾
Electric Boat	22	22	Tel. & Tel. Co. of Am.	5	5
Electric Boat, pfd.	51	50	N. Y. & N. J. Tel.	170	170
Electric Lead Reduc'n	3½	3½			

BOSTON.

	June 8.	June 15.		June 8.	June 15.
New England Telephone.	—	143	Erie Telephone	57½	54
Mexican Telephone	2½	—	General Electric, pfd.		
Westinghouse Electric	70	69	Am. Tel. & Tel.	173¾	152
Westinghouse Elec., pfd.	75	76	Boston Electric Light	240*	—

PHILADELPHIA.

	June 8.	June 15.		June 8.	June 15.
Electric Storage Battery.	58	53	Philadelphia Electric	5½	5½
Elec. Storage Batt'y, pfd.	60	52	Pa. Electric Vehicle	1	1
Elec. Co. of America	8¾	8¾	Pa. Elec. Veh., pfd.	1	1
General Electric Auto	—	—	Am. Railways	45	43½

CHICAGO.

	June 8.	June 15.		June 8.	June 15.
Chicago Edison	175	177	Chicago Telep. Co.	270	275
Chicago City Ry.	250	—	Union Traction	18¾	19¼
National Carbon	16	16	Union Traction, pfd.	49	58
National Carbon, pfd.	84½	84	Northwest Elev. com.	48	49

*Asked.

PURCHASE OF TOLEDO TROLLEYS.—Announcement is made of the purchase by the Everett-Moore syndicate of Cleveland, of all the street railway lines of Toledo, and other negotiations in progress, when completed, will give the syndicate control of all electric railways between Detroit and Cleveland. Every electric railway in Northern Ohio and Southern Michigan will also be merged, with the exception of Pomeroy interests and the Little Consolidated Street Railway of Cleveland. The suburban traction property at present being considered for purchase by the syndicate is the Rapid Railway, of Detroit, and the Toledo, Fremont and Norwalk Railway. At a meeting of the stockholders of the Sandusky & Interurban Company, it was decided to make a transfer of the property to the Lake Shore Electric Railway, an Everett-Moore property. E. W. Moore and Henry A. Everett have been in New York in conference with bankers. The purchase price of the Toledo lines is said to be $9,000,000. The scheme of the promoters is to control urban and interurban traction lines between Cleveland and Detroit along the lake shore. The Toledo purchase embraces all the electric lines in that city known as the Toledo Traction Company, consisting of 99 miles of track.

NEW YORK ELECTRIC VEHICLE.—Last week a report was circulated in Wall Street, as a dispatch from Newark, N. J., that Vice-Chancellor Stevens had issued an injunction forbidding the collection of the assessment upon the stockholders of New York Electric Vehicle Transportation, which was ordered on June 5. A suit is pending in chancery calling upon the company to show the condition of its affairs, but the officials of the company say that no such injunction was issued when the bill was filed, nor at any other time; in fact, the state of the proceeding is simply that a stockholder's bill has been filed, on which a hearing will be had this week. President Sanderson, of the Transportation Company, says that when the hearing is had his attorneys will fully acquaint the public with the assets of the company, what was paid for them, how they were acquired, what they are worth at the present time, how the new assessment came to be made, and what is intended to be done with the money collected. He says he will show that the company is in a splendid condition. It is stated that the assessment has already been largely paid in.

BIRMINGHAM, ALA., BONDS.—The Birmingham Railway, Light & Power Company, which consolidated the street car, gas and electric light properties of Birmingham, has called a meeting of the stockholders of the three properties to be held in Birmingham July 18. The purpose of the meeting is to arrange for an issue of $6,000,000 of bonds and agree on a trustee, and also to ratify the appointment of the Old Colony Trust Company, of Boston, Mass., as transfer agent. Robert Jemison, now vice-president of the Birmingham Railway, Light & Power Company, will be president of the consolidated company. A board of directors has been agreed upon, including Gordon Abbott, Boston; J. K. Newman, New Orleans; H. M. Atkinson, Atlanta, and T. T. Hillman, William A. Walker, Nat Baxter, Jr., G. B. McCormack, M. V. Joseph, Robert Jemison and A. M. Shook, of Birmingham.

CHICAGO EDISON.—The Chicago Edison Company has increased its capital stock from $6,000,000 to $10,000,000. The right to subscribe for 15 per cent of the increase will be given to the stockholders at par on Aug. 1. The financial statement of the company for the year ending March 31, 1901, is summarized as follows: Gross earnings, $2,517,000; expenses, including dividends, interest on bonds and debentures, $2,371,000; balance, $146,000. The old directors were re-elected. President Insull is quoted as saying: "While our stock has been increased $4,000,000, we shall issue only $900,000 to stockholders at par about Aug. 1. The other $3,100,000 will remain in the treasury for use as the extension of business demands. This authorization gives the board of directors the right to issue new stock from the treasury at its option, but it will be put out only on needed improvements."

NIAGARA POWER.—At a meeting of the board of directors of the Niagara Falls Power Company the officers of last year were reelected and Daniel O'Day and Victor Morawetz were added to the board. The board took action upon the proposition to develop power on the Canadian side of the Niagara River under the charter of the Canadian Niagara Power Company, which it controls. Work has been commenced in the Queen Victoria Niagara Falls Park, and will be pushed vigorously to a first installation of not less than 25,000 horse-power. It is proposed that half of this shall be transmitted to Toronto to be used in that city, the Buffalo transmission having proved satisfactory and remunerative.

DIVIDENDS.—The United Traction & Electric Company, of Jersey City, has declared the regular quarterly dividend of 1 per cent on the capital stock, payable July 1. The Manchester Traction, Light & Power Company, controlling the electric light and street railway interests of Manchester, N. H., has declared its first semi-annual dividend of 3 per cent, payable July 15. United Gas Improvement Company, of Philadelphia, has declared a quarterly dividend of 2 per cent ($1 per share), payable July 15.

WASHINGTON TRACTION & ELECTRIC.—The reorganization committee of the Washington Traction & Electric Company held a meeting a few days ago. It was substantially agreed that the bondholders would receive in lieu of their present collateral trust bonds, new mortgage 4 per cent bonds to the par value of 55 per cent and preferred 5 per cent stock to the par value of 55 per cent, thus giving the bondholders in fixed charge and preferential securities 110 per cent of their present holdings.

AMERICAN TELEPHONE & TELEGRAPH.—It is stated that American Telephone & Telegraph will soon be listed on the New York Stock Exchange. New York holders of the stock think this will add 25 per cent to the market value of the stock, as New York banks will then accept it more favorably as collateral.

WESTERN UNION STATEMENT.—The estimated returns of Western Union Telegraph Company for June 30 quarter compare as follows:

	1901.	1900.
Net revenue	$1,750,000	$1,600,925
Bond interest	239,040	223,945
Balance	$1,510,960	$1,376,980
Dividend	1,217,001	1,217,000
Surplus	$293,959	$159,980

The report for the year ended June 30, partly estimated, will show the following results:

	1901.	1900.
Net revenue	$6,672,810	$6,165,362
Bond interest	956,120	906,102
Balance	$5,716,690	$5,259,260
Dividends	4,868,003	4,867,983
Surplus	$848,687	$391,277
Accrued surplus	9,306,891	8,458,204

The directors of the company have declared the usual quarterly dividend of 1¼ per cent, payable July 15.

INSPECTING OHIO ROADS.—C. D. Jameson, an electrical engineer and expert representing large New York and London banking houses, visited Cleveland last week and went over several of the properties of the Everett-Moore syndicate with a view to making a thorough examination of the character of the lines. He stated that the banking houses he represents propose devoting much attention to the investment of capital in street railway enterprises, and that Cleveland was selected as the most advantageous point for such investigation. In company with several officials of the various roads, he was shown over the Northern Ohio Traction Company, the Lorain & Cleveland Railway, the Cleveland, Painesville & Eastern Railway and the Cleveland & Eastern Railway. The trips to Akron and Chardon demonstrated the ability of electric cars to surmount heavy grades while the ride to Lorain showed something of the speed of a first-class electric line. On the return from Lorain the run from the power house to the city limits, eight miles, was made in 11 minutes including two stops. As a result of his inspection he will make a favorable report, and it is expected that in the near future, a financial expert will visit the city and make a thorough examination into the finances of the various roads.

MEXICAN TELEPHONE.—The Mexican Telephone Company reports for April show these results:

	1901.	1900.	Changes.
Gross earnings	$17,339	$15,078	Inc. $2,261
Operating expenses	8,197	7,687	Inc. 510
Net earnings	$9,142	$7,391	Inc. $1,751
From March 1 to April 30:			
Gross earnings	$34,543	$29,710	Inc. $4,833
Operating expenses	19,324	17,419	Inc. 1,905
Net earnings	$15,219	$12,291	Inc. $2,928

NEW ENGLAND TRANSPORTATION.—It was reported this week that the New York Transportation Company had purchased the New England Electric Vehicle Transportation Company. This is not true, but probably arises from the fact that the New York Company had purchased, or will within a few days, the Newport branch of the New England Company. Negotiations for a sale of the assets of the New England Company have been opened with a number of interests, but other than a sale of the Newport department nothing has been consummated.

BOSTON CONSOLIDATION.—Stockholders of the Edison Electric Illuminating Company at a special meeting called for June 24 to act on the merger of the Boston Electric Light Company will also vote on the question of increasing the board of directors from 9 to 12 members. Four Boston Electric Light Company directors will be added to the board should the increase be voted, as there is a vacancy in the present Edison board.

BROOKLYN RAPID TRANSIT.—The Brooklyn Rapid Transit Railroad reports gross earnings for April of $989,993, an increase of $5,409, as compared with the same month of last year, and net $331,711, an increase of $13,287. For the 10 months ending April 30, the gross earnings were $9,844,597, an increase of $284,849, as compared with the corresponding period of last year, and net $3,321,865, an increase of $439,365.

UNION TRACTION, PHILADELPHIA.—The Union Traction finance committee, which has just completed an examination of the underlying and other securities in the company's treasury, found the aggregate value of such securities to be $8,000,000. In addition, there is between $700,000 and $800,000 in the company's insurance fund.

Commercial Intelligence.

THE WEEK IN TRADE.—The general improvement in trade, noted in last issue, continued during the past week, both as to tone and volume. The prospects in the great staples—wheat, corn and cotton—are very satisfactory, and these conditions are reflected in all other lines of retail trade. One of the most satisfactory features of all is that, after quite a period of dullness, pig iron has been taken more freely at leading markets, and bars and plates have sold better, the latter even noting an advance. The production of pig iron is proceeding at an unprecedented rate, but consumption appears to wait promptly upon output. Railroad earnings continue in undiminished volume, and the only unfavorable feature in the general industrial situation is the failure to settle the machinists' strike. At the close of the week the strikers gave up the fight in some quarters, but there is a wide belief that the contest will be long drawn out. Specially good trade reports coming from the Northwest and Southwest, are induced by liberal rains affecting the wheat crop outlook. There is an active demand for building material generally, particularly in the lumber line. In the iron and steel industries, wire and wire goods are in heavy demand, and deliveries are behind hand. Machinery manufacturers are moving cautiously as to future contracts on account of the uncertainties of the machinists' strike. For the month of May 94 roads, operating over 103,000 miles, report earnings that aggregate $59,986,000, 9.2 per cent in excess of the figures for May, 1900. Southwestern roads show the heaviest ratio of increase, 26 per cent, followed by the central-western roads with 13.3 per cent, while next in order are the coal roads on 10.2 per cent. The trunk lines report an increase of 6.4 per cent, the Pacific roads 5.6 per cent and the grangers 2.8 per cent. The coal roads show a decrease of 11.9 per cent and the Mexican roads one of 3 per cent. The business failures for the week as reported by *Bradstreet's*, aggregate 188, as against 163 the week previous, and 180 the same week last year; 150 in the same week in 1899, 207 in 1898 and 226 in 1897. The copper market remains firm, with unchanged prices. Very little new business has been done, and there was practically no export demand. Prices are: Lake, for home consumption, 17 cents; electrolytic and casting copper, 16⅝ cents.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended June 12: Antwerp—16 packages electrical material, $894. Argentine Republic—98 cases electrical material, $2,043; 1 case electrical machinery, $345. Bilboa—2 cases electrical material, $100. Berlin—40 cases electrical machinery, $380. British Guiana—18 packages electrical material, $410. Bremen—4 packages electrical material, $120. Brazil—35 cases electrical machinery, $982; 14 cases motors and parts, $180. Barcelona—1 package electrical machinery, $57; 11 packages electrical material, $369. British Australia—55 cases electric machinery, $12,512; 18 cases electrical material, $940; 8 motors, $250; 6 motor vehicles, $5,000. British East Indies—1633 packages electrical material, $253,914. British West Indies—3 packages electrical material, $138. Central America—3 packages electrical material, $62. Copenhagen—2 packages electrical material, $30. Cuba—174 cases electrical material, $5,985. Dundee—1 package electrical material, $30. Dutch West Indies—4 packages electrical material, $41. Ecuador—115 packages electrical material, $903. Genoa—14 packages electrical material, $926. Glasgow—4 packages electrical machinery, $575. Gijon—9 cases electrical material, $1,622. Hamburg—31 packages electrical material, $1,277. Havre—10 packages electrical machinery, $14,052; 127 packages electrical material, $3,110. Japan—18 packages electrical material, $650. London—580 packages electrical material, $34,551. Liverpool—73 packages electrical machinery, $6,435; 854 packages electrical material, $2,922. Libau—2 packages electrical material, $521. Lisbon—1 package electrical material, $30. Marseilles—25 packages electrical material, $300. Mexico—93 packages electrical material, $2,175. Moscow—15 packages electrical machinery, $1,791. Milan—8 cases electrical material, $1,164. Palermo—1 package electrical material, $9. Peru—4 cases electrical material, $210. Riga—6 packages electrical material, $600. St. Petersburg—1 case electrical material, $187; 1 case electrical machinery, $70. Southampton—21 packages electrical material, $1,288. Stockholm—1 case electrical material, $17. St. Helena—3 packages electrical material, $190. Uruguay—1 package motor carriage, $290. U. S. Colombia—4 packages electrical material, $113. Venezuela—91 packages electrical material, $1,696.

NEW STURTEVANT FACTORY.—After a most careful consideration of sites, the B. F. Sturtevant Company has recently completed the purchase at Hyde Park, Mass., of a tract of land containing some 15 or more acres, and is preparing plans for the erection thereon of a large up-to-date plant for the manufacture of blowers, engines, motors, forges, heating apparatus, etc. This purchase, although hastened by the recent fire which damaged the works at Jamaica Plain, Mass., which will be eventually abandoned, is the natural outcome of the rapid growth of this concern during the past few years, and of the congested condition of the present plant in which increased facilities could not be advantageously provided. The new site is on the same railroad line, the N. Y., N. H. & H. R. R., only five miles from the old plant and less than ten miles from Boston. It is admirably located; 1300 ft. along one side abut upon the railroad with all desired switching facilities, an ample stream of water marks the boundary on another side, a noted spring of remarkable purity is within the area, the high ground which is practically on a level with the tracks will accommodate buildings having a floor area of 750,000 square feet, ample for all needs of the immediate future. The lower land furnishes abundant area for dumping. The new plant will be arranged to reduce to a minimum the labor cost of handling material, and will provide for its direct progress through the shop from foundry to shipping room. It will be equipped throughout with new modern tools and labor-saving devices.

AUSTRIAN DISCRIMINATION.—Consul Schumann, reporting from Mainz to the State Department on the methods employed by Austria to protect home industries, quotes a trade journal which declares that the Government threatened to withdraw the subsidy granted to a hat factory at Temesvar because the latter had ordered an electric lighting plant from a German firm, and was only prevented from carrying out its threat by being convinced that there was no firm in Austria which could have carried out the contract as required. A match factory at Raab was reproved by the Government for purchasing foreign materials. The electric tramway companies of Fiume and Temesvar were fined for purchasing their motors from a German firm. The electric mining road of Derna only received permission from the Government to purchase locomotives, dynamos, etc., from a German firm after the managers had proved conclusively that for their special purposes they could use only the machines of this firm. Furthermore, it is said the Austrian Government keeps a register of all Austrian firms which purchase foreign goods or raw material, and to such firms the Government never grants the least favors, nor do they ever receive Government contracts.

WANT NO EDISON FACTORY.—Mr. Thomas A. Edison's purchase of the Hayden mill in Glen Ridge, N. J., for use in manufacturing his new storage battery, has filled the Glen Ridge Park Association with alarm. The association's fears were embodied in a communication sent to the Borough Council last week, and the latter body, becoming frightened, voted in favor of issuing $35,000 worth of bonds to be used in purchasing the property for park purposes. A special election will be called at the earliest possible date to obtain the approval of the voters. "About two years ago," said the communication to the Council, "the citizens of this place decided to form an association known as the Glen Ridge Park Association for the purpose of acquiring real estate. This was for the purpose of preserving this section of the glen. The reasons for the application to the Council are especially pressing just now. Thomas A. Edison has acquired the property known as the Hayden mill, and the advent of a large number of workingmen may cause the erection of a business structure of an objectionable character in the immediate vicinity of the works and park, and the beautiful rural appearance of the neighborhood may be seriously menaced thereby."

ANOTHER LONG ISLAND TUNNEL.—The Long Island Extension Railroad Company has been incorporated to build and operate by electricity underground tunnels about four miles long over the route, from near the Long Island Railroad property in Queens Borough, running thence to and under East River, to and under Manhattan Borough, to a point south of Fiftieth Street and Broadway, which points are to be the terminals. The capital is $1,000,000. The directors are Dumont Clarke, William H. Baldwin, Jr., New York City; Thomas DeWitt Cuyler, of Heverford, Pa.; C. Stuart Patterson, Sutherland M. Prevost, Philadelphia; John P. Green, of Rosemont, Pa.; William A. Patton, Radnor, Pa.; Charles E. Pugh, of Overbrook, Pa.; Samuel Rea, of Bryn Mawr, Pa. The latter takes 780 of 1000 shares of stock subscribed for. Mr. Baldwin, who is president of the Long Island Railroad, states that the scheme means the electrical extension of the road right into New York City.

THE L. WOLFF MANUFACTURING COMPANY, manufacturers of plumbers' supplies, recently contracted with the Northern Electrical Manufacturing Company, of Madison, Wis., through its Chicago office, for a complete equipment of generators and motors to be installed in their immense works located at Carroll Avenue and Roby Street, Chicago. Constant additions to their plant, coupled with the necessity of introducing modern methods. were the principal reasons for making the change at this time. The installation will consist of two 200-kw, 250-volt generators, direct connected to Allis-Corliss engines, operated at a speed of 110 r. p. m. The motors will be slow speed, a number of them being entirely enclosed, and arranged, as far as possible, for individual driving of machines throughout the plant, ranging in sizes of from 7½ to 80 horse-power each.

GERMAN DEPRESSION.—Special cables from Berlin, of June 16, say: The week began with the crash of the Dresden Credit Anstalt and the Kummer Electric Company, which owes 9,000,000 marks to the Dresden Credit Anstalt alone. Rumors are in circulation to the effect that a number of other electric concerns and the banks supporting them in Dresden, Berlin and Dantzic are in serious difficulties. The week was notable for rumors. They found sustenance in the highly unfavorable reports which came in from every kind of business, especially concerning Westphalian industrials and iron and machine firms and mining concerns. It generally was pointed out that many German electric works were neither founded soundly nor financiered soundly, and in consequence of these conditions fears are expressed that other concerns would encounter financial difficulties.

PLANT FOR BROOKLYN TROLLEYS.—President Jacob L. Greatsinger, of B. R. T., is quoted as follows: "The chief difficulty has been that we have not had enough power to move our rolling stock as it should be moved. For example, the recent fire in the Kent Avenue power house was due to the fact that our machinery was unable to stand the strain of traffic in the rush hours of the early morning. The dynamo had too much work to do and gave out. We have been studying the problem and are in a fair way to arrive at the solution. The system is also in need of more cars. We are now placing 150 new cars into service, 100 on the surface lines and 50 on the elevated roads." In the meantime, to help out, 24 of the old locomotives have been called in to carry part of the traffic.

RAILWAY CONTRACTS.—The Cleveland office of the Westinghouse Electric & Manufacturing Company has recently closed several good contracts, among them the following: Garrett-Cromwell Engineering Company, engineers for the plant of Crucible Steel Company, at Pittsburg, three 550-kw, 125 r. p. m., 250-volt direct-current engine type generators, to be direct connected to Allen-Porter engines; Cleveland City Railway Company, one 1500-kw, 75 r. p. m., 550-volt railway generator, to be direct connected to a 2250-hp cross-compound Allis-Corliss engine, and 11 quadruple equipments, No. 56, Westinghouse motors, to the Mahoning Valley Railway Company for use on the company's new extension to New Castle.

FRANKLIN ELECTRICAL MANUFACTURING COMPANY.—Note is made elsewhere in this issue of the death by accident of Mr. John Waring, president of this company. Mr. Jonathan Camp, the secretary and treasurer, in reply to inquiries, says: "While we can never hope to replace Mr. Waring as a friend and business associate, his death will in no way affect our enterprise, and the company will continue the manufacture in the regular way of its incandescent lamps. We have already made arrangements for doing the work formerly performed in the carbon house and laboratory, and are in a position to fill orders promptly." The fire at the factory was in reality of small extent, although so sadly fatal.

ELECTRIC PRINTING.—The Seattle *Intelligencer* celebrates with a special issue its new press equipment. The handsome new Hoe press is driven by a C. & C. Electric Company 50-hp, 6-pole, double-commutator, compound-wound, 250-volt motor directly geared to the main driving shaft of the press, the maximum motor speed being 400 r. p. m. The company's new system of series parallel control is used, affording the widest variations in speed. Current is taken through a fine marble switchboard from the mains of the Seattle Electric Company.

CONSOLIDATING FIXTURE INTERESTS.—A certificate of consolidation of the American Gas Fixture Company, of New York City, with the Oxley & Enos Manufacturing Company, of New York City, has been filed at Albany with the Secretary of State. The consolidated corporation will be known as the Oxley-Enos Company, and has a capital of $450,000. The directors are: W. F. Moody, Jr., of Cranford, N. J.; L. B. Franklin and C. F. Fuerstenburg, of Flatbush, and Thomas Plunkett and W. L. Scovil, of Brooklyn.

W. W. WHITEHEAD COMPANY, of Davenport, Iowa, report Corliss engine sales as follows: Deere & Mansur Company, of Moline, Ill., 22 by 42 by 48 tandem compound condensing; Chicago Brick Company, 24 by 48 condensing; Le Roy Mining Company, Rossland, B. C., 16 by 42; Northport Mining & Smelting Company, Northport, Wash., 16 by 36; Western Tube Company, Kewanee, Ill., 28 by 48; Parkersburg Iron & Steel Company, Pittsburg, Pa., 28 by 60, and the South Halsted Street Iron Works, Chicago, 18 by 42.

ALUMINUM FOR TELEPHONE WIRES.—The Sunset Telephone Company has started work on a new line from San Francisco to Fresno alongside of the Santa Fe Railroad track. The wire to be used will be the first of its kind put up in California for telephone work. It will be an aluminum cable of seven strands, or separate wires.

General News.

THE TELEPHONE.

ADAIRSVILLE, GA.—The Bell Telephone Company has decided to put in a long distance telephone at this point. The wire will be run ten miles from the main line, between Atlanta and Rome, to reach Adairsville.

ATLANTA, GA.—B. H. Veal is president of a new company which will soon complete a Bell telephone system in Austell, Ga., connecting with Atlanta. J. P. Woodson, of Atlanta, will construct the line at once.

CHICAGO, ILL.—A council committee will meet June 21 to listen to arguments by representatives of the Chicago Telephone Company concerning the question whether the telephone business is a natural monopoly. The question comes up over the proposed grant of the United Telephone & Telegraph Company, Chicago, Ill.

GREENCASTLE, IND.—Recent severe wind and electrical storms throughout this and adjoining counties greatly damaged and impaired the telephone service. The temporary suspension demonstrated to the many patrons the value and convenience of the service.

TERRA HAUTE, IND.—The linemen employed by the Central Union Telephone Company of this city have gone on a strike. The company conceded the wages asked, but refused to sign a contract with or recognize the Electrical Workers' Union, and then the men quit work.

INDIANAPOLIS, IND.—The Central Union Telephone Company has opened a supply station and established a plant in this city. Seventy men are employed. All the electrical appliances used by the company in the State will be distributed from the new station, and many of the appliances the company uses will be made here.

INDIANAPOLIS, IND.—Articles of incorporation have been filed by the Citizens Telephone Company of Brazil, capital stock $10,000, and the Farmers' Mutual Telephone Company of Elkhart, capital stock $5,000. The Home Telephone Company, of Columbia City filed additional papers increasing its capital stock from $10,000 to $25,000.

INDIANAPOLIS, IND.—The American Telephone & Telegraph Company is asking for franchises in a number of counties in the northeastern part of the State. C. M. Cole, of New York, is looking after the company's business in this State and had a conference with other representatives of the company in this city recently. The company, he said, is an Indiana corporation, but refused to divulge its plant. It is alleged that the company Mr. Cole represents is a part of the Bell Telephone Company, which has, it is said, filed articles of incorporation in other States as it has in Indiana; that it is the intention to build a line from Chicago to New York, and that it asks only the right to construct a line and one toll station in each county. It is understood that work on the line between Chicago and Pittsburg is to commence soon.

INDIANAPOLIS, IND.—The Secretary of State has been asked if telephone companies may be organized in Indiana on what is called the "Wisconsin Valley plan." This plan is strictly coöperative. Stock can be bought only by persons that rent telephones, and such persons can buy as many shares of stock as telephones rented by them, and no more. When a stockholder ceases to rent the company cancels his excess or entire stock and refunds to him its par value. The company binds itself to furnish stock to every renter of its service. It must also regulate its monthly charges so as to be able to pay a dividend of 1 per cent a month, to be credited to the monthly renter. As an illustration a rental of $2.25 a month for business houses and $1 for residences is charged, and a monthly dividend of 1½ per cent (75 cents) is credited on the rental account of each stockholder, hence he actually gets his business service for $1.50 and his dwelling service for 25 cents a month. There are no companies organized in Indiana on this plan, although there is no law forbidding such.

LOUISVILLE, KY.—The Home Telephone Company, of Louisville, Ky., a new independent company, has been granted a permit, and will begin work on a plant soon. It paid $10,000 for the franchise.

BOSTON, MASS.—The Erie Telephone Company's Lowell offices, have been moved to Boston and now occupy the ground floor in the Whittier building, 15 Exchange street. The president's and vice-president's office will remain for the present at 15 Congress street.

LANSING, MICH.—The Michigan Telephone Company is putting in a 200-line board at Mason.

DETROIT, MICH.—Articles of incorporation of the People's Telephone Company have been filed at Lansing. The capital stock is $2,500,000 and the stockholders are as follows: Henry A. Everett, Edward W. Moore, Arthur Pack, Joseph W. Martin, Theodore D. Buhl, Henry Stephens, Alex. McPherson, Charles L. Palms, George L. McPherson, John B. Corliss and J. C. Hutchins.

MAYSVILLE, MO.—The Dekalb County Mutual Telephone Company, of Maysville, with a capital stock of $5,000, has been incorporated by J. E. Roberts, Eugene De Hart, James B. Mays and others.

NEWARK, N. J.—Hudson & Middlesex Telephone & Telegraph Company, capital stock $15,000; formed to operate telephone lines, etc.; principal office, 164 Market Street, Newark.

BATAVIA, N. Y.—The construction of the Home Telephone line will be commenced in a few days. This company was incorporated a short time ago with a view of building a line to cover the entire village to be in operation by July 1. It has been granted a franchise by the village council.

SPRINGFIELD, OHIO.—The Springfield council has granted a franchise to the United States Telephone Company to build toll lines through this place.

MINERVA, OHIO.—The Minerva council has granted a franchise for a local toll station and exchange to the Stark County Telephone Company of Canton.

TROY, OHIO.—The Troy Telephone Company has increased its capital stock from $40,000 to $75,000 to provide for improvements. H. M. Allen is secretary of the company.

PIQUA, OHIO.—The Piqua Home Telephone Company has increased its capital stock from $75,000 to $100,000, to provide for improvements. D. Odell is manager of the company.

FOSTORIA, OHIO.—Manager A. R. Knabenshue, of the Central Union Telephone Company (Bell) states that the local exchange will be rebuilt and improved at an expense of $20,000.

CARDINGTON, OHIO.—The Morrow County Telephone Company has increased its capital stock from $12,000 to $30,000, to provide for improvements. M. L. Phillips is manager of the company.

COLLINWOOD, OHIO.—The Collinwood Home Telephone Company has increased its capital stock from $25,000 to $50,000 to provide for improvements. L. C. Ballinger is manager of the company.

SIDNEY, OHIO.—The Sidney Telephone Company has increased its capital stock from $40,000 to $60,000, to provide for improvements. W. H. Wagner is president and H. T. Mathias secretary of the company.

SPRINGFIELD, OHIO.—Farmers of Harmony township have organized the Home Telephone Company to build a farmer's exchange. C. A. Schneider, E. E. Hoge, and E. H. Campbell are the promoters. The capital stock is $10,000.

ASHLAND, OHIO.—The Star Telephone Company has commenced the work of rebuilding its exchange in this place. New apparatus will be installed throughout. A toll line is being built to Clearcreek township which will connect up about 50 farmers in that vicinity.

LIMA, OHIO.—The Lima Telephone & Telegraph Company has been incorporated with $150,000 capital stock, to operate telephone lines in Lima and throughout Allen County. Incorporators: W. L. Parmenter, Henry W. Neff, Kent W. Hughes, M. C. Purtscher, Joseph A. Dutton.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company, composed of local and Cleveland people, and the Springfield Citizens Telephone Company, composed wholly of local people, are having a hard fight for the franchise in this city. The matter will be decided in a few days.

XENIA, OHIO.—The Miami Telephone Company is rapidly completing its new exchange. The new switchboard has a capacity of 1000 and 700 subscribers have been secured. Country lines are being built to Cedarville, Jamestown, Spring Valley and surrounding villages. The rates will be $2 per month for business and $1 for residences.

CLEVELAND, OHIO.—In celebration of the completion of the connection made with the Pittsburg & Allegheny Telephone Company, giving through service from Cleveland to Pittsburg, the United States Telephone Company and the Cuyahoga Telephone Company gave free service to the public on June 10 and 11. Free service was given by the Pittsburg company on Cleveland connections on June 12 and 13.

TOLEDO, OHIO.—Despite the fact that it has not yet secured a franchise the Toledo Home Telephone Company, which is promoted by Frank Graves, and supposed to be backed by the Federal Telephone Company of Cleveland, is pushing matters with a view to commencing work as soon as possible. About 3000 subscribers have been secured and the company now agrees to give a rate of $24 per year for residence telephones. The company has leased two floors of the new Nasby building for an exchange.

PORTLAND, ORE.—The Western Union Telegraph Company recently strung a new wire from Portland, Oregon, to Vancouver, Wash. A new cable one mile in length will be laid at the crossing of the Columbia River.

MILLVILLE, PA.—The Enterprise Telephone & Telegraph Company, of Millville, having stations at Port Norris, Ocean City, Egg Harbor and Cape May, has sold its lines to the Interstate Telephone Company, of Philadelphia, which will connect the lines with Philadelphia and Pennsylvania towns.

BEAUMONT, TEX.—The Beaumont Telephone Company, of Beaumont, has been incorporated; capital stock, $60,000. Incorporators: Melville D. Shaw, Charles N. Haskell. James King Duffy, James E. Boynton, Charles H. Roser, Sheppard H. Van Wormer and William H. Aldridge, Texas.

MILWAUKEE, WIS.—The recently organized Citizens' Telephone Company is drafting a franchise to be introduced in the common council.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has been granted a franchise by the city of South Milwaukee to build a telephone system in that city. The system will be completed in about sixty days.

BELMONT, WIS.—The farmers' telephone line, incorporated under the name of the Belmont & Pleasant View Telephone Company, is about completed from Belmont to Pleasant View. The company will build the line to Darlington in a short time.

LA CROSSE, WIS.—The date of the semi-annual convention of the Wisconsin Independent Telephone Association has been set for June 26 and 27 at La Crosse. Plans will be made for a through telephone line between La Crosse and Milwaukee, and a movement to connect all independent lines between the two cities will be considered.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company is about to extend the private telephone system used on the railway system by adding several new stations and instruments. The telephone system is reported to be one of the most complete in use for railway purposes, and places the employes in direct communication with the general offices. The system is also used for interurban train dispatching.

ELECTRIC LIGHT AND POWER.

LIVERMORE, CALIF., is in darkness on account of a suit and attachment upon the plant of the Livermore Gas & Electric Light Company, levied by Wm. M. Mendenhall.

SAN FRANCISCO, CALIF.—The Nevada County Gas & Electric Company has been incorporated. San Francisco is named as the principal place of business. Directors: John Martin, F. H. Pierson, H. U. Roeding and W. M. Pierson. Capital stock, $100,000; subscribed, $500.

ALBANY, GA., will vote on a bond issue of $25,000 to erect a modern electric light plant. The city invested $25,000 in a second-hand plant several years ago, but this has not given entire satisfaction.

MASCOUTAH, ILL.—A special committee of the city council has been appointed to confer with the electric light company officials, with the view to the purchase of the company's plant.

CHICAGO, ILL.—Corporation Counsel Walker will be asked by the council to draw up a form of ordinance for small electric light companies who wish to get franchises in the downtown district. A number of block lighting companies are already supplying current to consumers in competition with the Chicago Edison Company.

FORTVILLE, IND.—J. K. Fautout, of Indianapolis, and Q. A. Wright, of this city, have secured a franchise for an electric light plant, the same to be in operation within ninety days.

FRANKFORT, KY.—Articles of incorporation have been filed by the Electric Light & Power Company, of Somerset, Ky., with $10,000 capital stock.

PARIS, MO.—The proposition to issue bonds for the purpose of building an electric lighting plant and water works was carried recently by the citizens of Paris.

ST. LOUIS, MO.—The board of education brought suit June 10 against the Imperial Electric Light, Heat & Power Company to compel it to put smoke consumers in its smoke stack and to raise a steam exhaust pipe so that the escaping steam will not blow against the wall of the plaintiff's building.

BATTLE CREEK, MICH.—The Northern Electrical Manufacturing Company of Madison, Wis., through its Chicago office, has secured the contract for the entire equipment of the new central station being built by the Citizens Electric Light Company of Battle Creek, Michigan. The installation will consist of one 275 and one 135-kw, two-phase Stanley inductor alternator, together with station and sub-station switchboards, step-up transformers, etc. The larger unit will be belted to a water wheel of about 250-hp, and the smaller one will be driven by a Buckeye engine. On account of the limited and uncertain water power available, it will be necessary to operate these generators in parallel, the smaller unit taking its load automatically in proportion to the power of the water wheel. This would mean that the water driven unit will at all times carry the bulk of the load; the engine driven unit only being called upon when the power of the water wheel falls below normal. These conditions have, however, been met and satisfactory results accomplished in many plants equipped with Stanley apparatus.

MT. AIRY, N. C.—A vote will be taken here on June 24 on the question of issuing bonds for waterworks and electric lights.

GREENSBORO, N. C.—The Greensboro Electric Company has filed articles of incorporation with the secretary of state; the authorized capital is $250,000. This company has the contract to light the city, and also holds a franchise for constructing an electric railway. John Karr and others are interested.

CONCORD, N. H.—The Concord Electric Company, formed to take over the property and business of the Concord Land & Water Power Company, has filed articles of agreement. The capital stock of the company is $400,000, and the incorporators are W. H. Whitney, Chas. H. Stone, of Boston; Fred C. Demond, Allen Hollis and Geo. L. Osgood, of Concord. The work of organizing the new company will now be proceeded with.

CAPE MAY, N. J.—The Cape May Electric Company has been incorporated. Capital, $100,000. Incorporators: Thomas Robb, Logan M. Bullitt and James M. E. Hildreth, Albany.

TRENTON, N. J.—The United Electric Power Company, capital $250,000, has been incorporated, to manufacture electricity. The incorporators are J. Dobson Good, J. H. Everett and K. K. McLaren, Jersey City.

TRENTON, N. J.—The Tuckerton Electric Company, of Haddonfield, N. J., has been incorporated; capital, $10,000. Incorporators: Ezra C. Bell, John H. Bell, Edwin R. Bell, M. W. Pharo, T. F. Pharo, J. W. Pharo, A. E. Pharo.

BUFFALO, N. Y.—The Depew & Lancaster Light, Power & Conduit Company has increased its capital from $20,000 to $75,000.

ROCHESTER, N. Y.—The Citizens' Light & Power Company is erecting a new generating plant in this city, of 10,000-hp capacity. The eight water-tube boilers will be equipped with automatic stokers. The engine room will contain five 1800-hp, vertical, cross-compound engines, made by the Southwark Foundry and Machine Company. These engines will be directly connected to sixty cycle, two-phase alternators, of about 1400-kw capacity each. There will be also one horizontal, cross-compound engine of 750-hp, made by the Dixon Manufacturing Company, of Scranton, Pa. This engine will be directly connected to a 500-kw, 60-cycle, Stanley induction alternator. The generators will have a uniform voltage of 2200.

NILES, OHIO.—The city council has decided to sell its lighting plant at public sale and has determined on a levy of 11.5 mills for next year's funds.

WELLSVILLE, OHIO.—The Wellsville Electric Light Company has increased its capital stock from $30,000 to $100,000 to provide for improvements.

DELAWARE, OHIO.—The Stratford Paper Mill property has been bought by the Columbus, Delaware & Northern Electric Railway Company for $2700. The new power house, to cost $90,000, will be located there.

TOLEDO, OHIO.—At the time of the organization of the Toledo Heating & Lighting Company, two years ago, those who took $50,000 or more of the bonds of the company at par were given the same amount gratis. For a long time the stock was considered of little value. Of late the record of the organization has been remarkable, and within a few days 80 has been bid and refused for a block of stock. Several months ago a block of $20,000 worth sold at 70.

ELYRIA, OHIO.—The Elyria Gas & Electric Light Company has secured an option on the Lorain Gas Company's plant at Lorain, and it is the intention to build large electrical plants at both Elyria and Lorain to supply both places as well as neighboring villages. Alternating current apparatus will be installed and the plants will be connected so that either one or both can be operated to carry the load of both towns.

MONTREAL, QUEBEC. At a recent meeting of the city council, a long petition was read from the Shawinigan Water & Power Company, setting forth that the company was ready to expend large sums of money in the development of electrical power; that a transmission line was shortly to be constructed from Shawinigan Falls into the city of Montreal, and that the company was anxious to get an entrance into the city. In order to distribute power and light in Montreal, it was necessary that the petitioners have the right to enter the city with their pole lines and wires.

QUEBEC, QUE.—Letters patent have been granted a new electric company in the Province of Quebec. The purpose of the company is to develop water powers and to manufacture and supply electricity for the purposes of light, heat and power; and moreover, to be vested with all the powers conferred upon the Canadian Electric Light Company, viz.: the power to furnish electric light, motive power and heat and other advantages to be derived from electricity, to the cities, towns and municipalities in Quebec Province, lying west of, and including, the city of Three Rivers. The new company will operate under the name of "The Provincial Light, Heat & Power Company, with a capital stock of $500,000.

CULPEPER, VA.—The city council has voted a ten-year franchise to J. M Spotts, of Staunton, Va., to erect and operate a plant to furnish electric lights to the city and citizens. Mr. Spotts has an option on the franchise until Aug. 30 next.

RICHMOND, VA.—The Richmond Industrial Development Company, capital $50,000, is a projected enterprise, which will erect a manufacturing building to be leased to small manufacturers. The building will be furnished with light and power. John L. Williams & Sons, Joseph Bryant, and others are interested.

MILWAUKEE, WIS.—The fire department has petitioned the common council to have search lights added to its equipment.

RIPON, WIS.—It is reported that an option on the Ripon Light and Water plant has been secured from the stockholders, and that the city is likely to become the owner of the plant and manage the same on public account.

MILWAUKEE, WIS.—The Julius Andrae & Sons Company has been awarded the contract for the electric lighting and power plant for Kroeger Brothers' new department store. The equipment will include one 75-kw and one 40-kw direct-connected units, complete switchboard, iron pipe conduit system and wiring to 1000 incandescent and 70 enclosed arc lamps, three 15-hp motors and one 10-hp motor. The plant will be modern in every detail.

THE ELECTRIC RAILWAY.

BALTIMORE, MD. The directors of the Washington & Annapolis Electric Railway have effected a permanent organization. W. H. Lamprecht was elected president, Otto Miller secretary and treasurer and James Christy vice-president. The directors are: W. H. Lamprecht, Otto Miller, Frank N. Wilcox, F. T. Pomeroy and E. W. Moore, of Cleveland; James Christy, Jr., of Akron, Ohio, and Wm. L. Marbury, of Baltimore. The line from this city to Washington will be a little more than 30 miles long.

BOSTON, MASS.—On the application of the International Trust Company of Boston, H. B. Rice, of Houston, Tex., was appointed receiver of the property of the Houston Electric Street Railway Company, which company owns the entire street railway system in the city of Houston. The proceeding is one to foreclose the consolidated 5 per cent mortgage of the railway company because of its default in the payment of the interest on its bonds and the general insolvency of the company.

DETROIT, MICH.—The sale of the Detroit and Pontiac suburban trolley line to the Detroit United Railroad was consummated on June 1. From now on the road will be run as part of the United Railroad system. The purchase is said to be another step toward a consolidation of all the suburban trolley lines with the Detroit United Railroad Company.

ALBANY, N. Y.—The New York & Port Chester Railroad Company, with a nominal capital of $250,000, has been incorporated to construct and operate a trolley line from Willis Avenue Bridge to Port Chester.

PENN YAN, N. Y.—A company was organized at Keuka for the purpose of constructing an electric road from Dundee to Bradford, a distance of sixteen miles. The necessary $16,000 for incorporation was secured and the company was organized by the election of Hon. George P. Lord, of Dundee, president, Hiram Munson, of Bradford, vice-president; R. S. Harpending, of Dundee, treasurer, and E. M. Sawyer, of Dundee, secretary.

NORTH BALTIMORE, OHIO. The council has granted a franchise through this place to the Findlay Street Railway Company.

FREMONT, OHIO. The Kerlin Bros. Company, who are building a line from Fremont to Port Clinton are advertising for large forces of men, and announce that construction work will start at this end at once. Much grading has already been done at Port Clinton.

FINDLAY, OHIO.—The stockholders of the recently incorporated Findlay-Marion Electric Railway Company have organized as follows: Directors, W. E

Schofield, Marion; Asa W. Jones, Youngstown; M. A. Smalley, of Toledo; Allen Smalley, of Upper Sandusky; P. B. Morrison, David Joy and Jason Blackford, Findlay; J. H. Ruhlman, of Youngstown; President, W. E. Scofield: Vice-President, Asa Jones; Secretary, Jason Blackford; Treasurer, P. B. Morrison.

NORWALK, OHIO.—W. T. Forsyth, engineer for the Sandusky, Bellevue, Monroeville & Norwalk Railway Company, states that the company has secured additional backing, and the road will be pushed to completion. Much work was done on the line last year; the power house being practically completed, but thus far this year nothing has been done. The line is being built by the Indestructible Roadbed Company, and it is said to be backed by Philadelphia capitalists..

CELEVLAND, OHIO.—At Detroit week before last Messrs. H. A. Everett and E. W. Moore instituted the first street car dining service ever operated in this country—so they claim. The gentlemen were making an inspection of the Rapid Railway from Detroit to Port Huron, and it was found it would be impossible to make the return trip in time for luncheon. The difficulty was overcome by engaging a chef from a hotel, who with the aid of a large oil stove and a goodly supply of food, served a bountiful repast while the car was en route.

EASTON, PA.—It is rumored here that the Union Traction Company, which operates all the trolley lines in Philadelphia, has absorbed the Lebigh Valley Traction Company, which controls and operates the Easton Transit Company's and other trolley roads in this locality.

MONTREAL, QUE.—Montreal capitalists, who control the Gatineau and Pontiac railways and the new inter-provincial bridge connecting the cities of Ottawa and Hull, are negotiating for the purchase of the Hull and Aylmer Electric Railway, which will enter Ottawa over the new bridge when the Montreal people get control. It is said that the price asked for the electric road is $1,000,000.

BALLSTON, SPA.—The stockholders of the Ballston Terminal Electric Railroad voted to increase the capital stock from $300,000 to $1,500,000, and to increase the bond issue from $200,000 to $1,200,000. The road will be extended from this village to Amsterdam, a distance of twenty miles.

RICHMOND, VA.—The Hampton Roads Railway and Electric Company, holding a franchise to construct its roads in Newport News, Va., and to extend to Old Point, has, it is understood, purchased $40,000 worth of electrical machinery for the new power house, now nearing completion.

SHEBOYGAN, WIS.—A new rail joint has been patented by J. Trilling and M. Wensauer. An offer has been refused for the purchase of the patent.

FOND DU LAC, WIS.—The Fond du Lac Street Railway Company will install a private dispatching telephone system in connection with its railway.

KAUKAUNA, WIS.—The common council has granted a franchise to the Wisconsin Traction, Light, Heat & Power Company for an electric road in the city.

RACINE, WIS.—The Milwaukee Electric Railway and Light Company has asked the Common Council for franchises to built its railway on several streets.

WAUSAU, WIS.—The Wisconsin Valley Electric Railway Company is making arrangements to build a interurban electric railway between this city and Merrill.

KENOSHA, WIS.—P. J. Haynes and G. L. Claussen, of Chicago, are seeking a franchise to build an inter-urban electric railway from this city to Lake Geneva, a distance of about eighteen miles.

MILWAUKEE, WIS.—The Sauk County Traction and Power Company has been incorporated by T. Hamilton, H. Green and T. C. Carter. The company is empowered to maintain and construct telephone and telegraph lines, and also to deal in electric light, heat and power.

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL ELECTRIC SYNDICATE, of New York City, has been incorporated at Dovel, Del., with a capital of $500,000.

THE EWART RAILWAY SUPPLY COMPANY, capital $24,000, to manufacture electrical supplies, has been incorporated under the New Jersey laws.

THE AUTOMATIC BOOT BLACKING MACHINE COMPANY, of New York City, has been incorporated, to manufacture machines to polish shoes by electricity; capital stock, $2,000.

THE WHEELER-GREEN ELECTRIC COMPANY, of Rochester, N. Y., has been incorporated; capital, $4,000. Directors: W. J. Dadee, Clarence Wheeler and T. H. Green, of Rochester.

THE SCIENTIFIC & ELECTRICAL EXCHANGE, of New York City, has been incorporated; capital, $25,000. Directors: W. F. Thompson, of New York City; A. E. Hartcorn, of Brooklyn; F. S. Cutler and W. D. W. Miller of Plainfield, N. J.

THE AUTOMOBILE.

AUTOMOBILE RACES.—The Automobile Club of New England held its first annual races at Clyde Park, on June 16. There were eight races and in every event a contesting machine broke down and in most cases the winners went over the track alone after the first lap. The race of the day was the last one, which was between the three winners making the fastest time in the previous races. This brought together K. A. Skinner, on a gasoline tricycle; J. T. Robinson, Jr., on a gasoline machine, and A. L. Riker, on an electrical racer. The five miles were covered in 8:47 4-5, Riker winning by a small margin. The first race, open for electric pleasure vehicles, two and one-half miles, was won by A. L. Riker, of New Jersey, in 9.17 3-5. There were two entries in the second race, which was for electric machines, Riker winning easily. The distance was five miles, which was covered in 9:07 2-5. The third race, five miles, open to two-passenger steam rigs, was won by J. E. Griffin in 12:41. The fourth race, five miles, open to four-passenger steam rigs, was won by H. McLaughlin in 16:09. The fifth race, for club members only, on gasoline pleasure vehicles, was won by T. J. Robinson, Jr. His time was 12:31 2-5. The sixth race, open to steam racers, was won by T. E. Griffin. His time was 11:42 2-5. The seventh race, open to motor tricycles, was won by K A. Skinner in 8:30 4-5.

OBITUARY.

MR. JOHN WARING. It is with deep regret that we note the death of Mr. John Waring, from accident, at Hartford, Conn. He was president of the Franklin Electric Manufacturing Company, well known as manufacturers of incandescent lamps, and an explosion of gasolene occurred on June 14 in their laboratory, a small building detached from the main factory. Although his own clothes were on fire, he went back bravely to rescue two of the girls in the experiment room, and in doing so, apparently inhaled the flames. He was taken to the Hartford Hospital, and hopes were entertained of his recovery, as his burns were not serious, but he sank rapidly and died on Sunday afternoon. Mr. Waring was only 39 years of age, and a graduate of Cornell University. About ten years ago he went to Hartford, and while there brought out the Waring vapor incandescent lamp, once well known in the field of lighting litigation. He was afterwards connected with the Mather Electric Company, and later with the Perkins Electric Switch Company. About a year ago the Franklin Electric Company was formed, in which he was president, with C. I. Hills as vice-president and Jonathan Camp as secretary and treasurer, and he was busily engaged in the development of the concern's product and business, bringing to bear the inventive ability that always marked his work. Mr. Waring had been a member of the American Institute of Electrical Engineers since 1890, and was greatly esteemed, although of reticent disposition. In speaking of his death one of the Hartford papers says: "His humanity and bravery were shown at the fire. It is certain that he would not have lost his life but for his brave and knightly act." Mr. Waring leaves a mother and sister. We present herewith the last portrait of him in our possession.

LEGAL.

TELEPHONE PATENTS.—As we go to press, we are informed that a decision was rendered June 7 in favor of the Western Electric Company, in the United States Circuit Court of the Eastern District of Missouri, on Patent No. 438,788, and that in the same court a decision was rendered upholding the Seely patent on the employment of answering springjacks in multiple switchboards. Both of these suits were brought by the Western Electric Company against the Kinloch Telephone Company of St. Louis. The apparatus found to infringe patent No. 438,788 is the carbon plate protector, manufactured by the Sterling Electric Company. The apparatus found to infringe the Seely answering jack patent is the multiple switchboard built by the Kellogg Switchboard & Supply Company, of Chicago.

BELT CONVEYOR PATENTS SUSTAINED.—On Oct. 15, 1900, the suit of Robins Conveying Belt Company, of New York, against the Exeter Machine Works was argued before Judge Wheeler, of the United States Circuit Court for the Southern District of New York. The Robins Conveying Belt Company maintained that the Exeter Machine Works had infringed letters patent Nos. 499,472, dated June 13, 1893, and 571,604, dated Nov. 17, 1896, both of which are the property of the Robins Conveying Belt Company. On November 15, 1900, Judge Wheeler issued an interlocutory decree establishing the validity of the patents in question, and granted an injunction against the Exeter Machine Works. An accounting was ordered before Special Master John M. Shields, whose report, dated March 6, 1901, awarded damages to the Robins Conveying Belt Company.

JERSEY TROLLEY TAXES.—The Supreme Court of New Jersey has decided the case of the Mayor and Aldermen of Newark against the North Jersey Street Railway Company, holding that street railway franchises in New Jersey are taxable as real estate, thus adding to the State revenues several millions annually. This is considered an important opinion, as it will affect every city, township, and borough throughout which a trolley road passes. It is thought it will prevent the building of some small trolley roads for which franchises have already been granted. In the opinion the court holds that as between Newark and the company the latter has acquired the right to lay in the soil the foundation for its rails, to lay rails thereon, and the right to the continuous uninterrupted occupancy of such part of the public estate. Its poles and tracks are there permanently to the exclusion of any others who might desire to use the land, and during the life of the franchise the city is without power to remove them. The part of the street used by the company must be of the same character as the whole. Therefore, the estate being valuable to the city, is taxable the same as the balance of property. Lawyers say that the decision is sweeping in its scope. For instance, one lawyer said that under the form of contract now used by the Lighting Trust, by which for the life of its contract the contracting municipality is barred from allowing any company to string wires or lay gas mains, every pipe and conduit is taxable as real property. It was also said that private meter companies would have to be taxed for their pipes, hydrants, etc.

PERSONAL.

DR. FREDERICK BEDELL, of Cornell University, will spend the coming year in Europe.

MR. W. S. BARSTOW, general manager of the Brooklyn Edison Company, has resigned from that position, his resignation taking effect immediately.

PROF. MORGAN BROOKS has resigned from the chair of Electrical Engineering at the University of Nebraska to accept a similar appointment at the University of Illinois.

MR. A. A. KIND, Jacksonville, Fla., has become associated with George C. Pease & Company, in connection with steam and electrical installations of all kinds. In addition to recent installations of Harrisburg engines, etc., they have been engaged on a complete overhauling of the plant of the Aragon Hotel at Jacksonville.

HUTCHISON-POMEROY.—The marriage took place on May 31 of Miss Martha Pomeroy, daughter of Mrs. John W. Pomeroy, to Mr. Miller Reese Hutchison, in this city. Mr. Hutchison has of late become widely known in connection with telephonic work, and with efforts for enabling the deaf to hear even faint sounds.

CAPT. SAMUEL REBER of the Signal Corps has been appointed Military Secretary to Lieut. Gen. Miles, with the rank of Lieutenant-Colonel, to succeed the late Lieut. Col. Francis Michler.

GENERAL A. W. GREELY, Chief of the Signal Service, U. S. A., left San Francisco on the last trip of the Transport Sheridan. He is bound for Manila and will inspect the telegraph lines and the extensive submarine cable system which have been constructed in the Philippine Islands.

MR. F. B. H. PAINE, a prominent official of the Westinghouse Electric Company, has been in Ottawa on business with Messrs. Ahearn & Soper, the Canadian agents of the company. Mr. Paine inspected the electrical development of the city and expressed himself as highly pleased with it.

MR. WALTER SCOTT STROWGER, of Rochester, N. Y., the inventor of the automatic telephone switch which gave rise to the automatic telephone exchange now in use in several localities, has, it is stated, just invented an electrical storage battery that he says beats anything of the kind. He also has invented, to go with this battery, a substance to take the place of the India rubber casing, which is superior to rubber for the purpose, and is 90 per cent cheaper and more desirable.

MR. JOHN E. WARD, vice-president of the Gold Car Heating Company has just returned to New York from a Western trip, on which he secured a large order for the Chicago Elevated for electric heaters. He is greatly pleased over a recent decision by the Court of King's Bench on appeal, holding that the Gold straight post coupler does not in any way infringe the coupler covered by the Sewall Canadian patent No. 26,601. Mr. Ward was himself a witness in this case in Canada, where the Gold people have built up a very large business, now free from interruption.

JUDGE J. M. THOMAS.—The report has been circulated in Cleveland that Judge J. M. Thomas, general manager of the United States Telephone Company has handed in his resignation to accept the position of president of the Telephone, Telegraph & Cable Company of New York, and that he will be succeeded by Mr. Maxime Reber, at present consulting engineer of the properties of the Federal Telephone Company. It is stated authoritatively that Judge Thomas has not yet accepted the proposition from the New York company, and it is probable that the matter will not be decided upon for several weeks.

MR. C. T. YERKES.—An incident in the early Chicago career of Charles T. Yerkes, who has recently acquired the London roads, says the New York *Times*, serves to illustrate one phase of his character. There was in existence some time after Mr. Yerkes's arrival in Chicago a newspaper which derived its revenue largely through not printing articles. Such articles were prepared about public men, and were couched in such terms that the men to whom they were submitted by the publisher of the paper or his confidential agent in many instances bought the "copy" for round sums. A story of this type was written about Mr. Yerkes, and the publishers' agent called on the prospective victim, handed him the article, and asked if it should be printed. Mr. Yerkes replied: "Print it." Two days later the publisher called in person and attempted to reopen negotiations, pointing out that the article was worth several thousand dollars to him, and winding up by asking Mr. Yerkes: "What would you do about it?" Mr. Yerkes opened a drawer in his desk, began toying with a pearl-handled revolver, and replied: "Print it! By all means print it; but first find some one to run your paper the day after it appears."

EDUCATIONAL.

ELECTRICAL LABORATORY IN ATLANTA.—Work has been started in Atlanta, Ga., on a new electrical laboratory at the Technological School, which will cost $17,000. The structure will be three stories high, 93x83 feet and will be constructed of brick and slate.

THE MICHIGAN COLLEGE OF MINES is at present planning for the erection of two much needed buildings, which have been provided by the Legislature of the State. One of these is to be for the department of civil and mining engineering, and the other for the department of chemistry and metallurgy. The mining engineering building will provide mining and hydraulic laboratories together with lecture and class rooms, all equipped with modern appliances. The amount allowed for its construction and equipment is $42,500. The building devoted to chemistry and metallurgy with its equipment will cost $35,000. Its laboratories will be fitted up in accordance with modern ideas of lighting, plumbing and ventilation. The appropriation provides also for an addition to the present engineering building which will accommodate the course in blacksmithing. The equipment of the electrical laboratory will be extended and the central heating plant enlarged, to take care of the added buildings. The college is closing one of its most prosperous years, with an enrollment exceeding that of any former year.

Trade Notes.

CHANGE OF NAME. The Graham Brothers Mfg. Company, Chicago, Ill., has changed its title to National Gas & Electric Company.

RED BOOK.—The Peru Electric Manufacturing Company, Peru, Ind., is getting out a new issue of its catalogue, which it calls the "Red Book."

THE ELECTRIC APPLIANCE COMPANY, Chicago, is putting out a new dry battery under its well known name "Eaco," which it especially recommends for telephone work, and where heavy service is required.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out a most complete catalogue of telephone and annunciator systems for hotels, factories, apartment buildings, etc. Copies will be sent upon application.

ALASKA CABLE.—The new Government telegraph cable, from Skagway to Juneau, Alaska, will be laid by W. R. Brixey. Some of the members of the cable laying expedition are expected to arrive in San Francisco in the near future.

THE EMERSON ELECTRIC MFG. COMPANY reports an unusual demand for alternating current desk and ceiling fans. The Emerson Company is now making 23 distinct types of desk, ceiling and exhaust fans for use on alternating current circuits.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has recently installed several Cross oil filters in the New York City public school buildings. Their field is unlimited, and they show a saving wherever oil is used for lubrication.

HYLO LAMPS are carried in stock by the Central Electric Company, of Chicago. This is a double filament regulating lamp, which is being advertised extensively. Besides being economical, it is found very convenient as an all-night light in halls, bath rooms, sick rooms, etc.

TURBINES.—The Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, has recently made a shipment of nine carloads of water wheels to the Remington-Martin Company for a paper mill at Norfolk, N. Y. The total power to be developed is 4375-hp when working under a head of 42 feet of water.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has moved its general offices and the engineering department to its new quarters at Pittsfield, the new works. Several of the other departments are also installed in the new buildings and by the end of June the new works will probably be completely occupied.

"THE ELECTRIC AUTOMOBILE A SYMBOL OF PROGRESS." The June issue of *The World's Work* contained an article under the above title, by Herbert Sherman Houston. This interesting article has been reprinted under the regular cover of *The World's Work*, by the Electric Vehicle Company, and makes an excellent addition to automobile literature.

THE NEW BRITAIN MACHINE COMPANY, New Britain, Conn., has issued a catalogue illustrating and describing a large line of machine shop furniture in iron and steel. This line embraces fifteen different styles of tool racks in two sizes, four sizes of lathe pans and shop shelving, and a new type of lathe rack and oil feeder.

TRAVELLING LINK GRATES.—The Green Engineering Company, Western Union Building, Chicago, Ill., in its Catalogue "B" illustrates and describes the Green travelling link grates. Views of several boiler plants equipped with these grates are shown. All managers of steam plants will be interested to investigate the merits of this system of stoking.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has issued a new wire price list dated June 17, in which is listed I. X. L. weatherproof wire, galvanized telephone wire, annunciator, office and magnet wires and lamp cord. This company will be glad to receive inquiries from those interested in this material and will be pleased to send copy of price list upon request.

COLUMBIA GASOLINE RUNABOUTS are the subject of a tasteful and useful pamphlet in oblong pocket form just issued by the Electric Vehicle Company. It not only gives an abundance of descriptive material but has three admirable sheets of lettered drawings at the end. The company is able to show some excellent reports on the operation of these mark eights.

THE CROCKER-WHEELER COMPANY, at Ampere, N. J., reports that the strike of its machinists has petered out completely. The company offered good terms, took a firm stand and then found an abundance of outside help Toward the end of last week many of the old hands sought to secure their former jobs. The company is now shipping its motor products as usual. Dr. Wheeler anticipates no further trouble.

THE HARTFORD ELECTRICAL SUPPLY COMPANY has just secured a $35,000 contract for underground cable work, including service and conductor wires, for the Hartford Electric Light Company. This company has not been long in business, but has taken some of the largest contracts in Connecticut and the adjoining territory for electrical equipment. The officers are: C. C. Cook, president; F. W. Bartlett, secretary, and F. E. Bartlett, treasurer.

KILFYRE.—The Monarch Fire Appliance Company, 27 William Street, New York, in an 8-page pamphlet gives a number of illustrations showing the application of "Kilfyre in the extinguishment of fires. This fire extinguisher consists of a dry powder put up in a metallic tube. A sudden jerk on the tube when hung up releases the cover, which remains hanging on the hook, thus leaving the tube open at the upper end and its contents free for instant use.

A COURSE IN DRAWING, designed especially to meet the requirements of teachers, has been prepared by the International Correspondence Schools, Scranton, Pa. Drawing is of considerable importance to teachers, a number of States requiring applicants for teachers' certificates to pass an examination in it, and it is probable that other States will do likewise. The schools' drawing course will qualify teachers not only to pass such examinations, but to fill positions successfully as instructors in drawing.

THE UNITED STATES CARBON COMPANY.—Mr. W. D. Sayle, receiver for the United States Carbon Company, of Cleveland, states that in the near future the company will undoubtedly be taken out of the hands of the receiver and will be reorganized by prominent Cleveland business men. He states that the plant is equipped to economically turn out 150,000 carbons per day, and that the business on hand indicates that the continuation of operations on present lines would yield a large profit.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., has recently taken the exclusive territorial agency for the Browning spherical steel-clad motors and dynamos. These machines are made in sizes of from 1-5 to 3½-hp and ⅛ to 2½-kw. The motors were designed to be used where a high grade, strong and compact machine was necessary, and are especially adapted for all small power work, for manufacturers, jewelers, hotels, clubs and restaurants, or for small private lighting plants. Catalogues are to be had on application.

CHAS. H. BESLY & COMPANY, 10 North Canal Street, Chicago, announce the recent shipments of complete shop equipments to points in Illinois, Indiana, Ohio, Wisconsin and Minnesota. They have just received an order from the Rock Island arsenal for several hundred vises, cutters, reamers and other small tools. Their factory at Beloit, Wis., is being worked overtime in order to fill orders for their general line of products. The firm states that it is selling more Gardner grinders now than ever before. A 300-page illustrated catalogue can be had on application.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently gotten out two attractive bulletins covering fan motors and ceiling fans for direct and alternating currents. It is offering for direct current the now well-known peerless ceiling and desk fans. The 1901 model of these fans embodies a large number of improvements both in inside construction and artistic outside designs. For alternating current it is offering the well-known Emerson desk and ceiling fans. Special attention is called to the Parker noiseless blades, with which all these fans are equipped.

PULVERIZED FUEL.—A handsome pamphlet issued by the Engineering & Powdered Fuel Company, Land Title Building, Philadelphia, Pa., is devoted to the subject of pulverized fuel and its uses. In this system the fuel is finely powdered and fed into the furnace along with the air required for combustion, through a special form of burner attached to a special type of door built to replace regular firing doors. A sheet accompanying the pamphlet gives tabulations of some tests made on pulverized fuel, the results of which show a considerable economy over usual methods of furnace firing.

THE FALCON FAN MOTOR for direct current is one of the leading fan motors on the market. It is made in three sizes, 12-inch, 15-inch and 18-inch, finished in black enamel with polished brass fan and guard. In operation this fan is perfectly noiseless and is provided with universal joint, which makes it adjustable to either wall or desk use. The Central Electric Company, of Chicago, are agents for this fan motor, and will be pleased to send to anyone upon request their 1901 fan motor catalogue describing the Falcon, as well as numerous other fans, which include direct and alternating current desk and bracket and ceiling fans, also battery fan motors.

PRIVATE BRANCH EXCHANGE TELEPHONE SERVICE.—The New York Telephone Company has issued an artistic brochure on the subject "Branch Exchange Telephone Service," in which is given a description of the use of this service, together with many illustrations. The popularity of this service is evidenced by the fact that there are at present over 1200 private branch exchanges in New York, the equipment ranging from 2 to 22 lines, and from 2 to 180 stations. Users of such service embrace almost every line of business, including publishers, newspapers, hotels and apartment houses, over 100 hotels and apartment houses being equipped with private branch exchanges.

REDUCING FUEL COST.—The opportunity for reduction in fuel cost in a small boiler plant is well illustrated by a statement made by the Eagle Machine Works, of Memphis, Tenn., in a recent letter to the B. F. Sturtevant Company, of Boston, manufacturers of the forced draft fan outfit, to the effect that "the boiler is estimated at 85-hp and hard worked. The blower is driven from a line shaft and the main air pipe is connected to the ash-pit to act on the forced draft principle. Soft coal is used. The saving according to the statement of the owners is $3.00 a day, and is caused by the difference in the price of coal. Formerly they used coal at $2.85, now they use coal at $2.25 per ton. The amount of coal used is the same. Formerly they were often short of steam, now they have plenty of it."

MR. W. G. CLARK, of Seattle, Wash., was a visitor to New York last week. Mr. Clark is manager of the Kilbourne & Clark Company, composed of C. A. Kilbourne and W. G. Clark, both of whom have had extensive experience in electrical work as contractors, construction agents, representatives and selling agents. The corporation is, however, a new one and already represents in its section manufacturers of gas and electric fixtures, electric lighting, street rail way and telephone supplies as well as generators, power motors, wires, cables, etc. There is seemingly a large opportunity for sales in the section of which Seattle is naturally the centre and the company could represent one or two manufacturers of specialties not already handled by it, who may be desirous of securing live representatives in that territory.

STERLING ELECTRIC COMPANY, of Lafayette, Ind., show phenomenal growth in output. Its factory was removed from Chicago December, 1899, occupying a building comprising 50,000 square feet of floor space. The growth was such that in January it purchased an additional building of like size, giving it something over 100,000 square feet of floor space. It is constantly equipping it with new machinery to facilitate the handling of its constantly increasing business. Its work has so grown into the multiple switchboards, and full common battery systems, that it has increased its capital stock to $150,000 to enable it to handle this additional new work. It is recognized as standard throughout the independent field, and its switchboards, protective devices, terminals and telephones have a wide reputation.

NEW TELEPHONE FUSE.—The American Electric Fuse Company, of New York, has just perfected a new telephone fuse. This fuse resembles in appearance the old style of fuse, manufactured by this company, but the fuse wire is enclosed between two pieces of mica, thus preventing any possibility of breakage. The fuse wire is left loose in the middle of the fuse, so that it fuses completely. The fuses are furnished in any amperage desired for telephone work, either in Western Union or Postal style. The company has made a large number of tests in order to secure the perfection of this device and announce that samples of these fuses are now ready for the market. They are moisture proof, indestructible, and will last a lifetime, unless burned out. The fuse will fit any standard block on the market, and can be furnished in any special shape or design required.

EXPOSITION INFORMATION BUREAU.—In view of the large number of students who will visit the Pan-American Exposition, the International Correspondence Schools, Scranton, Pa., have established an information bureau at their Buffalo office. Arrangements have been made to secure accommodations both in the hotels and private families during the Exposition. The Schools state that no rooms can be secured at less than $1.00 per night for each person, and that persons wishing rooms held for them must forward remittance to pay for the time the rooms are wanted. The information bureau is conducted free of charge. All correspondence intended for the information bureau should be addressed to the International Correspondence Schools, Ellicott Square Building, Buffalo, N. Y. Students and others visiting the Exposition are invited to call at the Buffalo office.

ROTH BROTHERS & COMPANY.—It is not often that Roth Brothers & Company, of Chicago, builders of dynamos and motors, blow their own horn. Yet they wish to announce that in the past month they have doubled their floor space, added much new machinery and increased their working force, which was absolutely necessary to keep up with the demand they are having for their motors and dynamos. This company also makes a specialty of battery charging motor dynamos and power ringers for telephone exchange service. These machines can be found in many of the principal telephone exchanges throughout the United States, are also on exhibition at the Pan-American. Under construction at their shops at the present time are telephone power machines for Milwaukee, Wis.; Clinton, Iowa; Oskaloosa, Iowa; Owensboro, Ky., and others for telephone manufacturers, destination not known.

THE BLOWER SYSTEM OF VENTILATION AND HEATING.—The particular features of this combined system of ventilation and heating in which a fan is employed to distribute the heated air are thus summarized in a recent lecture lecture by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Company, Boston, Mass.: "The entire heating surface is centrally located, enclosed in a fireproof casing, and placed under the control of a single individual, thereby avoiding the possibility of damage by leakage or freezing incident to a scattered system of steam piping and radiators. The heater itself is adapted for the use of either live or exhaust steam, and provision is made for utilizing the exhaust of the fan engine, thereby reducing the cost of operation to practically nothing. At all times ample and positive ventilation may be provided with air tempered to the desired degree. Absolute control may be had over the quality and quantity of air supplied. It may be filtered and cleansed, heated or cooled, dried or moistened at will. By means of the hot and cold system, the temperature of the air admitted to any given apartment may be instantly and radically changed without the employment of supplementary heating surface."

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JUNE 11, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

675,878. ELECTROGRAPH; M. Beck, Minneapolis, Minn. App. filed Aug. 8, 1899. Apparatus for transmitting pictures in which the transmitter contains a plate coated with material whose resistance is affected by varying shades of light and a receiver having a plate coated with material variably affected by the current of varying intensity, suitable tracers moving synchronously being also provided.

675,894. PRINTING TELEGRAPH; F. H. Littlefield, St. Louis, Mo. App. filed June 18, 1900. A perforated tape is fed to the transmitter, and the receiver perforates in a similar manner another tape, after which suitable selecting devices complete a circuit through a printing magnet for each combination of perforations in the tape and thus print a letter.

675,895. PRINTING TELEGRAPH; F. H. Littlefield, St. Louis, Mo. App. filed Feb. 23, 1901. An improvement on the preceding invention.

675,918. STORAGE BATTERY; V. G. Apple, Dayton, Ohio. App. filed Nov. 1, 1900. (See Current News and Notes.)

675,931. ELECTRIC METER; L. E. G. Cauro, Naples, Italy. App. filed Dec. 31, 1897. Details.

676,006. RECEPTION AND RETRANSMISSION OF ELECTRICAL IMPULSES; A. Muirhead, Shortlands, Eng. App. filed Feb. 20, 1901. An improvement in sub-marine telegraphy, whereby the effect of any prolonged contact made by the receiving relays is converted into the same number of separate impulses as those originally transmitted, notwithstanding the fact that the receiver coil itself remains on one contact during the whole period.

676,035. SYSTEM OF ELECTRIC PROPULSION; H. Halberstadt, Kenosha, Wis. App. filed Jan. 26, 1900. A trolley pole projects downward from each platform of the car to a third rail.

676,043. ELECTRIC DRILL; J. C. Lincoln, Cleveland, Ohio. App. filed Nov. 22, 1899. The drill is sustained in position by an electro-magnet, the invention residing in the means for accurately adjusting the position of the drill point.

676,068. INCANDESCENT ELECTRIC LAMP; L. Lobenthal, New York, N. Y. App. filed Oct. 11, 1900. A two-filament lamp which can be adjusted to any single filament socket, means being provided for cutting in either filament at will.

676,069. INCANDESCENT ELECTRIC LAMP; L. Lobenthal, New York, N. Y. App. filed April 1, 1901. Details of a switch used in the preceding lamp.

676,074. INCANDESCENT ELECTRIC LAMP; J. McCullough, Newark, N. J. App. filed April 2, 1901. Improvement upon the preceding invention.

676,085. AUTOMATIC ELECTRIC FIRE ALARM; W. J. Brewster, Port Ewen, N. Y. App. filed Aug. 4, 1900. Details.

676,091. PRINTING TELEGRAPH TRANSMITTING APPARATUS; K. Himrod, Chicago, & J. R. Tucker & C. C. Hinckley, Aurora, Ill. App. filed March 10, 1899. In connection with a keyboard transmitter a plurality of sets of immovable pole changers are used and actuating mechanism is inserted between the pole changers and keys to successively select the different sets of pole changers with the keys.

676,092. RAILROAD SIGNAL APPARATUS; J. K. Hoddinott, Baltimore, Md. App. filed April 30, 1900. Two conductors are arranged adjacent to the track in a suitable housing where landslides are likely to take place, the crushing of the housing and consequent contact of the wires therein will set a danger signal.

676,098. ELECTRICAL CONTACT MAKING DEVICE; P. R. Papin, St. Louis, Mo. App. filed Sept. 24, 1900. Details.

676,105. PROTECTING DEVICE FOR COILS OF ELECTRICAL APPARATUS; P. H. Thomas, Pittsburg, Pa. App. filed Nov. 9, 1900. (See Current News and Notes.)

676,137. PRINTING TELEGRAPH RECEIVER; J. M. Joy, New York, N. Y. App. filed Sept. 20, 1900. Device for moving and controlling the type wheel.

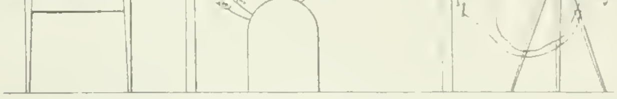
676,166. REGULATING ROENTGEN RAY TUBES; H. F. Waite, New York, N. Y. App. filed March 23, 1901. A vacuum adjuster for Roentgen-ray tubes, consisting of a shunt-circuit including in the path of the current, a volatile salt within the vacuum-inclosure, and a spark gap within a closed receptacle.

676,185. LIGHTNING PROTECTOR FOR ELECTRICAL APPARATUS; F. Gattinger, Vienna, Austria-Hungary. App. filed March 28, 1896. Consists of a number of carbon plates respectively connected in sets and in parallel with opposite terminals of a circuit wire and the ground, the plates being of such area and so arranged as to conduct to earth without sparking all of the atmospheric charge the circuit wire is capable of taking up.

676,202. INCANDESCENT LAMP SOCKET; W. H. Perkins, Waterbury, Conn. App. filed April 9, 1901. Details for holding the parts of the casing together.

676,263. AUTOMOBILE; I. Kitsee, Philadelphia, Pa. App. filed March 29, 1901. Means for controlling the operation of the motor and brake and auxiliary means for preventing operation of the motor until the brake has been released.

676,267. TRANSFORMER; W. S. Moody, Schenectady, N. Y. App. filed Feb. 23, 1901. A transformer which has a plurality of secondary windings adapted for supplying work-circuits of different characters, one of which circuits requires a sensitive regulation and hence good inductive effect and low resistance between its secondary and the primary, and the regulation of the other of which circuits may be benefited or at least not badly affected by higher reactances; the primary and secondary windings being divided into sections which are so intermixed that there is a low reactance between the primary and one secondary, but a correspondingly increased reactance between the primary and another secondary.



675,878.—Electrograph.

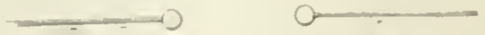
676,276. MEANS FOR SECURING POLE PIECES; H. G. Reist, Schenectady, N. Y. App. filed Jan. 29, 1900. A bolt to which the pole piece is attached passes into a radial hole, the hole being intercepted by a lateral opening through which a key passes to engage a slot in the end of the bolt.

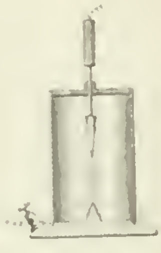
676,280. ELECTRIC SWITCH; E. Schultz, Barmen, Germany. App. filed Nov. 20, 1900. Details.

676,281. ELECTRODE FOR PRIMARY BATTERIES; W. T. Seddon, Philadelphia, Pa. App. filed Dec. 17, 1900. Consists of carbon plates held in a lead frame.

676,289. SWITCH FOR ELECTRIC LAMPS; C. Wagner, New York, N. Y. App. filed Feb. 28, 1901. A miniature lamp carried at the end of a tube presenting the appearance of a candle is provided with a convenient switching device.

676,298. BRUSH HOLDER; A. F. Batchelder, Schenectady, N. Y. App. filed Feb. 28, 1901. A contact plate rests freely against the carbon brush and the spring rests freely upon the plate, thus assuring automatic adjustment to maintain good contact.





676,166. Regulating Roentgen Ray Tubes.

676,300. SYSTEM OF ELECTRICAL DISTRIBUTION; E. J. Berg, Schenectady, N. Y. App. filed March [illegible], 1900. (See Current News and Notes.)

676,305. SYSTEM OF MOTOR CONTROL; A. G. Davis, Schenectady, N. Y. App. filed March 5, 1900. A controller comprising fixed and movable contacts, a series of separately actuated devices for moving the controller step by step and means for successively operating the actuating devices.

676,308. BRUSH HOLDER; H. Geisenhoner, Schenectady, N. Y. App. filed Feb. 28, 1901. Details.

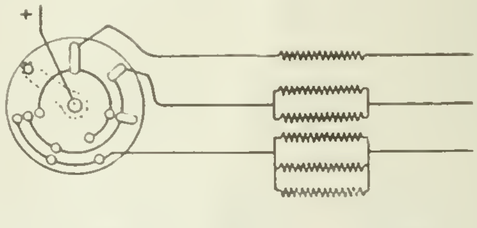
676,309. MEANS FOR CONTROLLING ELECTRIC HEATERS; E. E. Gold, New York, N. Y. App. filed March [illegible], 1897. A switch for connecting the coils of an electric heater in various combinations to obtain any desired degree of heat.

676,311. MECHANISM FOR CONTROLLING AND INDICATING TEMPERATURE LIMITS; E. H. Griffiths & W. C. D. Whetham, Cambridge, Eng. App. filed Dec. [illegible], 1900. The indication is effected by the melting of fusible material which flows to a point where it will close a circuit.

676,332. APPARATUS FOR WIRELESS TELEGRAPHY; G. Marconi, London, Eng. App. filed Feb. 23, 1901. (See Current News and Notes.)

676,339. SYSTEM OF DISTRIBUTION; H. F. Parshall, London, Eng. App. filed Jan. 23, 1901. (See Current News and Notes.)

676,343. MEANS FOR PREVENTING COLLISIONS OF RAILWAY TRAINS; J. Skopec, Vienna, Austria-Hungary. App. filed April 18, 1900. By the closure of certain circuits, part of which are in the road bed, and other parts on the locomotive, a fluid motor in the locomotive is started, to pull the whistle cord, close the throttle and apply the brakes.



676,309.—Means for Controlling Electric Heaters.

676,344. REGULATING DEVICE FOR ALTERNATING-CURRENT CIRCUITS; Elihu Thomson, of Swampscott, Mass. App. filed Jan. 26, 1900. Relates to improvements to constant current transformers whereby the range of the relative movement of the coils may be considerably reduced, thereby effecting a large saving in iron and securing a more compact structure.

676,357. PROCESS OF MAKING METAL PAPER IN ENDLESS STRIPS, C. Endruweit, Berlin, Germany. App. filed Dec. 31, 1897. (See article page 1074.)

676,365. MEANS FOR ELECTRICALLY LIGHTING LIGHT SHIPS OR OTHER STATIONARY VESSELS; J. H. Junge, Cuxhaven, Germany. App. filed June 28, 1900. An electrical contact appliance surrounding the ship, by which the ship can swing at its anchor without disturbing the connection.

676,378. SAFETY TROLLEY BASE; A. C. Wolfe, Denver, Colo. App. filed Jan. 22, 1901. Details.

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INDEX.

It is customary to issue with the last number of each volume of ELECTRICAL WORLD AND ENGINEER an index of its contents. Such an index would have appeared as usual in the present number, but for the fact that work on it had to be dropped in order that we might give our readers promptly the full text of the important Berliner telephone decision handed down on Monday last, and consisting of some 40,000 words. The index will be published next week.

◆

THE BERLINER DECISION.

At the end of last February Judge Brown, in the United States Circuit Court, District of Massachusetts, gave out a rescript in the case of American Bell against the National and Century Telephone companies, deciding that the latter did not infringe the Berliner patent, on a microphone transmitter. At that time, we noted duly the decision of the judge, and we now present verbatim the full text of his opinion, handed down in Boston last Monday. Realizing the importance of this matter to the telephonic community, and indeed to the electrical public at large, we issue the whole text, with all the reference cuts, in our present issue, and in spite of the difficulty of the task—there being some 40,000 words and a dozen illustrations—the decision is available without the slightest delay.

This is indeed one of the "celebrated cases" of the electrical art, and the remarkably able study by Judge Brown of the questions submitted to him constitutes a document and memoir of the first interest. We may summarize once more the main points settled, viz., that at the date of his application, June 4, 1877, Berliner had not made the invention ascribed to him and covered by the patent issued Nov. 17, 1891; that the invention in the patent is radically different from that in the application; that the invention had been previously patented by Berliner, and that Edison was the prior inventor to such an extent that his work and that of Bell rendered Berliner entirely superfluous. In other words, it is not possible to read into the Berliner patent any of Edison's work utilizing carbon. To those who know Mr. Berliner and are familiar with his extraordinary ingenuity and inventiveness, it seems strange, indeed, that his share in creating a great art can be deemed so slight and can have loomed so large on so small a basis. For the judge's careful and painstaking review of the situation, the testimony and the argument, we must refer our readers to the opinion itself, one of the most important we have ever had the honor of publishing in a long series of great verdicts on priority in electrical invention

◆

TROLLEY NETWORKS.

The art of electric railroading is rapidly entering upon another stage—that of systems. The beginnings of this have been seen in the largest cities where it is now the rule rather than the exception to find all the local companies massed into one financial and physical network. To what extent the promised economies in operation have been realized, is still an open question, but there is no doubt that in the matter of transfers the public has benefited hugely. The next step in this development is seen in such enterprises as those undertaken by the Everett group of financiers, whose ambitions are not limited by any given locality, but extend from town to town, and include a thousand miles of track ramifying all over a State. The modern method of three-phase transmission renders physically possible the creation of networks of this character, and it will be interesting to see what the financial results are. Such systems, even more than little local lines, must have a vital interest for the steam roads whose passenger and freight patronage they invade. In proportion as the trunk roads combine under the influence of the "community-of-interest" principle for through traffic these trolley networks move up into the place of the old steam road, under the influence of the "interest-of-the-community" principle, for the finer and closer development of the welfare of each locality by giving it better transportation than it ever had before.

A French Pilgrimage.

We are very glad to note that our excellent French contemporary, *L'Eclairage Electrique*, through its editor, Professor Blondin, has organized a trip to the United States, so timed as to fall in with the meeting of the American Institute of Electrical Engineers at Buffalo, the date of departure from Paris being Aug. 3, and the sailing date of return being Sept. 13. Professor Blondin has laid his plans with great care, but, of course, the programme as published does not include all the provisions made here for the entertainment of our friends from abroad. As the circulars of the Institute have already shown, a round of hearty and abundant hospitality has been laid out, and we may add that the contributions toward the fund are already handsome in amount, enabling the committee to return in a liberal manner the cordial reception given to Institute members abroad last year.

To our French friends we can only say that they will be peculiarly welcome in this country, whose history is so full of the records of French valor and love of liberty, and whose political institutions rest on the same philosophical principles of broadest humanity. Nowhere is French leadership in the arts and sciences more thoroughly appreciated than on these shores; nowhere do the Gallic clearness of vision and felicity of expression find a warmer admiration than among our people, now so rapidly differentiating into a great, new composite nation of which probably the French element is unfortunately one of the smallest. In the art and science of electricity, the qualities of the French people have been displayed at their best, and our friends will be very much at home among those who have been trained in the school of Ampere and Coulomb and Arago, or have found their life work in trying to improve on the inventions of Planté, of Faure and of Gramme.

Electro-Chemical Theory of the Edison Storage Battery

Elsewhere in this issue we print an article by Dr. E. F. Roeber, giving a theoretical discussion of the electro-chemical principles embodied in the Edison storage battery, recently described in a paper read before the American Institute of Electrical Engineers. The article furnishes an excellent example of the manner in which the modern electro-chemical theories may be applied to the consideration of storage batteries, and in this respect alone is of direct value in view of the little attention that has been given to these theories in this country, and the criticism to which they nevertheless have been subjected. Lack of information in full detail concerning the Edison battery—acquaintance with which appears at present to be confined only to those connected with Mr. Edison's laboratory—necessarily causes Dr. Roeber's article to be somewhat hypothetical in its premises, but the conclusions coincide with the claims made for the battery in at least two very important points. One of these is that the concentration of the electrolyte as a whole is not changed; and the other, that while the concentration in the neighborhood of the plates is subject to change, diffusion is necessarily more rapid in this type of battery than in the lead type.

Wanted—A Volt.

We wonder what would be the result of gathering from each of, say, fifty central stations the voltmeters by which the working pressure is regulated, and then comparing the lot. Possibly two might be found alike to a small fraction of a volt, but we should be greatly surprised if the readings of the aggregation did not cover a range of four or five volts. This, of course, assumes that the comparison is made fairly within the working range of the instruments, but that no corrections or adjustments are to be made for, say, thirty days prior to the test. We often see in the theses which bloom like flowers, in the spring, long series of measurements recorded to hundredths of a volt. Now, we do not wish to cast aspersions upon the hard-working young gentlemen who do the work, but we really wonder how many of them understand what degree of precision such a measurement implies. It means far more than estimating tenths of a division on an open scale instrument, and it really involves an exactness that is very rarely attained in working with commercial appliances. We are well aware of the excellence of American electrical measuring instruments—they have won their way to the remotest corners of the earth—but it is one thing to turn out a fine and well-cultivated instrument and a very different thing to be sure that such instruments will read alike after they have been in use for a while.

One of the most interesting and important tasks which will fall to the lot of the recently established Bureau of Standardization will be the overhauling of our present standard of electromotive force. A general scrutiny of instruments and a convenient source for exactly testing standard cells is greatly needed, and we earnestly hope the Bureau will see its way clear to an early attack upon the problem It is a thing not only of great scientific importance, but of direct commercial importance. Fancy, for example, the amount of disputes that would easily arise if two manufacturers of incandescent lamps had working voltmeters even half a volt apart, and dealt with customers whose standards varied by a volt—and we more than half suspect that such a contingency is not exactly outside the range of probability. Verily, in these days of congresses, a congress of voltmeters would be an entertaining gathering.

Wireless Telegraphy.

In another column we print an extremely interesting article by Professor Fessenden relative to the important work in wireless telegraphy which has been done under the auspicies of the United States Weather Bureau. From time to time we have noted progress in the installation of Government wireless telegraph stations along the Atlantic Coast south of Cape Henry, which constituted the first practical application of this system on our continent, and indeed the first extended application in the world. From Professor Fessenden's article it appears that simultaneously those connected with the work have carried on a thorough experimental investigation of the phenomena involved in wireless transmission, some very important results of which are now for the first time disclosed in the article.

It is interesting to note that the investigation has resulted in discoveries which suggested modifications almost identical in principle with some which Marconi has recently introduced into his system, and which are described for the first time in his recent paper to which Professor Fessenden refers. One of these relates to a form of aerial conductor in connection with an adjustable inductance whereby the radiation from the sending conductor may be controlled and strengthened, and another to a method of tuning the sending and receiving stations. It is to be noted, however, that in each the principles experimentally established by Professor Fessenden and his assistants resulted in applications differing considerably from those of Marconi; and as the article to which this refers gives a discussion of these principles, the reader is enabled to judge as to the relative merit of the parallel applications. Moreover, later experiments have led to the substitution of even more efficient arrangements for the attainment of the same ends.

While that part of the work of the Weather Bureau which Professor Fessenden describes in detail forms in itself a valuable contribution to the art of wireless telegraphy, the article refers to still more important results that have been attained, but which at present cannot be disclosed. These results, from the intimations given, appear to be of the highest value and of a kind that may work a revolution in the methods of wireless telegraphy. One of these consists in a method of controlling the radiating power of the sending spark, and increasing its efficiency many fold, it being stated that with the powerful radiation that may thus be obtained, transmission over the relatively short distance of 50 miles may be accomplished with apparatus of the simplest kind. Another important discovery of which the details are withheld is in connection with the radiating conductor, the height of which for ordinary transmission is thereby reduced to a few meters. Still another improvement of which the details will be eagerly awaited, relates to a method of selective signaling which is stated to obviate objections to which the latest Marconi syntonic system is subject. Altogether, the article of Professor Fessenden forms a contribution of unique importance to the subject of which it treats, and the Weather Bureau is to be congratulated upon the magnificent work which has been performed under its auspices.

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TESTING LARGE TRANSFORMERS.

A very interesting article by Mr. J. S. Peck on the testing of large transformers appeared on page 1083 in last week's issue—the exigencies of "make up" having deprived it of the position of prominence that its importance called for. A number of interesting facts are brought forward. The 2250-kw transformers referred to are the largest yet constructed, and consequently it is of especial interest to observe the main facts in connection with them. The iron core weighs 6½ metric tons, or for each kilowatt of full-load activity of the transformer there is provided not quite 6½ lbs. of iron core, representing an activity per unit mass of about 150 watts per pound of core. The cyclical magnetic density is also carried up to nearly 12 kilogausses, and the total cyclic flux appears to be nearly 4 megamaxwells. The efficiency is a maximum in the neighborhood of full load, and amounts to nearly 0.987, a very convenient fraction to carry in the memory. This represents a loss of about 1.3 per cent at full load, the loss at 10 per cent of full load being only 2.7 per cent.

It is interesting to observe that the iron and copper losses are approximately equal at full load, the load of maximum efficiency, and that the eddy-current loss is half the hysteresis loss or one-third of the total iron loss. The density of current in the high-pressure and low-pressure coils is nearly equal, and the magnetic leakage is kept low by an intimate sub-division of the primary and secondary coils, there being apparently six of one set sandwiched between seven of the other. The reactance factor of the transformer is only about 2.6 from the figures given, which is very low considering that the high-pressure coils withstand 22 kilovolts normally, and are tested up to nearly 50 kilovolts effective. The full-load copper drop referred to the influence of both primary and secondary coils is about ¾ of 1 per cent, and the full-load reactance drop nearly 2 per cent. It is very interesting to notice that it takes nearly half an hour to obtain a steady reading of potential difference on the low-tension windings in multiple, and with the high-tension coils short-circuited. If the short-circuited coils were devoid of resistance, this time—already 30 minutes—would be extended indefinitely. By the same reasoning the insertion of external resistance into the circuit of the closed windings should diminish the time of attaining a sensibly steady state.

The method devised by Mr. C. F. Scott to separate the hysteresis loss from the eddy-current loss is also ingenious, and virtually consists in determining the outline of the hysteresis loop from successive measurements of the inclination of tangents at successive points along its contour. From the area of the loop so derived the hysteretic loss is computed, and the residue of the total iron loss is attributed to the eddy currents. A more common method of making this analysis is to operate the iron core at successively increasing frequencies, keeping the magnetic density in the iron constant, and observing the corresponding successive total iron losses. On the assumption that the hysteresis losses increase as the frequency, while the eddy current losses increase as its square, the two are capable of separation. The analysis in this case, however, is only capable of being correctly effected if the temperature of the core remains substantially constant throughout the range of frequency employed.

It is interesting to observe that the reason for the use of the transformers referred to is the reduction of pressure at the junction of the overhead and underground conductor systems near Buffalo, N. Y., from 22 to 11 kilovolts. This shows the importance of obtaining an insulating material for underground cables which shall be cheap and which shall at the same time be capable of withstanding a high pressure. The reduction of pressure from 22 to 11 kilovolts can certainly not be on the score of safety to person or property. The only reason that can be suggested for the reduction is to assist the subterranean cables, which, if guaranteed against the higher pressure, would have to be made much thicker and more expensive. It has, therefore, evidently been judged preferable to pay a toll in the transformers of some 2 per cent in the power transmitted to Buffalo, in addition to the extra copper loss for the lower pressure, rather than pay for the extra insulation which would sustain 22 kilovolts safely.

A paper upon the subject of subterranean cables was recently read before the British Institution of Electrical Engineers by Mr. O'Gorrman. It was therein pointed out that by reason of the geometry of a cable the electric stress brought to bear upon its insulating material was much greater at the inner than at the outer layers, and that consequently the inner layers were apt to become overstrained and to break down before the outer layers were brought to a like condition. He proposed that the layers of a cable should be so varied successively as to increase the specific inductive capacity inwards, for the purpose of reducing the internal stress at the increase of the external, and thereby tending to make the stress distribution more nearly uniform. It would seem that although this might not be capable of being accomplished in such a manner as to bring about uniform distribution, it might be attempted in some degree with advantage. There can be no doubt that a substantial improvement in the volt-resistance of subterranean cables without undue expense would tend greatly to reduce the expense of urban high-tension installations. At present if we add insulating layers on the outside of a cable, the volt-resistance does not tend to increase in anything like the proportion of the added expense in insulating material. At the present time transformers can be built for high pressures without unduly marked increase of expense for volt resistance, and the safety of the low-tension system connected therewith can be amply provided for against accidental crosses; but the heavy expense of subterranean cable insulation considerably reduces the magnitude of the pressures that can safely be employed in city limits.

Proposed Telephonic Opposition in Chicago.

An agitation is now going on in Chicago on behalf of the United Telephone, Telegraph & Electric Company, of Hyde Park, for an extension of its franchise, so as to enable it to give telephone service throughout the city, offering lower rates than those now paid to the Chicago Telephone Company. President Sabin, of the latter company, appeared last week before the committee on gas, oil and electric lights of the City Council, and opposed a wider franchise.

He said: "The prices already are as low as it is possible to make them and conduct the business at a profit, and the presence of one or more competing companies in the city would not induce us to make any lower rates. What we are now trying to do, however, is to really cut the rates by giving our subscribers a much better and more extended service. Up to now only the cream of the telephone business in Chicago has been skimmed off, and there are not one-third as many people having telephones as there would be if the system was properly developed. The present number of instruments in use is being rapidly added to, and we expect to have 60,000 in our exchanges before the year is out, and the total number in Chicago should reach 120,000. With this number of connections the subscriber to the Chicago Telephone Company will have the cheapest service in the country at its command."

Manager Bloch, of the Hyde Park Company, which is asking an extension of its franchise so it can cover the entire city, took the affirmative side of the question. He made the argument that it was the experience of all citizens where two companies were in existence that rates had been lowered so it was cheaper for the user to have two instruments in his office than one before the competition began. He read a letter from Philadelphia asserting that the telephone service had been both cheapened and improved by the starting of the rival company and that the same thing was true of Cleveland, Detroit and other cities.

For his company, if it were given a franchise, Mr. Bloch said, he would promise a rate of $85 for a single wire, double metallic telephone, and a rate of from $40 to $60 for others, against an average of $125 now existing, with a percentage of the gross receipts to be paid the city. His company desired, he said, to install residence telephones free of charge for all incoming calls, alongside of every instrument now installed, the charge to be 5 cents for every outgoing call.

"That is not a remarkably generous offer," said President Sabin. "We would be glad if we could get 2 cents for every switch we made."

President Sheerin, of the New Long Distance Telephone Company, of Indianapolis, spoke in favor of the proposed ordinance, saying that if it were passed it would allow his company to obtain an entrance to Chicago. Being an opposition concern, his company could not make any arrangement with the Chicago Telephone Company, and was unable to get any nearer to Chicago than Lafayette, Ind.

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Condition of Erie Telephone.

The Eastern Audit Company has completed its examination of the Erie Telegraph & Telephone Company's treasurer's accounts in Eastern offices at Lowell and Boston, and are now at the division headquarters of the several subsidiary companies in the West engaged in checking the accounts with the treasurer's books. This work will be completed about Sept. 15, and with the physical report will form a basis upon which a plan will be devised to pay the $7,500,000 loan due Jan. 10, 1902, and arrange for the money that the company will require for the next year and determine the rate of dividends for the future.

The Erie Companies' gross earnings for the first four months of 1901 are $400,000 more than the corresponding months of last year. May's growth in subscribers, 3564, is one of the best the company has had and the 150,000 mark for total number of subscribers has now been exceeded by 144. While the policy of the new management is not to make any extraordinary canvass for subscribers all regular applicants for profitable service are receiving prompt attention. The natural annual growth should be at least 25,000, but the cost of connecting will be largely reduced from the fact that ample facilities for a large growth were provided during the past year.

The $26,300,000 valuation placed on the Erie Telephone properties by Messrs. Stone & Webster, being in their judgment an estimate of what it would cost to duplicate the property to-day, exclusive of rights of way and franchises, shows that the Erie funds have been well invested. To this sum a fair value of rights of ways and franchises, provided this could be obtained, adds $6,000,000, making the total valuation of the property $32,300,000. Nearly all of the Erie's 95,000 miles of long-distance wires are built upon rights of way purchased and owned absolutely by the company, and not on the highway, while an equal amount of exchange wire, 95,000 miles, is underground.

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Exports from the United States.

Exports from the United States in the fiscal year 1901 now about to end will probably reach $1,500,000,000, the highest point ever recorded for a single year in the history of our export trade. For the 11 months ending with May, 1901, the total exports were $1,385,013,595, being double those of the corresponding period of 1889, and $100,000,000 in excess of the total for the 11 months of last year, which broke all previous records. Taking the commerce of the 11 months ending with May of various years as the basis of comparison, the figures of the Treasury Bureau of Statistics show that during the period under review our exports in 1889 amounted to $694,133,804; in 1894, to $834,636,085; in 1899, to $1,130,629,075; in 1900, to $1,285,831,125, and in the present year, as already stated, $1,385,013,595; while for the full fiscal year our total exports give promise of exceeding one and a half billion dollars, as the 11 months' figures only fall $115,000,000 short of that amount, and the monthly exportation of merchandise from the United States has exceeded $120,000,000 since March 1 of this year. The distribution of our exports during the year among the grand divisions, basing the estimate upon the percentages for 10 months already available, will be in about the following proportions: To Europe, $1,155,000,000, as against $1,040,000,000 last year; to North America, $105,000,000, as against $187,300,000 last year; to South America, $44,000,000, as compared with $38,900,000 in 1900; to Asia, $48,000,000, as against nearly $65,000,000 in 1900; to Oceania, $36,000,000, as against $43,400,000 last year, and to Africa, $26,000,000, as against $10,500,000 in the preceding year. It will be observed that the only decreases will be in our exports to Asia, where unsettled conditions in China have seriously affected trade, and to Oceania, from which Hawaii has been omitted as a foreign country since its organization as a territory of the United States.

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Crowding Trolley Cars.

The New York aldermen have postponed for a time the consideration of an ordinance penalizing on the part of passenger and conductor the standing up in the aisles of open trolley cars. The universal opinion is that the cars run as closely together as possible, and that passengers will never consent to wait for an "empty seat that never comes." The New York *Evening Post* says sensibly on this subject: When a hundred people who can get carried in a car after a fashion are confronted with a law forbidding more than 50 to board it, the law will have to give way. To attempt to enforce it would lead to the most desperate struggles among passengers, and the feebler among them would suffer severely. The conductors would be powerless to enforce such an ordinance, and even the police would be helpless. To arrest the conductors for failing to do the impossible would not promote the rapid movement of the cars, and it would be foolish to suppose that the arrest of passengers would be sustained by public opinion. We have enough laws that are not enforced now on the statute book, and it is demoralizing to increase the number.

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Wisconsin University Trade School.

The summer school for apprentices and artisans of the University of Wisconsin will begin on July 1, ending Aug. 9. This school has been established for the benefit of mechanics, superintendents of electrical plants and for young men who wish to qualify themselves for these callings. The course in applied electricity covers the management and testing of electrical machinery, the use of electrical measuring instruments, electric wiring, meters, transformers, lighting, telephone service, primary and storage batteries, central station records, elementary theory of alternating currents and their applications, electroplating and electrotyping. Only part of these courses can be taken during one summer.

Paper Making by Electricity at Millinocket, Maine.

By ALTON D. ADAMS.

THE largest paper mill in the world has made a unique advance by the distribution of electric power for that industry at Millinocket, Maine. In the works of the Great Northern Paper Company, at that place, the long and heavy lines of shafting common in paper making plants, are replaced by electric generators, circuits and motors.

One of the important problems in great factories is the distribution of power from the prime movers to the machines that work directly on the product. The high first cost and subsequent low efficiency of extensive shafting equipments are well known. In many cases such efficiency is hardly more than 25 per cent, and it seldom rises above 50 per cent on long lines. It is now common practice in numerous branches of manufacture to connect electric generators direct to steam engines or waterwheels, and to distribute the power to electric motors that drive either individual machines or short lines of shafting. In this way the main costs and losses of shafting are avoided, and a degree of flexibility is obtained that would not otherwise be possible. The influence of this practice on the costs of manufacture obviously increases with the ratio of power consumption to the value of the product turned out.

In paper making, and especially in the manufacture of paper from wood, the required power is very large compared with the cost of the output. In spite of this fact, conservative forces in the paper-making industry have generally held to the old method of power distribution by shafting. It is therefore of special interest that the greatest paper mill in the world should be also the first of importance to adopt electrical distribution for its machinery.

The mill at Millinocket is devoted to the manufacture of newspaper stock from wood. This process involves the reduction of the wood to pulp by grinding, and the subsequent passage of the pulp through a variety of processes to obtain the finished product. A distinction between the grinding and the subsequent operations is here pointed out, because the reduction of the wood to pulp is done in a comparatively small space, but yet takes much more power than do all of the subsequent processes put together. These facts have an important bearing on the extent to which electric distribution of power in a mill can be applied with advantage to paper making of this class.

In this Millinocket plant, both steam and water power are used, though the water-power alone is abundant. To furnish steam, 12 Cahall boilers, eight set to burn coal and four set to burn wood refuse, have been provided with an aggregate rating of 4600 horse-power. Steam from these boilers is mostly consumed to heat the pulp digesters, the paper machines, and in general heating of the mill. As steam loses but little of its heating value in engines, they have been provided to furnish power for the paper machines, the exhaust going into the paper machines for heating after it leaves the engines. As steam power drives only the paper machines, and has no connection with the electric equipment, this explanation of its use is all that need be said concerning it here.

Water furnishes the great bulk of the power used in the plant of the Great Northern Paper Company. This power is all developed in turbines of the Rodney Hunt make. All of the water-power here employed may be divided into two parts, that used to drive the pulp grinding machines, and that which operates the electric generators. Except the paper machines driven by steam power and the grinding machines by water power direct, the entire plant is operated by energy from the electric generators.

This paper mill is located on the bank of the river known as the Millinocket Stream, a tributary of the West Branch of the Penobscot, which joins it some miles below the mill. About one mile from the site of the paper mill flows the West Branch of the Penobscot at an elevation of 110 ft. above the surface of the Millinocket Stream.

This difference of elevation between the two rivers is accounted for by a fall of over 100 ft. in the West Branch of the Penobscot before it is joined by the Millinocket Stream. The Great Northern Paper Company has constructed a dam at the head of these falls and leads the water desired for power through a canal to the mill on the bank of the Millinocket Stream. By means of the dam the water in the West Branch of the Penobscot is raised in level about 10 ft., and a large storage reservoir created between the river and the mill. The West Branch of the Penobscot drains 1800 square miles of forest land, and furnishes ample water power for the mill at all times.

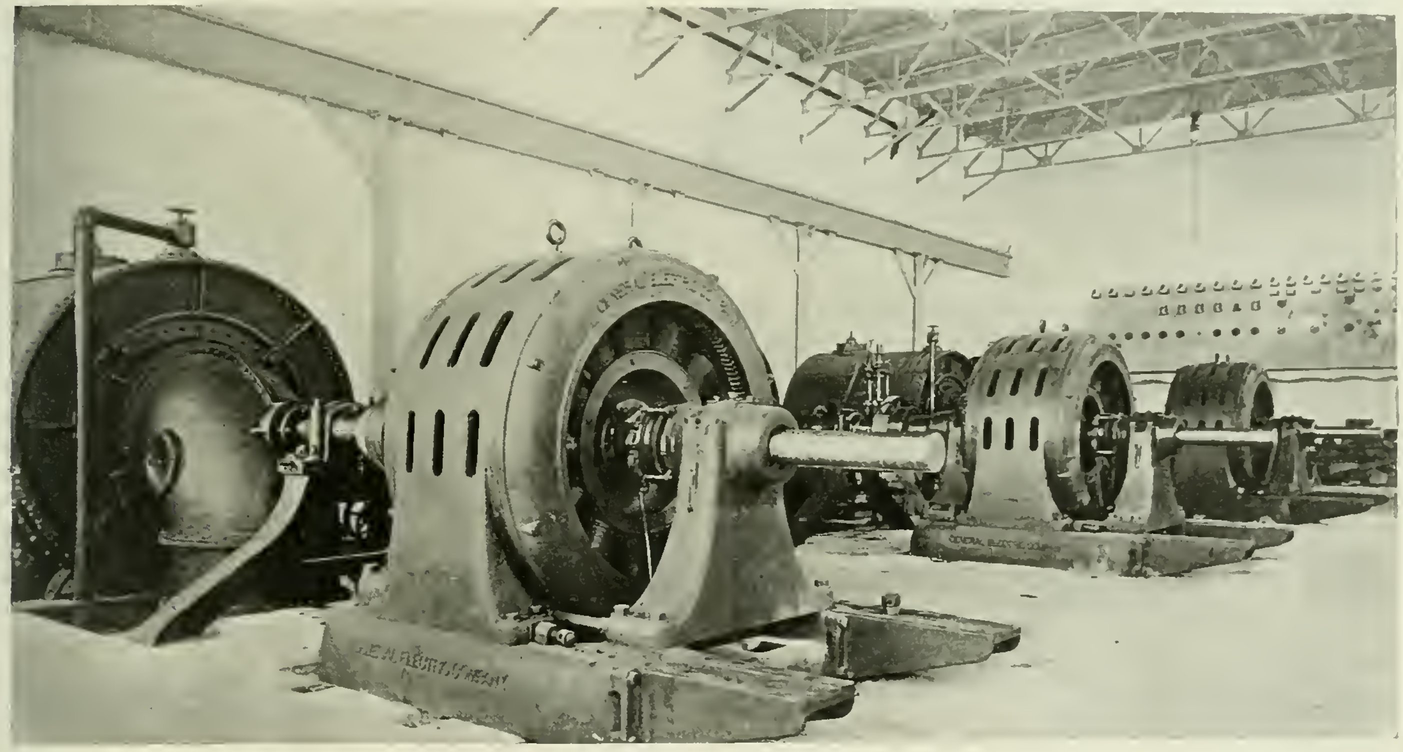


FIG. 1.—GENERATORS AND SWITCHBOARD IN PAPER MILL, MILLINOCKET, ME.

The grinder room is moderate in dimensions, only 211 by 187 ft., but its machinery is intended to consume 23,400 horse-power.

Grinders to the number of 72 are provided for in the grinder room, and 48 of these are already in position. The grinders are arranged in six rows of 12 each, and a pair of turbine wheels drives each row of grinders direct connected on their extended shaft. Each pair of turbine wheels driving a row of grinders are 57 inches in diameter, and competent to develop 3900 horse-power, giving a total capacity of 23,400 horse-power for the six pairs of wheels. Particular attention is called to the conditions under which the grinders are driven, as they are so close to the wheels that the problem of power distribution is practically eliminated.

From the reservoir on the same level as the West Branch of the

Penobscot, and between that river and the paper mill, four steel penstocks, each 10 ft. in diameter, are laid to the grinder rooms. Each of these four penstocks connects directly, and only with one of the four pairs of wheels, driving a line of 12 grinders. By this construction the water may be shut off at the reservoir head gates from any one penstock, thus stopping one line of grinders without any influence on the others. As soon as the other two rows of grinders for which room has been provided are in position, two more penstocks will be laid from the head gates at the reservoir to the wheels for the grinders. Each of these penstocks is 1000 ft. in length.

This arrangement of separate penstocks and wheels for the several rows of grinders is of special interest because it illustrates the policy that has governed the application of power throughout the entire plant.

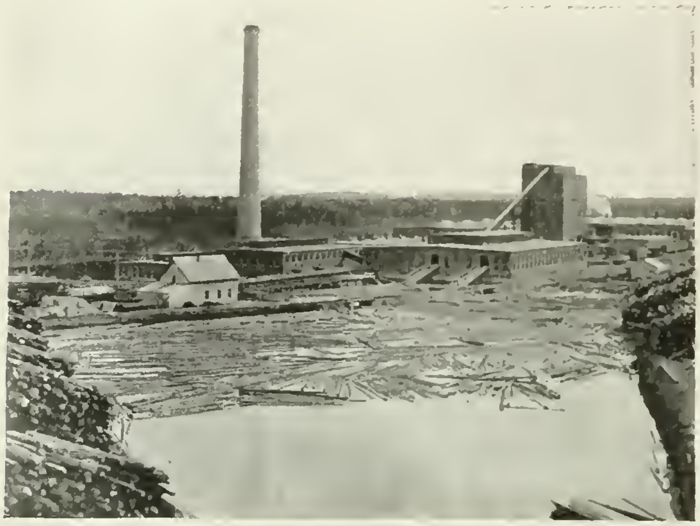


FIG. 2.—GENERAL VIEW OF MILL.

The important aim in the design of the Millinocket mill was to secure the most direct movement of stock through the several departments, and to make each independent in its operation, in order to ensure a low cost of manufacture. As the plant covers most of an area 465 by 975 ft., with a large number of departments on different levels, the flexibility and arrangement desired made many power units necessary. Such a division of generating units might be obtained with separate waterwheels and penstocks, but this equipment with its attendant construction would be very expensive. Long lines of very heavy shafting might have been used to transmit power throughout the plant, as in the ordinary paper mill construction. This would not only have been expensive, but would not have given the required flexibility. After consideration of all available plans, electrical distribution of power throughout, except for paper machines and grinders, was decided on.

To supply water for wheels to drive electric generators, a fifth penstock, 11 ft. in diameter, was laid from the head gates at the reservoir to the electric generator room. This room is next to that in which the grinders are located, and is located about 714 ft. from the more distant end of the plant. Three alternating generators, each three-phase, with a capacity of 1000 kilowatts, at 600 volts and 400 r. p. m., are located in this room. Each generator is driven direct by a pair of 36-inch special turbine wheels, competent to develop 1500 horse-power at the speed named.

Two exciters are operated for these generators, each exciter having a capacity of 60 kilowatts, direct driven by a special 24-inch wheel, at 600 r. p. m. The shafts of these 24-inch wheels are extended on the sides opposite to the exciters, and terminate in friction rolls, which can be connected to drive rotary fire pumps when desired. The pair of 36-inch wheels for each of the main generators is provided with a Lombard governor. All of the turbine wheels were made by the Rodney Hunt Machine Company. A 10-ton traveling crane is provided in the generator room that can be brought directly over any of the machine units. At one end of the room, on a gallery built for the purpose, is the switchboard that controls the entire electric system.

On the panels of the board are located indicating instruments, and the handles of switches for the several generators, the various circuits and the regulating rheostats. The space beneath the gallery is enclosed by brick walls, with a door at each end, and in this space, which is about 32 ft. long, 8.25 ft. wide and 9 ft. high, are located the main working parts of the switchboard, including the oil switches. Circuits are arranged to connect the board with single large motors or groups of small motors in the different departments of the mill so that the power consumed by each may be indicated and recorded. Connections between the generators, exciters and switchboard are made by wires and cables laid in tile conduits beneath the floor of the generator room.

While most of the energy from the electric plant is used to drive motors, a very considerable amount is devoted to electric lighting, which is the only method of illumination provided for. About 750 incandescent and 92 enclosed-arc lamps are used to light the entire plant, and these are all operated by the alternating generators. The incandescent lamps used require about 120 volts, and transformers are consequently located at suitable points about the mill to reduce the line pressure from about 600 volts and limit the lengths of the lamp circuits to short distances. The arc as well as the incandescent lamps are operated on these secondary lines from transformers. Circuits that supply transformers for lamps are not connected to motors with heavy and fluctuating loads, because of the variations that would result in the light of lamps.

Electric wiring throughout the mill is of the open or exposed type, and the kind of insulation used is varied to suit the conditions in the several departments. In that part of the mill where acid is used to treat the wood pulp for the production of sulphite, lead-covered wires are run, in order to protect the insulation from the acid fumes. In many other places where the ceilings and air are wet, rubber-covered wire is employed. Much of the wiring about the plant is in dry places, and is covered with simply fireproof insulation. As the buildings are constructed entirely of brick, tile, stone, steel and concrete, and the electric circuits are erected with porcelain supports, they come in contact with nothing that can be set on fire.

The most unique feature in the equipment of this paper mill is the use of electric motors to drive all departments, except the grinder room and the paper machines. The equipment includes motors of both the synchronous and induction types with speeds, capacities and methods of connection as follows: One 300-hp, 400 r. p. m. synchronous motor, connected by rope drive; two 300-hp, 400 r. p. m. synchronous motor, belted; three 300-hp, 480 r. p. m. induction mtors, belted; one 250-hp, 480 r. p. m. induction motor, with rope drive; four 250-hp, 480 r. p. m. induction motors, belt connected; one 200-hp, 480 r. p. m. induction motor, belted; one 100-hp, 600 r. p. m. induction motor, belted; one 75-hp, 800 r. p. m. induction motor, belted; three 50-hp, 800 r. p. m. induction motors, belted; three 30-hp, 800 r. p. m. induction motors, belted; one 10-hp, 1200 r. p. m. induction motor, belted; three 5-hp, 1200 r. p. m. induction motors, belted.

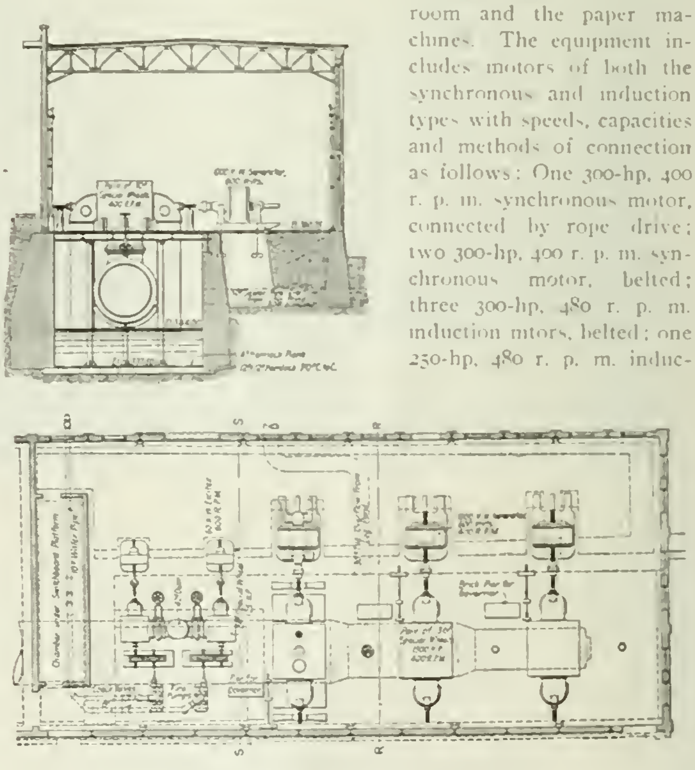


FIG. 3.—SECTION AND PLAN OF STATION.

The aggregate nominal capacity of these motors is 3690 horse-power, though they are, of course, capable of temporary overloads. It was found above that the grinder room alone has four pairs of wheels that develop 3900 horse-power each at the present time, or a total of 14,600 horse-power. But this large amount of power is consumed in the limited space of 211 by 187 ft., while the motors deliver their power over an area 975 by 405 ft. At 60 watts each the 750 incandescent lamps require 45 kilowatts, and at 500 watts each the 90 enclosed-arc lamps also consume 45 kilowatts, making a total of 90 kilowatts, or 120 horse-power for lighting. Together with the 3690 horse-power for the motors at normal output, the total load on the electric generators is 3810 horse-power. The three generators have a combined rating of 3000 kilowatts, or 4000 horse-power, so that the present load is less than their rated capacity. As the average motor load is naturally less than the rated capacity, the present generators may be sufficient when the grinder room receives its full equipment of 24 more grinders, and the work in other departments demands more motors.

To indicate the diversity and kinds of work done by the motors, the following are mentioned. The sulphate screen, wet machines, an 18-inch centrifugal pump, and the screen scrapers are operated by one 300-hp synchronous motor. Each of two 300-hp synchronous motors, and each of two 300-hp induction motors drives four beating engines, two refining engines and two stuff chests. One 24-inch centrifugal stock pump, one 18-inch centrifugal white water pump, a small vacuum pump and sliver and millard screens, from the load of another 300-hp induction motor. One 8-inch special white water pump, two 8-inch centrifugal stock pumps and two agitator shafts are driven by an induction motor of 250 horse-power. An induction motor of 250 horse-power drives the ground wood screens, 27 Decker wet machines, 6 felt wet machines, 1 elevator and screen scrapers. Two conveyors, three chippers, a rechipper, two chip crushers and a rotary chip screen are all driven by another 250-hp induction motor. Two induction motors of 250 horse-power each do the work of driving two loghauls, four sets of live rolls, four swing saws, a 4-ft. wood saw, with platform conveyor, two chain conveyors, four splitters and four waste conveyors. The entire acid plant, including four lime tanks, two absorbing tanks, four large vacuum pumps, two small lime pumps, and a small acid pump, are driven by one 250-hp induction motor. A 100-hp induction motor is required for an 8-inch centrifugal acid pump. A special 8-inch centrifugal stock pump is driven by the 75-hp induction motor. All of the following motors are of the induction type. A 50-hp motor is employed to drive a 6-inch centrifugal pump for washing filters. Another 50-hp motor drives the machine shops. Two chain conveyors to carry blocks to the grinder room are operated by a third 50-hp motor. Of three 30-hp motors one drives the belt conveyor for chips, another operates the belt conveyor that takes waste wood to the boiler house, and the third is required for the calender roll grinder. The 10-hp motor runs an elevator. Each of three 5-hp motors operates a section of the cleaners for the economizers.

It is evident that the 25 motors here mentioned allow a wide variation in the rate at which operations in the several parts of the plant shall be carried on.

Each motor is provided with a switch near its point of use so as to be readily started or stopped at any time. It is stated by those in charge of the plant that the use of electric motors for individual machines and for separate departments makes it practicable to determine the power consumed in the various operations of paper making much more accurately than has previously been the case. It is worthy of note that the alternating, three-phase system is used throughout this plant, though the distances are so short that no high voltage is necessary. While the operation of direct-current machines at their commutators is now nearly perfect, it is evident that the use of such machines for the plant here would have introduced an element of wear and possible trouble that is now absent. It seems certain that this innovation in the distribution of power at paper mills, with its many advantages, will be quickly imitated, and that electrical equipment will prove as popular for this line of work as it is in other industries.

The entire contract for the above electrical plant was let to the General Electric Company. The electric generators were first started Oct. 27, 1900, the lamps Oct. 28, the motors Oct. 29, and the entire equipment has operated in a most satisfactory manner ever since.

For the facts stated in this article especial thanks are extended to Mr. H. S. Ferguson and Mr. J. W. Tower, the engineers to whom the successful design and operation of the plant of the Great Northern Paper Company, are due. By the operations of this company a thriving town has taken the place of scrub oaks and scanty pines within a period of less than two years.

Wireless Telegraphy.

By Reginald A. Fessenden.

Even an experimenter working along similar lines and finding a considerable number of devices which he had considered as peculiarly his own, described in the paper, may be pardoned for feeling a considerable degree of pleasure in reading the admirable communication recently made by Mr. Marconi to the Society of Arts. Mr. Marconi is certainly to be congratulated not only upon the practical results which he has achieved, but also upon the beauty of the methods employed. It is most certainly apparent that his method has now passed from the original crude stage to a practical and commercial one.

It may be of interest to compare the results, at least some of them (for it would be inadvisable at present to publish more than a part), obtained on this side of the water by the United States Weather Bureau. These experiments were commenced under the direction of the chief of the Weather Bureau, Professor Moore, in January, 1900. Under his direction and with his approbation the subject was investigated from the beginning, with a view first to finding out definitely the nature of the phenomena, and then devising means for utilizing the forces to best advantage. First will be described a number of cases in which the work of Mr. Marconi and that of the Weather Bureau has gone along parallel lines; secondly, the differences between the methods and results obtained so far as published, and, lastly, an indication of work done by the Weather Bureau which has not been, so far as is known at present, duplicated. Naturally, on account of commercial considerations it will not be possible to go into details so much as might be desired, and for the present this deficiency must be excused.

The first point in which parallel results have been obtained is that concerned with the employment of larger capacities, more especially in the form of cylinders. Mr. Marconi describes the use of concentric cylinders, the inner one connected through a self-inductance to ground, and explains very clearly that in the case of wire conductors the electrical oscillations rapidly die away, and that with greater capacity we have a more persistent vibrator.

The following quotation from one of the patent applications of the Weather Bureau experimenters will show that in this respect the same result has been reached, "The employment of simple wires having small capacity as sending conductors is objectionable for the reason that the radiation is so rapid that there are very few oscillations in each discharge, and hence the inductive rise in voltage at the receiving station cannot attain sufficient value to permit of the use of inductive devices for arresting the potential at such station. By the employment of conductors having large capacity at the sending station, and by properly proportioning the self-inductance and resistance, the radiation from the conductor can be so controlled that there will be a large number of oscillations; for example, 50 or more at each total discharge. In other words, the discharge is so controlled that only a small fraction of the total energy is radiated at each oscillation. By thus extending the period of radiation opportunity is afforded for the inductive voltage at the receiving end to rise to its full value. By increasing the number of oscillations for each total discharge from the sending conductor, and by adjusting the receiving system so that its natural periodicity corresponds, or approximately so, to the period of the electromagnetic waves, the distance of travel of the waves is not solely dependent upon the heights of the sending and receiving conductors as has heretofore been held." And the corresponding claim:

"In a system of wireless telegraphy a conductor adapted to radiate electromagnetic waves having its capacity, inductance and resistance so proportioned that only a relatively small fraction of the energy of the large conductor is radiated during a single oscillation, thereby preventing rapid vibrating in oscillations substantially as set forth."

As regards the details by which this is accomplished, Mr. Marconi uses two concentric cylinders, the inner one having an inductance connected with it. The object of the inductance is not fully described, but Mr. Marconi lays great stress upon it. According to the writer's experiments, the object of this inductance is three-fold. In the first place, as Mr. Marconi explains, it gives a difference in phase; secondly, it is only the outer conductor which radiates, and this radiates just as a simple cylinder of the same size would radiate if used as an ordinary vertical conductor, but for the fact that the oscillations are more persistent when the inductance is put in. For the formula for logarithmetic decrement contains the power, $\frac{R}{L}$, and hence we can decrease the decrement, i. e., render the oscillation more prolonged by increasing L. Also the two concentric cylinders act as a condenser, and this in combination with the inductance means that we really are shunting the spark-gap with a synchronous circuit of larger capacity, as was suggested by Dr. Pupin in his discussion of wireless telegraphy before the American Institute of Electrical Engineers.

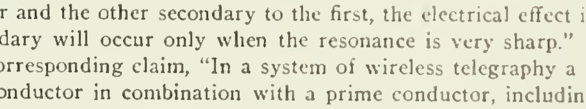
In this respect the work has not been parallel, for while the patent application and the drawings described inductances used in this manner, the same effect has been obtained, not by increasing the denominator, but by decreasing the numerator of the fraction $\frac{R}{L}$. This has been done in three different ways which will be described at a later date. The advantage of this method is that whilst when we increase the denominator we decrease the period and also decrease the total amount of energy radiated per oscillation, if we decrease the numerator we keep the amount of energy radiated the same and do not change the period, while at the same time we make the logarithmetic decrement just as small as can be obtained with the inductance. This means a greater sending power with a given height.

Another line in which parallel results have been obtained is in the tuning of the secondary of the receiving transformer. Mr. Marconi shows clearly the necessity of this, and we may compare this with the following statement from another of the patent applications:

"It has heretofore been impossible to make the receivers respond solely to waves of one periodicity, as other periodicities, if above a certain power, will affect the receivers. By constructing the second conductor so that the oscillations for each total discharge are increased, and by employing at the receiving station two or more tuned circuits, a very perfect resonance or tuning between the stations can be obtained. With one tuned circuit at the receiving station and with conductors permitting a rapid radiation at the sending station, electrostatic and hysteresis effects become very prominent, and the great self-inductance desirable for sharp resonance cannot be attained. By employing two tuned circuits, one connected to the receiving conductor and the other secondary to the first, the electrical effect in the secondary will occur only when the resonance is very sharp." And the corresponding claim, "In a system of wireless telegraphy a sending conductor in combination with a prime conductor, including the receiving conductor and one or more secondary circuits controlled by the primary circuit; a transmitting device included in the last circuit of the series, the several circuits being tuned to correspond to the period of the second conductor substantially as set forth."

Here, however, there is another difference. Mr. Marconi makes the secondary of his coil equal to the height of the sending conductor. The writer makes it equal to twice the height of the sending conductor. Two explanations of this are possible: First, that Mr. Marconi uses the secondary wound in such a manner that the wire really has a longer natural period than if it were straight; secondly, that he is really working with the first overtone. I have found that the overtones are very pronounced, more especially when the spark length is slightly longer than that generally used. There may be some other cause not at present known, but all the writer's experiments seem to show that the wave length is really four times the length of the vertical conductor and not twice.

Another difference consists in the form of the radiating conductor. Mr. Marconi uses concentric cylinders, but in the Weather Bureau experiments simple cylinders were at first used. Later these were replaced by conductors of the form shown in the accompanying sketch, in which A is a tower, BB are cables insulated from the tower at its top, CC are insulated strain insulators, and DD ropes boiled in an insulating compound. The spark or other apparatus is placed at the top of the tower and the waves go out, as shown by the dotted lines. This kind was later superseded by a third form, and this kind by a fourth, which will be referred to later.



FORM OF EXPERIMENTAL CONDUCTORS.

Another case in which parallel work was done is that in which a Thomson high-frequency coil (commonly called a Tesla coil, but in reality first brought out in its present form by Professor Elihu Thomson) was used. Unfortunately, however, some other modifications are used with it, which, as the patents have not been granted, it will be impossible to describe at present. The writer's experiments show plainly that Mr. Marconi's remarks on Professor Slaby's work are justified, and that much better results can be obtained by the Marconi methods.

Lastly, with respect to the general direction in which the work of the Weather Bureau has progressed. In the first place, it has been found possible in several ways to get over the old difficulty which troubled Hertz, and later experimenters, i. e., that when the spark length was increased beyond a certain length the discharge become no longer oscillatory. An electrical device was invented which, on being applied directly to the sending wire, measured directly the amount of energy radiated. A curve was then plotted, showing the relation between spark length and energy radiated, and it was found that the curve gave a sharp bend with a spark about one inch in length, and no further increase of radiation could be obtained. Different kinds of coils with different primaries and secondaries, different methods of producing the voltage, different kinds of gases and fluid insulators in which the balls were immersed, and different kinds of arrangements of the terminals were tried, but all without success. But finally the solution was found, with the result that with the later apparatus an amount of radiation 16 times as great as that got with the ordinary 12-inch coil and 1-inch spark was obtained. This means, of course, greater sending distance, and it may be mentioned here that transmission without the use of transformers, inductive devices, cylinders or any other apparatus for raising the voltage, has been accomplished over a distance of 50 miles without using more than a fraction of the available energy. The same result was also accomplished in two other ways.

The question of high conductors has proved a rather serious one, because, as Mr. Marconi has pointed out, if we use large surface conductors, though they may be short, yet they are objectionable on account of the wind pressure. Means for overcoming this are described in some of the patent applications, but the method was finally abandoned because means have been found by which a conductor only one meter high can be made to radiate as much energy and of the same period as a conductor 100 meters high. Another difference again has been the fact that it has been found necessary to differentiate in form between the receiving and sending conductors, i. e., to have the receiving conductor with more self-inductance and less capacity than the sending conductor.

Other work done by the Weather Bureau has been along the line of producing a non-interfering system. The admirable and beautiful work of Mr. Marconi has resulted in a system by which within certain limits messages can be sent without interference. But one great objection has been found in the Weather Bureau experiments to this method, although it is described in some of the earlier patents of the Weather Bureau experimenters. That is, that while it is no doubt possible, under certain conditions, to send and receive individual messages, yet by connecting two brass semi-circles to a motor revolving at several thousand revolutions per minute, it is possible to make what may be called an electrical siren which runs up and down a scale of seven or eight octaves several thousand times a minute, and which, as at some period of the scale it gives a note corresponding to any given syntonized receiver, is consequently able to stop all communication, when used in conjunction with the apparatus for strengthening the radiation, within a radius of 500 miles or so. Consequently this method has been superseded by several other methods which permits of selective signaling, no matter how strong the interfering radiator may be or how close it may be, even approaching the interfering radiator within a few feet producing absolutely no effect.

The parallel manner in which a considerable part of this work has been done may possibly be taken as evidence of the fact that the matter has now got down to a sound scientific base. Mr. Marconi and his eminent colaborateur, Dr. Fleming, are certainly to be congratulated on the results they have so far achieved, and no one joins more heartily in wishing them the best of success than the writer. The future of wireless telegraphy in their hands is certainly assured, and it cannot be many years before Mr. Marconi will see the great system which he was the first to see the points of and to put in practical form, in as universal use as our present methods of telegraphy.

On Theoretical Concentration Changes in the New Edison Battery.

By E. F. Roeber, Ph.D.

In this article I intend to draw some conclusions from the modern theory of the electrolysis of aqueous solutions regarding the working of the new Edison battery. As I have had no opportunity of making any experiments with the cell I have been unable either to confirm or to refute my results. It seems to me, however, quite legitimate and interesting to discuss the processes in the new Edison cell from the point of view of a theory which, in the opinion of many, gives a good description and explanation of a large number of electro-chemical facts.

The following research refers not only to the Edison nickel-iron cell, but to the general type of cell of which the new Edison cell is a special example. This general type may be characterized as a cell in which the chemical process during charge and discharge consists in the transport of oxygen from one plate to the other, while the chemical composition and the total concentration of the electrolyte (i. e., the ratio of the total number of molecules of the dissolved electrolyte to the total number of water molecules) remain unchanged.

I have defined the "total concentration" of the electrolyte in this exact way, to avoid a misunderstanding. This misunderstanding would be to assume that the electrolyte is not changed at all. From all electro-chemical facts, however, we know that an electrolyte always undergoes concentration changes during electrolysis. If the "total concentration," as defined above, does not change, there are nevertheless concentration changes in the different parts of the electrolyte; either the concentration of the solution increases at the anode and decreases at the cathode, or it decreases at the anode and increases at the cathode. It will be shown presently that Hittorf's theory leads to such conclusions for the Edison battery, and the numerical data will be given. These changes of concentration, however, must have some influence upon the practical working of the Edison cell. This may be concluded from the analogy with the lead accumulator, where the concentration changes in the porous plates are of the greatest importance for the behavior of the battery.

It may be of advantage to give a brief review of a few characteristic examples of the general type of the Edison cell.

Silver-Copper Battery.—This somewhat expensive, but theoretically very interesting battery has been devised by Mr. E. W. Jungner (German Patent 110,210, March 31, 1899; see also *Centralblatt f. Accum. u. Elementenkunde,* April 15, 1900, and *Elektrochemische Zeitschrift,* August, 1900). The positive plate is peroxyde of silver in a finely divided state, the negative plate copper in a finely divided state, the electrolyte is an aqueous solution of potassium hydroxyde. The discharge consists of two steps, the chemical reactions during these two steps being represented respectively by the equations

$$Ag_2O_2 + 2\,Cu = Ag_2O + Cu_2O$$

and

$$Ag_2O + 2\,Cu = Ag_2 + Cu_2O$$

The e. m. f. of the first step corresponds to the difference between the formation heats of Ag_2O_2 (from Ag_2O and O) and Cu_2O (from $2\,Cu$ and O). The e. m. f. of the second step corresponds to the difference between the formation heats of Ag_2O (from Ag_2 and O) and Cu_2O (from $2\,Cu$ and O).

Copper-Cadmium Cell.—This is an older cell of Mr. Edison, which was described in the Electrical World and Engineer, April 6, 1901.

Nickel-Iron Cell.—This is the new cell of Mr. Edison, described in Dr. A. E. Kennelly's Institute paper (Electrical World and Engineer, May 25, 1901). The positive plate is a "compound of nickel" in a finely divided state, the negative plate is a "compound of iron" in a finely divided state, the electrolyte is an aqueous solution of potassium hydroxide. If the "compound of iron" at the beginning of the discharge is expressed by Fe and the "compound of nickel" by NiO_2—where Fe and NiO_2 may not represent the exact chemical composition, but are simply convenient signs—the chemical action during discharge is given by the formula

$$NiO_2 + Fe = NiO + FeO \qquad (1)$$

It will be seen that in all examples of this type of battery during the discharge the positive plate is reduced from a higher state of oxidation to a lower state of oxidation, and the negative plate is oxidized from a lower state of oxidation to a higher state of oxidation, while the chemical composition of the electrolyte is not changed. The electrolyte in all these batteries is an aqueous solution of potassium hydroxide, or of sodium hydroxide, or, generally speaking, of "any metallic hydrate soluble in water and having a metallic radicle which decomposes water" (Jungner).

In the discussion which followed Dr. Kennelly's paper, Mr. C. J. Reed has pointed out the following features which make this general type of battery extremely interesting. The capacity of the cell is not limited by the quantity of the electrolyte. Very little electrolyte is therefore required in it, the electrodes can be brought near together, and the resistance and the weight are thereby diminished. Further, the resistance of this type of cell will tend to remain constant to a far greater degree than that of the lead accumulator. In the latter lead sulphate is formed during discharge, which is a far poorer conductor than the oxides in the Edison cell. Finally, Mr. Reed pointed out that with this type of cell there is a possibility to charge it by a non-electric method, i. e., to reduce the one plate and oxidize the other plate outside of the jar by a non-electric method, so that this type of battery might become an instrument for transforming heat and chemical energy from other sources into electrical energy—an instrument for an indirect process of getting electrical energy, possibly out of carbon, and perhaps a very economical process.

Now, the question arises: What is the action of the electrolyte during charge and discharge? What is the mechanism by which the electrolyte transports oxygen from one plate to the other plate? To discuss this question, I will assume as fundamental hypothesis the so-called "theory of electrolytic dissociation." According to this theory, there is in an aqueous solution of KOH a certain number of KOH molecules split up into K ions and OH ions, each univalent gram ion K being charged with 96,540 coulombs of positive electricity and each univalent gram ion OH being charged with 96,540 coulombs of negative electricity; 1 gram ion means so many grams as the equivalent weight indicates. The degree of ionization (i. e., the ratio of the number of molecules KOH, split up into ions, to the total number of molecules KOH, dissolved in the water), depends upon the concentration and may be determined by Arrhenius' method by a measurement of the electric conductivity. Only the charged ions K and OH are active in the conduction of electricity through the electrolyte. The water molecules and the neutral KOH molecules which are not split up into ions, are inactive. When 96,540 ampere-seconds flow through the electrolyte, 1 positive gram ion is set free at the cathode and gives off its charge and 1 negative gram ion is set free at the anode and gives off its charge so that indeed 96,540 coulombs of positive electricity have been transported from the anode to the cathode; or when 1 ampere-second flows through the electrolyte, $\frac{1}{96{,}540} = 0.0000104$ positive gram ions and 0.0000104 negative gram ions are set free. This is nothing else than Faraday's law, which states that 0.0000104 gram equivalents KOH are decomposed by 1 ampere-second.

If we apply this scheme to the new Edison battery we find that when in discharging it gives off $2 \times 96{,}540$ ampere-seconds, two gram ions OH become free at the Fe plate and two gram ions K at the NiO_2 plate. The chemical reactions at each plate may then be represented by the following formulas:

$$Fe + 2\,OH = FeO + H_2O \qquad (2)$$

and

$$NiO_2 + 2\,K + H_2O = NiO + 2\,KOH \qquad (3)$$

The summation of these two formulas gives, of course, again equation (1), but these two formulas show more than equation (1). It will be seen from (2) and (3) that in the dischrage of $2 \times 96{,}540$ ampere-seconds the chemical reactions at the electrodes cause the formation of one molecule of water at the Fe plate, and the consumption of one molecule of water at the NiO_2 plate, so that the solution at the Fe plate thereby becomes less concentrated, and that at the NiO_2 plate more concentrated.

For the chemical reactions (2) and (3) we assumed that 2 ions OH and 2 ions K are set free at the iron and nickel plate, respectively. How did they come there? The theory assumes that they have come there by migration, that all positive K ions have migrated with a certain speed in the direction of the current, and all OH ions with a certain speed in the opposite direction. The question of the relative speeds of the two kinds of ions was first discussed by Hittorf. Let us assume we have at the beginning of the electrolysis m ions K and m ions OH in the solution. To get a convenient mechanical illustration of Hittorf's views, let us think that the m ions K are arranged one after the other in a straight line between the iron and nickel plates, and the m ions $O\,H$ one after the other also in a straight line at the side of the K ions. It will be seen that each positive ion has a negative ion at its side, so to speak, as a partner. In order to compare the relative speeds of the two kinds, we divide the lines of ions into two parts by an imaginary plane, normal to the direction of the current, and ask: How many positive K ions cross this plane in one direction and how many negative $O\,H$ ions cross this plane at the same time in the opposite direction?

The number of K ions set free by a given number of ampere-seconds at the cathode may be n, the number of $O\,H$ ions set free at the anode, must then also be n. From this alone we cannot say how many K and how many $O\,H$ ions have crossed our imaginary plane in opposite directions. For we might assume that only the K ions traveled and the $O\,H$ ions remained at their places; if n K ions and no $O\,H$ ion cross the imaginary plane, every K ion passes along n $O\,H$ ions, and at the end of the time the n leading K ions have lost their partners and at the other terminal the n last $O\,H$ ions have also lost their partners. Or we might assume that the K ions remained at their places and only the $O\,H$ ions traveled in a direction opposite to the current; then if no K ions and n $O\,H$ ions cross the imaginary plane, every $O\,H$ ion passes along n K ions and at the end of the time the n leading $O\,H$ ions have lost their partners and at the other terminal the n last K ions have also lost their partners. Or we might assume that both kinds of ions travel in opposite directions, and that, say, y ions K cross the imaginary plane in the direction of the current and $n - y$ ions $O\,H$ cross it in the opposite direction; then, again, at each terminal n ions will loose their partners. We see, therefore, that the fact of n ions becoming free at either end, may be explained in any of these ways, or, in general, by the assumption that y ions K have crossed our ideal plane in one direction and $n - y$ ions $O\,H$ in the opposite direction, where y is a number between zero and n. But it will be seen at once that when we assume different values for y, we obtain different concentrations in each of the two parts in which the electrolyte is divided by our ideal plane; in other words, all other things being equal, the concentration in each of these parts of the electrolyte is a function of y. Hittorf has first worked out this idea, and by measuring the concentration changes at anode and cathode separately, he was enabled to determine the unknown value, called above y. This scheme will become more clear later, when we will apply it to the calculation of the concentration changes in the Edison cell from given values of y.

Hittorf has defined the "transport number of the cation" as the ratio of the number of cations crossing the above ideal plane, to the sum of the cations and anions crossing the same plane in the same time, i. e., the ration of y to n. In the same way he has defined the "transport number of the anion" as the ratio of the number of anions crossing that ideal plane to the sum of the anions and cations crossing the same plane in the same time, i. e., the ratio of $n - y$ to n. These definitions may obviously be given also in the following way: If u and v are the speeds of migration of cation and anion, respectively, the transport number of the cation is $u \div (u + v)$, and the transport number of the anion is $v \div (u + v)$. Any transport number is essentially a positive value between zero and 1.

We will now apply this scheme to the Edison battery. We place our ideal plane parallel to the electrodes through the central part of the cell, so that it represents a cross-section of the liquid between the two plates. The total solution is thus divided into two parts, which may be called briefly the iron part and the nickel part. As there is only very little solution between the plates, by far the greatest part of the solution is in the pores of the iron and nickel plates, and these are also the loci, where the electrolyte is required, because these are the loci of electro-chemical action. Now, suppose the volumes of the iron part and of the nickel part of the solution are equal—which supposition does not restrict in any way the general view of our investigation—and let, in the beginning of the discharge, the concentration of the solution be uniform at all points of the solution. Let there be a chemical molecules $K\,O\,H$ (comprising the K ions and $O\,H$ ions as well as the neutral, non-ionized molecules $K\,O\,H$) and c molecules $H_2\,O$ in the iron part of the solution and the same number of molecules in the nickel part of the solution. And further, let x be the transport number of K, hence $1 - x$ the transport number of $O\,H$. We have noticed above that when $2 \times 96{,}540$ ampere-seconds are given out by the battery during discharge, 2 ions K are set free at the nickel plate and 2 ions $O\,H$ at the iron plate. According to Hittorf's views, we must therefore assume that $2\,x$ ions K have crossed our ideal plane from the iron part to the nickel part of the solution and $2\,(1 - x)$ ions $O\,H$ have crossed the same plane in the opposite direction.

In considering first the iron part of the solution, we see that on account of migration $2\,x$ ions K have disappeared and $2\,(1 - x)$ ions $O\,H$ have appeared. Further, the chemical change of 1 gram molecule Fe to $Fe\,O$, according to equation (2), has caused the disappearance of 2 ions $O\,H$ and the formation of 1 molecule $H_2\,O$. Hence while we had at the beginning of the discharge a chemical molecules $K\,O\,H$ and c molecules $H_2\,O$, we have now $a - 2\,x$ chemical molecules $K\,O\,H$ and $c + 1$ molecules $H_2\,O$; hence during the change of 1 gram molecule Fe to $Fe\,O$, the number of the chemical molecules $K\,O\,H$ decreases by $2\,x$, and the number of the molecules $H_2\,O$ increases by 1. Both effects act together in diminishing the concentration of the solution at the iron terminal of the cell during discharge.

In the nickel part of the electrolyte $2\,x$ ions K have appeared and $2\,(1 - x)$ ions $O\,H$ have disappeared on account of migration. Further, on account of the chemical change of 1 molecule $Ni\,O_2$ into $Ni\,O$, according to equation (3), there disappear 2 ions K and 1 molecule $H_2\,O$, while 2 molecules $K\,O\,H$ are formed. Hence while we had at the beginning of the discharge a chemical molecules $K\,O\,H$ and c molecules $H_2\,O$, we have now $a + 2\,x$ chemical molecules $K\,O\,H$ and $c - 1$ molecules $H_2\,O$; hence during the change of 1 gram molecule $Ni\,O_2$ into $Ni\,O$, the number of the chemical molecules $K\,O\,H$ increases by $2\,x$ and the number of the molecules $H_2\,O$ decreases by 1. Both effects act together in increasing the concentration of the solution at the nickel terminal of the cell during discharge.

The results thus obtained for each part of the liquid separately may be summed up in the following statement: When 1 gram molecule O is transferred from the nickel plate to the iron plate during discharge, $2\,x$ gram molecules $K\,O\,H$ are transferred from the solution at the iron terminal to the solution at the nickel terminal, and 1 gram molecule $H_2\,O$ is transferred from the solution at the nickel terminal to the solution at the iron terminal. The concentration decreases at the iron terminal and increases at the nickel terminal, but the total concentration of the solution is not changed.

It is interesting to compare this result with an analogous calculation, made by Dr. W. Nernst for the lead accumulator (Dr. F. Dolezalek, Die Theorie des Blei Accumulators, Halle, 1901, p. 68), under the assumption that the chemical reactions at both electrodes during discharge are represented by the equations

$$Pb + S\,O_4 = Pb\,S\,O_4$$

and

$$Pb\,O_2 + H_2 + H_2\,S\,O_4 = Pb\,S\,O_4 + 2\,H_2\,O,$$

he finds that when 1 gram molecule Pb and 1 gram molecule $Pb\,O_2$ are changed into lead sulphate, w gram molecules $H_2\,S\,O_4$ disappear at the lead plate, while at the peroxide plate $(2 - w)$ gram molecules $H_2\,S\,O_4$ disappear and 2 gram molecules water are formed, where w is the transport number of H in sulphuric acid. According to Hittorf w is $= 0.81$ for an acid concentration of 20 per cent. Hence, at the spongy lead plate 0.81 gram molecules $H_2\,S\,O_4$ disappear, while at the peroxide plate 1.19 gram molecules $H_2\,S\,O_4$ disappear, and 2 gram molecules water are formed, so that the concentration decreases at both terminals. The total concentration of the solution must therefore also decrease.

I will now proceed to complete the calculation of the concentration changes in the Edison storage battery by introducing a numerical value for the transport number. I will give the calculation for both, $K\,O\,H$ and $Na\,O\,H$, as electrolyte. In Ostwald's Lehrbuch der allgemeinen Chemie, v. II., pp. 606 and 608 (1893), a summary of the determinations of the transport numbers x of the cations in these electrolytes at different concentrations is given:

	Liter per gr. mol.	x		
$K\,O\,H$	1.75	0.255	0.285	W
	1.2	0.261	K	
	5.3	0.270	K	
	9.7	0.258	K	
$Na\,O\,H$	0.8	0.161	0.153	W
	0.92	0.173	K	
	3.5	0.200	K	
	9.2	0.157	K	

The transport numbers, marked W, were determined by Wiedemann, those marked K by Kuschel. It seems therefore that the highest concentrations for which determinations of the transport numbers in these electrolytes have been made, are 1 gram molecule per 1.2 liter for $K O H$ and 1 gram molecule per 0.8 liter for $Na O H$, i. e., solutions containing about 5 per cent by weight of the electrolyte. The solution in the Edison battery contains between 10 and 40 per cent by weight of $K O H$, and is therefore considerably stronger. I will assume 0.25 as the transport number of K in $K O H$ and 0.16 as the transport number of Na in $Na O H$, i. e., I assume that the $O H$ ions travel with a speed three times that of the K ions, and a little more than five times that of the Na ions. These values are to be considered, of course, as approximate values only. We obtain then the following results for $K O H$ as electrolyte: When 1 gram molecule O is transferred from the nickel plate to the iron plate during discharge, 0.5 gram molecules $K O H$ are transferred from the solution at the iron terminal to the solution at the nickel terminal, and 1 gram molecule $H_2 O$ is transferred from the solution at the nickel terminal to the solution at the iron terminal. For $Na O H$ as electrolyte the result is exactly the same, except that here 0.32 gram molecules $Na O H$ are transferred from the solution at the iron terminal to the solution at the nickel terminal. This result corresponds to a discharge of 2 × 96,540 ampere-seconds. We can, therefore, express this result also in the following form:

When the battery gives out in discharge 1 *ampere-second, the changes in the battery, due to the migration of the ions and to the electro-chemical processes at the electrodes consist in the transfer of*

$$\frac{1}{2 \times 96{,}540} = 0.0000052 \textit{ gr. mol. } \mathrm{O}, \textit{ or } 0.000083 \textit{ gram } \mathrm{O} \textit{ from the}$$

nickel plate to the iron plate, the transfer of 0.0000026 *gr. mol.* $\mathrm{K O H} = 0.000146$ *gram* $\mathrm{K O H}$ [*or in a* $\mathrm{Na O H}$ *solution* 0.0000017 *gr. mol.* $\mathrm{Na O H} = 0.000068$ *gram* $\mathrm{Na O H}$] *from the solution at the iron terminal to the solution at the nickel terminal, and the transfer of* 0.0000052 *gram molecule* $\mathrm{H_2 O}$ *or* 0.000094 *gram water from the solution at the nickel terminal to the solution at the iron terminal. This result is entirely independent of the nature of the metals used for the electrodes and ought to be valid for the Edison nickel-iron cell as well as for any other form of this general type of battery.*

It may be well to concisely sum up again the suppositions from which this result has been deduced: They are, first, that the transport of electricity through the solution is accomplished by the ions K and $O H$ in a $K O H$ solution, and by the ions Na and $O H$ in a $Na O H$ solution, the $O H$ ions traveling with a speed three times that of the K ions and 5 times that of the Na ions; and, second, that the chemical reactions at the electrodes are those represented by the equations (2) and (3).

We have so far only considered the changes in the cell directly due to the migration of the ions and to the electro-chemical reactions at the electrodes, and we have found that if our suppositions are correct, during discharge the solution becomes less concentrated at the iron plate and more concentrated at the nickel plate. We must now also take into account the diffusion which sets in as soon as any concentration differences develop. There will also be convection currents. During the whole discharge there will be diffusion and convection, with the result that when the cell has run for some time the concentration changes will be less than found by the calculation given above, because diffusion and convection have then had time to act against the concentration differences. The values, found by the above method of calculation, therefore represent only the upper limit which the concentration changes would reach, if there would be no diffusion and convection. The concentration changes, due to the migration of the ions and to the chemical processes at the electrodes, depend only upon the number of ampere-hours given out by the cell; diffusion which counteracts these concentration changes depends upon the time of the discharge; the quicker a given number of ampere-hours is given out by the cell, the less will be diffusion, and the more nearly will the real concentration changes have the values found by the above calculation, provided that there are no convection currents.

For instance, if one ampere-hour is given out by the cell, the above calculation gives the result for $K O H$ as electrolyte that $3600 \times 0.000146 = 0.526$ gram $K O H$ are transferred from the solution at the iron plate to the solution at the nickel plate, and 0.338 gram $H_2 O$ from the solution at the nickel plate to the solution at the iron plate. These theoretical values represent the upper limits for the possible concentration changes which will be valid for an instantaneous discharge, say, 3600 amperes in 1 second; with a slower discharge, say, 1 ampere in 1 hour, diffusion and convection have time to destroy the developing concentration differences. The above method of calculation enables one, therefore, to predetermine the amount of electrolyte required for an instantaneous discharge, or, in other words, for high discharge rates. For low discharge rates, however, diffusion and convection may be relied upon to suppress concentration differences, so that only enough electrolyte is required to wet the plates in order to enable the chemical reactions at the plates to take place.

By a calculation, entirely analogous to that of the discharge, we can also investigate the processes during charge. They are exactly the reverse processes. While during discharge the concentration decreases at the iron plate and increases at the nickel plate, we have during charge an increase of the concentration at the iron plate and a decrease at the nickel plate. In both, charge and discharge, the decrease of concentration occurs at the anode. For high rate charges and discharges the anode therefore represents the weak point where there is a possibility of "polarization" setting it. As Mr. C. J. Reed has pointed out in a recent Franklin Institute paper (*Jour. Frank. Inst.*, June, 1901), the "polarization" of an electro-chemical cell may be defined as "electro-chemical fatigue." It is caused by the exhaustion of the reagents at the loci of electro-chemical action and their consequent replacement by other substances which produce a new electro-chemical action. This would occur in the Edison cell at the anode, if during a quick discharge or charge all $K O H$ or $Na O H$ molecules would be removed from the neighborhood of the anode to the cathode. In practice, it is, therefore, important that diffusion and convection should freely act to bring fresh electrolyte to the anode. For a proper test of the theory, given above, it would, however, be necessary to eliminate diffusion and convection. For this purpose the cathode should be placed horizontally at the bottom of the jar containing the solution, and the anode should be suspended horizontally at the top of the solution. The solution would, according to the theory, concentrate at the cathode which is at the bottom. Convection currents are prevented by placing the plates in parallel and horizontal position at the top and at the bottom. To prevent also diffusion, the cell should be charged or discharged quickly enough. By such an arrangement concentration changes should be obtained which should have approximately the theoretical values.

Let us consider also a case important practically: If at the beginning of a charge the concentration is uniform throughout the cell and we charge it rapidly at a high rate, and after the charge has been completed, we discharge it at once, we should, according to the above theory, have the solution more concentrated at the iron plate and less concentrated at the nickel plate at the beginning of the discharge. During discharge all influences—diffusion, the migration of the ions, and the chemical processes at the electrodes—tend together to decrease the concentration at the iron plate and increase it at the nickel plate. If, however, after the battery has received a full charge, we do not begin at once to discharge it, but leave it at open circuit, diffusion and convection will destroy the concentration differences until the concentration is uniform throughout the liquid, and when we then begin with the discharge, the migration of the ions and the chemical processes at the electrodes tend to decrease the concentration at the iron plate and increase it at the nickel plate, while the diffusion tends to keep the concentration uniform. From the theory one should expect in these two cases of discharge differences in the curves of discharge, especially in the first part and perhaps also in the last part of the curves.

A few words may be added to point out some important differences between the concentration changes in the lead accumulator and our theoretical concentration changes in the Edison battery. In the Edison battery the concentration decreases during discharge at the iron plate and increases at the nickel plate, but the total number of water molecules and $K O H$ molecules remains unchanged. In the lead accumulator the concentration decreases during discharge at both plates. In both batteries diffusion and convection will bring fresh electrolyte to the places of lower concentration. In the lead accumulator the electrolyte diffuses from the part between the plates to both sides into the pores of the plates. The concentration in the middle part, therefore, also decreases. In the Edison cell diffusion of the electrolyte takes place from the pores of the nickel plate to the pores of the iron plate. The concentration of the solution, taken as a whole, is not changed, nor can that of the solution between the plates be changed to any considerable degree, so that the above theory of concentration changes in the Edison battery is not in disagreement with the statement of Dr. Kennelly that "the specific gravity of the electrolyte does not appreciably vary during charge and discharge," as it might be supposed that the measurements of specific gravity have been made in the liquid in the middle part of the cell between the two plates.

From the point of view of our theory there appear to be reasons why the diffusion should act more quickly in the Edison battery than in the lead accumulator. The diffusion is the greater, the greater the differences of concentration and the nearer the places of different concentration. In the lead accumulator the solution in the middle part of the cell, while not altered by the immediate action of the current, diffuses to both sides, as at both sides the concentration has decreased. In the Edison cell there is practically no middle part of the cell, and the places of the concentration differences in the pores of the two plates are very near together, so that diffusion brings the solution from the pores of the nickel plate, where the concentration increases to the pores of the iron plate, where the concentration decreases.

There is another, apparently very important point. We know that the form of the charge and discharge curves of the lead storage battery, and the whole question of the "reversibility" of its action, are intimately connected with the concentration changes in the pores of the two plates (see the book quoted above by Dr. Dolezalek, Chapters VIII. and IX.). The question naturally arises: Are the concentration changes which must occur in the Edison battery according to the theory given in this article of an analogous importance for the working of the Edison cell? But it seems to me premature to attempt an answer to this question as long as experimental data are lacking regarding the influence of the concentration of the solution upon the e. m. f. of the cell and especially upon the e. m. f.'s at both terminals separately.

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The Arons Mercury Arc.

By E. C. Roberts.

THE interest excited by the demonstration before the American Institute of Electrical Engineers, at its recent Conversazione, of the mercury lamp of Mr. Peter Cooper Hewitt, has made it seem worth while to call attention to another research carried out along similar lines by L. Arons, in Berlin. In *Wiedemann's Annalen*[1] he published a description of what he called a mercury arc light (das Quicksilber Lichtbogen). He says of it, "While studying gaseous conduction I discovered an extraordinarily good arrangement for maintaining an arc between mercury electrodes for long periods and without any of the usual troubles incident to such cases."

The apparatus usually took the form shown in the drawing. Here the short leg of an L-shaped tube is sealed off, and provided with an electrode. The other end of the tube is open, and is connected to a mercury reservoir by a rubber tube. The tube is exhausted to a vacuum corresponding to a pressure of 1 or 2 mm. of mercury. When in use the electrodes are connected through a controlling resistance to a source capable of maintaining a difference of potential of about 100 volts. In starting the arc, the mercury is raised in the tube by means of the reservoir till it flows over into the short leg. It is then immediately lowered. As soon as the mercury breaks at the top, a brilliant discharge passes from one electrode to the other. Its color is a greenish white. In two later papers[2] he gives the following results:

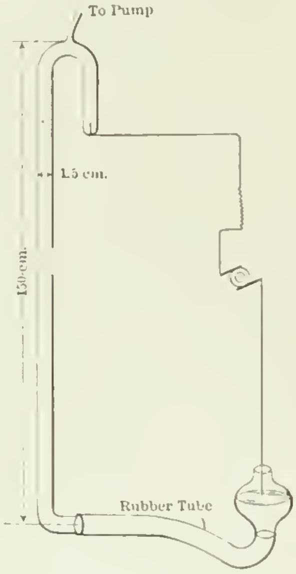

DIAGRAM OF MERCURY ARC APPARATUS.

1. At currents between 5 and 9 amperes the voltage drop is principally dependent on the length of the tube. Experiment showed that the drop per cm. was approximately .6 volt for a current of 6.5 amperes. The electrode loss is 8 volts at the anode and 6 volts at the cathode.

2. The specific conductivity of the vapor is 6×10^{-10}, which is 8 times as great as that of the best conducting solution of sulphuric acid.

3. The temperature of the discharge was great enough to melt thin platinum wire at the center of the tube. The average temperature was 470 degs. C. above that of the room, while computation based on Warburg's experiments[3] showed that at the center, with a current of 6.5 amperes, the temperature should reach 4600 degs. C.

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Storage Battery Patents.

Among the patents of June 4 are three issued to W. J. Buckley on novel forms of storage batteries. One of these is a high-tension battery—that is, one in which the e. m. f. of each pair of plates is added to that of its neighbor, a number of pairs being contained in a receptacle common to all the elements. The receptacle is divided into compartments by liquid-tight metallic partitions; on one side of a partition and in metallic connection therewith is a positive plate and on the other side a negative plate. These plates do not quite extend to the bottom of the receptacle, so that the electrolyte in a single compartment is in communication with the two partitions of that compartment and the two sides of both plates therein. Another patent describes a battery formed of a number of similar plates, separated by a continuous metal band around the edges of each pair. Any flat plate or grid may be used having a solid metal core or otherwise made liquid tight, should the various elements be included in a serial circuit. When, however, the battery plates are intended to be placed in a cell having an electrolyte common to all the plates, as when in parallel circuit, then the liquid-tight quality of the plates is not essential. In the space formed between plates by the separating metal band is placed powdered or granular carbon, such as wood charcoal. The inventor states he has found that the charcoal used as a separator has the quality of absorbing gases to a high degree. The gas is readily absorbed as fast as evolved, and while the charcoal is to some extent an electrical conductor, and while it is also true that there is a natural electrical potential difference between the carbon and the metallic electrodes, which difference may produce a slight local action in the cell, yet he states that the benefit derived from the use of charcoal over-balances this objection.

A third Buckley patent describes a battery formed of superposed trays separated by an insulating material in the form of a grid. Small notches are cut in the tops of the grid cross bars to give passage to the electrolyte. The grid compartments are filled with coke and oxide of lead. A number of such tray elements are nested to form a cell. The lower tray rests in a wood support the shape of the bottom of the tray, and a similar one, but convex, fits into the upper tray, the two being bolted together A patent issued on the same date to G. W. Hough, describes a battery consisting of plates of semi-circular form, with pockets formed by cross ribs for the active material, which is filled in flush with the tops of the ribs. The plates are set up in a horizontal position, the negatives forming one half-cylindrical pile, and the positives another similar pile, the whole forming approximately a cylinder, with the two piles electrically separated. Conducting lugs are cast to the edges of each pile.

A patent issued on the same date to C. L. R. E. Menges, The Hague, Holland, describes a storage battery of cellular construction, in each compartment of which are plates of only one polarity. In its simplest form, the receptacle consists of a number of chambers separated by non-conducting permeable partitions. In one chamber there are two positives, one in contact with each partition, and in each of the adjacent chamber two negatives in contact with the respective partitions, and so on. In a practical cell the non-conducting permeable partitions may consist of a supporting piece of insulating material with perforations and channels covered by a porous non-conducting substance, and with active material on both sides. In a patent issued June 11 to V. G. Apple a "two-cell integral unit" battery is described. A lead or alloy case or box is divided in the center by a partition of similar material, thus forming two compartments. The interior surfaces of each compartment is provided with indentations for containing active material, space for the electrolyte being left after the active material is applied. Each of such cells we give four volts. A patent granted June 18 to Wilson H. Abbey and Jacob Altmos describes an element formed of a corrugated sheet bent to and fro horizontally to form a series of parallel shelves and approximately circular channels between the shelves. The longitudinal corrugations or crimps have spans or lips punched in them at intervals, thus providing openings for the circulation of the electrolyte, and at the same time giving strength to the structure, the span thrust out by the punching bracing the corrugation. The troughs formed by the corrugations are filled with active material, after which the opposite ends of the shelves are dipped into molten lead, thus encasing the element—the lowermost shelf not being perforated.

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[1] *Wied. Ann.*, 1892, page 767.

[2] *Wied. Ann.*, 1895, page 625.

[3] *Wied. Ann.*, Vol. 58, page 77, and Vol. 62, page 569.

Convention of the Canadian Electrical Association.

The eleventh annual convention of the Canadian Electrical Association convened on Wednesday, June 19, at 10 o'clock a. m., at the Russell House, in the city of Ottawa, Ont., and remained in session until Saturday morning, June 22.

The president, Mr. A. A. Dion, of the Ottawa Electric Company, occupied the chair, and the following other officers were in attendance: First vice-president, Mr. E. E. Cary, Montreal; second vice-president, Mr. P. G. Gossler, superintendent Royal Electric Company, Montreal; secretary-treasurer, Mr. C. H. Mortimer, *Electrical News*, Toronto; executive committee, Mr. J. J. Wright, manager Toronto Electric Light Company; Mr. Ormond Higman, chief of Electrical Inspection Department, Ottawa; Mr. A. B. Smith, superintendent G. N. W. Telegraph Company, Toronto; Mr. D. R. Street, secretary-treasurer Ottawa Electric Company, Ottawa; Mr. B. F. Reesor, manager Electric Light & Power Company, Lindsay; Mr. W. H. Browne, manager Royal Electric Company, Montreal; Mr. John Yule, manager Guelph Light, Heat & Power Company, Guelph.

The attendance of members and friends was one of the largest in the history of the association, and the addition of many new members was an indication of the increasing and widening interest in the association.

The complete success of the convention was largely due to the president, Mr. A. A. Dion, general superintendent of the Ottawa Electric Company, and the members of the local reception committee. The electric roads and the doors of many of the clubs were thrown open to the members of the association while in the city.

Mayor Morris, Aldermen Deering and Des Jardines delivered addresses of welcome to the convention. President Dion said it was not his intention to take up the time of the convention with a lengthy address, as the topics usually dealt with, namely, the progress and development of electrical science and industries during the year, had already been fully delineated by the lay and technical press.

He was happy to be able to welcome the members this year to his own city, as he had hoped to do in 1900, but in which he had been disappointed, owing to the disastrous fire which had devastated a large portion of the city of Ottawa during that year.

The report of the secretary-treasurer, Mr. C. H. Mortimer, showed a total membership of 267, composed of 235 active and 32 associate members, being a gain since the last convention of 23.

Mr. J. J. Wright presented the report of the Legislation Committee, showing effective work being done by that committee, but deploring the lack of support received from companies receiving the benefits of the work of the committee, and urging upon the association the need for financial aid, as during the coming year the committee would have plenty of work before them, it being likely two important questions would be taken up by the Government, that of company assessment, and the Conmee bill, which provides for the taking over by any municipality of the existing plant supplying light and power, in cases where municipal ownership is desired.

Mr. O. Higman reported for the committee on "Arc Lamp Rating," stating that an amendment to the act had been made at the last session, whereby power was given to fix a standard rating. With this amendment the committee would be in a position to do good work during the coming year.

Mr. F. Nicholls, of the Canadian General Electric Company, voiced the sentiments of many members when he said he had always felt and felt strongly that the executive officers of the association should be chosen solely from members actively engaged in operating companies; and that it was a serious mistake and a menace to the future well-being of the association to have the offices open to those representing manufacturing, supply and other commercial companies, whose interests were to sell supplies to the active members of the association. He thought the fact that there was not a larger number of central station men attending the conventions was due to this cause, and the thought they entertained, whether true or no, that the association was controlled by the selling companies.

Owing to the sickness of Mr. H. L. Doherty, of New York, a paper by him on "Rates for Electric Light," which had been looked forward to with a great deal of interest, had to be foregone.

A paper by Mr. K. B. Thornton on "The Construction and Protection of Aerial Distribution Systems," considered the selection, fitting and location of poles and stringing of lines thereon. This paper will be printed in full in these columns. In another issue will also appear abstracts of papers by Professor R. B. Owens and Mr. J. R. Robertson, the title of the former being "Conversion from Alternating Constant-Potential to Alternating Constant-Current, and of the latter, "The Influence of the Load Factor on the Design and Operation of a Lighting and Power Plant."

DOMINION TESTING LABORATORY.

Mr. O. Higman, of Ottawa, read a paper on the work done under his direction to carry into effect the provisions of Canadian legislation passed in 1894 providing defining electrical units and certain standards.

The resistance standards consist of a Board of Trade and a Reichsanstalt ohm. The laboratory also possesses a resistance box containing 10 1-ohm coils with suitable plugging arrangements for putting the coils in series as a 10-ohm standard, or in multiple as a 1-10-ohm standard; a Kelvin resistance coil of 100,000 ohms with 10 sub-divisions of 10,000 ohms each arranged with plugs for connecting in series or in parallel or any combination of series and parallel, and a Wheatstone Bridge (Anthony pattern) with ratio coils 1, 10, 100, 1000 and 10,000 on each side with bridge coils of tenths, units, tens, hundreds and thousands. These coils are made of manganin specially selected and the box is fitted with an electric thermometer. Measurements of great accuracy can be obtained with this bridge used in conjunction with a sensitive reflecting Darsonval galvanometer. Intercomparisons between the standards are made from time to time, and records kept of their variations.

For the measurement of current a set of Kelvin balances are provided, ranging from 0 to 125 amperes, and for the measurement of power a Kelvin watt balance of 100 amperes and 200 volts. For graduation and standardization a silver voltmeter is used, and a Crompton pentrometer is now being installed. For the measurement of current the "Vienna" method is also employed in connection with a Weston milli-voltmeter.

For measurement of e. m. f. there are two standard Clark cells, three Hibbard cells and a set of six Kelvin special standard multicellular electrostatic voltmeters. Weston voltmeters are used for secondary standards. For photometric measurements a Bunsen photometer and standard sperm candles are used.

A committee was appointed to consider requesting the Dominion Government to establish a bureau for comparing, testing and calibrating instruments under in measuring current and e. m. f. This, it was thought, would be a great advantage, owing to the difficulties at present experienced in having to send these instruments to the manufacturers in the United States for calibration.

BALANCING THREE-WIRE ALTERNATING SECONDARY SYSTEMS.

In a paper with the above title, Mr. L. Denis described the method used by Jacques Cartier Water-Power Company, of Quebec, for keeping its three-wire secondary network in proper balance.

The lighting territory is divided into several districts fed by separate single-phase primary feeders, the power service being supplied for separate circuits. In each district there is a main bank of transformers connected to 108-volt, three-wire secondary mains. The transformers are separated from each other by fused junction boxes in the two outside secondary wires and set midway, electrically, between transformers. The primary feeders are regulated by means of Stillwell regulators from readings taken at different points of each of the banks and carried to the station by pressure wires; the neutral wire is also carried back to the station, so that readings are obtained on each side of the three-wire system.

To apply the method, it is necessary to know (1) the side of the secondary circuit to which the connection is made, (2) what transformer in the bank the connection is made on, (3) what the approximate demand will be.

The method employed to ascertain these three facts is as follows: For each consumer to be connected a form is filled out, giving the name and address; from the latter the supply transformer is determined, and by referring to the record the best side to connect the consumer is determined. The slip is thus filled out and handed to the service foreman, who returns it to the office as soon as the work is completed. If however, for some reason it is found impossible to follow the slip to the letter, it is handed back showing the actual manner in which the connection was made.

As to the manner in which one side of the secondary is distinguished from the other, the three wires are strung on a four-pin cross-arm, using three consecutive pins, and the same relative position is maintained all along the line. This gives at each pole the same two wires (one outside and the neutral) separated by the pole; and the other two (the other outside and the neutral) with nothing between.

As to the second point, maps of the different districts of the city are kept up-to-date, and show the secondary line and taps, and the exact position of transformers and junction boxes. Knowing a consumer's address, his exact location is ascertained and the transformer feeding the nearest mains determined. The transformers are distinguished from each other by numbers painted thereon.

When it found from the records that a transformer in a bank is being overloaded, it becomes necessary to have the transformers at that point nearer one another, which means that another transformer has to be inserted, and possibly the existing ones moved. To get at the best position for this new transformer, what may be termed "trial records" are made out from the original connection slips belonging to the transformer or transformers to be relieved, by placing the new transformer and its junction boxes in different imaginary positions on the map, and choosing the position which gives the best results on these "trial records." These "trial records," although very nearly correct, cannot be relied upon as absolutely accurate, and an inspection of the line has to be made after all changes are completed to determine exactly what customers have been changed from one transformer to the other, and the records are changed accordingly.

As to determining the demand of consumers, this is governed mainly by the rate under which a consumer contracts, but in some cases also by the class of consumer to be served. For ordinary meter consumers (residences and stores of moderate size), 40 per cent of the total installation is taken as a maximum demand; for the larger stores and manufacturers individual factors are assigned, which generally vary from 75 per cent to 90 per cent of total installation. For consumers on the flat rate, 90 per cent of total capacity contracted for is taken. Consumers on limited capacity system are the most easily dealt with, as naturally the maximum demand contracted for must be taken as their maximum demand without introducing any factor whatsoever.

As indicating the success of the system described, it is pointed out that in spite of the very rapid growth of the plant (over 30,000 lamps of 16 candle-power having been connected in about one year) not one case of burnt-out transformer from overload has occurred, and only three cases of blown fuses.

In answer to an inquiry, Mr. Denis said that the "fused junction box" referred to in his paper was an ordinary street car motor fuse box. The fuse to be used should not be above a third of the capacity of the transformers that are banked. Sometimes this had to be exceeded in cases where proper line arrangements could not be obtained. These junction boxes were inspected every weak and any fuse which was blown replaced, the ordinary common fuse being used.

Topical discussions were had on "The Best Practice in Cleaning, Trimming and Inspection of Enclosed Arc Lamps," and "The Different Systems of Charging for and Measuring Power Consumed by Induction Motors with Varying Power Factors."

Mr. F. H. Leonard, Jr., said there was a variety of methods in vogue, one being that of charging a fixed rate per horse-power which was in a measure modified by the amount of power used on the average. There was one suggestion in connection with this which was that the time for using the power should be limited to certain hours to prevent overlapping the lighting load.

Some of the members thought if the consumers of power were approached properly there would not be much difficulty in obtaining contracts on this basis, unless in exceptional cases. The method of charging on a meter basis for the motor load was necessarily a heavy tax on the consumer of power, as it meant the carrying of reserve apparatus by the power companies, and they must have a price which would compensate them for the carrying of such reserve apparatus.

Mr. J. J. Wright presented the report of the Nomination Committee to strike the standing committees, which, on motion was adopted and is as follows:

Committee on Statistics.—Messrs. A. A. Wright, K. B. Thornton and J. F. H. Wyse.

To Confer with Underwriters.—Messrs. P. G. Gossler, Edward Slade, A. A. Dion, Alderman Sadler, A. Sangster and J. J. Wright.

On Arc Light Rating.—Messrs. O. Higman, P. G. Gossler, Fred Thomson, John Yule, Professor Owens, J. M Robertson and Mr. Lambe.

On Legislation.—Messrs John Yule, B. F. Reesor, A. A. Wright, C. B. Hunt, W. H. Browne, A. A. Dion, W. H. Briethaupt, R. O. McCullough and J. J. Wright, with power to add to their numbers.

On Standardization of Accounts.—Messrs. D. R. Street, A. A. Wright and Mr. Henshaw. (Same committee continued.)

The social programme for the convention was excellently prepared and timed. It consisted in the annual banquet, at which about 150 members and invited guests sat down. A band concert at Brittania-on-the-Bay was given through the courtesy of the Ottawa Electric Railway Company; an exhibition by the Ottawa Fire Department was given at Hotel Cecil, followed by a trip to Rockliffe Park and Rife Ranges; a visit to power houses and other points of interest at the Chaudiere. Trip to Queen's Park, Aylmer, through the courtesy of the Hull Electric Company, stopping at Deschenes Rapids to visit the power houses of the Hull Electric Company and the Capital Power Company. There was also tendered by the citizens of Ottawa a carriage drive around the city. The association was photographed on the main steps of the Parliament Buildings The election of officers, which took place on Friday morning, resulted as follows:

President, P. G. Gossler, Montreal, Quebec; first vice-president, B. F. Reesor, Lindsay, Ont.; second vice-president, Edward Slade, Quebec City; secretary-treasurer, C. H. Mortimer, *Electrical News*, re-elected.

Executive Committee (five members re-elected)—Messrs. J. J. Wright, Toronto; John Yule, Guelph; A. B. Smith, Toronto; W. H. Browne, Montreal, and O Higman, Ottawa. (Five new members elected)—Messrs. A. A. Dion, Ottawa; J Murphy, Ottawa; A. Sangster, Sherbrooke, Quebec; W. G. Holman, Quebec City, and K. B. Thornton, Montreal, Quebec

The committee on drafting amendments to the constitution re-membership brought in a report, but owing to a provision of the constitution that this report could not be adopted until the following day after its presentment, and in order that it might not lie over for another year, a special meeting was called for Saturday morning, after which the convention adjourned to meet in Quebec City in 1902.

St. Lawrence Power Company.

The new electric development works of the St. Lawrence Power Company, at Sheik's Island, Ont., were primarily intended for the sole purpose of lighting the Cornwall canal, but the company will probably transmit power also to Montreal. The power for the working of the plant will be supplied by water from the Cornwall canal, through a very short head race, and will discharge directly into an old channel of the river St. Lawrence. The first development will provide for 4000 horse-power, under a head varying from 20 to 30 feet. There will be installed at once 1000 horse-power. It is expected that 15,000 horse-power will be developed when the demand warrants the production of this amount. The generators to be installed are of the rotating field type, of 750-kw capacity, designed to deliver three-phase currents at 2200 volts. There will be two exciters, each of 50-kw capacity, and either one is sufficient to excite the four generators which will make up the capacity of the station. The step-up transformers, of the air-blast type, are to be installed on the first floor of the wire tower, where the potential will be raised from 2200 volts to 11,000 volts. The circuits will fan out in both directions from the tower, to heavy station poles. Cedar poles, trimmed and painted, will take the lines mostly along the south bank of the canal. The lighting and power lines are supported by the same poles, which are spaced about 100 feet apart, every fourth pole supporting a series alternating enclosed arc lamp. The locks are provided with from six to thirteen lights, and motors are provided for handling the sluice gate and for opening and closing the lock gates. The generators, exciters and other station equipment will be installed by the Bullock Manufacturing Company, of Cincinnati, Ohio. Messrs. T. Pringle & Son, of Montreal, are engineers for the entire installation.

Twentieth Annual Convention of Railway Telegraph Superintendents.

THE twentieth annual meeting of the Association of Railway Telegraph Superintendents was held at Statler's Hotel, Buffalo, N. Y., on June 19, 20 and 21. The first session was called to order at 10.15 a. m. Wednesday by President W. F. Williams. He called on Mr. Henry W. Pope, a resident member of the association, who made a few remarks of welcome. After referring to Buffalo and its many attractions, he extended to the ladies of the party an invitation to visit the Bell Telephone Company's exchange in the afternoon, where a luncheon would be served. He also extended, on behalf of the general manager of the Long-Distance Telephone Company, and of his own company, the Buffalo Company, the courtesy of free telephone service during the convention. Another courtesy extended by Mr. Pope on behalf of his company was a trip to Niagara Falls by special trolley car, which was set for Thursday afternoon. After doing the honors, Mr. Pope referred to the new work of his company. The service, he said, had been entirely renovated, and when the improvements were completed the Buffalo Company would have a plant modern throughout, which would equal any in the world.

Mr. Charles Selden, on behalf of the association, replied in a fitting manner to Mr. Pope's welcome, after which the business of the meeting was taken up. After the election of new members, Secretary-Treasurer Drew read his report for the past year. The report showed the association to have a balance on the right side of the account, the association being free from debt.

The next order of business was the election of officers and the selection of the place for the next meeting. It was decided to go to Boston. The following-named gentlemen were elected for the ensuing year: President, C. F. Annett, of Chicago; vice-president, F. B. Valentine, of Boston; secretary-treasurer, P. W. Drew, of Milwaukee. Mr. Annett was at once conducted to the chair. He thanked the association for the honor conferred upon him. Mr. Valentine, the new vice-president, also made a few remarks of like nature.

The secretary read a letter from Mr. T. A. Edison in reply to an invitation from President Williams to attend the meeting. Mr. Edison expressed his regrets at not being able to be present. He stated that his absence in the South and the consequent accumulation of laboratory work, together with the great demands upon his time in connection with the bringing out of his new storage battery, kept him so closely applied that he could not spare the time to attend.

Secretary Drew also read a letter from the Interstate Commerce Commission asking for a sketch of the association and its work, for the purpose of incorporating the same in the Commission's report. Mr. Drew stated that he had supplied the desired information. Several letters were read from electrical exhibitors at the Pan-American Exposition inviting the members to visit their exhibits.

The next order of business was of a rather unique character. A Phillips-Morse transmitting instrument had been connected up in the meeting room, and it automatically transmitted a story entitled "Troubles on No. 4 East." "No. 4 East" was a celebrated press report wire several years ago between Boston and New York. The operators constituted a rather exclusive set, and when a strange operator chanced to be assigned to that wire at any one of the many offices on the circuit he always received a warm reception. The story ticked off on the instrument was a reproduction of the work on "No. 4 East" on an occasion of this sort, and created much merriment among the members, especially those who had been personally familiar with the peculiar ways of the "No. 4 East" clique. After the instrument had told its story, Mr. J. J. Ghegan read a paper prepared by Mr. Walter P. Phillips, entitled "Rapid Telegraphy," an abstract of which will be given in a subsequent issue.

This paper was followed by one read by Mr. Selden, in which was described an instrument called the "Voltaplex," devised by Mr. H. D. Bartholomew, of the Baltimore & Ohio Railroad at Newark, Ohio. The principle of the Voltaplex is analogous to that of simultaneous telegraphy and telephony and the phonoplex system of telegraphy, in that graduating apparatus is employed to avoid interference between the two sides of the usual artificial line of the duplex system. The Voltaplex instruments are connected in the line as an auxiliary to the Morse system, and are operated entirely independent of the latter, neither system interfering with the other in any particular. The effect of the graduating device of the voltaplex upon the line is to slightly prolong the Morse signals and to absorb the extra current at the moment of make and break of the Morse circuit. A condenser affords a path to ground for the voltaplex currents. The transmitting coil is of special construction. There is no transmitter in the arrangement; the key, relay and sounder comprising the only instruments with which the operator has to do. The construction and operation of the special apparatus in its relation to regular circuits were illustrated by means of diagrams. The voltaplex, as an open circuit system for equipping lines independent of the Morse, it is thought, should find a large field. Very satisfactory results have been obtained in various tests made over wires of different lengths and capacities, a recent test between Newark, Ohio, and Pittsburg, Pa., a distance of 180 miles, over a No. 10 copper wire, gave exceptionally good results.

Mr. W. E. Athearn then read a paper giving an account of his experience with storage batteries in telegraphic work, with some information as to the care of cells. At the Jersey City terminus of the Central Railroad of New Jersey 500 local gravity cells were displaced in 1894 by storage batteries. The first cost of the storage plant was a little over $200. No expense was entailed for the first two years, but a new set of positive plates was put in at a cost of less than $100. At the end of six years a complete new battery was furnished, but many of those cells are still in use where the demands of capacity are lighter.

A simple rule given as to the capacity of batteries is to allow one ampere-hour for each single telegraph wire that is to be supplied. This is based on a 24-hour service, ample allowance being made for the gradual wearing out of the cells. An experience of over five years with nearly 20,000 storage batteries has demonstrated the correctness of this rule.

At Jersey City there are two distinct sets of batteries for the main lines. One set furnishes current to the telegraph wires for 24 hours and is then put on charge over night, while its companion bank of cells takes care of the telegraph service during the succeeding 24 hours. This makes the work easy for both banks, and would permit the maintenance of the service for four days, even if the electric light plant should fail, and no fresh charge could be put into the cells for that length of time. The locals are also taken care of by the use of four cells of 125 amepere-hour capacity. Two cells charge in series and discharge in multiple. One leg of the electric light branch that furnishes light to the operating room, is looped down, so that all the current passing to these lamps also passes through the two storage cells in series. This causes a drop in voltage of that particular room from 110 to between 105 and 106 volts. Lamps of the latter voltage are used, when full candle-power is expected from them. The reason for using four cells, instead of two, is that the current in that particular branch of the light service would not put sufficient charge into one storage cell to enable it to supply the 20 or 30 4-ohm sounders they require in their service.

In the discussion of Mr. Athearn's paper, Mr. Jacoby, of the Lehigh Valley Railroad, gave the experiences on his lines with storage batteries. Prior to the adoption of such batteries for furnishing current for the operation of the telegraph circuits, current was supplied by a dynamo driven by a water motor. This motor, however, was expensive to operate, the cost for water alone being $20 per month. By the substitution of storage batteries the cost of maintenance had been reduced three-quarters, and the company saved $3,000 to $4,000 a year.

A paper entitled "Cipher Code for General Railroad Telegraphing" was read by Mr. C. S. Rhoads. A reference to this paper will be found on another page of this issue. The reading of the paper was followed by a discussion, after which a committee was appointed to take up the subject with a view to devising a code that could be applied to all railroad telegraph service, and report its findings at the next annual meeting.

After the reading of a paper by Mr. A. R. Swift, of the Rock Island road, on "The Inefficiency of the Ordinary Operator," the meeting, at 12.45 p. m., adjourned until 9.30 a. m. Wednesday.

The afternoon and evening were spent by the members at the Pan-American Exposition.

Thursday's meeting was called to order at 10 a. m. Mr. T. D. Lockwood read a paper entitled "The Importance in Telegraphy of Apparently Little Things."

In a paper entitled "The Importance in Telegraphy of Apparently Little Things," Mr. Thomas D. Lockwood discussed many details relating to telegraph lines, batteries and operating instruments. He considers that the regular twist joint used in this country is superior to the Britannia joint. Iron line joints ought to always be soldered, and Mr. Lockwood believes in a general soldering campaign at intervals of, say, three years. As to copper wire, the twist joint should not be employed, and such joints should not be soldered, owing to the risk of burning the wire. Either the two-sleeve McIntyre or the three-wire joint should be employed. As to glass and procelain insulators, it is a question whether carefully tested porcelain insulators would not along the coast and for some 50 miles inland be a material improvement over glass insulators. In making ground connections a water pipe should be chosen in preference to a gas pipe; but if the latter only is available, the connection should be made, if possible, on the street side of the meter. A comparatively small pipe should be chosen in preference to a very large one, and the surface filled or scraped clean, and a copper wire of many turns soldered about the same.

Mr. Lockwood recommends the instruction of young operators, not only in sending and receiving Morse, but also in everything that can be taught about the line, instruments and batteries with which he is to be associated, and there might properly be a regular inspection system for lines, batteries and instruments, but especially the two latter—this being so carried out that each office should be thoroughly inspected at least twice a year.

The two ideas might be combined in the person of a suitably qualified, and well experienced operator, who visiting offices periodically could not only perform such personal inspection, but could likewise devote a portion of his time to the questioning and instruction of the younger operators; and in some cases also of such of the older ones as do not already know it all or are not too old and case-hardened to learn.

In the discussion of this paper Mr. A. B. Taylor spoke of the importance of properly insulating wires leading into buildings from outside lines. He called attention to common errors of construction men in doing such work, and pointed out the proper means to be observed to secure the desired results. Mr. Drew stated that the use of staples on inside wiring was not allowed by his company under any circumstances, as they were a source of much trouble. Messrs. Athearn, Maver, Lockwood, Taylor and Ryder made brief remarks on the relative advantages of oils, tallow, etc., for use in gravity cells to prevent evaporation of the liquid. Mr. Lockwood favored tallow because it caked and could be readily removed when necessary. Mr. Taylor referred to the destruction of the rubber insulation on the wire leading to the copper of gravity cells, at the point where the wire entered the liquid. Mr. Maver explained that this effect was due to the corrosive action of oil on rubber. A wire insulation was made, however, and is used by the Western Union Company, which avoids this difficulty entirely.

Mr. F. P. Vallentine, of the New York, New Haven & Hartford Railroad, Boston, then read an instructive and interesting paper on the use of the telephone in railroad work, after which the meeting adjourned in order to make the trip to Niagara Falls. An abstract of this paper will appear in a following issue.

Immediately after the opening of the meeting on Friday Mr. E. A. Chenery read a letter from Mr. G. A. Clark, superintendent of the Omaha Bridge & Terminal Company, in which he (Mr. Clark) gave an account of the use of the telephone in the dispatching of trains on his company's system. Mr. Clark stated that the telephone system had been in operation over a year, during which time there never had been an accident, an error or any misunderstanding. In several respects, Mr. Clark considered the service far more efficient than that of the telegraph.

After a discussion on Mr. Vallentine's paper read on Thursday the subject of handling trains by telephone was next considered in all its bearings, and the questions asked by members indicated that many were deeply interested in this matter.

Mr. William Maver, Jr., was next called upon for some remarks on the Strowger automatic telephone. He stated his inability to make the demonstration of the operation of the system, as he had intended, for the reason that the apparatus which he had expected for the purpose had gone astray. In this connection, he referred to the unique means that had been planned to provide the necessary direct e. m. f. to operate the apparatus. The lighting current in the hotel was alternating, and that could not be used without a rotary transformer; and primary batteries could not be considered on account of the large amount of room necessary for them, not to speak of other objections. It had been decided, therefore, to hire three automobiles and get the necessary voltage from their batteries.

In lieu of the talk on the Strowger apparatus he gave some practical information on the subject of underground cables for railroad telegraph work. He compared the advantages of paper and rubber-insulated cables, both classes of which, however, should always be had covered for protection. He advised the use of ducts in places where there was danger of mechanical injury, or where electrolytic or chemical action was likely to occur. In such circumstances rubber insulation should be used in preference to paper, for the reason that should the lead sheathing be punctured or corroded the rubber insulation might still be depended upon, whereas in the case of a paper covered conductor the entrance of moisture would soon destroy the insulating properties of the paper. In answer to a question, Mr. Maver stated that the use of jute covered cables in underground work had been abandoned—lead covered cables being now used altogether. Under favorable conditions lead-covered cables could be laid directly in the earth.

Dr. Cardwell being called upon made a few brief remarks about his typewriting telegraph system, which is now being experimentally operated on the Lond Island Railroad. Mr. L. S. Wells, superintendent of telegraph of the Long Island Railroad, stated that it was giving very satisfactory results, and had been working for a long time without any attention whatever.

A resolution of thanks was then passed for the many courtesies extended to the association by the telegraph companies, the telephone companies and others, and especially to Mr. Henry W. Pope, of the Buffalo Bell Telephone Company, who had taken such pains to provide for the entertainment and comfort of the party.

The convention then adjourned.

Storage Battery Auxiliaries—IV.

By Lamar Lyndon.

THE DIFFERENTIAL BOOSTER (*Concluded*).

In the preceding article the differential booster was discussed, being considered with the connections, as shown in Fig. 9, which is here reproduced. The generator current is, in this case, all passed through the coil S_1, which, therefore, produces a m. m. f. proportional to the generator load, which combined with the other m. m. f.'s from coils S_2 and *f* produces the resultant booster e. m. f.

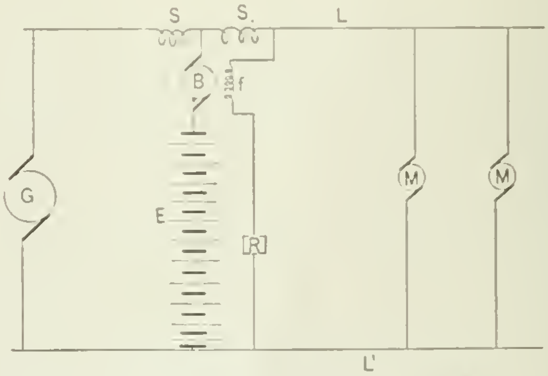


FIG. 9.—DIFFERENTIAL BOOSTER CONNECTIONS.

It is, therefore, evident that if the coil S_2 can be made to give a m. m. f. proportional to the generator current, the booster will work under the same operative conditions as if it were connected, as in Fig. 9. The series coil S_2 is sometimes connected between the equalizer and positive bus-bars when operated with compound generators, as shown in Fig. 10. In this case the current in the coil, while not in series with the generator current, gives an e. m. f. proportional thereto. To calculate the turns on S_1 it is necessary to know the drop through the series coil of the generators, or what amounts to the same thing, the difference of potential between the positive and equalizer bus-bar at normal load. The turns on S_1 are then calculated as shunt coils producing a given armature e. m. f. with a definite voltage at its terminals.

This form of connection is most desirable where the generator current is large as compared with the maximum battery current and reduces the size of wire required to be wound on the field, though it does not reduce its volume nor the weight of copper, as compared with the regular series connection.

The sudden current rush from generator on increase of load is very much less in the differential than in the compound booster system, because of the self-induction of S_1 and S_2, through which all current passes to reach the outside load where the connections are, as shown in Fig. 9. If the booster be connected, as shown in Fig. 10, the reactance of S_2 only, can assist in choking back the current rush S_2, however, usually has a much smaller inductance than S_1, and the booster therefore will operate more satisfactorily on rapidly fluctuating loads when S_1 is connected in series with the generator current.

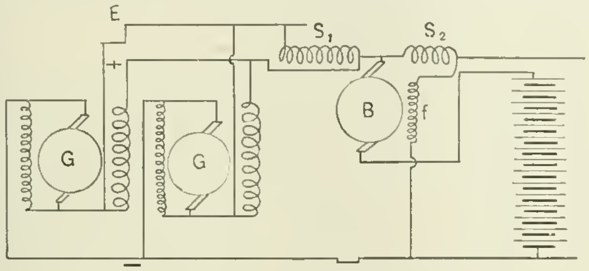


FIG. 10.—DIFFERENTIAL BOOSTER CONNECTIONS.

Double commutators may be necessary on differential boosters under conditions of small V and I_0 very great—generally on low potential systems.

Fig. 11 shows the switchboard in complete detail of a differential booster system. The combinations possible are:

(*a*) Generator feeding directly to bus-bars, battery and booster out of service.

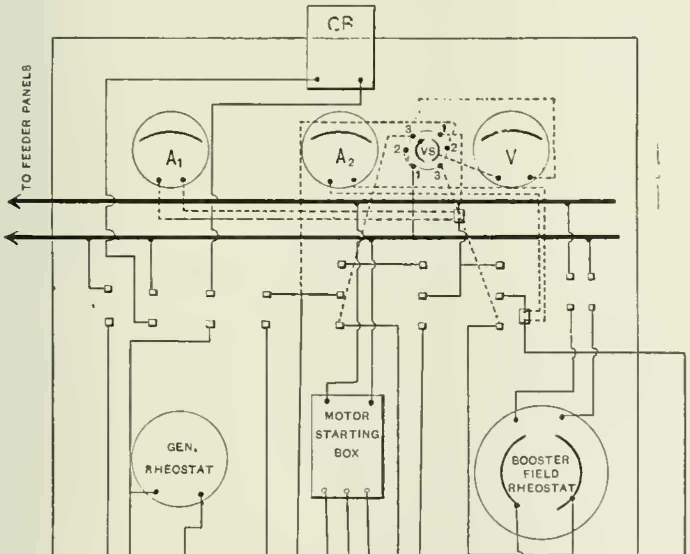


FIG. 11.—DIFFERENTIAL BOOSTER SWITCHBOARD CONNECTIONS.

(*b*) Generator feeding to bus-bars, battery in parallel with bus-bars.

(*c*) Booster in series with battery, series coils operating, booster and battery connected across the line.

(*d*. Booster in series with battery, series coils short-circuited, battery charging only.

If the negative bus-bar be connected to the ground and the positive carried on to feeder panels, the diagram shows the complete arrangement as applied to railway systems.

The Los Angeles 33,000-Volt Transmission Plant and Electric Railway.

The Edison Electric Company, of Los Angeles, Calif., is of special interest as owning and operating a 33,000-volt transmission line, 83 miles long, from a power plant in the cañon of the Santa Ana River northeast of San Bernardino to Los Angeles.

This line and power house were originally built by the Southern California Power Company, and the transmission is popularly still known by that name. O. H. Ensign, chief engineer of the company, is able to give many interesting and valuable points regarding the operation of this line. Both Mr. Ensign and the others connected with the company agree that there is no more practical difficulty in operating the 33,000-volt transmission line than in operating the 110-volt circuits around town, and they laugh at any one who considers operation at that voltage anything but a simple and practical matter. Their experience with it has evidently been sufficient so that it is no longer a matter of any more than ordinary consideration.

The transmission line for the most of the way follows the Southern Pacific Railroad. There are two three-phase circuits on the same poles; both of No. 1 B. & S. medium hard-drawn copper wire on Imperial porcelain triple petticoat insulators, mounted with the petticoat 4 inches above the cross-arm. Only one of the two circuits has been used at a time so far, as there has been no necessity for doing it to keep down the loss in line and the effect of putting the two long lines in parallel is somewhat feared. When the necessity arises, Mr. Ensign thinks it will be time to try it. As at present operated one line is ordinarily used, and the other kept idle in reserve. When such a heavy short occurs on the line that is in use that it is necessary to stop using that line the sub-stations have to be shut down for a short enough time so that the switches can be thrown onto the other line. In making such changes current is cut off from the high-tension transformers at the power house before changing the high-tension switches.

In spite of the fact that the line wires are only from 18 to 24 inches apart in some places arcs do not hold long between wires when once started. However, if the line were to be built over again the wires would be given greater separation, because arcs are more likly to be started by birds and sticks thrown across than if the wires were farther apart. The porcelain insulators on this line were all tested with a 10-kw transformer to 70,000 volts before being put up. It was in the erection of this line that the fact was first forcibly demonstrated that insulation breakdown tests of insulators must have plenty of transformer capacity behind them, otherwise the leakage over the insulator may be heavy enough to seriously pull down the voltage of the testing transformer. Only one insulator has proved defective on the entire 83 miles in two years of operation. Of course, some have been broken by being shot at. The high-tension sides of the transformers are connected Y-fashion, and the neutral grounded. This, of course, throws a greater strain than would otherwise be on the insualtors, especially when the poles and cross-arms are wet, as there is 1900 volts between wires and ground. Strange as it may seem, there is one case on record where a line wire lay directly on the cross-arm without setting the arm on fire.

Another peculiar thing noticed on this line is that when a broken insulator permits leakage onto the pin and cross-arm and thence down the pole to ground the cross-arm is burned only where it touches the pole. The electrical contact between the cross-arm and pole is evidently not very good. The 83 miles of line is looked after by two patrolmen, and both of these have other duties—one at the power house and the other at a sub-station. An average of about 90 owls and other birds fly into the line in a year. This starts an arc which in most cases lengthens itself out in the air until it breaks. When a short of this kind occurs the attendants at the sub-station usually succeed in pulling through without shutting down the synchronous motor generators, of which there are a number on the line. This is done by instantly tripping the circuit breakers on the direct-current ends of the motor generators, and then opening the field switches of the synchronous motors just far enough, so that the field circuits are closed through a resistance by means of a small auxiliary contact on the switch. The synchronous motors are thus run as induction motors without load for a few seconds until the short is off the line. The fields are then thrown in again, the motors jump into step, and the circuit breakers are closed on the direct-current side to resume regular operation. No fuses are put in the high-tension line or at the power house, except that the generators are fused to 4 or 5 times their capacity. Occasionally one of these fuses blows, but is replaced before the service is interrupted.

The power house is now delivering about 3000 horse-power. It contains four 750-hp G. E. revolving field, 50-cycle, 750-volt, three-phase generators direct connected to Pelton wheels, operating under a 728-ft. head. Generators of this type connected to waterwheels do not give sufficient current on short circuit to endanger their windings, hence the practicability of running without fuses. Indeed fuses would be very much of a nuisance on these lines.

It has been claimed that climate conditions are favorable in Southern California for such transmissions. They are as regards freedom from lightning, although there is some of this, and there is plenty of rain. The most trying thing, however, is the ocean fog which sometimes drifts up the valley and covers everything with moisture. In such cases the pole tops at high points on the line are luminous at night, but the leakage on the 83 miles of line is less than 500 watts at such times. The lightning arresters used on this line are G. E. Wirt with 1-16-inch gaps between cylinders, and one gap to every 400 volts potential across their terminals, making 48 gaps in all. There is a static discharge continuously between the gaps for about half the distance to ground. The balance of the gaps are silent. General Electric air blast transformers are employed on all the 33,000-volt work and none has ever been burned out.

The management of this company is a firm believer in the superiority of motor generators over rotary converters for use with a frequency as high as 50 cycles. Mr. Ensign claims as high all day efficiency for them as for rotary converters where the sub-station is supplying both alternating and direct current as is the case in most transmission plants. If rotary converters are used two sets of static transformers must be put in, one set for supplying the rotaries and the other for supplying alternating current for distribution. With motor generators one set of static transformers only is needed and they can be worked at higher efficiency than two sets. With synchronous motor generators there is no trouble with pumping or surging as there is likely to be with high frequency rotaries and the high commutator speed of the rotary is done away with. The synchronous motors are always started as induction motors with unexcited fields.

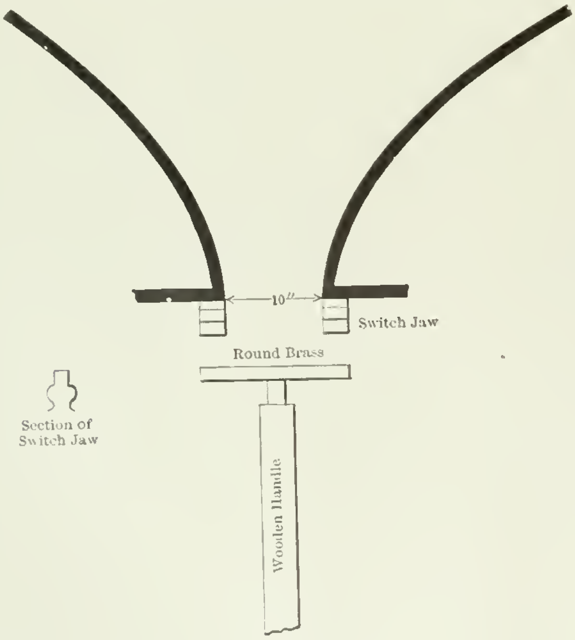


FIG. 1.—HIGH-TENSION SWITCH.

The high-tension switch used on the 33,000-volt lines is very simple, and is not as formidable looking as the long break switches in use on most lines of this kind. It is constructed on the principle shown in Fig. 1. The distance between the switch jaws is but 10 inches. Extending upwardly from the jaws is a pair of horns made of line wire. Connection between the switch jaws is made with a piece of round brass rod attached to a long, dry wooden handle. This brass rod and handle is kept from falling out of the switch jaws when the switch is closed by the spring catch shape of the jaws as shown in the section in Fig. 1. When it is pulled down out of the switch jaws the arc is carried up between the horns by the heated air and is broken. This switch has never failed to break the circuit when opened under any conditions which have so far existed. Of course it is seldom used as most of the circuit opening is done is done first on the low-tension side of the transformers at both power house and sub-stations. The main use of these switches when opening live loaded circuits would be in case a transformer should begin to burn out. Although not at present so arranged the sub-station will have these switches put in each transformer circuit as well as in the high-tension lines as they enter the sub-station.

The insulators on the line are put on wrought iron pins with a wooden sleeve 4 inches high, covering the pin between the insulator and the cross-arm. In constructing another line, in view of his past experience in testing insulators at high voltage, Mr. Ensign would use a porcelain insulator with a single petticoat mounted on a pin with a cast-iron shoulder, with a sulphur joint between the pin and insulator. He would make the bolt hole in the cross-arm for the pin large enough to be a loose fit so that a lineman could quickly take out one insulator and pin and put in another. The bolt could be screwed tight enough to hold the pin firmly.

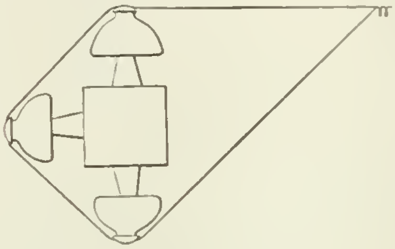


FIG. 2.—STRAIN INSULATORS.

The 83-mile transmission line is now being sectioned, with outdoor switches at the end of each section for transferring from one line to another to make repairs without shutting down the sub-stations. At spans across streams insulators are arranged to take the strain according to Fig 2.

This company is decidedly in favor of porcelain as against glass for high tension lines because of its mechanical strength.

It is of value to note with what entire success the telephone line is operated on the transmission line poles, even though the transmission line is run with a grounded neutral. It shows that there is very little leakage on the transmission line. The telephone wires are run 6 ft. below the transmission line on pony glass insulators.

Some odd stories are told regarding the behavior of the 33,000-volt current. A lineman climbing up over a transformer case got his head so near one of the high-tension wires that an arc jumped across the air space to his head The voltage between the transformer case and ground was about 10,000 volts. The man was picked up for dead, but was resuscitated. A hole was burned in his skull and the skin burned off the soles of his feet. Skin was grafted on to replace his loss and the man recovered, at last accounts being in the employ of the General Electric Company at Tacoma.

The most peculiar freak of the 33,000-volt current, however, happened in the Santa Ana Cañon. One of the transmission line poles was guyed to a large boulder by means of an eye bolt in the boulder One night an arc got started from one of the lines to the guy wire An employe of the company passing along saw the flame and rushing to the nearest telephone told the power house that a pole was on fire, to get ready to shift over to the other line. The employees at the power house spent a few anxious moments watching the instruments and preparing to switch over on a moment's notice. Minute after minute went by, but no sign of any line disturbance showed on ammeter or wattmeter, nor had there been any noted previously. A party was sent out on the line, but could not find the burning pole. All was dark. The next morning the pole was found. The arc had broken itself, but not before the boulder, through which the current was seeking ground with 19,000 volts behind it, had sweat great drops of slag and burst. The company has evidently discovered a new way to break up rock. The volume of current required must have been very small, as it was not detected by the station instruments.

SIX STATIONS IN PARALLEL.

The Los Angeles Railway serves as a kind of dumping ground for the surplus power generated by both transmission companies. In the winter when water is high in the cañons the water power plants are able to carry a considerable railway load. In the summer if necessary the railway feeds power into the transmission companies' sub-stations. The arrangement is advantageous all around. The railway gets cheap water power when available, and the transmission companies are able to carry a larger light and motor load than would otherwise be possible.

There are now six power houses and sub-stations in and near. Los Angeles connected in parallel, viz., the Los Angeles Railway power house, the Edison Electric Company sub-station, the San Gabriel Electric Company sub-station, the Los Angeles-Pacific Railroad power house, the Los Angeles & Pasadena Electric Railway power house at Pasadena, and the San Gabriel Electric Company sub-station at Pasadena.

Steam Engine Specifications.

The Engine Builders' Association of the United States has submitted for the consideration of architects and engineers the following suggestions in connection with specifications for the installation of steam engines:

First.—That contracts which provide a penalty for failure to deliver in time or for failure to meet guarantee ought also to provide equal premiums for earlier or better results than specified.

Second.—That bonds should not be required on installation contracts unless corresponding bonds for similar amounts are given to secure payment. An exception always being made in the case of Government, State or municipal contracts.

Third.—That settlements or any part of them ought not to extend beyond three months from completion of contract, and that delay on the part of the owner ought not to delay payment beyond a reasonable time.

Fourth.—That a guarantee against defective material or workmanship should not be made to cover a period of more than one year from date of shipment.

Fifth.—That purchasers of engines ought not to be furnished with complete working drawings, but simply with general drawings showing the assembled engine in outline, with such principal dimensions as will answer for building foundations, the erection of engines or their care.

Connectors for Electric Furnace Electrodes.

The electrode holder for the arc light carbon was a highly developed structure before the electric furnace, in the modern sense of the term, came into existence. But when the problem arose of transmitting a current of some thousands of amperes from a metal conductor to the massive carbon terminal of a furnace, it was soon found that the existing types of connectors had little value or applicability. The coefficient of expansion of metal is much greater than that of carbon, and the heated gases from the furnace reaction, as well as the heat conducted and radiated from the arc, cause the joint to open a little. At once an increased resistance is introduced at the point or surface of separation, accompanied by a further heating effect, or even by one or several arcs, and the two interacting causes will often combine to entirely destroy the connection. The problems introduced with the large electrodes and heavy currents used in industrial electric furnaces are so novel in character as to have led the German Patent Office to hold that arc light constructions are not to be considered, upon the question of novelty, as against devices performing an analogous office for the electric furnace. Of late a considerable number of devices especially designed for electric furnace work have been designed.

Two patents recently issued (June 18) to Mr. Alfred H. Cowles, of Cleveland, Ohio, cover connectors of forms especially applicable to open and closed electric furnaces, respectively. In the former the carbon rod, which serves as one electrode, is socketed in a metal cup, which in turn is surmounted by a water-tight chamber. An inlet pipe extends through this chamber, and through it a stream of water is projected against that portion of the chamber wall nearest to the carbon. An outlet tube is placed above so that in operation the chamber is filled with water in continuous flow. The furnace shown is of the water-jacketed crucible type, provided with lateral openings for a reversing flow of gas, and adapted to work in connection with a system of regenerators.

The carbon electrode for the closed furnace is connected through a series of interposed metal plugs and pins with a metal conductor bar, and the whole is encased in a vertical sheet metal tube surmounting, but insulated from, the cover of the furnace, the bar passing out through a stuffing box at the top of the tube. Adjustment of the electrode is effected by sliding the carbon in its metal sheath, and access of the heated and corrosive furnace gases to the connection between the carbon and its metal conductor bar is prevented by forcing into the tube above the carbon a neutral gas, preferably a hydrocarbon, and preferably under such pressure as to maintain a slow downward current between the electrode and its sheath, into the furnace.

This furnace is of the class recently described in these columns (May 18), having a crucible electrode of porous carbon, surrounded by a water-jacketed condenser, and especially applicable for the reduction of compounds yielding a volatile element, as sodium or phosphorus. The process then described, involving the reduction of sodium aluminate with simultaneous production of metallic sodium and aluminum carbide or aluminum bronze, forms the subject of a third patent to the same inventor and bearing the same date.

Calcium Carbide from Impure Raw Materials.

Calcium carbide is almost unique among commercial products in that it cannot be refined by any known method. Refining processes have been developed for all of the metals, and for the common marketable chemical products a process of purification is elaborated and adopted as a matter of course. The high melting point of calcium carbide, however, excludes processes involving recrystallization or sublimation, or any such fusion treatment as is applicable to iron, and the metals generally; and its insolubility under all circumstances prevents the application of any of the methods based upon treatment by and separation from solvents. Pure calcium carbide is now produced, therefore, only from pure raw materials, and is of necessity very costly as compared with the lower grades.

On the other hand, it is a comparatively simple matter to produce acetylene of sufficient purity for ordinary use from a low-grade carbide. The calcium hydrate which remains as a residue when the carbide reacts with water is itself an efficient absorbent for hydrogen sulphide, and other gases evolved can be readily absorbed by appropriate reagents. But the necessity for the application of any purifying means, however simple these may be, to the evolved gas, at once takes away from calcium carbide one of its chief advantages over other sources of illuminants, viz., its availability for small and especially for portable generators. It remains therefore as a sole practicable alternative to so conduct the furnace operation as to enhance the purity of the product, either by applying during the reduction or by incorporating with the charge, such agents as will determine the elimination of the more noxious impurities, or will render them inert during the subsequent treatment of the carbide for the production of acetylene.

This is a neglected field of study, but two suggestions to this end being noted in the literature. Hewes has proposed to use a furnace charge consisting of 26 parts of carbon, 64 of lime, 8 of calcium carbonate or limestone, and 2 of peroxide of manganese. From this charge carbides of calcium and of manganese (Mn_3C) are formed simultaneously, the latter acting as a flux to reduce the temperature of the reaction and to increase the fluidity of the product, and serving also by evolution of methane (CH_4) to somewhat dilute the acetylene and hence to lessen its tendency to deposit carbon. The calcium carbonate yields a considerable volume of gas which, bubbling through the molten carbide, is said to mechanically carry much of the sulphide and phosphide of calcium to the surface where it forms an easily removable crust.

The second suggestion is due to Dr. Walther Rathenau, of Berlin, and forms the subject of a patent recently issued (June 18). It is proposed by him, when producing calcium carbide from either lime or coal of high silicic acid content, to incorporate with the charge a metal or compound capable of forming a silicide stable at the temperature of the reaction, in quantity sufficient to unite with all of the silicon present. If iron or iron oxide be chosen the silicide formed collects beneath the molten carbide and may be tapped from the furnace, or afterward detached from the carbide block. Compounds of copper, manganese or chromium will serve the purpose as well as iron, but the latter metal is preferred, not only on account of its cheapness, but because of the many industrial uses which are being found for its conductive and chemically resistant silicides.

Governmental Use of Telephones in Washington.

By B. C. Washington, Jr.

PROMPTLY at 9 a. m. every week day the work of a "billion-dollar country" is taken up and the busy tinkle of more than a thousand telephone bells is started in the Government's great administrative factories. As is well known throughout the world, in Washington City are located the principal offices of the Government, where thousands of men and women are engaged in transacting the truly enormous business of a "world-power" government.

The tremendous machinery of the Government works as smoothly as a well-balanced flywheel on a Corliss engine. To be sure, there are hundreds of parts to this machinery, yet so well are they organized and operated that there is little lost motion or friction. It is quite safe to say that the telephone plays the most important part of each day's work. Seven of the eight departments, and the larger bureaus of those departments, have private branch exchanges, installed and owned by the Chesapeake & Potomac Telephone Company. In the Capitol are two exchanges, one being in the Senate end and the other in the House end. These exchanges are about 750 ft. apart, so that some idea can be had of the dense volume of business that requires two exchanges and over 150 telephones in one building in order to transact that business. The Library of Congress, the Navy Yard, Pension Office and other large offices named have well-equipped exchanges. The operators of these exchanges are all employed by the Government, and in some cases shifts are employed, so that important exchanges are manned at all hours of the day and night. In a number of cases, where the departments do a large amount of telegraphing, the telephone and telegraph business is put in charge of experts, well experienced in both these branches; and the telephone and telegraph apparatus is placed in one room.

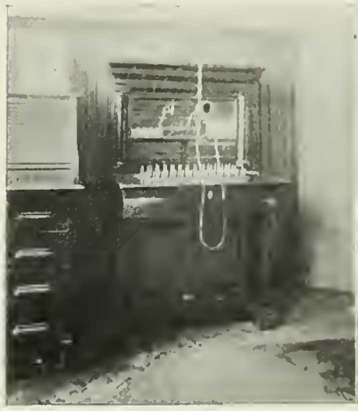


FIG. 1.—POST-OFFICE SWITCHBOARD.

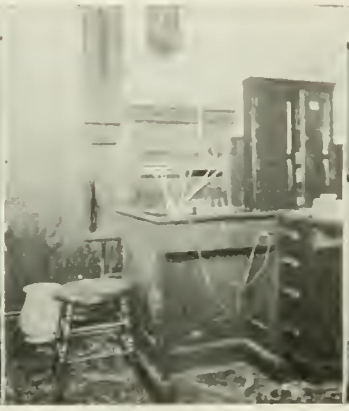


FIG. 2.—PENSION OFFICE.

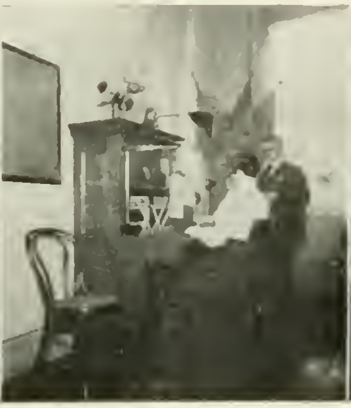


FIG. 3.—NAVY DEPARTMENT.

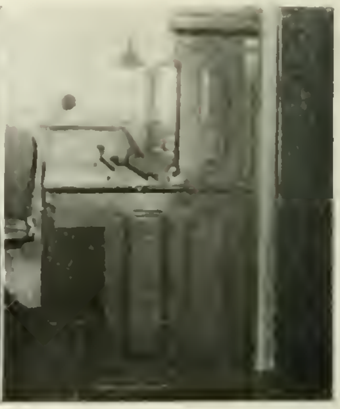


FIG. 4.—UNITED STATES SENATE.

Telephony in Government Departments.

In the Pension Office one man sits in a revolving chair with the telegraph instruments mounted on his desk in front. On his right is the telephone switchboard, and on his left a typewriter. This man has become so expert that he can receive a telegram and typewrite it and give meanwhile proper attention to a busy switchboard. This is an excellent demonstration of the many automatic features possessed by this style of telephone apparatus. Another point well worth mentioning is the compactness of the apparatus, as is illustrated by putting the Senate switchboard in a window recess. It is quite well known, however, that many of the Government buildings in Washington occupy several acres of ground. The Capitol, for instance, occupies over 3½ acres, so does the Library of Congress, while the War, State and Navy Building occupies about four acres. The buildings having private branch telephone exchanges in them cover an aggregate of 30 acres.

Taking into consideration that the departments have been organized with the idea that each department is a distinct and separate branch of the Government, it is easily understood that within such departments there is absolute necessity for a very large amount of inter-communication between the chiefs of divisions. Under the old order of things, personal interviews were held or letters conveyed between the chiefs by messengers. This was slow work and unbusiness-like, and the results were far from satisfactory. Now, under the present up-to-date methods nearly every room of importance is provided with a telephone, and the business of the Government is transacted with expedition. The volume of business transacted through these private exchanges is very large. Taking the estimates of the operators as a basis, the aggregate number of calls independent of central is for the 18 exchanges approximately 6000 per day of seven hours. At the same time, a large aggregate of calls come and go through "central."

At this dull time of the year, during the recess of Congress, the calls average about 2050 per day, but when Congress is in session this is nearly trebled. Then the operators at the Senate and House exchanges receive and send, each through their switchboard, messages at the rate of one a minute, and the department exchanges do a greatly increased business.

Naturally, the question suggests itself, Who does all this telephoning, and what is it about? To explain at length would require a resumé of the entire business of the Government. A short sketch will suffice to throw some light on the nature of the telephone work. At the Capitol the bulk of the work is during the sessions of Congress, and the local work is largely the business of the numerous committees who have charge of the thousands of bills that are introduced in the Senate and House. From the talk on the respective floors of the House and Senate, as evidenced by the *Congressional Record*, it is easily understood how the Capitol telephone wires are kept warm. In the departments and bureaus the telephoning is mostly relative to routine work.

The private exchanges and telephone data concerning them is to be found condensed in the accompanying table:

PRIVATE BRANCH TELEPHONE EXCHANGES OF THE UNITED STATES GOVERNMENT IN WASHINGTON, D. C.

Name of Private Branch Exchaoge.	Number of telephones in Exchange.	Number of trunk lines	Number of trunk lines independent of Central.	Approximate number of calls per day through Central on Government account.		
				Out.	In	Total.
Interior Department	107	4	3	75	33	108
War Department	83	10	.	122	91	213
Treasury Department	79	7		204	114	318
House of Representatives	74	7	3	43	16	59
Government Hospital for the Insane	73	1	....	20	17	37
Senate	72	9	3	107	31	138
State Department	71	9	.	160	77	237
Post Office Department	68	4		45	55	100
Government Printing Office	46	4		68	77	145
Department of Agriculture	37	2	......	46	53	99
Pension Office	21	1	...	5	10	15
Census Office	28	4	....	80	40	120
Interstate Commerce Commission	26	2	.....	22	23	45
Department of Justice	25	2	....	61	51	112
Library of Congress	24	2	2	46	10	56
National Museum	22	2		61	39	100
Washington Navy Yard	6	2	..	35	55	90
War Dept. Q. M. G.'s Office	6	2		23	31	54
Total	870	74	11	1 223	823	2 046

This data covers only the branch telephone exchanges properly charged to the general Government. There are, in addition to these, a large number of telephones located in the smaller bureaus and departments. With these may be noted the large number of telephones in the use of the city post office, and the branch post offices.

The expenses of the District of Columbia Government is shared by the whole country, Congress, largely on account of the vast untaxable Government properties, paying half the expenses, so that it is readily seen that the United States Government is carrying half the expenses of the District's police, fire, school and city departments, telephones, etc. The aggregate of the Government's and the District's telephones, not included in the table, is about 225 instruments.

In this connection, therefore, it is deemed worthy to give a few details concerning the very excellent apparatus the local telephone company has installed for this service. The Government telephone system, worked on the basis of branch exchanges, is of the central energy type, connected with the main exchange of the company by trunk lines. When a Government employee desires the attention of the operator he simply removes the telephone from the hook, this operation actuates a little signal which is exposed directly in front of the switchboard operator. The operations are thenceforward essentially of the central energy method until the connection has been cleared out and the conversation closed. When the conversation between the two parties is ended the act of restoring either receiver to its hook again actuates the corresponding visual or signal in the cord circuit, and causes it to disappear from the operator's vision, thus indicating that the conversation has been finished. It can be readily told by the operator which one of the parties placed their receiver on the hook first, as there is a visual on the cord circuit, as above explained. This absolutely prevents the necessity of an operator "going-in on the line," and inquiring if the user has transacted his business, or whether he obtained the party wanted, and the many other annoyances and interruptions of service that occurred in the old style switchboard apparatus, such as the departments had previous to the introduction of the central energy system.

Each departmental branch has a complete storage battery plant in duplicate, with a ringing machine for the calling of subscribers, the proper switches, etc., and it is so operated by the Telephone Company that while one set of storage batteries is furnishing the necessary current for transmission, or the signaling of the operator by the subscriber, the duplicate set is being charged ready to supply the necessary current for the next 24 hours. These battery sets alternate, each operating 24 hours. The instruments used are of two styles, the one known as the desk set, is a very neat and handsome nickel-plated piece of apparatus. The other style used is known as the wall set.

Electrical Engineering and Young Men.

Professor F. B. Crocker has the leading article in the *Saturday Evening Post*, of June 22. It is entitled: "The Young Man and the New Force," and discusses in a most interesting and suggestive manner the opportunities and the requirements in the field of electrical engineering. He points out that the profession is one in which young men are peculiarly numerous and predominant, and says that having personally followed the careers of several hundred men, in electricity he is "convinced that they have gone ahead more rapidly than would have been possible in any other line of human effort." One of the reasons for this is that the industry is so new and has expanded enormously, forcing men ahead." The other reason is the fact that electricity is a peculiar subject. In its pursuit general intelligence or knowledge is not sufficient for pronounced success. A man possessing special taste for it soon differentiates himself from the others working alongside who may not be endowed with the same advantages. Such a man will forge ahead of his fellows at a rate that is absolutely impossible in any other calling in the world. The successful electrical engineer has more than mere ability. He is gifted with special talent, like the successful artist or the musician. Electricity is, to my mind, the only mechanical pursuit that has 'soul.' The successful electrician is born. Many of the qualities that are his are intangible, just as the fine musician's qualities are. But there must also be tangible qualities, certain fixed mental traits. He must have great mental alertness; the ability to think quickly, to grasp a given situation at once. He must be of an analytical turn of mind—that is, able to reason from cause to effect, or vice versa. In electricity one thing follows from another with absolute certainty."

While admitting the fact that electricity is more or less of a marvel in spite of its exactitude, Professor Crocker criticises the popular idea that electricity remains unknowable. He contends rather that the proper attitude of the electrical worker is that of willingness to accept innovation, and not of prejudice against it. "It is the first duty of an electrical worker to fall in with rapid advances and radical departures. Therefore, a necessary qualification for the successful electrician is an interest in things that are new *because they are new*. Any one with a strong conservative tendency would be at a disadvantage in the electrical field. This is probably the reason why Americans have got along faster than any other nation in the development and use of electricity. An American prefers a thing that is new, whereas a foreigner considers newness in itself an objection. The man who is interested in ancient literature, or in archæology, cares little for electricity. This is a fact I have observed among my own friends. Those who have gone into electricity with the idea of saving themselves labor have made a great mistake, because electricity requires fully as much application and intensity of purpose as any other lien of work."

After arguing for the value of technical training and its results, as shown by the preference given to electrical engineers who have graduated from a college or technical school, Professor Crocker remarks: "Of course, success is a somewhat relative term, and it is rather hard to say what proportion of men succeed, as success may be measured in various ways. But it is probably fair to say that nearly all electricians make a good living within a year or two after they graduate. It is probably a fact that at least half of the men make what can be called a substantial success within three or four years after graduation. I have in mind several young men who have reached prominent positions, and won a national reputation in their profession, within five years after graduation from Columbia University. One of them is chief electrical engineer of the Niagara plant, the largest in the world. Another is professor of electrical engineering in a prominent university. Another became chief engineer of a well-known manufacturing company in less than two years after graduation.

"But though these men and many others have done exceedingly creditable work and now fill responsible positions, it is a fact that the pay is not as large in the technical branches as it is in the administrative departments. This is true, however, in all other human pursuits. The technical men in a railway, for example, receive much smaller salaries than the executive officers. The same is true in chemical industries, and in many other lines. There is no more responsible position, or one requiring more knowledge or skill, than that of captain of a transatlantic liner, and yet his pay is comparatively small. The presidents of the steamship companies, with nothing like such direct responsibility, receive salaries 10 or 20 times greater than those of the captains of the vessels. By the technical man, $5,000 a year would be considered a very good and $10,000 an exceptionally large salary. There is one thing to be considered, however. In the logical development of the new business scheme that is controlling all our great corporations, technical knowledge is beginning to be more and more to the advantage of the men who seek the great positions in these corporations. As the years go by the demand will certainly become steadily greater for a class of men who combine executive ability with a thorough technical understanding of the work they are called on to supervise. Already we have a number of striking examples of technical men who have won great business positions."

Professor Crocker sees few limitations to the growth of electrical industry, and believes that most lines of manufacture and transportation are becoming dependent upon it.

Rectifier for Polyphase Alternating Currents.

The June number of *Tuft's Engineer* contains a paper by Lewis H. Haynes on "A Rectifier for Polyphase Alternating Currents." The rectifier described is for two-phase currents. Each phase has a separate two-part commutator with two collecting brushes on each side, the object of the auxiliary brush being to enable the length of time each phase is short-circuited to be varied, as there is a certain interval in which there is minimum sparking. The shaft carrying the two-part commutators also carries four rings connected with the two-phase circuit, these rings being joined to the respective parts of the commutators. The conclusions drawn from the experimental rectifier are that it is perfectly feasible and practical to build a rectifier for commercial arc lighting to operate at voltages as high as 7000 or 8000, and that from an economical standpoint such a rectifier is desirable.

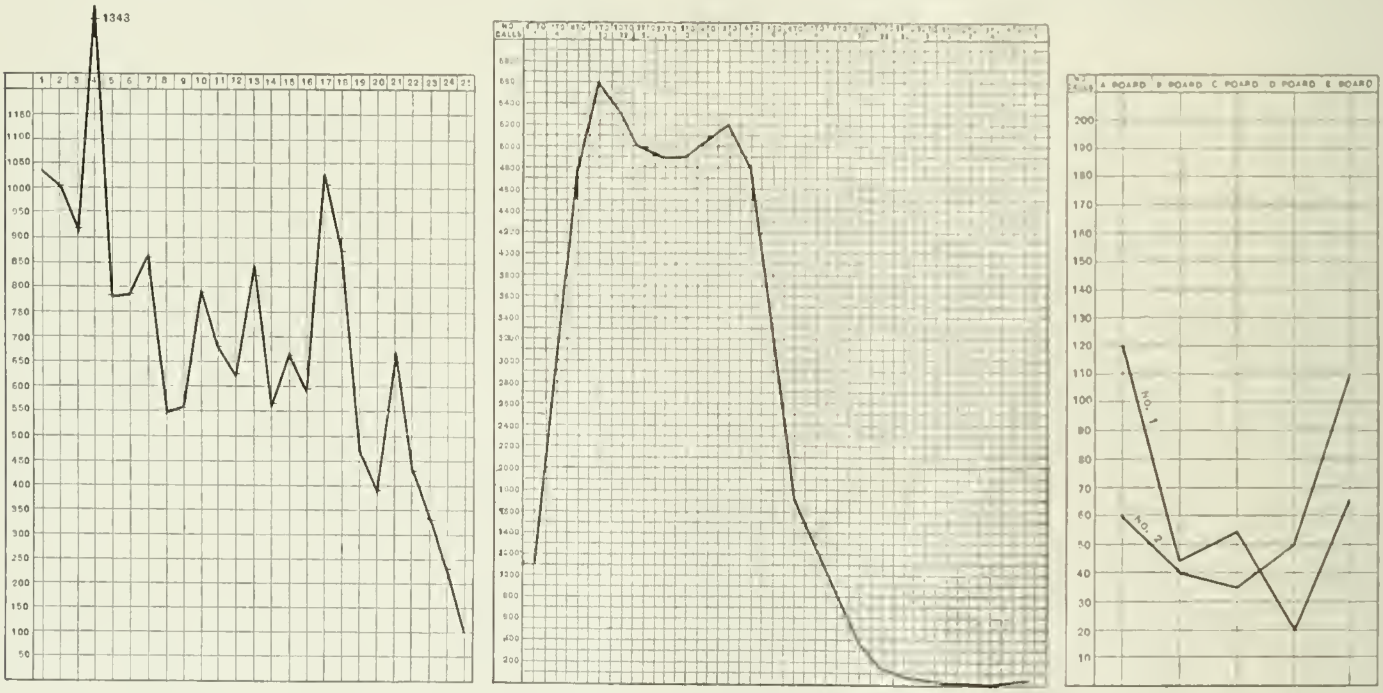
A Missionary Electrician.

By Professor W. H. Hallock.

AMONG the honorary degrees conferred by Columbia University at its annual commencement June 12 was that of Master of Science conferred upon Mr. F. D. Gamewell. It is, perhaps, unusual that the conferring of an honorary degree should be of special interest to electrical engineers, or that the honoring of a missionary should call for special mention in a technical journal, but Mr. Gamewell certainly deserves this recognition.

Some six years ago, when Mr. Gamewell spent the winter in New York preparing to enter upon his duties as Professor of Physics in the University of Pekin, he was offered $500 to buy an electric light plant for the mission house and laboratories. Mr. Gamewell naturally discovered that this amount would go but a little ways towards purchasing the engine, dynamo and fittings. Indeed, the first estimate which was made for him as to the price of the simplest outfit that would pay for the trouble of installation was about $1,400. Mr. Gamewell's missionary ability was exhibited nowhere more forcibly than in his success in bringing down the electric supply company and bringing up his donor until they finally met, and he was enabled to take with him a very satisfactory plant adapted to supply about 150 incandescent lamps. His engineering ability was exhibited in his ingenuity in planning the distribution of material in the plant and providing everything for its equipment, and making himself sufficiently familiar with all the details so that he would be able to install it with the aid of native labor. Mr. Gamewell did install his plant at Pekin and operated it successfully to the unbounded amazement of the natives. It was, I believe, the first electric light plant in Pekin, outside of the Imperial Palace.

It seemed at one time as if disaster was certain, inasmuch as the means of transportation between the seaport and Pekin were such that the heavy castings and armature of the dynamo were unceremoniously dumped upon the bank of the river to lie there for a week or ten days before he accidentally got track of them and ultimately transported them to the city. Not content with surprising the natives with the sudden brilliancy of his electric illumination in the chapel, he introduced the laboratory method of teaching physics into China, and even translated into Chinese the instructions for performing the ordinary laboratory experiments. Unfortunately, this Chinese manuscript was lost in the conflagration which wiped out the electric light plant, the mission house and the whole university. He often refers to the strangeness of attempting to convey to the Chinese mind the operation and principle of such instruments as the galvanometer, Wheatstone bridges and such things. One can scarcely imagine how Ohm's law would look when translated into Chinese.



FIGS. 1, 2 AND 3.—TELEPHONE LOAD DIAGRAMS.

When it is remembered that Mr. Gamewell was trained as a missionary of the Methodist Episcopal Church and served in Western China in that capacity for 10 or 15 years, the full importance of his engineering feats will be appreciated. Beside establishing a physical laboratory and electric light plant and building a mission house on the American plan with native labor, in spite of the fact that foreign engineers declared that he could not, Mr. Gamewell placed the final capstone upon his engineering accomplishments by constructing a system of defences around the legations in Pekin, which military engineers have declared could not have been improved upon by Todleben himself.

Telephone Load Diagrams.

In the course of his paper read recently before the Independent Telephone Association at Buffalo, Mr. L. W. Stanton, of the Cuyahoga Telephone Company, Cleveland, referred to the results of some "peg count" tests which he exhibited in diagrams. The subjoined are his data in detail, now furnished in regard to the diagrams:

In chart No. 1 we have the load curves showing the number of calls answered by each operator. The numbers 1, 2, 3, etc., along the line at the top of the chart, designate the operator's position. The figures in the vertical column at the left, designate the number of calls answered in 24 hours. The heavy black line, where it crosses the operator's position line, designates the number of calls for that operator's position for 24 hours. For example, the heavy black line, or index line crosses the line representing position No. 1 at approximately 1040, which is the number of calls answered at that position during 24 hours. Position No. 2 answered during 24 hours 1000 calls; position No. 3, 910 calls; position No. 4, 1343 calls, etc.

The above chart is not imaginary, but one accurately compiled from an exchange of 1563 subscribers, and the number of calls is slightly over 17,000 in 24 hours, which gives an average of 10 and a fraction calls per telephone. While this exchange is being operated by 25 operators, they are not giving as prompt and efficient service, on a whole, as would be obtained by eight or nine operators with a switchboard properly designed, and the board equalized by means of an intermediate, or cross connecting board. By the use of an intermediate board in connection with a multiple switchboard, the subscriber's line signal and answering jack may be shifted in front of any operator, without changing the subscriber's telephone number. In this manner the busy lines which are generally located in front of the first few operators may be shifted in part to one of the operators who has mostly residence telephones, and in turn some of the residence telephones should be shifted in front of the operator who has all business telephones. In this way each operator may be given approximately the same number of calls for the 24 hours, which should be practically 2000. This would mean that during the busiest hour she would answer approximately 250 calls.

It has been found through hundreds of tests that one-eighth of the number of calls answered during 24 hours is approximately the number answered during the busiest hour. Two thousand for 24 hours, 250 of which are answered during the busiest hour, is not excessive for any ordinary operator; in fact, there are many operators who are handling busy positions that are answering considerably in excess of this number. In one case, the writer knew of an operator answering 528 calls an hour, and in another case of a trunking operator handling 1248 calls per hour. This is excessive, and cannot be continued but a short time, but an operator answering from 200 to 250 calls per hour on a modern switchboard is not excessively busy, and with good team work among operators they can give better than four-second service. Operators without exception prefer the busy positions, and the operators who answer the fewest calls are invariably the ones who give slow service.

Chart No. 2 shows the necessity of distributing the business and residence telephones in front of the operators. In this chart the vertical column shows the number of calls answered per hour, and the horizontal heading at the top shows the different boards. *A* board has all busy telephones, while *B*, *C* and *D* boards have about the same number of each business and residence telephones, while *E* board has all residence and farmer line telephones. Index line No. 1 designates the number of calls answered by each operator during the hour from 8 to 9 in the morning. The operator on *A* board answered 120 during this hour, while the operator on *E* board answered approximately half this number. Index line No. 2 shows the number of calls answered from 11 to 12 a. m., and during this hour the *A* operator has answered about half what the *E* operator answered. This will be seen to be a complete reverse from what it was during the hour from 8 to 9, or, in other words, one operator is idle while the other is busy and vice versa. In this exchange, with a proper switchboard, and the load equally distributed, two operators could answer all the calls, and give first-class service.

Scores of peg counts taken among the independent telephone companies show that 10 and a fraction calls per telephone are the average. Taking these figures as a basis, it will require 200 subscribers per operator to give an average of 2000 calls for each position for 24 hours. This number would be excessive if they were party lines with four or six parties on a line, or if they were all business lines like we find in some downtown branch offices, which have no residence telephones to reduce the average number of calls per telephone, or in an exchange where a large per cent of the calls have to be trunked to another exchange, in which case the trunking consumes more of the operator's time than is required where connections are made direct in the multiple.

Chart No. 3 shows the number of calls answered per hour for 24 hours. A chart similar to any one of the three can easily be made after taking a count of the number of calls answered by each operator during each of the 24 hours. The calls may be tallied with a pencil and paper or by moving a peg from one jack to another, or, best of all, by using the tally register made by Jas. O. Benton, of New York.

Pacific Coast Electric Transmission Association.

The fifth annual convention of the Pacific Coast Electric Transmission Association was held at the Hotel Vandome in San Jose on June 18. Forty members from various parts of the State were present. Prince Andre Poniatowski, of San Francisco, president of the association, presided, and George P. Low acted as secretary. Papers were read by Louis A. Hicks, T. E. Theberath, C. A. Poole, C. E. Dutcher and A. G. McAdie.

Officers were elected as follows: President, Dr. C. W. Van Norden; vice-president, E. J. Desable; treasurer, William Angus; secretary, George P. Low, all of San Francisco. Dr. Van Norden, John Martin and H. H. St. Clair constitute the new executive committee.

On the evening of the 19th a banquet was given to the visiting members at the Hotel Vendome. On the following day the members of the association were guests of the Electric Improvement Company, of San Jose. Special cars were provided to carry the members to the different points of interest in the city.

On the day that the convention met in San Jose, the street cars in that city began to be operated by power generated 184 miles away. The current was transmitted on the wires of the Standard Electric Company, and will be hereafter used in operating all the street cars of the city.

Pan-American Electrical Exhibitors.

The exhibitors and exhibitors' representatives at the Electricity Building of the Pan-American Exposition held a meeting Tuesday evening, June 18, at the office of Professor G. F. Sever, superintendent of electrical exhibits for the purpose of forming an organization for mutual benefit in a business and social way. Officers were elected as follows: F. W. Hurlbert, of the General Electric Company, president; W. M. Probasco, of the Westinghouse companies, vice-president; W. Jac Marland, curator of the collective exhibit, secretary; W. H. Markgraf, of the Edison Manufacturing Company, treasurer. The question of a name for the organization elicited considerable discussion and suggestions varied all the way from "The Pan-American Electrical Exhibitors and Electrical Exhibitors' Representatives Society" to "Pan-Electric Club." The matter was finally left to a committee. The organization will probably meet for a few minutes once a week on Monday evenings.

New Canadian Power Scheme.

An order-in-council, passed by the Ontario Government, authorizes the Niagara-Welland Power Company to commence work. The company's plan is to tap the Welland River, east of the canal, and by means of a cut to carry the water of the Niagara and Welland Rivers to the high bluff near the city of St. Catherines, Ont., where a fall of over 180 feet may be obtained, and thence waste into Lake Ontario. This route also gives three other falls of 33 feet and 56 feet below the bluff, or a total fall of about 300 feet. The capacity of the waterway will be over 100,000 water horse-power, which at the first fall will produce over 75,000 electric horse-power at the wheel, still leaving three falls for later development. There would be a primary installation of 30,000 electrical horse-power, a large part of which the company hopes to transmit to Toronto, the balance to be utilized at St. Catherines.

CURRENT NEWS AND NOTES.

MAIL TUBES.—Mail-tube service in New York City, failing an appropriation by Congress, will be discontinued on July 1, and the distribution of mail matter will therefore be slower than it has been in the last two or three years.

IMPROVING SUBMARINE BOATS.—The *Petit Parisien* says that the new French submarine boats building will be furnished with double motors, steam and electricity, similar to the fittings of the Holland, thus increasing their sphere of action and enabling them to plunge quicker than the Narval. The latter's recent experiments were unsatisfactory. The crew suffered greatly, and navigation on the surface was also defective.

CONNECTICUT TROLLEYS.—It is stated that during the recent session of the General Assembly not less than 50 special acts relating to street railways were passed. As the result of franchises that were granted a large number of interurban trolley lines will be built. Connections will be made between Hartford and Springfield, Derby and New Haven, Waterbury and New Haven, Meriden and New Haven, Middletown and Meriden, and Rockville and Stafford Springs. The present tendency in the trolley development of Connecticut is toward the construction of trunk lines.

GOVERNMENT TELEGRAPH SCANDAL.—A cable dispatch from London of June 22 says: A betting scandal has been discovered this week in the Government telegraph department. Operators in the central office in London have been in league with others in suburban and provincial offices for swindling bookmakers. The methods adopted have been ingenious, elaborate and successful and included a resort to forgery. About a score of men have been suspended, preliminary to their dismissal, and an exhaustive inquiry is now proceeding with a view to ascertaining the exact extent of the evil. The present intention is to institute criminal proceedings against the ringleaders.

HIGH-FREQUENCY ALTERNATOR.—The June number of *Tuft's Engineer* describes a high-frequency alternator designed by Professor W. L. Hopper and constructed by the electrical engineering students of the classes of '98 and '99 of Tuft's College. The alternator is of the Mordey type, and has 12 sets of coils, 4 in series. Each set of coils has outer terminals, and the coils can be arranged in series, in multiple or in any combination of multiple series. With all the coils in series the machine gives from 7 to 10 amperes at 100 volts. The machine is intended to run at a speed of 1250 r. p. m., at which it will give a periodicity of 1000.

LUCANIA'S WIRELESS TELEGRAPH.—The Cunarder Lucania, in on Saturday from Liverpool and Queenstown, experimented with the Marconi system of wireless telegraphy on her voyage to this port. Going down the Mersey she exchanged aerial greetings with the British schoolship Conway, which is equipped with the Marconi apparatus. She also exchanged salutes with wireless-telegraph stations on the Irish coast, and while at sea with the Elder-Dempter liner Lake Champlain, also fitted with a wireless system of communication. Many passengers sent messages to their friends ashore by way of the stations on the Irish coast.

ELECTRO-CHEMISTRY AT THE UNIVERSITY OF WISCONSIN.—The University of Wisconsin has a course in applied electro-chemistry extending over four years. During the first two years the course is identical with that of the electrical engineering course, and in the final two years in a number of studies is also identical with the latter course. The instruction in electro-chemistry and electro-metallurgy is given by Professor C. F. Burgess. The list of branches as they appear in the bulletin of the University are: 1. Primary and Secondary Batteries. 2. Electrolysis and Metallurgy. 3. Applied Electro-Chemistry. 4. Electricity as Applied to the Treatment of Metal Surfaces.

PRESENTATION TO PRESIDENT McKINLEY.—Mr. Chas. H. Baker, president of the Snoqualmie Falls Power Company, of Seattle, Wash., on June 21 presented to President McKinley at Washington a gold and silver plate valued at $500, the gift of the Power Company. The President and the Cabinet would have visited the falls on the occasion of the projected tour to the Pacific Northwest had not Mrs. McKinley's illness prevented the trip north of San Francisco, and the plate was to have been presented there. On the plate are elaborately wrought pictures of scenes surrounding the falls and industrial plants in Seattle and Tacoma, supplied by the falls' power. Mr. Baker told the President that every wheel in Seattle and Tacoma, including the street cars in both cities, is turning by electric power from Snoqualmie Falls.

FRENCH ELECTRICAL ENGINEERS TO VISIT THE UNITED STATES.—Our Paris contemporary, *L'Eclairage Electrique,* is organizing a technical excursion to the United States to visit the Pan-American Exhibition in Buffalo, and to attend at the same place the convention in August of the American Society of Electrical Engineers. The party will leave Paris Aug. 3, arrive at New York, Aug. 11, and leave for Philadelphia the same day. Aug. 13 will be spent in Washington, and the party will remain in New York from the 14th to the 18th. The programme from the 18th to the 26th coincides with that of the American Institute of Electrical Engineers. From Buffalo the party will go to Chicago, and from that city by way of the Lakes and the St. Lawrence River to Montreal and Quebec, returning to New York Sept. 3, and sailing from the latter city Sept. 5.

A PROPOSED TELEGRAPHIC CODE.—In a paper read at the recent Buffalo meeting of the Railway Telegraphers' Association, Mr. C. S. Rhoads discussed in a paper the subject of cipher codes for railroad telegraphing. In conclusion, the desirability of a code for the use of presidents, general managers and general superintendents was suggested. As an illustration of the use of such a code the paper says: "Just imagine what a saving in time of both the wire and the clerk (or even official) to have, for instance, instead of 'Yes, we had a delightful time at the theater last night; that ice cream was immense; but I didn't like the way you made "goo-goo" eyes at that blonde waiter one bit,' the one word 'Quack.' Then the reply, 'Oh, don't say a word—I overslept myself, got to the office an hour late this morning and couldn't get down to business until I'd called you up—don't mention blondes—your black sparklers are good enough for me. Will be around again to-night. The "old man" is waiting to use the 'phone—so long'—all contained in the one word 'Smack.' "

WATER-POWER COSTS IN AUSTRIA.—Mr. Frank W. Mahin, United States Consul at Reichenberg, reports as follows: During the consideration of the subject of water power, at a recent meeting of the Lower Austrian Industrial Union, figures were produced and instances cited to prove that water power was cheaper to establish and much cheaper to operate than steam power. The following test case in the Tyrol was mentioned: A factory was equipped with both water and steam power, of the same volume. The first cost 1.60 florins (65 cents) per horse-power and the latter 1.80 florins (73 cents). In the cost of operating, however, the difference was great. With water, the expense was 0.174 kreutzer (0.07 cent) per horse-power per hour: with steam, 1.266 kreutzers (0.61 cent). The saving in a year by the use of water amounted to 502,000 florins ($203,812), representing in Austria a capital of 10,000,000 florins ($4,060,000). Another Austrian water-power plant mentioned operates an electric plant which lights a town 11 miles distant. Power is also cheaply supplied to several neighboring factories. This plant was established in 1897, and the effect has been to give renewed industrial life to that locality. Its operating cost is 0.16 kreutzer (0.065 cent) per horse-power per hour. Other instances were also given, among them that of a water motor of 15,000 horse-power now being erected. This will operate a number of factories, several of which are at present under construction. The price charged will be 80 crowns ($16.24) per year per horse-power.

LETTERS TO THE EDITORS.

Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—In a letter on the above subject published in your journal of June 22, 1901, I notice that the rectilinear propagation of electric waves such as are used in wireless telegraphy, is said not to agree with experiments. It is there stated that "If this radiation does not go through, it must go around, etc." This conclusion does not appear to be at all necessary, as the ascending vapor, more especially that over water, is continually being condensed above, on account of the colder air in the upper regions, clouds visible and invisible are being formed, and these clouds would reflect the waves in a multitude of directions, but always away from their source; the initial angles of incidence and reflection being always equal, there would, in addition, be secondary sources formed. It can thus readily be seen that the rectilinear propagation of electric waves is not at all disproved by such experiments.

BALTIMORE, MD. ALFRED G. DELL.

Litigation on Telephone Switchboards.

To the Editors of Electrical World and Engineer:

Sirs.—I have been asked to make a statement with reference to the decision of Judge Marshall sustaining the Seely patent in the suit of the Western Electric Company against the Kinloch Company at St. Louis.

The Kinloch switchboard was the first switchboard manufactured by the Kellogg Switchboard & Supply Company. It was begun in the year 1897 and finished the next year. It was not considered by us that the board would infringe the Seely patent, and it is only by the most favorable construction of the patent that it can be considered to do so. For instance, the claims have as elements, in addition to the multiple jacks, additional or answering jacks arranged in "uniform groups." Judge Marshall's opinion is to the effect that in the Kinloch board there is not an "actual uniformity," but only an "*apparent* uniformity" or a "uniformity apparent to the eye," to quote from the Judge's decision.

Learning in the year 1898 that the Western Electric Company claimed that the Kinloch board infringed the Seely patent, we from that time changed the construction of our switchboards so that it could not be claimed that they infringed the patent, even "apparently." All the multiple switchboards which have been constructed by our company, excepting the Kinloch board, which was of the date of 1897, have been constructed with this point in view.

The whole matter is one of minor importance, and the victory a barren one. The case will be appealed, and should the Appellate Court decide that the patent is a valid one and is infringed, certain changes would be easily made in the board, which would remove all claim for infringement. Such changes would not affect in the slightest the efficiency of the service of the Kinloch Company, nor the cost of the operation of the Kinloch plant.

Our Company is a believer in patents and intends to respect all valid or apparently valid patents. It has in the past and is continuing in the policy of investing large amounts in inventions and patents. We are, for this reason, inclined to look upon Judge Marshall's decision sustaining the Seely patent and giving to it a very liberal construction as a "blessing in disguise" to ourselves as a large owner of patents and patent rights.

Chicago, Ill. Milo G. Kellogg.

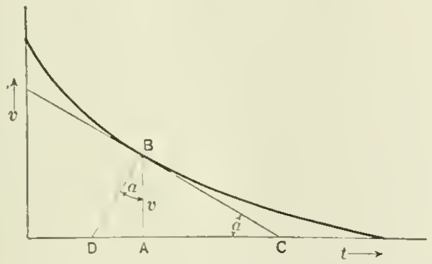
DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers

Measuring the Losses in Dynamos.—Peukert.—Dettmar has shown that the friction loss in a dynamo can be found by running it as a motor, stopping the supply current to the armature and for the excitation of the field, and measuring the gradual decrease of speed. The loss by friction in a certain time is proportional to the difference of the squares of the speeds at the beginning and at the end of this time. For measuring the speed the remanent magnetism of the machine may be used to advantage, if by a precedent test with a voltmeter the dependency of the e. m. f., generated in the armature, upon the speed is determined. The speed is then, so to say, measured by the voltmeter. The results of the main test may be plotted in a curve, in which the ordinates represent the speed and the abscissas the time. The present author shows that this method may be used also for determining the total loss in the armature when the supply current is interrupted, while the field magnets remain excited. The decrease of the kinetic energy in the armature, which is determined by measuring the decreasing speed, represents the total loss in the armature by friction, eddy currents and hysteresis. He describes a test in which he has determined the total loss and the value of the single losses of a motor by this method.—*Elek. Zeit.*, May 9.

Kuhlmann.—A communication referring to the above article of Peukert. He modifies slightly the theoretical considerations of Peukert and develops a formula which is more exact than that of Peukert. He also shows how the different losses may be determined separately by this method.—*Elek. Zeit.*, May 23.

Bloch.—A communication referring to the article of Peukert. He describes an interesting graphical method for determining the friction loss per second by Dettmar's method. The adjoining diagram shows Dettmar's curve; the abscissas represent the time and the ordinates the speed of the armature; the curve shows the decrease of speed when for $t = 0$ the current supply and the excitation of the field are interrupted. The present author shows that the friction loss per unit of time is directly proportional to the speed multiplied with the first time differential quotient of the speed, and that it can be directly measured by the length of $A\ D$ in the figure. $B\ C$ is a tangent to Dettmar's curve, $B\ D$ is perpendicular to $B\ C$, and $B\ A$ perpendicular to $A\ C$.—*Elek. Zeit.*, May 30.



DETTMAR'S CURVE.

Modified Induction Motor.—Grob.—A reply to the criticism of Osnos (Digest, May 11). He remarks that it is not fair to consider his motor as a special case of a synchronous motor. He discusses at some length the influence of a difference of the winding numbers in stator and rotor. Such a difference has an effect analogous to straying. He claims that his motor is at least as efficient as the ordinary induction motor.—*Elek. Zeit.*, May 9.

REFERENCES.

Voltage Drop in Polyphase Alternators.—Rey.—A long, illustrated, mathematical article on the predetermination of the voltage drop in the armatures of polyphase alternators, based upon Blondel's "theory of the two reactions." His theoretical results were found to agree well with actual measurements.—*L'Ind. Elec.*, May 25.

Synchronous Motors and Alternators in Parallel.—Russell.—The first parts of what promises to become a long series of "notes on the theory of synchronous motors and of alternators in parallel." He investigates the effect on the difference of two machines in parallel. He discusses the fundamental equation of a synchronous motor. The article is well illustrated with diagrams.—Lond. *Elec. Rev.*, May 31, June 7.

Modified Induction Motor.—Bauch.—A brief criticism of a special point in Osnos' communication (Digest, May 11).—*Elek. Zeit.*, April 18. A longer reply by Osnos to this criticism in *Elek. Zeit.*, May 9. A reply by Bauch to the latter communication in *Elek. Zeit.*, May 23.

Synchronous Converters.—H. S. Meyer.—A French translation of his long illustrated article on the calculation of synchronous converters, mentioned in the Digest, May 4.—*L'Ind. Elec.*, May 10.

Lights and Lighting.

Lightship Equipment.—An illustrated description of the electric equipment of lightship No. 72. There are two generating sets, each of 8½ kilowatts. The principal office of the ship is to show powerful masthead lights as a warning to navigators. These lights are flashed by a device attached to each generator at the commutator end. This device consists essentially of a circuit breaker, revolving on a horizontal shaft, set at a right angle with the generator shaft. The disks of the circuit breaker are three in number, 4.5 inches in diameter, on a shaft seven-eighths inch in diameter. This shaft carries a worm gear, with 138 teeth, which engages a worm revolving with and being practically a continuation of the generator shaft. The frame containing the bearings for the shaft of the circuit breakers is fastened to the outboard pedestal of the generator by a single plane, thus allowing the worm gear to be engaged or disengaged at will. The three disks have a speed of 2 r. p. m. On the outer surface of one disk are copper strips whose length determines the duration of the flash or time the lamps are illuminated. Two resistance coils, one for each generator, are connected in series with the masthead lights and the circuit breaker, so that when the lights are on, the resistance will not be in the circuit, but the instant the lights are turned off this resistance is at the same instant automatically turned on, thus providing a steady load on the engines. On each mast there are three incandescent lamps of 100 cp and 100 volts.—*West. Elec.*, June 15.

Power.

Keeping the Angular Variation of an Engine Within a Fixed Limit.—Astrom.—An abstract of a paper read before the Amer. Soc'y of Mech. Eng. on the "Determination of the flywheels to keep the angular variation of an engine within a fixed limit." He shows that the weight of flywheels on compound engines may generally be greatly reduced by placing the cranks of the two engines at an angle other than 90 degs. or 180 degs. By using the crank angle which gives the most uniform rotative effect, the displacement of crank pin has been found to be reduced by 15 to 30 per cent. Then the engine has not the greatest possible starting power, but this is not, as a rule, essential with engines requiring a very close regulation. In large engines, the reduced cost of the flywheel will cut some figure, but the greatest advantage is gained in those cases where in order to obtain a high degree of regulation the speed of the flywheel rim approaches the allowable limit, when the required regulation can be obtained with a wheel of the same weight but of a considerably reduced diameter.—*St. R'y Rev.*, June 15.

Engines for Parallel Operating of Alternators.—Trinks.—A paper read before the Engineers' Soc'y of West. Penna., on "The parallel operation of alternators from the engine builder's point of view." He first discusses with the aid of diagrams and mechanical analogies, the reasons of hunting. He shows that the successful parallel operation is almost entirely a question of uniform rotative speed of the engine. He discusses at some length the influence of the engine governor. He speaks of the use of heavy flywheels for reducing the fluctuations in speed, but says that they are unable to keep the speed variations that result from hunting governors or imperfect valve gears, within reasonable limits. He prefers three-crank engines to two-crank or single-crank engines, because they give a more uniform turning moment, and therefore do not require excessively heavy flywheels, provided that the angles between the cranks have been so determined as to give the best results. The valve gear should receive the most careful attention. Undue governor oscillations call for the use of adjustable friction brakes or oil dash pots, and for a good drop of speed between no-load and full-load; or, in other words, a high degree of stability. A governor of small stability is much more liable to hunt than one of higher stability. He discusses the relative advantages of a friction brake or oil dash pot for damping the governor oscillations. He discusses the different methods of paralleling. —*Power*, June.

Steam Turbo-Alternator.—Ewing.—A report, with tables and diagrams, on tests on 500-kw Parsons steam turbo-alternator. The machine is a compound turbine of the parallel flow type, running at about 2700 r. p. m., and governed electrically to give constant volts with its shaft directly coupled to the armature of a four-pole alternator, generating 250 amperes at 2500 volts. The exciter armature is on a prolongation of the same shaft.—Lond. *Elec.*, June 7.

REFERENCE.

Steom Turbine.—Kuebler.—A brief communication giving a diagram, which is the result of a test made to analyze the no-load power of a steam turbine.—*Elek. Zeit.*, May 9.

TRACTION.

Polyphase Plant for Traction.—Eborall.—The first part of an article on "Polyphase generating and sub-station plant for electric traction." He refers to a recent statement of Hobart, that for electric traction work of an extended character, where converting substations are necessary, the use of rotary converters is a mistake and synchronous motor generators should be used instead. The present writer does not agree with this view, as lighting work is not in question, but simply power work, and therefore the great advantage of synchronous motor-generators, namely, of excellent pressure regulation very simply attained, hardly comes into consideration. He believes that the present good modern practice is the correct one, and he summarizes its features in the power station, the feeder network, the sub-stations and in general. Sub-stations should each have a complete rotary converter equipment. "Air blast (not oil cooled) step-down, transformers, with duplicate blower equipment. If underground feeders, the winding on both sides to be star connected, with middle point of primary windings well earthed; if overhead feeders, the windings to be mesh connected on both sides, unless the pressure between line conductors exceeds 10,000 volts. Each rotary converter to have its own step-down transformers, arranged with six-phase connection."—Lond. *Elec. Rev.*, June 7.

Wigan Corporation.—A well illustrated article on the Wigan Corporation Electric Supply & Tramway Works. The permanent station has just been started and a short length of tramway has been inaugurated. The plant promises to grow into a large and important municipal undertaking. The equipment is entirely on the continuous current system, with boosters and balancers, for feeding on the two-wire system and distributing on the three-wire system, with battery regulation. The capacity of the four dynamos installed at present is together 720 kilowatts.—Lond. *Elec.*, June 7.

Size of Wheels for Automobiles.—Luxenberg.—An article on the influence of the size of the wheels upon the power consumption of an automobile. Three different formulas have been developed. One states that the specific resistance of the rolling friction is inversely proportional to the cube root of the square of the wheel diameter; the second formula states that it is inversely proportional to the wheel diameter; the third that it is inversely proportional to the square root of the wheel diameter. It is probable that all these formulas are valid only under special conditions. He discusses experimental data of Morin, which show that the first of the above formulas is correct only to a very limited degree, and gives entirely wrong results in many cases.—*Centralblatt f. Accum. und Elem. Kunde*, June 1.

REFERENCE.

Return Currents of Electric Railways—Krohn.—A reply to the criticism of Jastrow. He claims that his measurements are correct. —*Elek. Zeit.*, May 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Tynemouth.—An illustrated description of this new British lighting and traction plant. There are two direct-current dynamos, each of 180-kw for lighting and a 190-kw dynamo for traction; 800 lamps of 8 candle-power are connected to the mains at present.—Lond. *Elec. Eng.*, June 7.

REFERENCES.

Rotherham.—An illustrated description of this new British plant. The three-wire direct-current system is used with a pressure of 230 volts at the consumers' terminals. The present plant has a capacity of supplying 4000 to 5000 lamps at one time.—Lond. *Elec. Eng.*, May 31.

Ilford.—An illustrated article on electric lighting and traction at Ilford, near London. The lighting plant has been completed, but the traction plant is still under construction. The plant contains at present three direct-current dynamos of together 500 kilowatts. There is also a battery of a capacity of 600 ampere-hours when discharged at a rate of 200 amperes in three hours.—Lond. *Elec. Rev.*, June 7.

Switch for Charging Storage Batteries.—Joseph.—A brief description of a simple switch for making connections with a storage battery for charging. The battery is divided into three equal parts, and two parts are charged at the same time from the supply network. The switch enables one to charge with the first and second part, or the second and third part, or the first and third part, or all three parts at the same time.—*Elektrochem. Zeit.*, June.

Automatic Regulating Switch.—Krausse.—An illustrated description of a new and simple automatic switch to be used for automatically regulating the number of cells of a storage battery or as an automatic shunt regulator for keeping the voltage of a dynamo constant. —*Elek. Zeit.*, May 9.

WIRES, WIRING AND CONDUITS.

Copper Required in the Three-Wire System.—Finzi.—A communication referring to a statement that the copper required in the three-wire system, with a middle wire of the same thickness as the outers, is 37.5, if the copper required for the two-wire system is 100, provided that watts, losses, voltage and distance are the same in both cases. In this statement one of the most important points for lighting installations, namely, "the elasticity of the system," is not taken into account. At constant voltage between either outer and the middle wire at the beginning of the line, and for equal per cent of voltage variations at the lamps, the copper required depends upon the possibly occurring difference of load on both sides of the system and varies between 37.5 and 112.5. The value 37.5 corresponds to the most favorable case, in which the load is equally distributed between the two halves of the system. The value 112.5 corresponds to the most unfavorable case, in which the difference of the loads of both halves may have any value.—*Elek. Zeit.*, May 9.

ELECTRO-PHYSICS AND MAGNETISM.

Induction Coils for Spark Discharges.—Klingelfuss.—An account of a demonstration before the German Electro-Chemical Society of two induction coils, one with a straight iron core for sparks of 1 meter length, the other with a closed iron core for discharges of 35 cm. length and of the thickness of a finger. The first one has two entirely separate primary windings, one having 140 turns for electrolytic interrupters, the other having 800 turns for mercury interrupters and for single discharges. The secondary winding has 86,000 turns, and has been wound by a special method. The voltage at the discharge poles was found to depend upon the form of these poles, especially upon the condition whether the positive pole was more or less pointed. The voltage for a given spark length was also found to depend upon the more or less strong magnetic field. With the same discharge poles and the same capacity of the condenser in shunt with the spark-gap, he found the following maximum voltages required for spark discharges of varying length: 107,500, 268,-

800, 618,100 volts for 10, 50, 90 cm. spark length, respectively. He also showed the influence of a variation of the capacity of the condenser.—*Zeit. f. Elektrochemie,* May 23.

Analyzing Periodic Waves.—Fischer-Hinnen.—An illustrated description of a quick method of determining the single harmonics into which a periodic wave is resolved according to Fournier's theorem. To obtain one point of the *n*th harmonics, he adds the ordinates of *n* points of the main curve, distributed at equal intervals over a wave length, and divides the sum by *n*. The determination of two points is sufficient for plotting this harmonics. The fundamental wave cannot be determined by this method. For the third and fifth harmonics corrections must be applied later. The method seems to be very quick and practical. It is claimed to be much easier than that of Houston & Kennelly, as the latter method requires the determination of as many areas as lengths of ordinates must be read in Fischer-Hinnen's method.—*Elek. Zeit.,* May 9.

REFERENCE.

Anode Rays.—Hibbert.—A brief illustrated description of several experiments with anode rays.—Lond. *Elec. Rev.,* June 7.

Electro-Chemistry and Batteries.

"Short-Circuit Diagrams" of Storage Batteries.—M. U. Schoop.—An article in which he gives "short-circuit diagrams" of a lead accumulator, obtained by the following method. From a battery currents were taken for a very short time, about 2 or 3 seconds, and the voltage at the terminals, the current, and the voltage at open circuit, were measured. The currents taken out of the battery were gradually increased up to short circuit. These measurements were made for about 7 different current strengths. The whole duration of such a test was about 5 minutes. The behavior of each electrode separately was also determined by means of a third auxiliary electrode. The results of the tests were used for plotting the "short circuit diagrams," in which the current strength in amperes are the abscissas and the voltage at the terminals and e. m. f., respectively, are the ordinates. The e. m. f. and the voltage at the terminals are straight lines. The measurements were made with a battery giving normally 25 amperes in 3 hours. The "short circuit" tests were made immediately before the beginning of the normal 3-hour discharge, and immediately after the discharge. In both cases the voltage drop (difference of e. m. f. at open circuit and voltage at the terminals with closed circuit) is considerably greater at the spongy lead plate than at the peroxide plate. The e. m. f. at the spongy lead plate is nearly constant for all current strengths used by him, while the e. m. f. at the peroxide plates decreases with increasing current strength. The e. f. m. at the spongy lead plate is only slightly smaller after the normal 3-hour discharge than before. He asks what is the reason of the large voltage drop at the spongy lead plate which is considerably greater than at the peroxide plate? He does not seem to have found a satisfactory explanation. He concludes that "the exhaustion of pasted peroxide plate is mainly due to slow diffusion of acid, i. e., to developing a lack of acid in the pores of the plate, while the capacity of spongy lead plates is principally due to the physical properties and to the quantity of the spongy lead. This supposition is confirmed by the well-known fact that the voltage and e. m. f. of a spongy lead plate which is being discharged drops suddenly, while the voltage and e. m. f. of a peroxide plate which is being discharged drops gradually, and that the "recovery" is mainly due to the peroxide plates." This refers, of course, only to a battery, of which both plates have the same capacity.—*Centralblatt f. Accum. u. Elemkunde,* June 1.

Electrolytic Phenomena at the Boundary Surface of Two Solvents.—Riesenfeld.—A German electro-chemical society paper on the concentration changes at the boundary surface of two solvents, during electrolysis. He uses a U-tube, the lower part of which contains a solution of K I in phenol, while the two arms of the tube above this solution contain an aqueous solution of K I. In the interior of each electrolyte there can be no concentration changes, but at the boundary surface the concentration must change, as the transport number of the ions are not the same in both solvents. He shows that in the case of his U-tube with the two boundary surfaces, the concentration at one of them must increase, that at the other must decrease, the amounts of increase and decrease being equal and proportional to the difference of the transport numbers of the cation in phenol and water. At which of the two boundary surfaces the increase of concentration takes place, depends only on the relative velocities of migration of the ions in the two solvents. An experimental determination of the concentration change enables one to draw a conclusion concerning the relation between the migration velocities in the two solvents. He describes some experiments which he has made.—*Zeit. f. Elektrochemie,* May 23.

Production of Perchlorates by Electrolysis.—Winteler.—A German electro-chemical society paper giving an account of experiments on the electrolytic production of perchlorates. He remarks that the perchlorates should be of industrial importance on account of the high percentage of oxygen which they contain. They are well adapted for explosive materials and for various oxidizing processes, especially those of fusing. Perchlorate of potassium contains 46 per cent, by weight, of oxygen, perchlorate of sodium 52 per cent, perchlorate of ammonium 54 per cent. The electrolytic production of perchlorates is a very simple process. He investigated the influence of concentration, current density, temperature and material of electrodes upon the electrolysis of solution of chlorides and chlorates of alcalies. He first electrolyzed a neutral solution of chloride of sodium. He found that the concentration of chlorate, as long as it is not below a minimum, has no great influence upon the output. The perchlorate which is formed and must then participate in the electrolysis, has no influence upon the final result of the electrolysis. The current density and the temperature have an enormous influence upon the output of perchlorate. The results of his tests are given in curves. The higher the current density at constant temperatures and the lower the temperature at constant-current density, the greater is the output of perchlorate. The condition of the surface of the electrodes—whether polished or rough, has also some influence. At a polished platinum electrode the oxidation process is considerably greater. He also investigated whether in the electrolysis of chlorides, perchlorates are formed in the very beginning, or only after hypochlorite and chlorate have been formed. He used various methods with and without a diaphragm, and at different temperatures, but he could not detect any primary formation of perchlorate as long as the chloride was in the solution in considerable quantities. Perchlorate was only found after the percentage of chloride had decreased below a certain minimum. This minimum was different for different solutions. It was between 5 and 0.4 per cent by weight.—*Zeit. f. Electrochemie,* May 23.

Periodic Phenomena in Electrolysis.—Koelichen.—A German Electro-Chemical Society paper, giving an account of experiments in which he investigated peculiar periodic phenomena, taking place during the electrolysis of sulphides of alcalies. The best oscillations are obtained with concentrated solutions of monosulphide of sodium at a current density of 10 to 20 amperes per square decimeter. When the circuit is closed the measuring ammeter and voltmeter at first tremble, after which periodic oscillations are gradually formed. He found that the seat of these periodic oscillations is the anode and that the oscillations are due to a periodic change of the resistance of the anode. This change is due to the deposition and redissolving of sulphur at the anode. Some curves thus obtained are reproduced. In the discussion which followed, other cases of periodic phenomena in electrolysis were mentioned.—*Zeit. f. Elcktrochemie,* May 23.

Application of Elcetrolysis to Organic Compounds.—Hewitt.—A continuation of his serial. He first deals with alcohols. The preparation of alcohols by electrolysis is probably not feasible, neither is the conversion of alcohols into other substances by electrical means likely to be of service in many cases, although the electrolytic production of chloral from ordinary ethyl alcohol is now carried out technically. Electrolysis has been proposed for the purification of alcohol, and the question of using ozone for the ageing of wines has attracted some attention. He also deals with acids and aldehydes and ketones. One aldehyde of technical importance is produced by an electrolytic method, viz., chloral. A still is divided by a diaphragm. In the anode space is a hot concentrated solution of potassium chloride. The anode itself is of carbon, and movable, so as to act as stirrer at the same time. The cathode is of copper. Electrolysis is carried out at 100 degs. C., alcohol being allowed to flow into the anode space where, in contact with the nascent chlorine, it is converted itno chloral: 50 grams of chloral are produced per horse-power-hour.—*The Elec. Chem. and Met.,* May.

Potential Between Metals and Non-Aqueous Solutions.—Kahlenberg.—An account of experiments in which he tested the formula of Nernst for the e. m. f. in a concentration cell with organic solvents. He found that the formula does not apply to non-aqueous solutions.—*Jour. Phys. Chem.,* Dec., 1900; abstracted in *Science Abstracts,* May.

REFERENCES.

Ketones.—Elbs.—A brief German Electro-Chemical Society paper on the electro-chemical reduction of ketones.—*Zeit. f. Elektrochemie,* May 23.

Peroxide of Hydrogen.—Bredig.—An account of an investigation of Calvert of the condition of peroxide of hydrogen in an alkaline solution by the methods of physical chemistry. He found that the peroxide of hydrogen acts as an acid.—*Zeit. f. Elektrochemie,* May 16.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Commercial Dry Cells as Standards of E. M. F.—St. John Hyde.—An account of "Experiments with commercial dry cells for secondary standards of e. m. f." While the standard Clark cell can be used only under special conditions because it is not constant, except with 10,000 ohms in circuit, he says that the "Mesco dry battery" and other dry cells are constant with 5 to 10 ohms. Three Mesco dry cells of an e. m. f. of about 1.4 volts were investigated. He found that "the e. m. f. is constant to 1 per cent or better, under all usual conditions, and this type of cell need only be standardized at long intervals; that time has but little effect on e. m. f. Even when polarized the cells recover their original e. m. f. almost completely."—*School of Mines Quart.,* April.

Mercury Standard for the Ohm.—Jaeger and Kahle.—In a former paper an account had been given of the construction of two mercury columns for the standard of resistance in the Reichsanstalt. It was thought advisable to use a larger number of mercury columns in the definition of the practical unit of resistance, and three others were accordingly made. In the present paper they give a detailed account of the standardizing of these three. One had a section of about 0.5 sq. m.m., and a resistance of about 2 ohms. The second, a section of 1.3 sq. m.m. and 0.5 ohms resistance, and the third, like the old ones a resistance of about 1 ohm and a section of 0.75 sq. m.m.—*Zeit. f. Instrumentenkunde,* Jan.; noticed in *Science Abstracts,* May.

REFERENCES.

Measuring Permeability.—Lamb and Walker.—A paper read before the Inst. of Elec. Eng., in which they describe an instrument for measuring the permeability of iron and steel. They endeavored to construct an instrument which would be extremely simple to use, and whose calibration should be based upon such principles as would render it incapable of alteration with time and with somewhat careless usage. The principle adopted is that of balancing the reluctance of an air-gap against that of the specimen under test by means of altering the length of the air-gap. They describe in detail the construction, use and calibration of their instrument.—Lond. *Elec.,* June 7.

Localization of High-Resistance Breaks.—Rymer-Jones.—The first part of a long illustrated description of a test for localizing a high resistance break in a submarine cable. The method is described and several tables for its use are given.—Lond. *Elec. Rev.,* June 7.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Sine Waves and Cable Telegraphy.—Breisig.—An illustrated article on the question whether the theory of alternating currents with pure sine waves may be applied to problems of cable telegraphy. He discusses the "sine-wave transmitter" of Crehore and Squier, and investigates whether, from a purely electrical standpoint, the form of e. m. f. obtained with this transmitter is more favorable than that obtained with the battery system. He emphasizes the fact that in practical cablegrams no strictly alternating currents are sent through the line, but there are positive and negative half waves indiscriminately, so that sometimes several half waves of the same sign follow another without intermediate half waves of the opposite sign. In the theoretical considerations of Crehore and Squier it is assumed that this practical case may be treated theoretically like the ideal case that a positive half wave is always immediately followed by a negative half wave, and this again by a positive half wave, and so on. He remarks that such an assumption has yielded wrong results in the investigation of another problem, dealing with the most favorable electrical design of the transmitting and receiving apparatus. An account of the investigation of this problem is given in detail. It was, therefore, very uncertain whether the above supposition had not lead Squier and Crehore to wrong results also. He examines their system and starts from the case that a positive half wave is followed after a sufficient interval by a negative half wave. He obtains the result that when e. m. f.'s of equal maximum value are used with the sine wave transmitter system, and the battery system, the sign received with the latter system is the greater one. In the comparison of these two systems Crehore and Squier have introduced the term equivalent voltage, meaning that the amplitude at the beginning of the cable has the same maximum value. The present author believes that this definition of the equivalent is not correct, as it is based upon inexact supposition regarding the e. m. f. at the beginning of the cable with the battery system. He claims, therefore, that in Crehore and Squier's comparison of their system with the battery system, the equivalent e. m. f. has been assumed too low for the latter system, so that their results are too favorable to their own system. He claims that the Crehore and Squier system has from purely electrical standpoint, no advantages over the battery system, although the differences in the results with both systems are only slight. But it may have other advantages, for instance, such due to the great simplicity of the sine wave transmitter, compared with the complicated form of the old transmitter. He concludes that the application of the theory of pure sine waves, leads to wrong conclusions in problems of cable telegraphy in such cases in which the time required for the complete transmission of an elementary sign on the cable is large compared with the period of the sinusoidal alternating current.—*Elek. Zeit.,* May 16.

Transmission of Compass Readings.—Weber.—A paper read before the Electrotechnical Society, of Berlin, on the problem of transmitting compass readings. A compass used on an iron ship does not give correct indications. It is desirable to place the compass at the most favorable place, for instance, at the top of the mast, where it is acted upon only by the terrestrial magnetism, and to transmit its readings to places at the ship where they are wanted. Several methods have been suggested, but do not seem to have been introduced into practice. He suggests a method which enables one to obtain on board ship at any time at any number of places corresponding indications of the instantaneous course of the ship. His fundamental idea has been to generate the electric currents required for the transmission of the indications, exclusively from the terrestrial magnetism.—*Elek Zeit.,* May 9.

REFERENCES.

Buffalo.—An illustrated article on independent telephony in Buffalo and vicinity.—*West. Elec.,* June 8

Telephone Apparatus.—An illustrated article on some new telephone apparatus and appliances of American make.—*Elec. Rev.,* June 8.

Batteries Used in Telephony.—Higgins.—The first part of an elementary article in which he describes several type of primary cells and discusses the methods of connecting them.—*El'ty,* June 12.

Telephone Line Construction.—The first well illustrated part of a serial written by "a Bell engineer." He describes in detail the method of setting and equipping poles.—*Tel. Mag.,* June.

Danger for Telephone Wires from Broken Trolley Wires.—An illustrated description of a device of Schoenberger for preventing the dangers arising for telephone or telegraph wires from a broken trolley wire.—*Elek. Zeit.,* May 30.

Repeater for Wireless Telegraphy.—Collins.—An illustrated article on the Guarini repeater system for wireless telegraphy, which was noticed before in the Digest.—*West. Elec.,* June 15.

MISCELLANEOUS.

British National Physical Laboratory.—Some editorial notes on a discourse of Glazebrook on this new British institution which is "to supply to the industries of this country a fuller measure of scientific and technical stimulus than at present exists." It is modeled on the German Reichsanstalt. Buildings and grounds have been presented for this purpose, and plans for the alteration and equipment of this site are being rapidly carried into execution. Among the subjects suggested as affording scope for useful research, are the following: The properties of iron and steel, when raised to a few hundred degrees below the melting point and cooled in various ways. The wind pressure on bridges and large structures. The properties of glass, especially in relation to its chemical constituents, etc. As the institute is regarded so far only as an experiment, the Government grant of funds is somewhat small.—Lond. *Elec.,* May 31.

REFERENCE.

Glasgow Exhibition.—The first articles of a series on exhibits at this exhibition.—*Lightning,* May 16, 23, 30.

The first of a series of articles on "steam electric generators at the Glasgow exhibition." This article deals with Willans and Robinson sets.—*Eng'ing,* May 31.

Electrical Engineering Industry in Continental Europe.—An article giving some information on the financial conditions of the larger companies of the Continental European electrical engineering industry.—Lond. *Elec. Rev.*, June 7.

Paris Exposition.—Ruhmer.—An illustrated description of induction coils and interrupters exhibited.—*Phys. Zeit.*, May 25.

New Book.

Electrical Designs. Descriptions of Electrical Apparatus of Simple Construction. New York: American Electrician Company. 262 pages, 289 illustrations. Price, $2.

This book gives descriptions in detail and dimensioned drawings for direct current motors or dynamos of from 1-6 to 3 horse-power, rotary converters of from 1 kilowatt to 4 kilowatts, a 100-ampere alternating-current rectifier, a 1-hp induction motor, transformers of from 200 to 1000 watts capacity, rheostats, voltmeters, ammeters, wattmeters, galvanometers of various types, a photometer and other pieces of experimental and commercial apparatus, such as storage battery cells, arc lamps, induction coils, telephones, etc. In general, the designs are well worked out, the dimensions conform to good commercial practice and the descriptions and drawings will enable any one with ordinary mechanical skill to construct the apparatus. The degree of skill required depends, of course, upon the nature of the machine or piece of apparatus to be made. Many of the simpler pieces, such as the galvanometers, transformers and testing set, are within the ability of any one with a few hand tools. The larger dynamos and converters, on the other hand, would require the facilities of a moderate-sized shop for their construction.

The designs for the direct-current motors, the transformers and the photometer are particularly good, the latter being a most excellent instrument which can be easily and cheaply constructed, and should do good work. The rotary converters follow closely commercial practice in their general form and construction, but seem to have the output overrated, and to be somewhat weak mechanically, especially in the smaller parts. The measuring instruments can be easily made and need only careful workmanship to make them very satisfactory.

The book will be of much interest and value to those who have occasion to design, repair or use small electrical machinery, measuring instruments and apparatus of various kinds, not only on account of the designs given, but also because much information, which will be useful in any kind of construction, is scattered through its pages.

BOOKS RECEIVED.

Experimental Physics. By Eugene Lommel. Philadelphia: J. B. Lippincott Company. 664 pages, 430 illustrations. Price, $3.75.

Recording and Integrating Electric Meters. How to Inspect, Repair, Test, Calibrate, Read and Compute. By Robert Ferris. Monmouth, Ill.: Robert Ferris. 47 pages, illustrated. Price, $1.

Practical Electro-Chemistry. By Bertram Blount. New York: Macmillan Company. 374 pages, 46 illustrations. Price, $3.25.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 9, 10 and 11, 1901.

Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

New York State Street Railway Association. Next meeting Rochester, N. Y., September, 1901.

Ohio Electric Light Association. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

Old Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

Pennsylvania State Street Railway Association. Next meeting, York, Pa., Sept. 4, 1901.

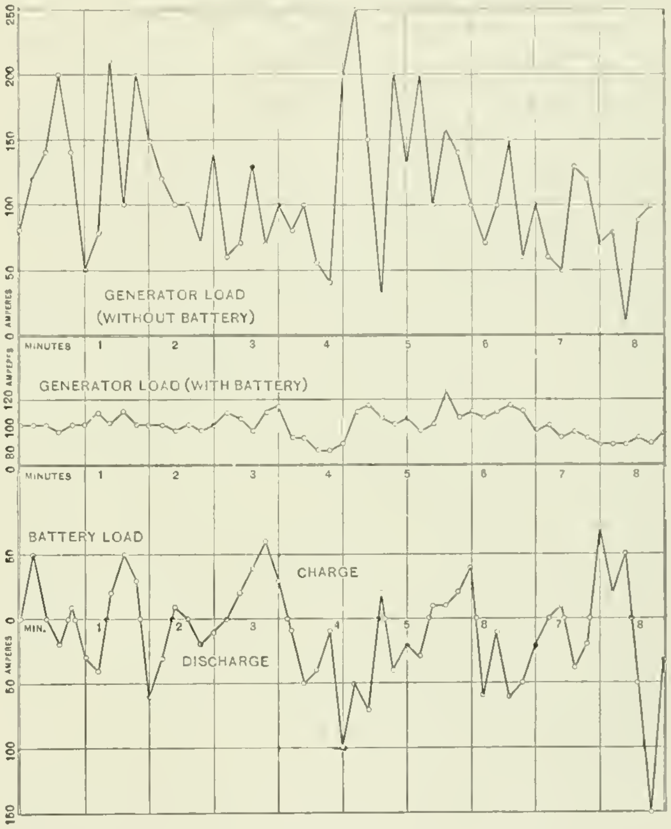
Storage Battery Plant of Lansing, Mich., Street Railway.

By Thomas J. Fay.

The Lansing Street Railway Company, of Lansing, Mich., finding that the service was not improving as the load factor increased with the growing demand, finally took up for consideration the addition of more generating capacity and more copper for the transmission system, or the installation of a storage battery.

That a storage battery is the equivalent of additional dynamo capacity and additional copper in the transmission system goes without saying, and the results obtained at Lansing appear to offer proof positive of the hypothesis. A dynamo, if run at full load continuously, will deliver its full rated output in ampere-hours, but if the translating devices do not require the full output continuously, the impracticability of taking advantage of the generator capacity is a self-evident proposition unless a reservoir is provided for the surplus. A storage battery is such a reservoir.

In the next place, if the copper in the transmission system is scant, the "drop" in transmission resulting from heavy demands by translating devices at a distant point from the source, will be excessive, and in the event of street cars being the translators, the attainable speed will be diminished and the motors will be subjected to extra and hazardous strains; for at a low voltage the current in amperes will be correspondingly high, and hence the C^2R losses will be augmented.



LOAD CURVES OF A STREET RAILWAY POWER STATION.

The storage battery at a distant point from the source of power does two things, namely, it reduces the distance of the transmission and acts as an independent source of e. m. f.

The storage battery problem is exceedingly simple in railway work because, owing to the allowable loss in transmission, the battery may be "floated" across the system in parallel with the generators, without the use of any regulating device as booster-crushers or end-cell switches.

At Lansing the battery is connected permanently across the line with absolutely no regulating equipment at all, and the results attained are so good that the plant is stated now to be run with a reduction of 50 per cent in the capacity of the generating plant. Prior to the introduction of the Gould battery the plant was struggling along with two units of 80 kilowatts each, and with the maximum load exceeding 160 kilowatts, with the result that the engines were being hammered out of existence, and the generators running overheated. After the battery was installed, one 80-kw generator was found to be capable of handling the load with no danger of being burned out.

The power required to operate the plant does not exceed 80 × 24 or 1920 kilowatt-hours per day, but the "freak" loads exceed 160 kilowatts many times during the day's run. The arrangement is such, using the battery, that when the demand is less than 80 kilowatts the battery furnishes the difference.

The exact performance is best shown by the load curves of Fig. 1. The conditions are represented in this diagram in such a plain manner that comment is unnecessary. That the operating expenses will be materially diminished in this plant is now an established fact, the plant having been run with and without a battery long enough to establish the fact.

The battery is one of the type capable of withstanding discharges down to the full output in a quarter of an hour. The output of this battery ranges from 320 ampere-hours for eight hours to 96 amperes for one-quarter hour, at the 8-hour rate, being 40 amperes, and at the quarter-hour rate, 384 amperes.

The battery is capable of furnishing the maximum required current for the most savage "freak" demand with a margin to spare, and as a result the generator is not subjected to fluctuations at all.

Referring to the question of efficiency, the steam plant works at its most efficient point, the generator is equally well placed, and the battery is capable of delivering nearly 100 per cent of the ampere-hour influx and about 87 per cent of the wattage influx at the 8-hour rate. As to the effect of high rates of discharge on the efficiency, it is sufficient to say that the time element is short, and if the energy is not taken out it is still available; that is to say, if 96 ampere-hours are withdrawn at a 384-ampere rate, then by putting back but little more than 96 ampere-hours, 320 ampere-hours can be taken out at the 40-ampere rate, and so on.

This can only be done to a high degree with an electro-chemically formed battery out of pure rolled lead plates in which the surface is increased by a suitable spinning or grooving process to such a point that the active material forms a thin, porous, cohesive and integral part of the conducting grid. This condition, however, cannot be attained in types of battery of which a large percentage of the active material is entirely inaccessible, and an even larger proportion so inaccessible that the diffusion of acid only takes place at a low and sluggish rate.

The performance of the Gould battery at Lansing shows another very important advance in storage battery performance, in that the battery does not demand a great change in e. m. f. to effect an economical charge, nor does the e. m. f. fall away under discharge nearly so much as has been noted in storage battery work in general. This is just what ought to be expected in a battery that is possessed of great porosity, and a thin layer of active material in intimate contact with the conducting grid.

The question of battery depreciation is not a question to receive more than passing notice in a battery in which the active material is thoroughly accessible and formed by a process that leaves it open to acid diffusion yet so evenly dispersed and in absolute contact with the supporting grid. Experience dictates that this is true, and even without experience it stands to reason that this is true.

The Plante process, as exploited by the Gould Storage Battery Company, while very old and once thought to be impracticable because of the slow formation, was considered by many as producing the most substantial type of battery, but the Gould Company so perfected its process that the cost of forming the layer constituted no obstacle to the commercial exploitation of the type.

Devices for Handling Extreme Potentials.

Switchboards and appliances adapted to the safe and convenient manipulation of the high potentials now used for long-distance transmission work have not in general kept pace with the development of the apparatus and appliances for the production of these high potentials. The apparatus illustrated herewith for this work, though new to the trade, has been thoroughly tried and proved successful.

To handle safely potentials from 5000 to 60,000 volts requires apparatus designed and constructed with special care. Probably the most important piece of apparatus for high-voltage work is a thoroughly reliable switch for connecting high-potential transformers and generators to lines at the generating end of a transmitting system, and for connecting high-potential lines to step-down transformers at the receiving end.

The S. K. C. combination switch and fuse is built for pressures of 10,000 volts and higher, and of 100 amperes capacity. They are in use on the 60,000-volt circuits of the Standard Electric Company, of California, and the Bay Counties Power Company, of California.

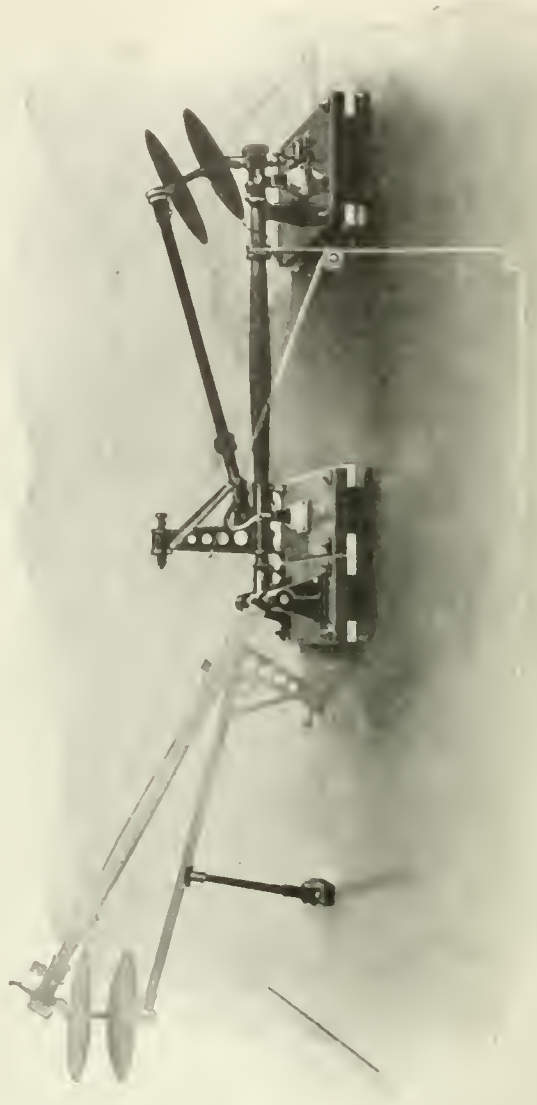


Fig. 1.—Two Positions of Switch.

This type of switch depends for its successful operation on the drawing of a metal fuse through a non-conducting powder which is enclosed in an insulated tube. The arc formed due to the breaking of contacts is ruptured as the fuse passes quickly through the powder. Figs. 1 and 2 illustrate the three positions of a single-throw switch. The combination consists of the main arm, an auxiliary arm, a fuse and fuse holder, and the two terminal jaws, together with the mechanical details for the proper operation of the switch.

The main arm is a wooden rod, hinged at the bottom, and having mounted on the top two zinc jaws which clamp one end of the fuse. On this main arm are also mounted two blades which make the contact with the terminal jaws. The upper blade is electrically connected to the zinc jaws, while the lower blade is connected to the auxiliary arm by means of a cable.

As the circuit is never meant to be broken between the terminal jaw and blade, but by allowing the fuse to slip from the zinc jaws the main arm is locked in its upright position and cannot be unlocked until the auxiliary arm has dropped into the horizontal position of Fig. 2, thus breaking the circuit.

The auxiliary arm consists of a hollow wooden rod hinged to the main arm at the bottom and having mounted on the top two zinc plates, which form the holding device for the other end of the fuse. Inside the wooden arm is a copper rod forming the connection between these plates and the cable connecting with the lower blade on the main arm. This auxiliary arm is intended to be pulled sharply away by the spring in the event of the unlatching of the fuse or the fuse blowing. The jar of its falling is taken up by the dashpot on the bracket attached to the main arm. The switch is set sufficiently high not to come within striking distance of the attendant's head.

The fuse holder consists of a hollow insulating tube having perforated corks and large washers at each end, and containing the non-conducting, non-fusible powder through which the fuse is drawn. It is tied to the main arm to prevent its falling to the floor when no longer supported by the fuse. The fuse enclosed in the fuse holder is held in position between the main and the auxiliary arms by means of the zinc jaws on the top end of the main arm and the zinc plates on the auxiliary arm.

The jaws forming the terminals are mounted on separate pieces of marble and are thoroughly insulated by means of porcelains and bushings so as to avoid any leakage to the marble. On the upper terminal marble is also mounted the catch, operated by a rope, and which opens the zinc jaws on the main arm, releasing the fuse.

Observing the switch in its normal position, the current enters at the upper terminal, passes to the zinc jaws on the main arm, then through the fuse to the auxiliary arm, down the auxiliary arm and through the cable to the lower blade on the main arm and thence through the lower terminal out. Pulling the rope attached to the catch opens the jaws and releases one end of the fuse. The fuse, thereupon, is passed rapidly through the non-conducting powder in the fuse holder by the auxiliary arm falling into a horizontal position, breaking the circuit and rupturing the arc.

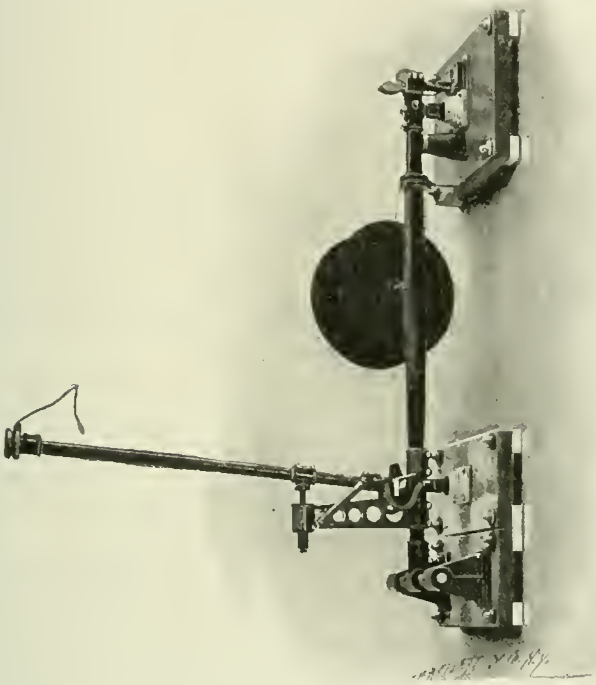


Fig. 2.—Horizontal Position.

The main arm may now be unlocked from the catch, and the whole combination allowed to swing down into position where easy access can be had to the working parts, and thus the fuse reset. This position is shown by the skeleton section of Fig. 1. After the fuse has been reset the whole combination is brought into its normal position by a rope attached to the main arm. As the combination is primarily a switch and not a fuse, the fuse is made sufficiently heavy so as to avoid its blowing under anything but extreme conditions. If on any account the fuse should blow, the action is precisely similar, except that the breaking takes place in the center of the tube instead of at the jaws.

Notes of the Railway Telegraph Superintendents' Convention.

In addition to the report of the convention which appears elsewhere in this issue, the following notes will be found of interest:

Ladies' Reception.—A luncheon was served to the ladies by the Buffalo Telephone Company on Wednesday at its main exchange.

The Knickerbocker Telephone & Telegraph Company, of New York, was represented by Mr. W. S. Eckert, its electrical engineer and general manager.

The Independent Telephone Association was represented by Mr. W. S. Eckert, of the Knickerbocker Telephone & Telegraph Company, of New York.

The Safety Insulated Wire and Cable Company, of New York, was represented by Mr. A. P. Eckert, who gave to the members a serviceable memorandum book as a souvenir.

The Webb C. Ball Company, manufacturer of watches, particularly recommended for railway men, was represented by W. J. Hurley, who distributed a unique money purse, which had a secret locking device.

The Railroad Supply Company, of Chicago, was represented by Mr. E. W. Vogel, its signal engineer. The signal and electrical department of this company handles all kinds of electrical signals for railways. The company has recently acquired control of several other crossing signal companies. Mr. Vogel presented each member with a handsomely bound volume of railroad stories.

Mr. Henry W. Pope spared no pains to provide enjoyment for the members and their families and friends, and while he received the formal thanks of the association for his careful attention to this feature of the meeting, the members individually did not fail to express their appreciation for his liberal hospitality and the many courtesies extended by him and secured through his efforts.

The Kellogg Switchboard & Supply Company, of Chicago, was well represented by Mr. Paul W. Bossart, who distributed among the members a leather card case. The company's excellent exhibit at the Pan-American Exposition attracted a great deal of attention, especially among those interested in railway telephone service, and of these it is a notable fact there is a constantly increasing number.

Niagara Falls Trip.—On Thursday afternoon the members and their friends enjoyed a trip to Niagara Falls on special cars provided by the Buffalo Bell Telephone Company, represented by Mr. Pope. Some of the party took a ride over the Gorge road on a special car, while the others spent their time visiting the many places of interest around the Falls. The party returned to Buffalo in the evening.

The Bunnell Telegraphic & Electrical Company, of New York, had an exhibit of relays, sounders, keys, a fire alarm box, a police, doctor, messenger and carriage call, and a watch and fire service instrument. The company was represented very ably by Mr. H. S. Young, Jr., who presented the members with a very beautiful sterling silver matchbox, which was highly appreciated by those fortunate enough to secure one. Mr. Young did some active work in behalf of his company.

J. H. Bunnell & Co., New York, had an able and effective representation in Messrs. W. E. McLaughlin and J. J. Ghegan. These gentlemen had an exhibit of a Morse-Phillips transmitter in practical operation in the meeting room, also an extension, loud-ringing telephone bell for use in noisy places. This instrument is practically a modification of the ordinary bell, of more powerful construction, and has two large gongs which can be readily heard above loud noises. It is operated by the ordinary calling currents. Mr. Ghegan presented the members with a souvenir in the shape of a silicate memorandum, and Mr. McLaughlin remembered the ladies by presenting them with beautiful souvenir silk handkerchiefs on which were wowen pictures of the different Exposition buildings.

Vitrified Conduit at the Pan-American.

The American Vitrified Conduit Company is prominently located in the northeast corner of the Electricity Building, with an interesting exhibit of a full line of their products showing the largest number in style and types of vitrified conduits. Its leading article of manufacture is the multiple duct conduit. While multiple conduits from 2 to 6 ducts have been for a long time well known on the market, this company is believed to be the first to succeed in producing perfectly formed 9, 12 and 16-duct conduits, which in themselves comprise complete systems. In the use of these, economical, solid and rapid construction is accomplished. Engineers have realized, it is said, that with the use of the square duct conduit cables are installed very rapidly, economically and satisfactorily, as cables are drawn into square ducts upon a flat surface; there is the least amount of friction to contend with and no possibility of shortening the life of the cables. The multiple conduits require no cement between conduits, very little concrete and none whatever on the sides. This company furnished last year all of the conduit for the Subway Commission, of Baltimore, Md., which amounted to over 5,000,000 ft. It also furnished upwards of 3,000,000 ft. to the Narragansett Electric Light Company, Providence, R. I.; the Boston Elevated Railway Company, Boston, Mass.; the Massachusetts Telephone Company, Boston, Mass.; Worcester Electric Light Company, Worcester, Mass., and many other large users. For the present season the rapid transit tunnel in New York which requires 20,000,000 ft.; the Manhattan Elevated Railway Company, New York, over 2,000,000 ft., and the Metropolitan Street Railway Company, New York; the Keystone Telephone Company, and the Girard Estate, of Philadelphia, have also purchased their conduits from this company.

VITRIFIED CONDUIT EXHIBIT.

The American Vitrified Conduit Company's factory has an enormous capacity, and for some time has been in operation night and day. The company also has a plant in Ohio, from which the Western trade is supplied. In addition to multiple conduit the company makes a full line of single-duct conduit, of which there is a heavy self-centering type, a light self-centering in 18-inch lengths, and the common single ducts with butt ends also 18-inch lengths. These are now being turned out at the rate of 80,000-duct ft. per work-day of 10 hours.

Mr. Wardell E. Brown, who looks after the construction interests of this company, and who arranged the exhibit, and is also in charge.

Standard Underground Cable at the Pan-American.

A neat and interesting exhibit is made in Section F, of Electricity Building, of the Pan-American Exposition, by the Standard Underground Cable Company, as shown in the accompanying cut.

STANDARD UNDERGROUND CABLE CO.
PA.
Wires and Cables for Electrical Uses.
CHICAGO
TELEPHONE
ELECTRIC LIGHT and POWER

STANDARD UNDERGROUND EXHIBIT.

The sample boards exhibited are handsome cabinets of black walnut, backed with birdseye maple, and the cases, four in number, contain samples in one case of street railway wires and cables and accessories; another of telephone wires and cables and accessories, another of electric light and power wires and cables, and another of telegraph and fire alarm wires and cables and accessories. The samples include rubber insulated wires, weatherproof and W. A. C. fireproof wires, Marsh duplex telephone wires, and many samples of rubber insulated telephone wires and cables, as well as samples of fiber and paper insulated cables, including 200 and 300 pairs paper insulated telephone cables.

Among the accessories are terminal heads, cable hangers, lightning arresters, suspension wires, manhole brackets, etc.

Meeting of Master Mechanics' Association.

The annual convention of the American Railroad Master Mechanics' Association was held in Saratoga, June 19, 20 and 21, with a very large attendance. The papers read and the discussions which followed were extremely interesting. On June 18 the railway supply men held their annual meeting at the Grand Union Hotel, Saratoga, and appointed their various committees, who have charge of the finance, entertainment, etc., of the Master Mechanics' Convention. Among the supply men attending the convention were a number of gentlemen well known in the street railroad field, and among the exhibits the following may be mentioned as being of interest to our readers:

National Tube Works Company, of McKeesport, Pa., was represented by Mr. Nicholson.

Charles H. Besly & Co., of Chicago, represented by Edward P. Welles, exhibited taps, parallel clamps, Gardner grinders, etc.

Crane Company, of Chicago, represented by Frank D. Fenn and E. A. Kimberg, exhibited a number of its valves and other steam specialties.

Link Belt Machinery Company, Chicago, represented by J. A. Werner, had a large album of drawings illustrating the application of its machinery.

Crosby Steam Gage & Valve Company, Boston, represented by W. F. Johnson and Thomas R. Freeman, had an interesting exhibit of gauges, pop safety and other valves

Lunkenheimer Company, Cincinnati, represented by Messrs. Samuel Mayer, C. Houghton, John Desmond and F. P. Leach, exhibited its injectors, globe valves, swing check valves, etc.

Consolidated Car Heating Company, of Albany, New York, showed its electric-heating as well as its steam-heating apparatus. It was represented by Messrs. R. P. Scales, F. C. Green and others.

Carborundum Company, Niagara Falls, N. Y., represented by F. H. Manley and R. L. Collingwood, exhibited a full line of Carborundum goods, showing its product made up in every conceivable form.

H. W. Johns Manufacturing Company, New York, represented by J. E. Meek and E. G. Sparks, exhibited a full assortment of asbestos goods, vulcabeston, lagging, packing, valves, air brakes, packing rings, etc.

Keasbey & Mattison Company, Ambler, Pa., also exhibited lagging and asbestos material, including valve and piston packings, and were represented by Messrs. George R. Wallace, R. L. Thomas, W. S. Gilmore and W. I. Harwood.

Standard Paint Company, New York, represented by J. C. Shainwald, Charles Earnshaw and J. N. Richards, had a car model with a rubberoid roof. The model illustrated the insulation of a refrigerator car and was painted with the famous P. & B. preservative paint.

Chicago Pneumatic Tool Company, Chicago, represented by W. O. Duntley and Messrs. Joseph and Frank Boyer and Thomas Aldcorn and others, exhibited the pneumatic tools made by this company, and also the Duntley electric headlight and motor. The company distributed a gold pencil as a souvenir of the convention.

Jenkins Brothers, New York, represented by Messrs. Joseph H. Williams, A. C. Langston, Charles W. Martin, Jr., and H. D. Gordon, had an interesting exhibit of packing and magnetic lamp holders for incandescent lamps, and also naturally their well-known line of valves and their rubber goods, such as Union rings, washers, gasket tubing, etc.

Bullock Electric Manufacturing Company, Cincinnati, was represented by Mr. Frank G. Bolles, who looked after the customers of the Bullock Electric Manufacturing Company very assiduously. Mr. Bolles states that the Bullock Company do a large business among the steam railroads, and many of the master mechanics present spoke highly of the Bullock motors which were in use in their various shops.

MANNING, MAXWELL & MOORE, New York, represented by Messrs. Charles A. Moore, John D. Derby, A. J. Babcock and P. M. Brotherhood and others, exhibited a full line of the Ashcroft gauges, Consolidated valves, Metropolitan injectors, H.-D. ejectors, Hancock inspirators, steam valves, check valves, hose couplings, etc. One of the interesting features of its exhibit was the first Hancock inspirator made a quarter of a century ago, still standard in design.

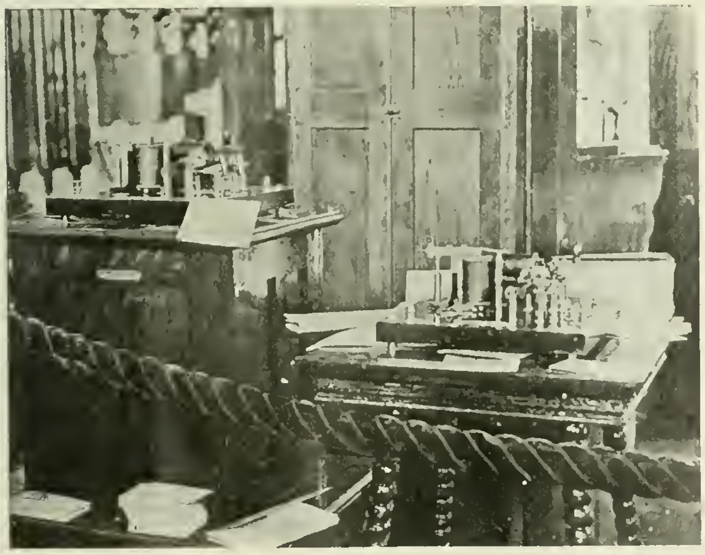
GENERAL ELECTRIC COMPANY, Schenectady, N. Y., was represented by Messrs. E. H. Mullin, Charles Pierce, Hawkes and J. L. Roe. It exhibited a 7-hp variable speed motor direct connected to a boring mill. The motor was driven by two G. E. generators belted to a G. E. motor, which in its turn was driven by power taken from the street railway circuit. The exhibit illustrated the method of operating machine tools by a direct-connected variable speed motor.

GOLD CAR HEATING COMPANY, of New York, represented by Edward E. Gold, John E. Ward, William E. Banks and James Watson, exhibited its electric car heater, electric heat regulating switch for street railway work and its locomotive equipment for steam heating and its car heating system for the different classes of cars. This company gave away the most handsome souvenir seen at the convention, a gold pencil, which was eagerly sought for, and which will serve to keep the name of "Gold" in the minds of every recipient.

RAILWAY LIGHTING.—An interesting exhibit was made by the Consolidated Railway Electric Lighting & Equipment Company, of New York, which was represented by John N. Abbott, J. L. Watson, Colonel John T. Dickinson, P. Kennedy and Arthur J. Farnsworth. It had a car belonging to the A. T. & S. F. Railway Company entirely equipped with its lighting system, with 15 lamps in the buffet and 24 lamps in the mail portion of the car. The car was stationed near the depot on the D. & H. tracks, and it was visited by practically all the railroad men present at the convention, who manifested great interest in it. It seems to be the universal opinion of those who saw the car that the system was one which has come to stay.

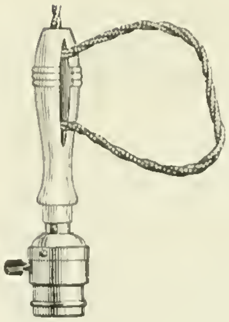
The Warner Ringer at the Pan-American.

Among the interesting telephone exhibits in the Electricity Building at the Pan-American Exposition is that of the Warner Electric Company, of Muncie, Ind., which makes the Warner pole changing device for central office ringing. This is exhibited in the booth of the American Electric Telephone Company. These ringers consist of a small vibrating pole changer which is kept constantly vibrating by one cell of Edison-Lalande battery. The pole changer serves to change from direct to alternating the current from 40 to 60 cells of dry battery, which current is used for central office ringing. One of these pole changers mounted on the cabinet which contains the dry batteries is shown at the left in the accompanying view of the exhibit. In case dry batteries are not used, wet batteries can be put in a storeroom and only the pole changer, shown at the right, is necessary.



TELEPHONE RINGER.

New Cord Adjuster.



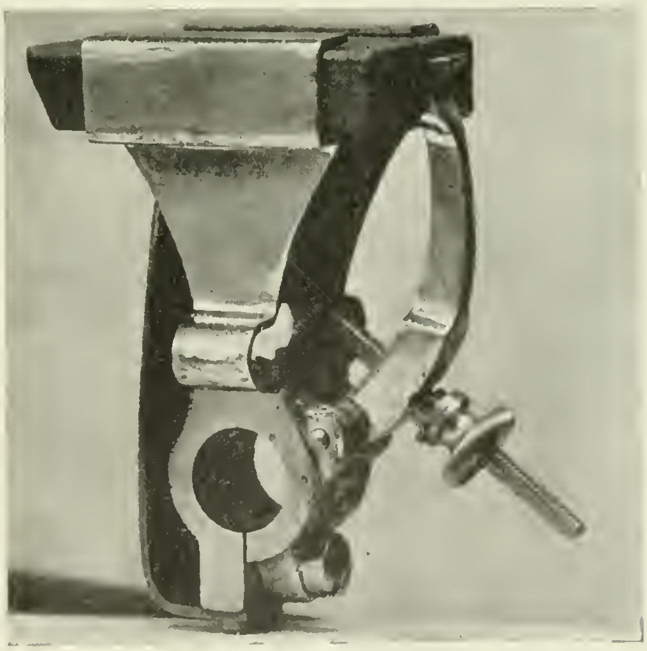
A new cord adjuster for incandescent lamps, herewith illustrated, has just been put on the market by Mr. George Webster, of Christiana, Pa. It is stated that this form saves half a cent's worth of cord, as compared with the cord in the ball form of adjuster, as the handle permits the utilization of all the cord in it, and requires no extra cord for its operation. It also holds the cord more tightly than is customary. The handle is at once strong and neat. The device is so simple that an explanation of its operation would be superfluous.

Socket Carbon Brush Holder.

An improved form of socket carbon brush holder has recently been patented by Mr. Oscar M. Stiegler, of Jamaica Plain, Mass. It is herewith illustrated. This brush holder is a brass casting which clamps onto the brush-stud, with two parts of sheet copper bent into shape so as to form the socket for the carbon brush when screwed into the recess of the head. The carbon brush is pressed against the commutator by means of a pressure-arm connected to a phosphor bronze spring, which is screwed to the extreme end of the head, making it long and flexible.

One novel feature is a T-shaped sheet-metal punching, with a square hole in the centre, used as a washer for the tension-nut while the two points rest in a groove in the pressure-arm, and act as a fulcrum. The tension-screw, being of square brass rod, makes it impossible for the washer to turn, and thus the points will always find their way into the groove.

One of the principal features of this holder is that the carbon brush is free from any separate connection for the purpose of contact, and can be removed from the socket for the purpose of cleaning, without moving the holder from its position. The contact between the brush and the holder is made perfect by the constant gentle pressure of the sheet-copper upon the sides of the carbon brush. Another good point is that it can be adjusted to take any brush, varying in width to one-fourth of an inch. This is a desideratum, if the brush desired should be but one-sixteenth inch wider than the commutator surface. As there is nothing to obstruct the brush from going through the socket, more than two-thirds of the brush can be used.



CARBON BRUSH HOLDER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 3 per cent. Time money was firmer, the rates being 3½ per cent for 60 to 90 days. Mercantile paper is quoted at 3¾@4¼ per cent for endorsed bills receivable; 4@4½ for highest grade, four to six months, single names, and 5@5½ for others. In the stock market speculation was quieter, and some reactionary tendencies were shown in prices, owing to fears of firmer money prior to July 1. Traction stocks were somewhat irregular, and a pool seemed to be working in Brooklyn Rapid Transit, basing its operations on an improvement in the earnings. This latter stock closed with a net gain of 1 point, the sales aggregating 126,200 shares. Metropolitan Street Railway was quiet, with a weakening tendency. The sales amounted to 24,600 shares, and the closing price was 1 point below that of the week previous. General Electric was held very firmly and the price continues to soar higher and higher. On Thursday it jumped to 263 from 248, the closing price on Wednesday, and practically maintained this high water mark up to the close, the last quotation being 260, a net gain of 12 points. Western Union was fairly active as far as trading was concerned, but the price is weaker, being ½ point lower than that at the close of the previous week. United States Steel stocks continued to maintain the leading position in the industrial list, the quotations for common and preferred shares being 48½ and 98⅝ respectively at the close. The curb market during the week was generally strong. Buying was active and, in several cases, there were advances. New York Elec. Veh. Transp. was quiet until Friday, when it jumped to 14⅝, which was a gain of more than 2 points over the close of the week previous. Following are the closing quotations at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	June 15.	June 22.		June 15.	June 22.
General Electric	248	260	Electric Vehicle	10	8
Brooklyn Rapid Transit	81½	82½	Electric Vehicle, pfd	16	16
Metropolitan Street Ry	175½	174½	General Carriage	1⅞	1⅞
American Tel. & Cable	99½	100	Illinois Elec. Veh. Tran	⅞	⅝
Western Union Tel	96	94¼	Hudson River Tel	120	120
American Dist. Tel	—	—	N. E. Elec. Veh. Tran	3⅛	3
Commercial Cable	—	—	N. Y. Elec. Veh. Tran	11¾	14
Electric Boat	22	22	Tel. & Tel. Co. of Am	5	5
Electric Boat, pfd	50	50	N. Y. & N. J. Tel	170	173
Electric Lead Reduc'n	3½	3			

BOSTON.

	June 15.	June 22.		June 15.	June 22.
New England Telephone	143	—	Erie Telephone	54	55½
Mexican Telephone	—	2½	General Electric, pfd	—	—
Westinghouse Electric	69	—	Am. Tel. & Tel	152	160½
Westinghouse Elec., pfd	76	78	Boston Electric Light	—	—

PHILADELPHIA.

	June 15.	June 22.		June 15.	June 22.
Electric Storage Battery	53	67	Philadelphia Electric	5½	5½
Elec. Storage Batt'y, pfd	52	68	Pa. Electric Vehicle	1	1
Elec. Co. of America	8¾	8	Pa. Elec. Veh., pfd	1	1
General Electric Auto	—	—	Am. Railways	43½	41½

CHICAGO.

	June 15.	June 22.		June 15.	June 22.
Chicago Edison	177	177	Chicago Telep. Co	*275	275
Chicago City Ry	—	206½	Union Traction	19¼	19½
National Carbon	16	18	Union Traction, pfd	58	58
National Carbon, pfd	84	87	Northwest Elev. com	49	47

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*Asked.

DIVIDENDS.—The directors of the Cincinnati Gas & Electric Company have declared the regular quarterly dividend of 1 per cent, payable July 1. Directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent and ¾ per cent extra. New York, Metropolitan Street Railway has declared the regular quarterly dividend of 1¾ per cent, payable July 15. The Boston Electric Light Company has declared the regular quarterly dividend of $2 per share and an extra dividend of $1, payable August 1. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable July 1. The directors of the Washington Water Power Company, of Spokane, Wash., have declared a quarterly dividend of 1 per cent, payable July 1. The Electric Storage Battery Company has declared the usual dividends of 1¼ per cent for the quarter ending June 30 on both common and preferred stock, payable July 1. The directors of the Columbus Edison Company have declared a dividend of 3 per cent on the preferred stock, payable June 29. The directors of the Mexican Telegraph Company have declared the regular quarterly dividend of 2½ per cent, payable July 1. The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable July 9.

DALLAS CONSOLIDATED ELECTRIC.—The sale of the Dallas (Tex.) Consolidated Electric Street Railway was consummated on June 11. The names of the purchasers are not known, but it is supposed that they are Pierre S. Dupont, of Lorain, Ohio, and his associates, who were negotiating for the purchase of the property. The system is a consolidation of the Dallas City Street Railway Company and the Queen City Railway Company, both of which were sold under foreclosure of mortgage. The Dallas Consolidated Street Railway Company was chartered in January, 1898, for fifty years, and is capitalized at $1,000,000. The company has outstanding first mortgage bonds to the extent of $365,000, which cover the entire property, and second mortgage bonds to the amount of $25,000, which cover the property formerly owned by the Queen City Railway Company.

NEW ENGLAND TELEPHONE.—At a meeting of the directors of the New England Telephone & Telegraph Company it was voted to issue $2,577,000 new stock. Payments are to be made one-half August 16 and one-half November 16. This issue will give rights to one share of new stock at par for every six shares now held. Part of the new issue will pay for the construction already done during the first half of this year, and will provide for the needs of the company for the remainder of 1901, and a portion of next year. The New England Telephone Company now has about 80,000 subscribers and is adding to this number at the rate of about 1,000 new subscribers per month.

NASHVILLE TROLLEY'S DEFAULT.—A receiver was appointed on June 22 for the Nashville Street Railway, capitalized at $13,000,000. Application was made in the United States District Court by the Baltimore Trust and Guarantee Company, which, as holders of $2,060,000 of the company's bonds, alleged that interest payment was defaulted last February. The complainants prayed for foreclosure, and on their petition Judge Clark appointed E. F. C Lewis and Percy Warner receivers, pending a sale by foreclosure. Joint bond of $30,000 was given by the receivers, who at once assumed control of the property. The company's capitalization is half in bonds and half in stock

BOSTON CONSOLIDATED.—Stockholders of the Edison Electric Illuminating Company of Boston at a special meeting last week, voted unanimously to purchase the Boston Electric Light Company's property. The total vote cast was 30,801 shares out of 43,105 shares outstanding. Stockholders of the Boston Electric Light Company also voted to accept the offer of the Edison Electric Illuminating Company of Boston for the purchase of the Boston Electric Light property by an exchange of shares. Of 30,000 shares outstanding, 21,033 voted in the affirmative. It was also voted to increase the board of directors from 9 to 12 members in order to give representation to Boston Electric Light interests.

AMERICAN LIGHT & TRACTION.—It is officially announced that July 1 has been fixed as the date on which dividends will begin to accrue on the preferred stock of the American Light & Traction Company, recently organized under the laws of New Jersey. The Trust Company of America is now prepared to deliver temporary certificates of the company's stock. The company has acquired practically all the stock of the following companies: Western Gas Company, Grand Rapids Gas Light Company, Madison Gas & Electric Company and St. Joseph Gas Company.

AMERICAN TELEPHONE & TELEGRAPH BONDS AND STOCKS.—Application has been made to list the American Telephone & Telegraph $15,000,000 4 per cent collateral trust bonds of 1929; and $114,946,000 capital stock on the New York Stock Exchange.

Commercial Intelligence.

THE WEEK IN TRADE.—During the past week the reports received by the mercantile agencies indicate that in some lines strength has been maintained, while in others further improvement is noted. The most significant feature of the trade situation is the advance in price in a number of leading commodities, notably cotton goods, bleached goods and a number of kindred products, and the increase in the price of the raw material is due as much to the better trade advices at home and abroad as to crop damage reports from the South. Iron and steel lose nothing in strength as the turn of the year approaches. On the whole, the demand for finished material is quiet, but mill production shows a seasonable shrinkage, and manufacturers are still 6 to 8 weeks behind in their orders. The railroad situation continues very satisfactory. Gross and net returns for April from 130 railways show a gain in gross receipts of $98,274,723, and in net of $29,412,414, being 13 and 18 per cent respectively. The heaviest gains are shown by the Southwestern roads, 25.2 and 39.6 per cent respectively for gross and net. Other large gains are those made by the Central-Western and Pacific roads, 28.7 and 23 per cent respectively. The trunk lines show a gain of 14 per cent, the coal roads 11.8 per cent, and the Southern and granger lines 8.3 and 6.5 per cent respectively. In the copper market trading was quiet but firm. While the consumption is very large there does not appear to be much buying at the moment. On the other hand, reports seem to indicate that manufacturers are not well covered ahead. Quotations remain unchanged at 16⅞@17c. for Lake; 16.35@16.45c. for electrolytic in cakes, wire bars and ingots; 16.10@16.20c. in cathodes, and 16.25@16.35c. for casting copper. The United States production of copper for the five months ending May shows a decrease of 1,049 tons, or 1.1 per cent; the exports for the same period show a decrease of 35,458 tons, or 48.2 per cent, as compared with the corresponding period of 1900. The business failures last week, as compiled by *Bradstreet's*, numbered 188, which was the same number as reported the week previous. The corresponding week last year the number was 167.

ELECTRIC TRAVELLING CRANES.—Pawling & Harnisch-*World's Work* for July gives a graphic explanation of how Wall Street has become a perfected mechanism for the handling of money; how it trades; the means concerned; its bankers, brokers, speculators and rogues; the details of its service, its expenses and all its various methods of doing business. The idea of the rush of life Mr. Nelson gives in a striking incident. To illustrate how quickly the news is delivered, the last Chicago, Milwaukee & St. Paul dividend meeting can be recalled. There was doubt about the rate. The old rate was 5 per cent a year; an advance to 6 was expected. Each news bureau had two men in the St. Paul office, 30 Broad Street, waiting for the adjournment of the directors. Each one of the three had secured control of a telephone and the wires were cleared to the home office of the news bureaus. In the meantime the bureaus had not been idle; each one had three sets of bulletins (covering any possible emergency) printed. All the bulletins were distributed at various stations througout the Wall Street district. Finally a man in the St. Paul office walked out and said: "The semi-annual dividend is 3, an advance of ½ per cent!" There was a mad scramble for the telephones. Each news bureau received its bulletin one minute after the announcement. At the same time fast messengers were despatched to the relays of boys stationed at various points telling them to "cut loose" with Bulletin No. 3, and so the St. Paul dividend was in every Wall Street office a very few minutes after it was announced.

AMERICAN SALESMAN ABROAD.—Consul Marshal Halstead sends from Birmingham some crisp criticism of American business men who think foreign trade is to be had for the asking. He says: "American manufacturers and merchants frequently open correspondence with United Consuls with the sentence, 'Being desirous of taking advantage of the rapidly growing demand for American products, etc.' There is for American goods no foreign demand of the 'shake the tree kind' these inquirers have in mind. The sales of our goods of all kinds are based on the merits and low prices of the articles, after energetic salesmen have made active demonstration of good points. I cannot understand the mental attitude of those American manufacturers who employ traveling salesmen to get trade in America, paying good salaries and allowing liberal sums for traveling expenses, yet wish to do business by correspondence in foreign countries. Why do they imagine they can trade successfully in Great Britain, Germany, or any other European country without employing their own travelers, when the necessity of having them is the first principle of their home business?" It may be pointed out, however, that American export goods are largely in the hands of foreign commission agencies, selling houses, local companies, etc.

GERMAN FINANCE.—A special cable dispatch from Berlin, of June 23, says: "More buying was done upon the Boerse yesterday, although cautiously, than had occurred in a long time. The favorites were the North German Lloyd Line and the Vulcan Shipbuilding Company, of Stettin. The shares of the electrical companies also were active. Notable among these were the Schuckert Electrical Company, of Nuremberg, the Hagen Electric Accumulator Company, the Boerse Electric Accumulator Company, the shares of which rose 11½ points; the Allgemeine Elektricitaets-Gesellschaft, of Berlin, and the Frankfurt Electrical Company. The increased activity in these securities is all the more remarkable because the first part of the week brought the bad news of the failure of the Kummer Electric Company, the announcement of which led to the collapse of the Saxon Accumulators System, and the branches of the concern at Teplitz and Leitmeritz." This week has come the news of the failure of the Leipziger Bank with a capital of over $11,000,000, due to the distress in the industrial markets. It is said to have been largely engaged in street railway enterprises.

POWER TRANSMISSION IN NEBRASKA.—On June 19 articles of incorporation were filed with the Secretary of State, Lincoln, Neb., for the incorporation of the Omaha Suburban Railway and Traction Company, with a capital stock of $500,000. The incorporators are well-known Omaha and Fremont capitalists, A. C. Foster, L. C. Lloyd, M. H. Hinman, J. F. Hanson and T. W. Blackburn. Omaha, South Omaha, Blair, Fremont and Plattsmouth are named as the termini of the road, headquarters of which will be in Omaha. The power plant necessary to operate the line is to be erected in connection with the gigantic reservoir to be built in the neighborhood of Fremont. A canal 30 miles long and 100 feet wide at the top will conduct the water from the Platt River to the reservoir. The dam 100 feet high at the highest point will be necessary to form the reservoir. The reservoir, canal and power plant are said to cost approximately $1,000,000. It will be constructed and operated under a separate company, for which the articles of incorporation have not yet been filed. Current is also to be transmitted to adjacent cities for power purpose. Omaha and South Omaha are at present using more than 50,000 hp of steam, which will mostly be displaced by electrical power transmitted from this plant.

AMERICAN AUTOS IN ENGLAND.—The City and Suburban Electric Carriage Company of London wrote an interesting letter this month to the Electric Vehicle Company, showing the popularity of American automobiles in England. One passage of it runs as follows: Her Majesty the Queen, who has been using one of your Mark XII Columbia Victorias for the past twelve months, which vehicle was supplied by ourselves, is extremely pleased with it, and we were granted the especial privilege of showing it at the Automobile Exhibition last month, where it attracted considerable attention. We are getting the vehicles placed with the very best people, such as the Earl and Countess de Grey, the Countess of Gosford, Baron Alfred de Rothschild, Baron de Meyer, and others of the aristocracy, all of which is popularizing the vehicles in the fashionable world.

THE JAPANESE HOUSE of Takata & Company, New York offices, 10 Wall Street, has just placed a contract for one of the smallest complete electric lighting plants ever shipped from the United States. The plant will be installed in the Kitahama Bank in Osaka, Japan. It will consist of a 10-kilowatt direct current engine type generator, which will be direct connected to a 6 by 8 single cylinder engine. The first named machine will be built by the Westinghouse Electric & Manufacturing Company, while the engine is to be Erie Ball make. There will be a complete Westinghouse generator panel switchboard. A 15-hp boiler is to be furnished by the Babcock & Wilcox Company. A 2 x 1¼ x 2¾ Knowles feed pump is to be supplied by the International Pump Company, and a 25-hp Wainwright heater will also be utilized.

ORDERS FOR TELEPHONE EXCHANGES.—Among the many contracts for telephone plants recently closed by the American Electric Telephone Company of Chicago, we note the following: Mansfield, Ohio, common battery, 1,200 installed, with provision for 3,000; Reading, Pa., central energy, 1,500 lines with 5,000 ultimate capacity; Zanesville, Ohio, common battery, 1,200 connected, with 3,000 ultimately; Huntington, Ind., 300 at present, to increase to 1,500; Austin, Tex., with 1,200 for immediate connection, 3,000 ultimately; Temple, Tex., and Tyler, Tex., 600 ready to connect, will provide for increase to 1,500; Xenia, Ohio, 600 in operation, provision for 2,000, and Oklahoma City, Ind. Ter., 750 subscribers on 1,200 line switchboard.

VICTOR TURBINES FOR CANADA.—The Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have just secured a large order for Victor high pressure turbines from the Quiatchouan Pulp Company, Quiatchouan, P. Q., Canada. It includes two 1,000-hp Victor high pressure turbines, one 500-hp Victor high pressure turbine, and one 100-hp Victor high pressure turbine. The two 1,000-hp wheels drive the grinders, the 500-hp wheel is to drive the screens and wet machines, and the 100-hp wheel is for electric lighting purposes. The order was secured by Mr. Clarence Folsom, engineer. The wheels will work under 240 feet working head and the pulp mill will have a capacity of 30 tons daily.

THE LORAIN STEEL COMPANY, of Lorain, Ohio, continue to capture contracts for tramway rails required by various British municipal corporations. Besides securing important contracts for Glasgow, Dundee and Halifax, the Ohio mills have just been awarded rail orders for Ayr, Scotland, Newcastle-on-Tyne, and Darwen, a town in the vicinity of Blackburn, Lancashire.

MR. LAWRIE, of Bulwer, Lawrie & Company, Calcutta, is at present in this country with a view to purchasing considerable electrical machinery, etc. He may be reached through the New York Export & Import Company, of 56 Pine Street.

BOROUGH ENGINEER LORD, of the important city of Halifax, England, reference to whose visit to this country was noted in these columns last week, when seen at the Fifth Avenue Hotel by a representative of the Electrical World and Engineer gave some interesting information regarding pending contracts in relation to the municipal electric traction system of that Yorkshire city. He said: "We now have in operation about 30 miles of track, which is to be extended until we shall have 57 miles of road in operation. About two years ago Mr. Whitney, the then chairman of the tramway committee, accompanied by Mr. Steele, the electrical engineer of the Halifax tramways, visited the United States and made a somewhat exhaustive inquiry into American electric traction methods, with the result that several contracts for material equipment, etc., have been placed with your manufacturers, and a goodly portion of the orders to be placed in connection with our present extension will find its way to the United States. Just before I left England our tramway committee placed a contract with the British Westinghouse Electric & Manufacturing Company for 72 single electric motor equipments of 35 hp each. These, I understand, will be made in America, as the British Westinghouse plant, of Manchester, is not yet in working operation. We shall want at least 8,000 tons of rails and as British mills cannot undertake contracts at the present time for prompt delivery, and moreover because we can purchase rails cheaper on this side, our orders in that direction are more than likely to be closed with Americans. We shall also be shortly in the market for a 600-foot span bridge 60 feet wide, which we anticipate will mean an expenditure of some $400,000. As the Halifax Corporation is not prejudiced in any way and buys where it can do so to the greatest advantage, American bridge builders will have an opportunity to figure on this contract. The last bridge we erected was of Belgian make. As our city is situated in a hollow surrounded by mountains, something like Pittsburg, we have many inclines to traverse. Our gradients average 1 in 9.5. While in Cincinnati and Pittsburg I was considerably interested to see how the cars are operated on the steep portions of the lines, and we shall inaugurate an almost similar system, with the exception that we shall employ electricity in connection with the platforms instead of steam, as is used out West."

ELECTRIC TRAVELING CRANES.—Pawling & Harnischfeger, Milwaukee, Wis., report business well up to the average of last year. Their recent sales of electric traveling cranes are: Midvale Steel Company, Philadelphia, Pa., one 60-ton, with 15-ton auxiliary hoist; one 30-ton, with 10-ton auxiliary hoist; two 25-ton, one 15-ton, one 10-ton, with 3-ton auxiliary hoist. Wheeling Mold & Foundry Company, Wheeling, W. Va., two 20-ton, one 10-ton. Hood Machine Company, Birmingham, Ala., one 12-ton. Mountain Copper Company, Keswick, Shasta County, Cal., one 25-ton. New York Shipbuilding Company, Camden, N. J., duplicate order for one 15-ton (double trolley). United States Government, new printing office, Washington, D. C., one 25-ton. E. Hodge & Company, Boston, Mass., one 15-ton. National Steel Casting Company, Montpelier, Ind., one 20-ton, with 5-ton auxiliary hoist. Erie City Iron Works, Erie, Pa., one 25-ton, with 5-ton auxiliary hoist; one 10-ton. Vilter Manufacturing Company, Milwaukee, Wis., one 30-ton, one 15-ton. Wisconsin Bridge & Iron Company, No. Milwaukee, Wis., one 15-ton. Butte City Water Company, Butte, Mont., one 20-ton (double trolley). Waterbury Farrel Foundry & Machine Company, Waterbury, Conn., one 20-ton.

GENERAL ELECTRIC IN ENGLAND.—The General Electric Company has purchased the German and French share holdings in the British Thomson-Houston Company, Limited, of London, England, thereby giving the General Electric Company the controlling interest. President C. A. Coffin, First Vice-President Eugene Griffin, and General Manager of the Foreign Department W. J. Clark, of the General Electric Company, will be members of the British Thomson-Houston board, and it is announced that the closest cooperation will exist between the General Electric and British Thomson-Houston Companies. The British Thomson-Houston Company was originally a licensee of the Thomson-Houston Company of America, and has been operating under patents of the General Electric Company, but as an independent concern. Parent company interests have, however, for some time held stock in the British company, which of late has been in need of the change now made.

WESTINGHOUSE IN ENGLAND.—A special dispatch from London, of June 21, says: The *Daily Mail* prints a long description of the progress of the Westinghouse factory which is being built at Trafford Park, Manchester. It says the factory will be an immense hive of British industry, directed by American brains. The American contractor, Mr. Stuart, is employing labor saving devices and is teaching and leading 2,600 British workmen so effectually that, while there is no hurrying or shouting, there is a steady, quiet progress. There is no loafing, the men working all the time. Mr. Stuart has taken a liking to his British employees. He says he finds the skilled labor good, but he regards the common laborer as a poor creature compared with an American of the same class. A village is springing up alongside the works, which are to be arranged on American plans and will be heated by gas and lighted by electricity. The correspondent says the village will be a "pocket edition" of Pittsburg.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., reports the export sales of its pinions as rapidly increasing. The company has recently shipped 100 electric railway pinions for G. E. 800 motors to London on an order from an electrical supply house in that city. The pinions are to be used on one of the big railways recently built there. A shipment of pinions has also been made to the Albion Motor Company, an English automobile company. In the general machinery line the company has just shipped a number of big bevel gears, both iron and raw hide, some of the latter as large as 32 inches diameter, to a large English ship building concern. A number of railway pinions have been shipped to Germany and Norway, and reports from those countries say that the demand for them is increasing. Several inquiries for catalogues and prices have lately been received from Japan. A good sized order is in process of construction for one of the mines at Kalgourlie, Australia.

BROOKLYN RAPID TRANSIT EQUIPMENT.—The Brooklyn Rapid Transit Company is preparing to use compressed air to some extent in the operation of several of its lines. A compressed air plant is to be established by the company in the neighborhood of the Brooklyn terminal of the big bridge, and compressed air is to be supplied to some of the cars on the Brooklyn elevated and surface roads by the Compressed Air Company of Manhattan. The system to be used is said to be an improvement on that tried in Manhattan, and if it proves a success it will be used permanently on some of the Brooklyn roads. President Greatsinger, of the Brooklyn Rapid Transit Company, said last week that since he was made the head of the road, on March 20 last, $3,200,000 had been laid out by the company for new cars, generators, sub-power stations, and other improvements.

EDISON BATTERY FACTORY.—A deed filed in the Essex County Court House, New Jersey, records the sale of the Hayden estate in Bloomfield Avenue, Glen Ridge, to Thomas A. Edison, for $19,000. The land is part of a plot on which Mr. Edison intends to erect a plant for the manufacture of his recently invented storage battery. The property is 200 by 580 feet. On the property are several brick buildings, which are to be removed within a week or so. Ground then will be broken for the factory. Wealthy residents of Glen Ridge do not want a factory on the site and have used every effort to prevent Mr. Edison from obtaining control of the property.

ROBERT W. BLACKWELL & COMPANY—The British electrical engineering and contracting firm of Robert W. Blackwell & Company, Limited, continues to place substantial contracts for overhead equipment, etc., required by various English traction systems. The New York office of the company is about to make shipment of some 700 tons of trolley poles for the Bradford and Manchester Corporation tramways. The poles are being turned out by the Morris-Tasker (Philadelphia) Works of the National Tube Company.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has voluntarily granted its employees a 9-hour working day with 10 hours pay, besides a 5 per cent increase in wages. New shops have recently been completed at Morningside, one mile out on the line of the Boston & Albany Railroad, and sufficient orders are reported already in hand to keep these running day and night for the ensuing year. President Perrine made the statement this week that at present 500 hands are effected by the change. The company has the reputation of being very liberal with its employees.

W. R. STEELE, of Burn & Company, Limited, Calcutta, which concern is one of the most prominent handlers of electrical apparatus, machine tools, etc., in the British East Indies, is now in the United States for the purpose of placing substantial contracts. He is at present in Cincinnati, but will have returned to New York, according to present arrangements, June 24. Mr. Steele purports visiting Philadelphia on the 26th inst. While in New York he will reside at the Holland House.

PAPER MILL IN FRANCE.—Mr. H. S. Van Buren, U. S. Consul at Nice, France, in reporting on paper mill industry, states that a company has been formed to take over the paper mill at Point de Peilles, establish it in the Var region and develop water power for electrical purposes of not less than 100 hp.

SIPE & SIGLER, of Cleveland, report that they have been awarded a contract for a battery of 64 storage cells of 800 amp. hour capacity, to be installed at the Schuylkill Arsenal, Philadelphia.

The Berliner Telephone Patent Decision.

CIRCUIT COURT OF THE UNITED STATES, DISTRICT OF MASSACHUSETTS.—IN EQUITY.

No. 653.—American Bell Telephone Company, complainant, *vs.* National Telephone Manufacturing Company et al., defendants.

No. 655.—American Bell Telephone Company, complainant, *vs.* Century Telephone Company et al., defendants.

Attorneys.—Fish, Richardson & Storrow, for American Bell Telephone Company; Edward P. Payson for National Telephone Manufacturing Company; James E. Maynadier for Century Telephone Company et al.; Robert S. Taylor also argued for defendants.

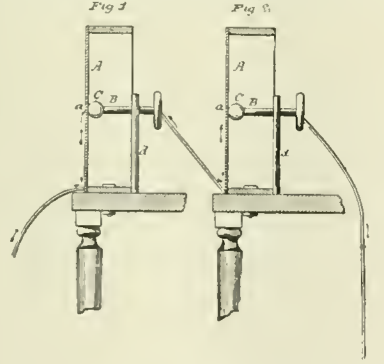
Opinion of the Court, June 24, 1901.

Brown, J. These suits are for infringement of Letters Patent No. 463,569, issued Nov. 17, 1891, to the American Bell Telephone Company as assignee of Emile Berliner. The patent states that the invention consists

> "in a new and useful improvement in transmitters for electrically transmitting sound of any kind."

The defendants contend that the patent is invalid, and that Claims 1 and 2, on which the complainant relies, are either invalid or so limited in scope as not to include the defendants devices.

The following drawing is from the patent.

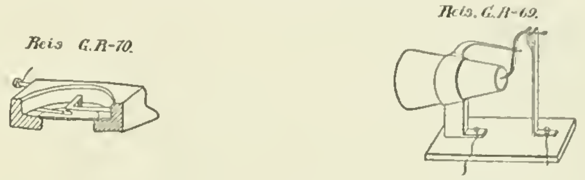


DRAWING FROM BERLINER PATENT.

The invention is thus described in the specification:

> "It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current, the pressure between both sides of the contact becomes weakened the current passing becomes less intense—as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner:
>
> "In Figs. 1 and 2 of the drawing, A is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball C, terminating the screw-threaded rod B, which is supported by the bar or stand *d*. The pressure of the ball C against the plate A can be regulated by turning the rod B. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate the pressure at the point of contact *a* becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station Fig. 1, and another instrument capable of acting as a telephonic receiver in the station Fig. 2, both situated on the same electric circuit in which a current is passing (as shown by the wire connections following the arrows). sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2, for as the vibrations of the transmitter Fig. 1 caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter Fig. 1 will be reproduced at the receiver Fig. 2, or in as many other receiving-instruments as are situated within the same electric circuit.
>
> "It is not essential that the plate should be of metal. It can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, or other suitable vibratory media may be used—a wire, for example. Any other metallic point, surface, wire, etc., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibrations. Both of the electrodes may vibrate, although it is preferable that only one should. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation.'

The drawing shows two distinct instruments. The transmitter, Fig. 1, is the subject-matter of the patent in suit. Its plate is vibrated by sound waves, and the vibrations produce electrical undulations. It is conceded by the complainant that the instrument of the patent is substantially the old Reis structure illustrated in the *Telephone Cases*, 126 U. S., pages 40, 53, 58, 60, 191, 196.



REIS TELEPHONE MAKE-AND-BREAK APPARATUS.

With this apparatus Reis, as early as 1861, transmitted musical tones. "He could sing through his apparatus, but could not talk," for the reason that he broke the contact of his electrodes and interrupted the current. The apparatus, however, under expert manipulation, is capable of transmitting speech, though this was not accomplished until after Bell's discovery that the true way to transmit speech was to operate on an unbroken current. 126 U. S. 540-545.

The receiver is represented by Fig. 2. Its plate is vibrated by electrical undulations, and the vibrations of the plate produce sound waves. The receiver is covered by another patent to Berliner, No. 233,969, dated Nov. 2, 1880. The claims in issue are as follows:

> "1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described."
>
> "2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate."

The patent contains the following disclaimer:

> "I do not claim that I am the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound-waves accompanying said sounds. Neither do I claim that I am the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing."

The last sentence has reference to Bell's variable-resistance method described in the *Telephone Cases*, 126 U. S. 531, 536, 537, 538, and covered by the following claim of Bell's patent:

> 4. The method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit, or by gradually increasing or diminishing the power of the battery, as set forth.

On page 323 of 126 U. S. is shown "Bell's Centennial Liquid Transmitter," an instrument operating by the variable resistance method covered by claim 4 of Bell's patent 174,465, March 7, 1876.

Though Bell's patent made no claim for apparatus operating by this method, his specification contained this language:

> "Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit . . .
>
> "The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting-wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence the vibration of the conducting-wire in mercury or other liquid included in the circuit occasions undulations in the current."

Prof. Wright, complainant's expert, says of this extract from Bell's patent:

> "This described a liquid transmitter, and I believe that any one familiar with electrical science, and having a knowledge of the art as it was at that time, would have been able to construct an apparatus which could be used for the transmission of speech."

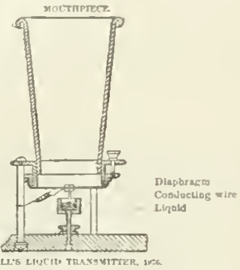
Speaking into the mouthpiece vibrates the diaphragm, whose movements cause the conducting wire attached to the diaphragm to move up and down in the liquid, thereby permitting more or less electricity to pass according to the extent of immersion. The liquid may be acidulated water or mercury.

Professor Cross, complainant's expert, says that this was the apparatus with which Bell first successfully transmitted speech, and that "the apparatus was and is perfectly operative." It was exhibited at the Centennial Exhibition in 1876. Professor Cross describes the operation as follows:

> "When the diaphragm vibrated the wire dipped more or less deeply beneath the surface of the liquid, so that that portion of the wire from which the current flowed into the liquid was alternately increased and diminished, thus increasing and diminishing the resistance at that place, and so producing electrical undulations."

A comparison of this instrument with that of Berliner's patent is of principal importance in this case. The defendants rely upon it, not as a complete anticipation of Berliner's instrument or invention, but as an anticipation of the broad claims of the patent, and of the broad claims of the complainant's counsel and experts as to the character and importance of Berliner's invention.

It appears by Berliner's testimony that, before constructing his instrument, he had carefully studied Bell's first patent, and that the metal plate or diaphragm A, of Fig. 1, was taken from Bell's second patent, 186,787, Jan. 30, 1877.



BELL'S LIQUID TRANSMITTER.

What appears in Bell's patents, or in Bell's liquid transmitter, cannot be claimed as novel with Berliner. Upon comparison, we find the following resemblances: Each is apparatus for practising Bell's art, process or method of "transmitting vocal or other sounds telegraphically. . . . by causing electrical undulations similar in form to the vibrations of the air accompanying. . . . vocal or other sound." Bell's patent, claim 5. The treatment of the current described in the Berliner patent is the same as Bell's. Each is apparatus for practising Bell's art by Bell's variable-resistance method, *i. e.*, "gradually increasing and diminishing the resistance of the circuit." Bell's patent, claim 4. The method of treating the resistance of the circuit is the same in each. Each receives the sound waves upon a diaphragm, which vibrates and effects changes in a circuit in which an unbroken battery current is passing, thus producing electrical undulations similar in form to sound waves. In each, there are electrodes in constant but variable contact. Each operates by a varying contact. In each, pressure is exerted upon the diaphragm by sound waves, and by one moving electrode upon another electrode; so that in each there is pressure between electrodes. In each, there is produced by the force expended upon the diaphragm a weakening and strengthening of the current, through the weakening and strengthening of physical and electrical contact of electroues. Bell's liquid transmitter is, therefore, a complete anticipation of Berliner's transmitter in these particulars: In the use of a battery current, instead of a current generated by the transmitter instrument, as in Bell's magneto instrument illustrated in Bell's patent. (See 126 U. S., page 5, Fig. 7.)

In the use of electrodes in constant contact with each other, and forming part of a circuit which includes a battery.

In the use of the pressure of one electrode upon another to strengthen an electrical contact, and of a relaxation of pressure to weaken the electrical contact.

It is, therefore, true, as the defendants contend, that claims 1 and 2 of the patent in suit, taken as they read in the ordinary sense of the words used, without limitation as to the size, shape, or materials of the electrodes used, are anticipated by Bell's liquid transmitter.

It may clear the discussion of this case if we observe that two distinct questions have been confused. Does Bell's liquid transmitter anticipate the first and second claims? Does Bell's liquid transmitter anticipate an invention made by Berliner?

The complainant misstates the position of the defendants, saying on its brief that "The National Company contends that the 'Bell liquid transmitter,' briefly referred to in Mr. Bell's great telephone patent of 1876, was a microphone and anticipated Berliner." The defendants do not so contend. The term "microphone," according to the complainant, denotes an instrument having solid electrodes. The defendatns do not contend that Bell's liquid transmitter was a microphone. To the defendants' assertion that the claims cover Bell's liquid transmitter, as well as Berliner's, the reply is that Bell's liquid transmitter does not anticipate Berliner's instrument nor Berliner's actual invention. This does not meet the true issue. The anticipatory effect of Bell's patent and of Bell's liquid transmitter cannot be ignored. The failure of the complainant to recognize this fully is a weak point in its argument.

It is clearly established that Bell was a prior inventor of a constant but variable-contact transmitter. It is also apparent that in every transmitter having a constant but variable contact of opposing electrodes (a contact varying according to the vibrations of a diaphragm), there must be, as an invariable and necessary accompaniment, a variation of pressure between the electrodes. Whenever, in transmitting sound, pressure is expended by one electrode upon an opposing electrode, there is varying pressure, whether the second electrode be of water or mercury, as in Bell's liquid transmitter, or of powdered carbon, felt saturated with water, or plumbago, as in Edison's devices, and whether the second electrode yields to the force exerted upon it, or resists this force. It is manifest, therefore, that when Bell invented a transmitter in which there was a varying contact between opposing electrodes, he also invented a transmitter in which varying contact was inseparably associated with varying pressure. To claim broadly variable pressure between electrodes is to claim in other words variable contact of opposing electrodes. The claims of the patent are such as could properly be made, if at all, only by the inventor of the first transmitter having a constant but variable contact of opposing electrodes, *i. e.*, Bell. As varying pressure is a uniform accompaniment of varying but constant contact of opposing electrodes, one who desired to define Bell's liquid transmitter, so as to distinguish it from the Bell magneto instrument, which had no electrodes in contact, or from the Reis transmitter (with an inconstant or broken contact), might do so by reference to either of the novel features of Bell, and say that its novelties were either "constant contact" or "variable pressure," or both. Either of the two names will distinguish a constant-contact transmitter from the Bell magneto instrument, or from the Reis apparatus when operated according to Reis's method. Definition by a single novel feature, under some circumstances, is quite as good as definition with a full enumeration of particulars, but it may lead to fallacy by creating two names for one thing. Berliner was not the inventor of the first constant-contact transmitter. His instrument cannot be distinguished from previous or subsequent constant-contact transmitters by referring to a single feature not novel with him, but possessed by several transmitters. Therefore he must point out, in his claims, some distinctive difference between his invention and what is disclosed in the Bell liquid transmitter, in order to show his advance in the art. His apparent difference is merely in apparatus, but his apparatus is so inefficient commercially that if his patent is to be construed merely as for apparatus, the complainant's case is hopeless on the issue of infringement. The complainant, therefore, rests its case upon the proposition that Berliner's invention was a "new mode of operation," and from this arise the principal difficulties in the case.

The complainant starts the search for novelty at Bell's magneto instrument, and at the instrument of Reis, and not from Bell's prior variable-resistance transmitter and, upon its brief, contrasts Berliner's apparatus with Bell's magneto transmitter and with the Reis transmitter, first saying of Bell's magneto transmitter:

> "The apparatus of Mr Bell was exceedingly perfect both in its theory and in the practical results which were reached by it. But the currents produced by the transmitter were extremely feeble, since the currents utilized were generated by the transmitter itself, and its motions, as it was actuated only by the sound-waves due to the voice, were but slight"

The brief then says, in italics, "Mr Berliner remedied this defect," and made a new type of transmitter, which employs Bell's method of transmitting speech. "It is what is known as a variable-pressure contact transmitter. It operates not as did the magneto, to generate the undulatory current produced by the small amount of energy which the voice can communicate to the transmitter, but simply to impress upon the electrical current furnished from another source—practically a battery—variations in strength which correspond to the motions impressed by the voice upon the transmitter."

But this is true of Bell's liquid transmitter, and was true of it in 1876, when it was exhibited at the Centennial Berliner's transmitter in this respect was not a "new type of transmitter," but merely a species of a new type of transmitter invented by Bell.

It is a remarkable fact that, in spite of the testimony of Professor Wright that the Bell patent sufficiently disclosed a liquid transmitter to enable a person skilled in the art to make one, and in spite of the testimony of Professor Cross that the Bell liquid transmitter was, and is, perfectly operative, the complainant should ignore the Bell patent and Bell's liquid transmitter, and explain Berliner's invention by saying that in Bell's magneto instrument the currents were very feeble, since they were generated by the transmitter itself, and by saying, in italics, "Mr. Berliner remedied this defect."

Such a contention cannot be sustained. Bell's patent suggested the use of a battery current, and Bell's liquid transmitter used it in 1876. Berliner's apparatus has never been used commercially and made no practical advance on Bell's magneto transmitter.

The error of attributing to Berliner the credit of an advance upon Bell in the substitution of a battery current for a current generated by the transmitter rendered necessary a foot-note to the brief:

> "It is true, of course, that Mr. Bell also suggested in his magneto patent that he could produce an undulatory current by varying the resistance, but he bad made no suggestion whatever that this could be done by varying the pressure between two electrodes in contact."

After the opinion of the Supreme Court in the *Telephone Cases* as to the variable-resistance method (126 U. S. 538, 246, 247), in explaining the importance of Berliner's work, counsel for the Bell Telephone Company call Bell's great patent "Bell's *magneto* patent," and ignore the instrument with which Bell first transmitted speech.

This is a confession of fundamental weakness in the complainant's case. It is essential to the complainant's argument that the true scope of Bell's variable resistance method, and of Bell's work in applying that method, should be ignored, in order that the Berliner patent may be construed as for a new "method" instead of for practically useless apparatus for practising the variable-resistance method of Bell.

The complainant further proceeds to show the nature of Berliner's invention by stating, as a main proposition on the brief, "Berliner's inventions do not reside in the structure involved." Berliner, "using substantially the old Reis structure," produced a "new mode of operation." In explaining this, the brief again ignores Bell's liquid transmitter and reverts to Reis, quoting the language of the Supreme Court to the effect that the question is "not as to the character of the apparatus, but as to the mode of treating the current of electricity on which the apparatus is to act." It refers to Berliner's "new electrical mode of operation," and also quotes the language of Professor Cross:

> "Structure here is not the controlling element. In machines generally the operation and the result are absolutely controlled and defined by the structure and organization of the machine. But this simple contrivance is more like a tool, because it can be compelled at the pleasure of the operator to perform the breaking operation and produce the broken Reis current, or to perform the variable-pressure operation and produce the undulatory current."

Berliner's "new electrical mode of operation" or mode of treating the current is new as to Reis, because it has that novelty which the Supreme Court has decided to constitute Bell's advance upon Reis. His mode of treating the circuit is new as to Reis in that the contact is not broken—but this is Bell's novelty.

The complainant's patent does not refer to any new treatment of an electrical current, and disclaims novelty in causing electrical undulations similar in form to sound waves.

As a substantive part of its case, the complainant has claimed for Berliner as distinctive features the use of a battery current and constant contact of electrodes, both of which are Bell's. Although the patent expressly disclaims that Berliner was the first to cause electrical undulations by varying the resistance of an electrical circuit in which a current was passing, and disclaims novelty in the production of electrical undulations similar in form to sound waves, the brief in effect retracts this disclaimer by showing Berliner's novelty against a prior art, from which is excluded what the patent by its disclaimers acknowledges was old at the date of the application. Bell's liquid transmitter is not in the prior art of the complainant's case. The attempt to dispose of that apparatus by characterizing it as a mere laboratory experiment, after Professor Cross's evidence that it is an operative instrument, and after it was presented to the Supreme Court as a speaking telephone (126 U. S. 247, 322), is not successful. This instrument is quite as important after the expiration of Bell's patent as it was before. It was the primary instrument employing the variable resistance method, and after it the problem was to improve upon Bell's electrodes. Improvement upon the resistance of the circuit was not a new art or method. Whatever the particular kind of resistance, whether "contact resistance" or "mass resistance," the method of varying it is Bell's. I am of the opinion that upon Bell's liquid transmitter the defendants have established their first defense, to-wit:

> "In the state of the art of electrical telephony in 1877, there was nothing in the Berliner transmitter of patent No. 463,569 patentable over Bell as an art (Claim 1), nor anything patentable as mechanism, unless in the substitution of a solid metal electrode for Bell's mercury electrode, which substitution only reproduced a Regnault or a Reis instrument, to be operated by Bell's method."

It appears also that there can be only two narrow grounds upon which the Berliner patent can stand:

1. That it was patentable to apply Bell's variable-resistance method to the apparatus of Reis.
2. That it was patentable to substitute a solid metal electrode for Bell's mercury electrode.

I am further of the opinion that these claims are invalid for excessive breadth, under the decision of the Supreme Court in the Incandescent Lamp Patent, 159 U. S. 465, 476, as attempting to monopolize the use of the pressure of one electrode upon another to effect changes in the circuit, and also as attempting to monopolize the use of apparatus operating by changes of contact between opposing electrodes; even if the electrodes be limited to solids.

Professor Cross, upon the *prima facie* case, was asked:

> "Is the patent confined to any particular sizes, shape or materials of the electrodes? and replied that "The patent is not in any way thus limited. . . . There is no limitation as to this matter in Claims 1 and 2 of the patent."

In argument, counsel for complainant, in setting forth the "remarkable character of Berliner's invention," and its great importance, state:

> "That this invention is broadly covered, and conceded to be broadly claimed in the patent in suit, is stated in this bill" (brought by the Government for the annulment of the patent); " 'And your orator avers further that the broad claims of said patent cover in their scope *every form of constont-contoct telephonic transmitter which it is possible to make;* and that, so far as can be foreseen, the possession of this patent, if it is valid, will continue to the respondent company without substantial diminution during the full term thereof the same close monopoly of the art of telephony in the United States which it has enjoyed under said patent to Bell 174,465.' "

I believe these claims to cover broadly all transmitters having variable-contact of opposing electrodes. They certainly are broad enough to cover every variable-contact transmitter that has been presented in this case.

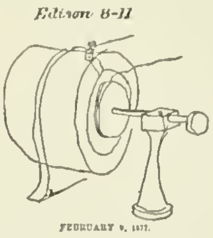
The concessions made by the complainant are sufficient to prove that these claims are what were termed in *Carlton* v. *Bokee,* 17 Wall. 471, "ingenious attempts to expand a simple invention of a distinct device into an all-embracing claim, calculated by its wide generalizations and ambiguous language to discourage further invention in the same department of industry and to cover antecedent inventions." It is a familiar rule that a generalization or definition that is too broad cannot be made good by making an arbitrary exception of each case that comes within its terms but which should not have been included. A single contrary example destroys the generalization.

The complainant claims broadly variation of pressure between electrodes in constant contact. This first conflicts with Bell's liquid transmitter. A liquid electrode is then excepted, but the exception of a liquid electrode still leaves the complainant claiming the mode of operation by variable contact for all electrodes other than liquids.

The claims limited to solid electrodes next come into collision with devices of Edison. The effect of these devices as anticipation will be considered later. We now consider them merely in connection with concessions of the complainant that the claims should not cover them.

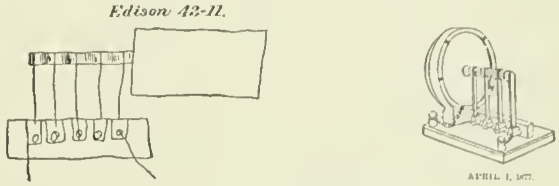
This device has solid electrodes, and was an operative telephone in February, 1877. It is the basis of Edison's patent 474,230, applied for April 27, 1877. Its electrodes are a diaphragm of sheet metal, and a disk of hard rubber coated with plumbago, or a disk of some conducting metal or substance.

In this apparatus Edison employed a battery current and constant contact. There was variable pressure between solid electrodes as in Berliner's apparatus. The complainant excepts this from the Berliner patent by saying that it operates by varying surface area of contact, and by varying the length of the path of the current outside of the area of contact, which is said to be different, theoretically and practically, from Berliner's method. It is, nevertheless, within the claims.



EDISON TRANSMITTER.

The claims are next confronted with apparatus of Edison dated April 1, 1877, which has solid electrodes. It consists of a diaphragm and "five vertical springs, each provided with a sleeve carrying a cylinder or button of hard-pressed plumbago fastened to a bar of insulating material. All the plumbago buttons were in contact, and the one at the end rested against the diaphragm. The circuit was complete from the first spring through all the carbons to the last spring." This the complainant says is not a variable-pressure transmitter, for the reason that Edison intended, by the vibration of the diaphragm, to compress electrodes of plumbago; thereby changing the molecular condition of the material of a part of the circuit. Counsel distinguish this, and impliedly limit the electrodes of the patent to solid electrodes having "transition resistance" due to a loose joint, by saying that the Edison device does not operate by variation of transition resistance. There can be no question but that, if Berliner had preceded Bell, Bell's liquid transmitter would infringe claims 1 and 2, both as to constant contact and variable pressure. If Berliner had preceded Edison, either of the devices shown would infringe the Berliner claims. The logical difficulty with the claims of the Berliner patent, in view of Bell's liquid transmitter and its position in the prior art, is that in attempting to define and mark out Berliner's novelty, they refer only to features that are common to Bell and Berliner, and not to the distinctive difference. It is definition "per genus," and not definition "per genus et differentiam," and the genus is Bell's. This is a defect not only of the claims, but of what may be termed the "variable-pressure" aspects of the complainant's argument. Practical accuracy, logical rules of definition and rules of law alike require that a definition shall include a statement of the distinctive difference. If we stop short of that, we err by being too vague. Though the complainant contends with great earnestness that Edison's devices are distinguishable from Berliner's, yet it is apparent that, in the same way that the claims fail to express a distinctive difference between Bell's liquid transmitter and Berliner's, they fail to express a difference between Berliner's and the devices of Edison.



EDISON TRANSMITTER.

To the objection that the claims are so broad as to include these devices, it is obviously no answer to reply merely that these devices are not analogous.

I am of the opinion, therefore, as the claims are statutory requirements, prescribed for the purpose of making the patentee define precisely what the invention is,—and as these claims are so broad as to include every transmitter of the general class of which Bell was the first inventor, and which is exemplified in his constant contact transmitter,—that they are invalid for excessive breadth, and for a vague generality which makes them a constant menace to all inventors who may seek to improve the art of telephony by applying what Bell has taught as to the practicability of operation by the constant but variable-contact method. This is also true if the electrodes are limited merely to solids.

By claiming "variable pressure of electrodes" as an art or method, the complainant seeks to monopolize an indispensable feature of every constant-contact transmitter having varying contact and opposing electrodes, and to suppress all subsequent invention in the same field. Walker on Patents, § 14. Counsel say that the method of operation by variable pressure is available "in the case of all electrodes which have surfaces between which there may be varying pressure." It is obvious that this language does not exclude even the liquid electrodes of Bell; and that, as all solids have surfaces of this kind, it includes the solid electrodes of Edison.

The final position of the complainant, upon the supplemental brief, is that the method of varying resistance in a battery circuit "by causing sound-waves to vary pressure between electrodes in contact" so as to "strengthen and weaken the contact" is a more specific and hence different thing from the mere effecting of "some physical changes in the path of the current."

Counsel fail to meet the actual contention that it is not a specific description sufficient to distinguish Berliner's method from effecting such physical changes in the path of the current as occur in Bell's liquid transmitter and in various devices of Edison.

I am of the opinion that the language of these claims is clear and that no resort to the specification is necessary to explain its meaning. They are not claims made in the infancy of an art by an unskilled inventor. They were put in the present form more than two years after Edison's carbon telephone had been placed on the market. They cover, if not every form of constant-contact transmitter which it is possible to make, at least every form that has been presented. They cover the use of variable pressure exerted by one electrode upon another, to vary the resistance of the circuit. They cover also all transmitters having a variable contact of opposing electrodes. They cover under a new form of words what was previously invented by Bell. To save these claims it is necessary, not to explain them by resort to the specification, but to ingraft upon them restrictive qualifications which the patentee omitted to point out.

This may not be done "for the purpose of changing it and making it different from what it is." *White* v. *Dunbar,* 119 U. S. 47; *Howe Machine Co.* v. *National Needle Co.,* 134 U. S. 388-394; *Paul Boynton Co.* v. *Morris Chute Co.,* 87 Fed. Rep. 225; *Day* v. *Fair Haven Railway Co.,* 132 U. S. 98, 102; *Merrill* v. *Yeomans,* 94 U. S. 568, 570; *Railroad Co.* v. *Mellon,* 104 U. S. 118; *Incandescent Lamp Patent,* 159 U. S. 465-472.

Later in this opinion, we will consider further the merits of the complainant's contention as to the importance and scope of what Berliner is said to have accomplished. Even if it be assumed that the complainant is lawfully entitled to the patent upon which its arguments are based, I am of the opinion that the argument by which the complainant seeks to show that the patent discloses an invention of broad character and scope is logically and legally unsound, and that what is described in the patent was, in view of the state of the art, of slight value and of narrow scope.

But before considering the reasons for this conclusion, we will consider the question of the validity of the complainant's title to the Letters Patent.

The case presents this remarkable feature,—that the application in terms denies that the instrument of the patent is adapted to the transmission of speech. The patent covers the transmission of speech by an instrument which the application does not describe as a speech transmitter, but, on the contrary, says is not adapted to the transmission of speech. Berliner's application filed June 4, 1877, was not for the invention covered by Letters Patent issued to the American Bell Telephone Company, as Berliner's assignee, on Nov. 17, 1891. Upon this question, we need consider only the single feature of "electrodes in constant contact" for speech transmission. The inquiry whether the application describes the "variable-pressure" method of Berliner is the same as the inquiry whether it discloses the constant but variable contact method of Bell, and whether it calls for the use of an unbroken current. The Supreme Court, in the *Telephone Cases,* 126 U. S. 544, 545, found that Bell discovered the true way to transmit speech; "to operate on an unbroken current by increasing and diminishing its intensity;" and that Reis, who preceded Bell, failed because he operated with a current made intermittent by the opening and closing of the circuit, saying:

> "To follow Reis is to fail, hut to follow Bell is to succeed. The difference between the two is just the difference hetween failure and success. If Reis had kept on he might have found the way to succeed, but he stopped and failed."

We shall find that Berliner did follow Reis, as a matter of fact, and that he failed, as a matter of fact, through attempting what was described by one of the examiners as a "kind of cross between the microphone and the Reis circuit-breaking operation." Our present question, however, is merely whether a document sworn to and filed by Berliner discloses a constant-contact speech transmitter, upon an examination of its text and drawings.

The examiner, on Jan. 31, 1882, decided that it did not; and filed on appeal before the Commissioner an answer which in my opinion conclusively shows that the invention disclosed in the application was not a speaking telephone, and not a constant-contact speech transmitter. The rejection of amendments by the examiner was overruled by the Commissioner, but it does not appear that he answered the specific reasoning of the examiner. A second examiner also made a ruling adverse to the amendments, which was reversed by the Board of Examiners on appeal, in a decision which stated:

> "It seems to be clear from this review of the original specifications that, so far as can be judged from the language used, two things were disclosed by it; first, the transmission of musical sounds whether uttered by the human voice, as in singing, or produced by musical instruments; and, secondly, the transmission of speech by means of a make and break of contact through the use of the secondary device. It is to be noted, however, that even as to speech, Berliner's statement is merely that he had succeeded in reproducing the vowels and other special sounds."

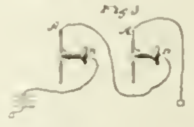
The Board held, however, that the Commissioner's prior decision permitting amendment, bound the Board, and reversed the examiner. This opinion of the Board as to the meaning of the language used seems sound. While this Court is not bound by these decisions of the Patent Office, and looks to them merely as interpretations of this document referred to in both briefs, it may be said that the weight of reasoning is very decidedly with those officials who found that the application was not for a constant-contact speech transmitter, and that the weight of decision in the Patent Office upon the sufficiency of the original application is decidedly against the complainant.

We will consider this matter on its merits. A comparison of the two documents seems to me to settle this question.

There has been in this case a great abuse of the use of expert testimony. Experts have offered their views upon questions that are entirely outside their province. They have entered into argumentative discourses upon the meaning of a document which is plain upon its face and expressed in terms of ordinary speech that require no expert explanation. The question of the meaning of the text, and the question of mistake in writing the text, questions of fact as to the intention of the applicant when he wrote the text, evidence as to the state of the art having no bearing whatever upon the meaning of terms, and arguments as to the meaning of isolated portions of the text, have been so confused as to obscure the real questions.

Did the original document filed by Berliner, read as a whole, disclose the invention of the patent; did it disclose the fact that Berliner had discovered that speech could be transmitted with the instrument of the patent; did it show that Berliner had made any advance upon Reis, or intended to claim anything more for the instrument of the patent than the transmission of musical sounds? The question whether certain portions of this document were inserted through mistake, and whether, when amendments and corrections are made, the application discloses the invention, is, of course, an entirely distinct question that should not be confused with the present inquiry. The application referring to instruments substantially similar to those of the patent in suit says:

> "If now the plate of one instrument, as in Fig. 3, is vibrated by sound waves (which happens whenever any kind of sound is uttered or produced by musical instruments in its neighborhood, every wave or vibration that strikes the plate will cause a weakening of the point of contact *x*, or also, if the sound is sufficiently strong, a break of the electric current at that point.
>
> It is evident that changes thus occurring at the plate of one instrument will be noticed at the plate of the other, or in any such instruments that are situated within the same electrical connection; and as often as one plate is caused to vibrate just so often will the others vibrate, caused by the break or the weakening of the electrical current. The same kind of sound therefore which affects the plate of the first instrument will be reproduced by the plate of the others."

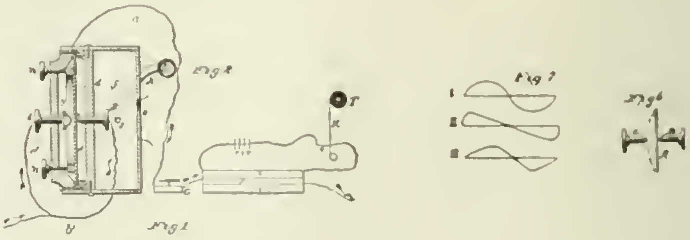


BERLINER DIAGRAM

Immediately following this is a statement which seems conclusive of the question whether the application claims a constant-contact operation for speech transmission.

A statement by Berliner, under oath, on June 4, 1877, which, unless proven to be a clerical mistake, is fatal to the complainant, not only on the question immediately under discussion, but on the fundamental question of whether, in fact, Berliner invented a constant-contact speech transmitter:

> "These simple instruments will reproduce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sound such as speech they are not adapted for the following reasons:
>
> In accepting the graphical name of wave for a vibration we must consider the same to have two dimensions, length and depth or height. In Fig. 7 I have represented three sections of waves, all of the same length and height, yet they differ in shape and their highest point is not always situated in the centre of their length. Such is the case with sound waves of various kinds of sounds. In a pure musical tone the shape of the wave is entirely regular like in Section I, but in every other sound this is not the case. It is therefore evident that the apparatus described thus far can not but transmit a pure musical sound because it transmits only the number of vibrations per second which is equal to the lengths of the waves, but nothing of the nature of each wave and the shape of their curves is recorded."



BERLINER DIAGRAMS.

The statement of the insufficiency of these instruments to transmit speech is accepted by the following description of the instrument, which was filed by Berliner as his model speech-transmitter:

> "This I accomplish, however, by situating within the vibrating field of the plate A a second screw E. In Fig. 6 the dotted line indicates the vibrating field of the plate B, the screw in contact with the plate, and E, the second screw. It will now happen in special sounds (meaning the nature of every sound besides its certain musical pitch) that the plate will not always strike the screw E in the middle of the duration of one wave or vibration, and taking, for instance, the duration of one wave to be one minute, the plate in special sounds will sometimes strike the screw E sometimes after twenty or twenty-five seconds from its beginning. This, now, is exactly recorded by this secondary screw E, which also makes an electric connection whenever the plate A, touches it, and at the receiving apparatus these special sounds will therefore be noticed. I have thus succeeded in reproducing a great many special

> sounds, such as the vowels and others. The principle of reproducing special sounds by break and make of contact rests mainly in the use of this secondary contact screw.
>
> In the drawing the point of this second screw consists of a piece of spring steel bent in semicircle; this is sometimes advantageous, but not absolutely necessary.

It will be observed that this drawing shows, in connection with the two pins, a hearing tube K and a speaking tube O.

It is idle to contend that, with this portion of the specification retained, and read in connection with the claims and other parts of the specification, the application was for a constant-contact speech transmitter. Applying the legal rule that a document must be read as a whole, and reading it as it stands, it is fatal to the complainant's contention. The application expressly disclaims speech transmission by the instrument of the patent, and claims as a speech transmitter a double-pin instrument operating to make and break the contact of electrodes. Berliner's model filed with his application was a double-pin instrument. The patent calls for constant contact of electrodes and an unbroken current; the application for an interrupted contact and a broken current. The Supreme Court has decided that these methods are radically distinct. (126 U. S. 544, 545.) We can find nothing upon the face of this document that requires the Court, as a matter of construction, to reject any portion of the text, or to interpolate any words which the context proves to have been omitted. The complainant contends that the statement that the single-pin instruments are unadapted for the transmission of speech is inconsistent with other portions of the text. It is said that the phrase, "whenever *any kind* of sound is uttered or produced by musical instruments," is an assertion that speech is to operate the single-pin transmitter. But is this so? The word "uttered" is used in the following paragraph to indicate the production of musical sound, thus:

> "These simple instruments will reproduce any *musical sound uttered* in the neighborhood of one of them, but for the reproduction of special sound, such as speech, they are not adapted."

The word "uttered" is used elsewhere in the application in the sense of produced. The Board of Appeals said, "The use of the word "uttered" in the latter part of the specification is significant, for, while it might appear from its use in the former part that it meant speech, this presumption is overcome by its use in the latter part in connection with musical sound." This is proper construction. The phrase has no reference to speech transmission. The word "uttered" being ambiguous, is to receive that interpretation which reconciles it with the rest of the text, rather than that which brings it into conflict therewith. It is then said that Berliner has stated that a "weakening of the current can be observed," and that changes at the transmitter that weaken the current can be observed at the receiver. But there is no inconsistency between the statement that weakenings can be observed and the statement that the instruments will not transmit speech. If some audible effects are referred to as produced by weakening the current, this is not speech. The document does not claim that, within the range of weakenings of the contact of the pin and diaphragm, speech can be transmitted; on the contrary, this is denied, and another inconsistent method is shown. Berliner has described the operation of the musical sound transmitter as a composite operation of weakenings and breaks of the current, saying that, "as often as one plate is caused to vibrate, just so often will the others vibrate, caused by the break or weaking of the electrical current." The statement relative to the irregularity of the sound waves and that nothing of the nature of each wave and the shape of their curves is recorded, applies to the composite operation and to both parts of it,—the weakenings as well as the breaks. The reproduction of special sounds is attributed solely to the supposed fact that the height of the waves is recorded by a contact with the second screw following a break of the circuit. It is said that the words, "any sound," include speech, and that therefore the subsequent statement that speech cannot be transmitted is inconsistent therewith.

But the words, "any sound," must be interpreted in connection with the specific exception of "special sound such as speech," which follows.

The contention that the particular clause is a contradiction of the general clause, is in effect a claim that a specific exception to a general statement should be rejected as inconsistent. We may test the validity of this method of construction by applying it to other text: "Of every tree of the garden thou mayst freely eat, but of the tree of knowledge of good and evil thou shalt not eat of it." Upon such a mode of construing text, the general permission is inconsistent with the special exception; therefore the exception should be eliminated. Such a mode of construction doubtless led to the fall of man. Legal rules of construction require that particular force be given to the specific exception. (*Bock* v. *Perkins*, 139 U. S. 628, 634, 637.)

It is further contended that the passage read as it stands would "make nonsense of the first three claims, which would be for inoperative combinations; the first of which would be entirely indistinguishable from the Reis transmitter, and the other two substantially indistinguishable." But this is not so. The first claim of the original specification is as follows::

> "1. An instrument for transmitting and reproducing sound-waves by the agency of electricity, consisting of a metallic diaphragm or other vibratory medium connected to or forming part of one pole of an electric circuit and arranged in contact with the opposite pole thereof, and capable of being put into vibration by the action of the electric current as set forth."

The second is substantially the same. If this claim as counsel for the defendants contend, is a claim for a receiver only, there is certainly no inconsistency. The words, "capable of being put into vibration by the action of the electric current," have no application to a transmitter, and support this view. The complainant relies, however, upon the words, "for transmitting," to overcome the force of this clause.

In *United States* v. *Bell Telephone Co.*, 167 U. S. 264, it was said: "In a sense the receiver is also a transmitter, for it passes the sounds from the wire to the ear." If, then, we should find, that reading this claim as for a transmitter, it was inconsistent with other portions of the text, we should, as a matter of construction, avoid this inconsistency by interpreting the word "transmitting" in the sense referred to in the opinion of the Supreme Court, following the rule that the text should be harmonized if possible. But, on the other hand, the claim can be read as for both a transmitter and a receiver without encountering any inconsistency. The single-pin transmitter's functions are described elsewhere as the production of musical sounds. A claim is not nonsensical that describes an instrument both as a receiver and as a transmitter of musical sounds, even if the instrument as a transmitter is substantially the Reis transmitter. Many patents describe and claim in clear language that which has been invented previously; they cannot, for that reason, be characterized as nonsensical.

The third claim of the application is:

> "The combination in one circuit of two or more vibratory diaphragms and contact pins adapted to operate similarly for the production and transmission of sound-waves when one diaphragm is caused to vibrate by means of any sound, as substantially as set forth."

This last clause makes particular reference to the specification and limits the function of the two instruments to the transmission of musical sound. A novelty is shown in the claim, and there is no nonsense here. There is nothing on the face of this text that requires us either to reject any part of it or interpolate anything as omitted.

Reading this document by itself, it is clear and consistent. Upon the view that there was no intention to describe or claim a constant-contact speech transmitter, there is no inconsistency or confusion. When we attempt to read it as for a constant-contact speech transmitter, then all is confusion, inconsistency and contradiction. The complainant contends that the patented invention was both described and claimed in the application before a word was altered by amendment; but, in support of this contention, argues that there was error in the expressions used and mistake in the text.

In considering whether portions of this document disclose a constant-contact mode of operation for the transmission of speech, the complainant contends that the specification was addressed to a person skilled in the art, and that this person would have known that there was no novelty in make and break of contact, and that speech could not thus be transmitted. It is then argued that for this reason the language must be interpreted as if the breaks were referred to as accidental. But surely such an assumption could not authorize us to reject an express statement by Berliner in this very document that he was attempting to reproduce special sound "such as speech" by make and break of contact; and that he had thus succeeded in reproducing a great many special sounds, such as the vowels and others. The document itself, on its face, disposes of the assumption, for purposes of construction, that Berliner knew better. Circuit breaking by two pins was new, not old. Berliner claimed it for speech transmission; and shows in his drawings a circuit breaker provided with a mouth-piece and ear-piece, and refers to this instrument when he says that "the operator is not in need of handling the instrument sidewards or moving his head while a conversation is carried on." And there seems to be no substantial ground for the statement of Professor Cross that the "circuit-breaking operation was known to be old, worthless and incapable of producing speech." The examiner considered many applications for circuit-breaking apparatus as late as 1882; and it appears that a circuit-breaking transmitter was greatly desired in order to avoid the Bell patent.

But even did the document elsewhere on its face fail to disclose the fact that Berliner was attempting a make-and-break operation, and were we simply construing those passages that relate to the single-pin instrument, we could not reject a distinct statement because it was erroneous as a statement of fact.

The attempt to construe this instrument according to supposed knowledge of the art completely fails, because Berliner expressly states that he thought otherwise than the expert is supposed to think, as well as because, on a question of the construction of text, a reference to the state of the art is permitted only for purposes of explanation and not to contradict plain language. In *Simpson* v. *Holliday*, 1 L. R. Eng. & Irish App. 315, 322, it was said:

> "This does not warrant us in giving effect to a specification claiming two things, one practicable and the other impracticable, because a skilful workman would know that one of them could not be acted upon and so would confine himself to the other. This would not be to construe a specification according to the language of workmen instead of according to our ordinary language, but to reject something claimed by the patentee, because a workman would know that it was an unjustifiable claim."

In *Clark* v. *Adie*, 2 App. Cases, 436, Lord Blackburn said:

> "When it is attempted . . . to say that inasmuch as these specifications show, or are alleged to show, matter which, upon a fair construction of the specification claimed by the patentee, were old at the time that the patent was taken out, and were generally known to be old, therefore the specification must be so construed as not to include them; that seems to me to be both contrary, so far as I know, to the cause of decision and contrary to principle. . . . It would afford a very simple recipe for saying that no patent should ever be upset upon the ground of want of knowledge. If, when you say you can show that a thing was old at the time the patent was granted, you are to construe the specification as not intending to claim that, because the man who claimed it would be suicidal and foolish, it would be a recipe for saying you shall never upset a patent at all for want of knowledge."

The question which counsel undertake to argue is, What does the document say? This is a question entirely distinct from the question of what it might have said or what it should have said, and from the question of mistake. In *Badische Anilin und Soda Fabrik*

v. *Kalle*, 94 Fed. Rep. 169, upon the question whether a certain document disclosed an invention so as to constitute an anticipation, it was argued that a certain statement was a mistake. Judge Coxe said:

> "The court has simply to consider what the publication in question has contributed to the art. If it fails to show the invention which it is said to anticipate, the contention that its author knew enough to write an anticipation and intended to do so is grotesquely irrelevant."

The argument whereby the complainant endeavors to show that the original application could support the patent in suit, is a labored attempt to place upon plain and unambiguous language forced interpretations which do not explain, but destroy its natural signification,—interpretations which do not explain, but contradict. I am of the opinion, therefore, that the patent in suit cannot depend upon the original application, since it is for an invention radically distinct from anything described or claimed in the original application.

The radical difference between a make-and-break transmitter and a constant-contact transmitter having been shown by the decision of the Supreme Court, in 126 U. S., the next question to be considered is whether the original application could, under legal rules, be so amended as to serve as the basis of the patent in suit. The Supreme Court, in *Railway Company* v. *Sayles*, 97 U. S. 563, said:

> "If the amended application. . . . embodied any material addition to or variance from the original,—anything new that was not comprised in that—such addition or variation cannot be sustained on the original application. The law does not permit such enlargements of an original specification, which would interfere with other inventors who have entered the field in the meantime, any more than it does in the case of reissues of patents previously granted. Courts should regard with jealousy and disfavor any attempts to enlarge the scope of an application once filed, or of a patent once granted, the effect of which would be to enable the patentee to appropriate other inventions made prior to such alteration, or to appropriate that which has, in the meantime, gone into public use."

In no case can there be stronger reasons for applying this rule than exist in the present case. See also *Hobbs* v. *Beach*, 180 U. S. 383, 396.

I am of the opinion that this patent is invalid for the reasons that the power to amend an application does not include the power to change the nature of the invention; that the right to amend or the right to complete an application under Section 4894 does not give the right to transform completely; that the only remedy for a radical mistake in substance so serious as to require a transformation so complete as is here shown is a new application. Robinson on Patents, Sections 561, 635; *Consolidated Elec. Lt. Co.* v. *McKeesport Elec. Lt. Co.*, 40 Fed. Rep. 21-27; *Railway Co.* v. *Sayles*, 97 U. S. 554-563; *Michigan Cent. R. R. Co.* v. *Consolidated Car Heating Co.*, 67 Fed. Rep. 121.

The first amendment affecting this controversy was made by Berliner on August 8, 1877, when he struck out the passage denying that the single-pin instruments could transmit speech, and also the claim for the double-pin instrument. The complainant contends that the application thus amended was a sufficient basis for the patent in suit. Assuming that the August amendment amounts to an assertion: "My single-pin instrument can talk. I strike out the reasons why it can't, and also the double-pin instrument, which for these reasons I previously said could talk;" here is a positive and clear contradiction of the former application, and the introduction of matter radically distinct. If this amendment is to bear this construction, I agree with the learned counsel for the defendant, that "probably no such flagrant instance of an application filed for one thing and then contradicted into its very opposite,— * * * —can be found in the books." If this was the effect of the amendment, it was clearly inadmissible.

Between the date of Berliner's application, June 4, 1877, and his amendment of August 8, there appeared a publication in the Philadelphia *Press* of July 9, 1877, in which was described a constant-contact variable-pressure speech transmitter, the invention of Edison. The apparatus included a diaphragm with a plumbago electrode in contact therewith.

> "This, again, is another original discovery of Mr. Edison's, viz., that plumbago changes its electrical resistance with enormous rapidity under pressure, the effect in this application being that when the diaphragm is vibrated weakly contact is made with the plumbago point very lightly, and the resistance of the plumago being but slightly reduced a weak current is sent out from the battery, and a weak effect produced at the receiving station. When, however, a strong pressure of the diaphragm is effected by reason of the exercise of a more powerful vibration of the voice, the resistance is very greatly reduced and a strong current passes to the line and and a strong or loud effect is produced at the receiving station. Hence the amount of power, with all its fine gradations generated by the voice at the transmitting station, is transmitted in its proportions to the receiving instrument, and thus the fine articulation of the voice is obtained."

On July 20, 1877, Edison filed an application for Letters Patent No. 474,231, which covers completely all that is now claimed for Berliner, see 126 U. S. 378. It is apparent that amendments filed after this would interfere with another inventor, and that Berliner's amendment must, in any event, bear date as of August 8, 1877, and cannot relate to the date of filing the original application. But the contention that the amendment of August 8 made the application a sufficient basis for the patent in suit is unfounded. Striking out the only speech transmitter claimed did not introduce a new speech transmitter. The mode of operation remained unchanged,—"as often as one plate is caused to vibrate, just so often will the others vibrate caused by the break or the weakening of the electrical current." If by amendment it was intended to claim the single-pin transmitter for the production of any sound, then it would appear, on reading the amended specification, that Berliner intended to transmit speech by a composite operation of weakenings of the normal current, and breaks of the current. That breaks were to occur in the operation appears from other portions of the amended specification, thus:

> "The operation of my invention is as follows: If a current of electricity of ordinary strength is made to pass through the plate and the screw across the point of contact, . . . the whole amount of electricity will not be able to pass quietly over the narrow point of contact, and the consequence will be that it will accumulate to a state of tension on both sides of the contact, and the passing over of the current at the point of contact will be so violent as to shake the plate off from the screw. The shock will be particularly strong at the setting in and at a sudden ceasing of the current, and a cracking sound will be heard from the plate, but a weakening of said current alone can also be observed by making for example a connection within the same current by a wire and the blade of a knife. When scraping the wire end over a blade of the knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute variations and cavities on the plate caused by the structure of the steel and which again cause minute alterations in the intensity of the current are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar scraping noise."

This is followed by the language which we have above quoted from the specification, pages 22, 23, *supra*. The language here employed, and the figure by which it is illustrated, have primary reference to a receiver and not to the transmitter; and this supports the contention of the defendants that the principal invention which Berliner sought to cover was the receiver. If, however, this language is applicable also to the transmitter, and if the passing of the current at the point of contact would be so violent as to shake the plate off from the screw, it is apparent that a true copy of the sound waves could not be made upon the line. This would account for the failure of the single-pin instrument as a speech transmitter, and show why Berliner had recourse to the double-pin instrument.

The absence of any specific amendment stating that Berliner contemplated speech transmission with the single-pin instrument, is a strong indication that he did not intend on August 8th that his amended application should be construed as for a speech transmitter. It is apparent that the apparatus with the double-pin completely embodies the single-pin instrument. Berliner has stated in his original application all that he could accomplish with this apparatus. He also testifies to his failure with it. When he strikes this out, he strikes out all claim for the transmission of speech.

Further amendments were made on Sept. 8 and 14, 1877. That of Sept. 8 added a carbon contact, afterward cancelled. But after these amendments the application still described in the original language the composite operation of weakenings and breaks. As Berliner's novelty is said not to reside in the apparatus but in the mode of operation, this is the vital point. It is of little consequence that the apparatus is shown, if it is not shown operating in the manner described in the patent. The rewritten specification of October, 1877, still preserves a description of the composite mode of operation, with a new claim for the single-pin instrument operating "by either altering or disconnecting said contact at each vibration."

Constant contact of electrodes is first definitely claimed and described in the rewritten application of Sept. 1, 1880. At that date the invention had been in public use for more than two years, as is conceded. I am of the opinion, therefore, that the defendants have established their second defence. Berliner's June 4, 1877, application did not describe the invention of the patent in suit and was never legally amended to do so. Assuming, however, that by the August amendment the application became sufficient to support the patent, and that such amendment might be made under proper circumstances, we have still to consider the validity of the grounds upon which the complainant claims the right to amend.

There can be no doubt that Berliner had the right to drop out any one of the inventions contained in an application whereby he sought to patent several inventions. That Berliner had the right to drop out claim 4 for the double-pin instrument, and also such parts of the specification as related solely to that instrument, is clear. The question is whether Berliner had also the right to drop out portions of the text which relate solely to apparatus which he retains in the specification, and thereby change or enlarge what remained. The plaintiff's brief says, "His amendments simply withdrew from the specification *another invention* which had proved practically useless, and incidentally cancelled statements in the description of that invention, etc." This is wrong. Inspection of the document disproves it. There is quoted by counsel, also, the letter of Commissioner Simonds to the Secretary of the Interior, dated Dec. 13, 1892:

> "These words describe and claim something which is separable from the main part of the instrument, an addition to what was shown in Berliner's caveat, and they embody an erroneous conception of the natural action involved. The tyro in electricity knows that now."

Referring to the amendment of Aug. 8, 1877, which struck out the passage in question, the Commissioner is quoted as saying:

> "In making that change Berliner had done two things. He had cancelled the description of an unnecessary adjunct. . . . He had cancelled an erroneous statement of the natural mode of action involved."

This supports the view that the application was not for the invention of the patent in suit, but stated a wrong and impracticable mode of operation. The Commissioner is obviously wrong, however, in stating that "these words describe something which is separable from the main part of the instrument"—"an unnecessary adjunct." This is a main part of the instrument, and of the description of the single-pin instrument. It is erroneous to state, as counsel do, that the words are "words of the specification that describe the double-pin instrument." The entire passage upon which the defendants rely relates solely to a statement of the incapacity of the single-pin instruments, and of the reasons therefor. Following this is a distinct description of the double-pin instrument, and there is no confusion between the two. It is separable from the rest of the document by cutting it out bodily, but in no other way. It is not separable as dealing with a distinct subject. The Commissioner was also manifestly in error in justifying the amendment by the rule "an inventor is not called upon to state and explain the principles of nature involved in the operation of his invention; and, if he does undertake to state them and thus misstates them, the error is not material;" and, "if the inventor undertakes to state the theory upon which his instrument operates and mistakes it, that fact is immaterial."

If an inventor states that he has invented a new machine that works, and theorizes erroneously as to why it works, he may strike out his theory and stand on his fact; and, in construing his document, we may ignore his theory as surplusage and rely upon other parts of the document. But when this inventor states as a fact that he has found that the instrument will not work, and gives an erroneous theory to explain why, when he strikes out his theory he has no fact to stand on. He has not made the instrument operative by discarding his notions as to the reason for the fact that it is inoperative. Strike out Berliner's theory, and his reasons for the inoperativeness of the invention, and there still remains his statement that "these simple instruments will reproduce any musical sound uttered in the neighborhood of either of them, but for the reproduction of special sound, such as speech, they are not adapted;" and these words can be rejected and amended, if at all, on one ground only,—mistake in writing them,—upon clear proof that this was not intended. As a statement of fact they still remain. *Jackson* v. *Brass Co.*, 72 Fed. Rep. 271.

They cannot be rejected on the ground that they relate to the double-pin instrument and not to the single-pin instrument, since inspection shows that it is not so. They cannot be rejected as theory, for there are statements of fact that remain after eliminating all theory. They cannot be rejected as an erroneous judgment as to the capacity of the machine, for the machine was old; and if Berliner had not learned its capacity to transmit speech he had made no advance upon Reis, and was not an inventor. If the amendment of Aug. 8 made the application good, it was by enlargement of the description of the capacity of the single-pin instrument by cutting off the express limitation that it was only for musical sounds, and thereby converting the application for a musical transmitter into an application for a speech transmitter. I think that it did not have this effect; but, assuming that the complainant's construction of the amended application is correct, it is manifest that the grounds, so far stated to justify the amendment, are untenable.

Counsel say, also, "Suppose it were possible that Mr. Berliner, when he filed the specification of June, 1877, thought that there was or might be some value in the breaking of the contacts in giving that louder, though harsh, sound, can it be contended that he cannot drop that error out when he discovered the contrary?" But this is inconsistent with the claim that Berliner's invention was a new mode of operation. So long as Berliner intended to make use of the breaks in the current, he had not invented a constant-contact speech transmitter. Until he had learned that speech could not be transmitted by a structure in which the two electrodes are not normally constantly in contact, he was following Reis; and, as the Supreme Court has said, to follow Reis is to fail.

An erroneous judgment as to the practicability of the composite operation of weakenings and makes-and-breaks described in the specification could not be amended as "mistake" or "error." *Manufacturing Co.* v. *Ladd*, 102 U. S. 408-411. Even should we be of opinion that rules of law permitted the amendments in question provided Berliner had, in fact, made the invention, we should still be obliged to find, as a matter of fact, to support this case, that Berliner was mistaken not as to the capacity of his instrument but merely as to the phrases employed in the application.

We therefore consider as the next question: Was Berliner's denial of the operativeness of the single-pin instruments contained in the application of June 4, 1877, a mistake of a scrivener? An examination of this question involves also the substantial question: Had Berliner, as a matter of fact, invented a constant-contact speech transmitter before June 4, 1877? The burden of proof on the question of mistake is upon the complainant. There rests upon the complainant the burden of overcoming the strong presumption arising from the terms of a written instrument. "If the proofs are doubtful and unsatisfactory; if there is a failure to overcome this presumption by testimony entirely plain and convincing beyond reasonable controversy, the writing will be held to express correctly the intention of the parties. A judgment of the court, a deliberate deed or writing, are of too much solemnity to be brushed away by loose and inconclusive evidence." *Howland* v. *Blake*, 97 U. S. 624-626; *Insurance Co.* v. *Nelson* 103 U. S. 544; *Coyle* v. *Davis*, 116 U. S. 108; *Cadman* v. *Peter*, 118 U. S. 73; *Moore* v. *Crawford*, 130 U. S. 122. The doctrine of these cases is fully applicable here.

A reading of the original application affords no evidence of mistake. The application does not disclose the fact that Berliner had made the invention of the patent in suit, nor that he intended to apply for it; it contains no evidence that Berliner had discovered that speech could be transmitted with the single-pin instrument. The document discloses no evidence of an intention of Berliner to include in it the single-pin instrument as a speech transmitter. I adopt the statement of counsel for defendant: "It is impossible to read the specification, with its perfectly lucid and orderly description of three specific inventions, following upon three caveats in which they were described in Berliner's own words, and not perceive that that is all he wanted to describe in his application,"—excepting, of course, the minor inventions of diaphragms. If this document be read with Berliner's denial of an intention to claim his single-pin instrument as a speech transmitter retained, it is perfectly clear and consistent, showing that he intended to cover a variable-pressure receiver, a sparking and recording receiver, a make-and-break double-pin speech transmitter, a concavo-convex diaphragm, a perforated diaphragm, and the two single-pin instruments for the transmission of sounds other than speech; or we may interpret it as proving an intention to claim the single pin instrument as a musical transmitter.

On the contrary, if we read it according to the complainant's contention that it was intended to cover a single-pin speech transmitter, the whole document is thrown into inconsistency and confusion. It is obvious that the statements concerning the single-pin instrument and its capacity are such as could have come only from Berliner himself. No scrivener would have volunteered such statements. No scrivener would have volunteered such reasons in support of the statements, nor illustrated them by references to drawings. The alleged mistake does not relate to a matter of form. The statement is of the substance. If there was mistake, it was in the erroneous opinion held by Berliner, and not in any expression of his beliefs or opinions. The word "error" is used by counsel in a double sense to signify, first, a mistake in expression; second, a mistaken belief. There are two distinct contentions, which should not be confused. We will consider later the contention that Berliner had made the invention of the speech transmitter of his patent, even though he believed on June 4, 1877, that his single-pin instrument could not transmit speech.

There is no express reference to the capabilities of the single-pin instrument as a speech transmitter, although, had he made the invention, Berliner could not have failed to state first and principally what he had accomplished with this instrument in the transmission of speech. Had his invention been made, had the adequacy of this means been proved, it is highly improbable that he would have made a claim for the double-pin instrument and a mode of operation which was a reversion to the theory of Reis; or, at least, was intermediate between the constant-contact method of Bell and the current-breaking of Reis. Berliner testifies that the two inventions of the "variable-contact transmitter" (as he terms it) and the contact receiver, consisting essentially of a diaphragm in electrical contact with a pin or screw, were meant to be covered by claims 1, 2 and 3 of the said application. I am of the opinion, however, that claims 1 and 2 were not intended to describe a transmitter, but merely a receiver; and that claim 3 was merely for two instruments for the transmission of sounds other than speech. It is to be observed that the force which actuates the transmitter is the force of the sound-waves; yet claims 1 and 2 contain the clause "and capable of being put in vibration by the action of the electrical current substantially as set forth." This is a characteristic wholly unnecessary to be mentioned in describing a transmitter.

Professor White, however, testifies that the mechanical conditions under which each instrument best performs its functions are also very different; "that, if we have a Berliner transmitter with steel points in circuit with a Berliner receiver also with steel points, and adjust the two instruments with care for the best performance of their respective functions, speech is readily transmitted and understood. If, now, without changing the adjustments of either instrument, we speak into the receiver, thus making it a transmitter, and listen at the former transmitter, thus using it now as a receiver, it is found that speech cannot be successfully transmitted and received. Sound is heard, but crude and harsh, with much breaking, and scarcely anything can possibly be understood. These experiments show in the most convincing way that the operations of the forces of the two instruments are by no means identical, on the other hand, are radically different; and that the mechanical conditions under which each best performs its functions are also very different." It thus appears that the words "capable of being put in vibration by the action of the electrical current" imply an adjustment that would practically incapacitate the instrument as a speech transmitter.

The learned counsel for the defendants have made a summary of the contents of the application which so completely covers that document as to negative any reasonable belief that Berliner's solicitor was mistaken in its preparation. There is no evidence that, in the description of the other inventions, the solicitor failed to express Berliner's meaning. The descriptions follow the caveats perfectly, and the claims follow the descriptions perfectly, except as to the transmitter of the caveat of April 14, 1877. Omitting that, the description and the claims are clear, complete and exact. The internal evidence of the application is all against the complainant.

Berliner testifies as to the preparation of the application, saying that he had made several distinct inventions and sought to save money by putting them into one application; that he had made one invention described in a caveat of March 29, 1877, for a system of magneto-telephony, which he did not believe valuable enough to include in the specification; that he intended to insert, "first and principally, the invention consisting of a diaphragm in electrical contact with an opposite pin, by means of which I could send undulatory currents of electricity corresponding to sound-waves by decreasing and increasing the pressure between said diaphragm and said contact pin. This is described in the caveat filed by me April 14, 1877." This statement must be read with great caution. It was made in 1893, sixteen years after the event; after continuous controversy in the patent office, and when he is to be considered as an expert. His language is to be given no liberality of construction. If statements of intention made under these circumstances can be of any force as against a written statement under oath, to the contrary, yet this statement is insufficient on the ground that it does not meet the point. It is obvious from the specification itself that Berliner did intend to include the single-pin instrument and to employ "weakenings" as a part of his composite method for the transmission of musical sound. The inquiry is not as to whether Berliner intended to send undulatory currents, but whether he intended to send undulatory currents of the form requisite for speech by the single-pin instrument. In the argument for the Bell Telephone Co., 126 U. S. 299-309, Mr. Storrow, interpreting the Bell patent, clearly pointed out that speech is not a necessary result of an undulatory current; that undulatory currents may be used for musical transmission and other purposes. Berliner's evidence does not prove an intention to claim the single-pin instrument operating throughout its entire range of movement without break, to produce an undulatory current of the form requisite for speech. Before the Board of Appeal, counsel for Berliner argued, "Can it be discovered from any part of the (specification) that the inventor meant to employ variable pressure as an element? For if he meant to employ it at all, that is enough." Counsel also refer to "variable-pressure periods of transmission" with intermediate breaks. Berliner's testimony may mean only that he intended to send undulatory currents in periods between his intended breaks, or that he intended to send some undulatory currents having "nothing of the nature of each wave and the shape of their curves."

The argumentative character of Berliner's testimony will be observed upon reading it. It is entirely reasonable to suppose that Berliner, when he gave this testimony, was of opinion that he did intend to employ undulatory periods as a part of his method of operation in connection with the makes and breaks; and that he reasoned that, as he intended to employ these, he intended his instrument for the production of an undulatory current and was entitled, therefore, to credit for the general invention of an undulatory current transmitter which would include speech transmission, though he had not accomplished it. Though this is erroneous reasoning, it was and is the reasoning of counsel and may fairly be attributed to Berliner.

Testimony as to an intention existing sixteen years before is of very slight weight at best, even when in direct and positive form; but when it may be based upon an "interpretation" and is equivocal in expression, it can have no force against a sworn statement in writing.

It is claimed that mistake arose from speedy preparation by an incompetent solicitor's clerk, and because this clerk had difficulty in understanding Berliner (who was a foreigner) on account of his imperfect accent. The charge that this statement appears in the specification through any fault of this clerk I believe to be unjust and untrue. It is certainly not proven. Berliner applied to a solicitor on May 13, 1877. His application was sworn to on June 2, 1877, and filed on June 4, 1877. He was turned over to Coombs, a clerk. Berliner says, "He made copious notes, and I remember giving him a few notes of mine." Coombs, the clerk who wrote the application, stated that he got explanations from Mr. Berliner previous to finishing the rough draft of the specifications; that they had an imperfect model or instrument, helped out with rough sketches and explanations; that at the time of drawing the specifications he had a general knowledge of electricity, but very little knowledge of speaking telephones; that Mr. Berliner's telephone was the first one he had ever seen or handled; that he found it rather difficult to understand Mr. Berliner on account of his imperfect pronunciation, and further "because the subject was strange to me."

The testimony as to the actual fact of mistake is remarkably meagre. Nor is it clear as to the amount of time spent in preparing the specification. Berliner testifies to a hurried examination of the rough draft of the specification, but that he did not read the final draft. That there was a mistake, we have no other evidence than the vague statement of Berliner. Coombs testifies to no mistake. There is evidence that Coombs was furnished with notes and explanations. No evidence is offered as to what those notes were, nor as to when they had been prepared. Berliner himself was not uneducated, but a man of intelligence and of unusual skill and facility in the use of language, and fully competent to have prepared complete instructions to Coombs. He had formerly written caveats by his own hand, viz., one of March 29, 1877, one of April 14, one of April 30, and one of May 9. In the summer or fall of 1877, he himself drew an application for patent No. 199,141, which is in perfectly good form, and conducted all the proceedings himself. The evidence as to speed in preparation of the application by a solicitor ignorant of the subject is evidence of the completeness of the instructions given by Berliner to Coombs. There is no evidence as to whether the caveats or copies were in the hands of the solicitor; but the application follows closely those caveats, and shows no error of Coombs in respect to any other invention. In fact, the only direct evidence of mistake is Berliner's own testimony.

Berliner does not testify that he instructed or informed Coombs that he had found that this instrument was capable of transmitting speech; nor does Coombs testify that there was any information offered to him as to the capabilities of the single-pin instrument for speech transmission. It certainly has not been made to appear that any mistake was made by Coombs in transcribing or putting into form any fact or statement communicated to him by Berliner. Coombs did his work thoroughly and accurately as to other inventions; presumably he did so as to this.

Berliner does not testify that he gave to his solicitor any documents inconsistent with the specification as filed. He does not state that any specific phrase in the document differs from what was stated by him to the solicitor. He does not state that he did not himself write or authorize the passage in question. He does not state that it was his intention to describe in his application a speech transmitter competent for the production of sounds without make and break. He is not called upon to deny categorically that any specific statement made in the specification was authorized by him. It was the duty of the complainant to prove in detail, and to the best of its ability, just what the mistake was, and how it occurred. Counsel say merely, Berliner was a German, his solicitor was incompetent, and application was hastily drawn and hastily read. They do not prove what the mistake was. They do not prove that Berliner did not fully authorize the statement that the instruments were not adapted to transmit speech. Expert interpretation is no substitute for testimony as to facts.

The oath of Berliner to his application completely overcomes his vague and uncorroborated oral evidence as to the actual fact of mistake. It would be contrary to the rules of law to allow a sworn statement to be swept aside by incomplete, loose and inconclusive evidence of this character offered by the party whose duty it was to produce all procurable evidence on this point. Berliner, however, has not only the burden of proving that mistake was made, but also the burden of accounting for his failure to discover it. If mistake was made it was on June 2. It was not discovered until August. We find, however, in the conduct of Berliner immediately after the filing of the application, evidence that this was no mistake. On June 27, more than three weeks after the filing of the application, an amendment was made relating to the double-pin circuit-breaker. On July 14 another amendment was made relative to the double-pin instrument and to the air discharge instrument; and on Aug. 8, 1877, the double-pin instrument was stricken out. From June 4 to Aug. 8 there stood on the files in the Patent Office a complete denial of the invention now claimed, and Berliner was examining and amending his specification in relation to the double-pin instrument, and during this period failed to discover any mistake. He attempts to account for this, saying that he had a badly copied letter-press copy of his specifications, "but in the course of time I would now and then, by fits and starts, pick up this letter-press copy, open its pages in a haphazard fashion, and then I would read passages of the specification in a manner. I would discover parts of passages which did not seem to sufficiently express all I meant to say and all I thought I had communicated to Mr. Coombs. After discovering such deficiencies, I would go to Mr. Norris's office and ask that the objectionable parts be amended or that additions be made, which was done by Mr. Norris. At another time this would be repeated. I would come across another passage which I thought needed amending, and I would again go to Mr. Norris to have it amended; and in that way the number of amendments referred to is accounted for." Not one of the amendments made by Mr. Norris up to Aug. 8 bears this out. The first amendment of June 27, 1877, contains no corrections, but an additional description of his make-and-break double-pin instrument, and a new claim for the bent spring. The second amendment of July 14 substitutes the terms "spring made of metal" for the words "steel spring;" and there is contained an additional statement, not a correction, in reference to the air discharge instrument. On July 27, 1877, is another addition, and not a correction, concerning the air discharge instrument. No one of these actual amendments corroborates the testimony of Berliner that he discovered objectionable matter in the expressions of Coombs, and therefore made amendments.

These amendments, on the contrary, contradict his testimony. It is entirely improbable that these passages in the original draft could have escaped the attention of a man so skilful in the use of the English language, and so intelligent as Berliner; that he could have examined the document for the purpose of making the specific additions that he did make, and that he could have overlooked the denial of the very essence of the invention which he claims. If there is any degree of probability in this statement, the preponderance of probability is so strong against it that this evidence must be rejected upon the ground of its weak and inconclusive character upon the issue of mistake. He testifies that his first discovery of the error of the section dealing with the secondary pin, double make-and-break operation was in the early part of August, 1877; that, happening to pick up the copy of the specification, he immediately noticed "that Mr. Coombs had mixed the matter up considerably, and that the passages referred to did not express what I had invented; and, in fact, misrepresented it. At first, I thought I would amend this part of the specification so as to make it read right and convey the correct meaning such as I had laid it down myself in the caveat of May 9, 1877." He then testifies that he had by that time concluded that the double contact make-and-break instrument did not amount to much, and resolved to strike out the whole matter relating to it. It is apparent, however, that even then, when he learned of this vital error, he did not change the conception of the single-pin instrument operating as a transmitter by make and break, for his amendment of Aug. 8 still left the statement that the break or weakening of the electrical current was the method of transmitting sound.

Prior to any amendment in which, by any liberality of construction, we can find a constant-contact speech transmitter, there appeared the Philadelphia *Press* article, and Edison filed his application of July 20, 1877, for patent No. 474,231.

Assuming, however, that Berliner's testimony is to be interpreted as meaning that he did intend to describe and claim the single-pin instrument as a speech transmitter, it can have no force against his written statement unless corroborated by other evidence. Unfortunately for the complainant the only evidence in this case as to any success in experiments comes from Berliner himself. The two other witnesses produced to testify on this subject both say that at the experiments attended by them no speech was transmitted. Berliner testifies, however, to the presence of several other witnesses at other experiments, but the witnesses are not produced or accounted for. The testimony of these two witnesses is corroborative of the statement, made in the application, that the simple instruments were not adapted to the transmission of speech; and the non-production of the other witnesses is a strong fact against the complainant.

We will consider, however, the contention of the complainant that, as a matter of fact, Berliner had made the invention before June 4, 1877. What did Berliner accomplish in speech transmission prior to June 4, 1877? He testified that he procured a copy of Bell's patent of March 7, 1876. "I studied his patent over and over again, and it became deeply impressed on my mind." A statement of the history of his invention was made by Berliner in Telephone Interferences, and was sworn to on April 12, 1879. In this he says that he commenced experiments in January, 1877. Being in a telegraph office, an operator explained to him the importance of pressing down the Morse key firmly in order to insure the prompt operation of the sounder; that it then occurred to him that, if a variation of contact pressure between the circuit-closing key and its rest could produce a variation in the current, then a varying pressure between the points of contact could be obtained by the vibration of one or both of them imparted to them by sound or sound-waves in the air in their neighborhood; that he constructed apparatus and proved by a galvanometer that changes of the current could be produced. He stated also that he made experiments on March 4, 1877; and that "a person at the receiver heard sounds when I spoke against the diaphragm of the transmitting apparatus, but could not generally make out the words I spoke;" also that, on April 12, 1877, using apparatus consisting of two single-pin instruments, "upon singing against the diaphragm of one of the instruments, the tunes could be heard distinctly at the other; and in speaking my voice would be recognized, and the persons listening said they understood what I said." He does not, in this document, state that he himself heard the instrument transmit a word.

In 1893, fourteen years later, Berliner testified in the case brought by the Government for the cancellation of the patent, and gave the names of the persons present at the experiment of March 4, 1877,—Simon and Gustave Oppenheimer. Simon Oppenheimer testified concerning this experiment, saying:

"Berliner and my brother went upstairs, and I remained on the lower floor, and he first whistled into the instrument and I heard that,—heard his whistling; and then he sang, and after trying that several times he tried talking. I could distinguish one from the other,—change of voice, but I could not make out any words."

Whether the witness means change in Berliner's voice, or change of voice from Berliner to his brother, is not clear. The other person present has not been produced or accounted for. The evidence of Oppenheimer throws light on the meaning of Berliner, when he says in his preliminary statement that a person could not generally make out the words that he spoke. Taking these statements together, the proof is that no words were heard on March 4, 1877. Berliner, in 1893, testified also to the experiment with two single-pin instruments in April, 1877, referred to in his preliminary statement. But a single experiment was made with this apparatus before the writing of the caveat of April 14, 1877. The preliminary statement and Berliner's evidence refer to this experiment, though in the preliminary statement the date is given as April 12, while in the oral evidence it is given as April 11. The second single-pin instrument was first constructed on the 10th of April. He says:

"On the next morning before going to the store, I tried a practical experiment from my room to the room downstairs, and made the ladies of the house listen. They were very greatly surprised when I transmitted, as I always did for the purpose of amusing them, by means of interrupted currents; they heard the tunes loudly all over the room, and when I made them listen close to the apparatus and transmitted by variation of pressure, they reported to me much better results that they had previously heard at other experiments, and they also thought that it was very wonderful indeed. They recognized and got familiar sentences now and then. It was very difficult to adjust the apparatus. I bad to run upstairs and downstairs continuously, both for adjusting the transmitter and the receiver. The current would heat the contact, the plate would bulge off a little and get out of adjustment; but we did get quite good results. I immediately prepared, on the evening of the same day, a caveat describing what I did. I made a clean copy of my rough draft on the 12th, swore to it on the 13th, and filed it on the 14th"

He testifies, also, to a practical experiment, the date of which is not given:

"My listeners reported to me that when accidentally, as it happened very [illegible] in these experiments, the current was interrupted, they heard that familiar buzzing—the familiar musical sound they had heard before; that between such sounds, however, they heard a very faint sound, which they recognized as my voice, and that occasionally they thought they understood familiar words or sentences. I then went downstairs to listen for myself, and I found the same result when some one was speaking or singing upstairs."

He testifies that:

"I then for the first time noted the very great difference in the character of the sound emanating from the reproducer. The quality of the sound when the current did not interrupt at the transmitter was that pure, human quality, sounding perfectly natural though very far off; but it was entirely different from the buzzing musical sound that had no admixture whatever of the quality of a human voice when the current was interrupted. I now and then thought I could make out the words of familiar sentences, but it was exceedingly faint."

He gives the names of persons who had listened at the instruments, namely, "Mrs. Gangewer, the lady I lived with; her daughter, at that time Miss Emma Gangewer; her son, Mr. Harry Gangewer; my room-mate, Mr. William Pribram; and two friends of mine, Mr. Simon and Gustave Oppenheimer, brothers." With the exception of Simon Oppenheimer, not one of these witnesses is produced, nor is the failure to produce these witnesses accounted for. A single other witness—Adolphus S. Solomons—testified that "I heard sounds which appeared to come from a violin; I felt sure I heard a violin playing." From his evidence it is apparent that Berliner endeavored to speak through his instruments; but the witness testifies that he told Berliner that he heard no speech, only some sort of a noise. The entire case as to experimental results in speech transmission rests upon the unsupported testimony of Berliner. As counsel says, there are occasions in the world when the paucity of proof in the affirmative is positive proof in the negative. Considering the great importance of establishing by other witnesses experimental results inconsistent with Berliner's express denial in his application, and the entire lack of any explanation of the absence of several witnesses who could testify upon this issue the presumption is justified that the testimony of these witnesses would be unfavorable to the complainant.

If a party has it peculiarly within his power to produce witnesses whose testimony would elucidate the transaction, the fact that he does not do it creates the presumption that the testimony, if produced, would be unfavorable. *Graves* v. *United States* 150 U. S. 118; *Runkle* v. *Burnham*, 153 U. S. 216-225; *Clifton* v. *United States*, 4 How. 242.

We should also consider the inherent dangers of oral proofs, when a witness undertakes to disprove former statements made by him in writing. In addition to this, the principles stated in *Barbed Wire Patent*, 143 U. S. 275, 284, 285, seem to be applicable to the testimony of Berliner, in view of the fact that his amendments were made after Edison's invention of a constant-contact speech transmitter, and after the Philadelphia *Press* article and the applications by Edison. Upon the whole evidence, I am of the opinion that, according to the strong preponderance of proofs, no one of Berliner's instruments ever transmitted a word of human speech under his manipulation; and that the only results that he ever got were such as are described in the application and attributed to the double-pin instrument. Professor Brackett testifies: "I have no doubt that, if he endeavored to transmit speech with the single-pin instrument of the application, which he refers to in the expression 'these simple instruments,' he found that they were not adapted for the transmission and reproduction of special sounds to be a fact. In this, his experience would not differ from that of every one who has attempted to transmit speech with the Reis and Regnault apparatus, which as apparatus is identical in principle and organization with that of the application." This was the fact with Edison, who rejected as useless what Berliner by his application rejected as useless. That a feat of experts has made that apparatus talk proves nothing as to Berliner.

The documentary evidence upon this point, to and including June 4, 1877, is the caveat of April 14, 1877; the caveat of April 30, 1877; the caveat of May 9, 1877; the application of June 4, 1877. The latter is by its character most important, being his latest statement of what he had done at the date of his application. This proves that he had not secured speech with the single-pin instruments; that he was seeking to secure speech by make and break of contact. It shows that he thought that, by this method, with a double-pin instrument he had succeeded in reproducing "a great many special sounds, such as the vowels and others." The application overcomes the evidence as to experiment. Moreover, the fact that he was beyond all question attempting to get speech with a broken current renders it highly probable that he had not got it otherwise.

We will next consider the bearing of evidence as to the capacity of Berliner's instruments. It is proven in this record that Berliner's instruments, under proper conditions and manipulation and when properly adjusted, are capable of transmitting speech. It may be said that it is highly probable, if instruments constructed by Berliner will transmit speech, that he succeeded in doing so. This argument was presented to the Supreme Court concerning the instruments of Reis, 126 U. S. 193. It was there argued that to admit that the Reis instrument will speak now, and at the same time to deny that, with all his efforts to that end, the inventor made it speak in his time, had only boldness to commend it; nevertheless, the Supreme Court rejected this argument, found that he had not, and said, "The question is not whether the apparatus devised by Reis to give effect to his theory can be made, with our present knowledge, to transmit speech; but whether Reis had in his time found out the way of using it successfully for that purpose." *Telephone Cases*, 126 U. S. 539; *United Telephone Co.* v. *Harrison*, 20 Eng. Rul. Cases, 601. It is curious that the Reis apparatus should be asserted both against Bell and Edison upon the testimony of experts as to its capacity. The present question is not as to the operativeness of the machine. It is a question of Berliner's knowledge; of discovery. The burden is upon the complainant, if it relies upon the present capacity of the instrument as proof of Berliner's knowledge; of his discovery and of mistake, to show, not its present capacity in the hands of experts, but its capacity under the exact conditions under which Berliner was working.

Expert experimentation has disclosed the fact that the ordinary Morse key, the Reis transmitter, French nails and Berliner's instrument can be made to transmit speech under proper conditions and manipulation, but we cannot accept this evidence upon the issue of mistake for it is not proved that the experiments were conducted under similar conditions. It is a familiar rule of law that experiments, to be of value as evidence on such an issue, must have been made under circumstances similar to those constituting the premises from which the original event is alleged to have been the conclusion. 12 Am. & Eng. Enc. of Law., 2d. Ed. Vol. 406; *Hawks* v. *Charlemont*, 110 Mass. 110; *Commonwealth* v. *Piper*, 120 Mass. 185; *Edit.* v. *Cutter*, 127 Mass. 522; *United Telephone Co.* v. *Harrison*, 20 Eng. Rul. Cases, 601.

The danger of this kind of evidence is apparent if we apply it to the double-pin instrument. Berliner was unable, according to his oral evidence as well as his statement in the application, to get speech with a double-pin instrument. Experts have succeeded in doing so, and Professor Wright testifies that, properly adjusted, the second pin "somewhat extends the range of voice intensity for which the instrument can be used;" but this does not disprove Berliner's testimony as to his failure with a double-pin instrument. In like manner, the success of experts with the single-pin instrument does not disprove the statement made by Berliner in his application.

The complainant, if it desired this evidence to be accepted as evidence of mistake or of Berliner's knowledge, should have proved and called to the Court's attention proof of the exact conditions existing at Berliner's experiments; it should then have proved that similar conditions were created in the experiments of experts, and that then the result accorded with Berliner's testimony. Anything short of this is not competent legal evidence to sustain the burden of proof as to mistake, though it might be were the issue merely as to operativeness. The question is not as to the capacity of the instrument, but of its actual performance at a certain time. Berliner's experiments in speech transmission with an instrument having an iron diaphragm were conducted hastily on the morning of April 11, before he went to the store. It is in evidence that he was accustomed to go to the store at half-past seven in the morning. For the first time he had coupled together two single-pin instruments; and this experiment was the first exhibition of his new receiver. He was embarrassed not only by the difficulties of adjusting his transmitter, but with the difficulties of adjusting for the first time his new receiver.

It is to be noticed that there is no evidence of results between April 14 and June 4, 1877. In determining the probability of successful results in speech transmission at this experiment, we should consider also the circumstances immediately preceding the filing of the caveat of April 14, which clearly show that it was based principally upon what he considered a new phenomenon. On the 8th of April occurred a dramatic and impressive incident, in consequence of which Berliner states, "I became much agitated." On the 8th of April, six days before filing the caveat, late in the evening, he had connected the instrument to the galvanometer, and was connecting two terminal wires for the purpose of closing the circuit.

> "It was exceedingly quiet about the house and on the street. In closing the circuit I suddenly heard a noise coming from the diaphragm, which surprised me very greatly. I thought I had mistaken my ears, but on repeatedly making and breaking the circuit, a distinct and sometimes loud tick came from the diaphragm and apparently from the point of contact between the diaphragm and the steel ball. That was entirely new to me, and I became much agitated, because I saw immediately that I had here a new acoustic phenomenon, viz.: that sound was produced without the aid of electrical magnetism, merely by the current itself. I quickly took the tuning-fork which I had in my possession; I wound one of the wire terminals around the shank of the tuning fork, struck the same on the table, and applied the vibrating prongs to the other terminals of the line. Immediately a loud musical sound corresponding in pitch to the sound of the tuning-fork came from the iron diaphragm. I knew at that moment that I had made an important addition to my observations, for I quickly perceived that if the diaphragm could give out a musical sound it could also reproduce speech when, instead of an interrupted current, an undulatory one was sent to affect it."

This was the first conception of his receiver—a new and distinct invention by which, using the language of his application of June 4, he could effect the object of producing by a common galvanic current "marked mechanical effects that will be distinctly demonstrated to the observer." Here, then, was a new invention; one not exhibited before, and which was first exhibited to others on the eleventh day of April. From that time he experimented only with his new receiver in connection with his transmitter.

It is in evidence that the adjustment of the transmitter and receiver is quite different.

In the experiments made by the experts it appears that the adjustments were delicate. It further appears that, for the successful transmission of speech, there is a very narrow range in the movements of the electrodes.

Professor Wright has testified that, "When transmitting speech, the electrodes of the microphonic transmitter are brought together with a pressure which is very light, and which has been determined by experiments to vary within a comparatively narrow range." The evidence shows clearly Berliner's readiness in applying for caveats upon hasty experimentation. His caveat of April 14, for the two instruments coupled together, was based upon a single experiment in which his attention was in all probability chiefly engaged in exhibiting the marked mechanical effects that he had discovered how to produce by his new receiver, and which seem to have been the chief incentive to the filing of the application of June 4. The evidence accords with the views of the defendants' counsel, that claims 1 and 2 of the original application were merely for a receiver.

The complainant contends that Berliner's invention did not reside in structure; that he reproduced substantially the old Reis apparatus, which can be operated either to break the current or to preserve it unbroken. His invention is said to be a new mode of operation. Proof that he reproduced the old apparatus does not prove that he discovered the practicability of a new mode of operation. He is not entitled as an inventor of apparatus to claim whatever may be found to be within its capacity, because his sole claim to invention is based upon an alleged discovery of a new capacity in old apparatus. If he did not discover this, nothing new remains that he did invent or discover. He did not "embody" an invention in a machine until he succeeded in making the machine perform Bell's process upon the current. He no more made the invention by making the machine than did Reis or Morse.

Upon the question of mistake and of the right to amend, we have, finally, Berliner's caveat of April 14, 1877. This document is the chief reliance of the complainant. It may be said that it is practically the complainant's case. It is presented as evidence of mistake in the application; the argument as to the right to amend is based chiefly upon it; it is also contended that it counts as a full reduction to practice. We have to consider two distinct contentions: first, that it is evidence that the application stated what Berliner did not intend to state—a question of mistake; second, that by writing this caveat Berliner had completed and reduced to practice the invention of a speech transmitter "even if he had not known that he could transmit speech, or even if he had believed that he could not." This remarkable contention raises a question as to the effect of erroneous opinion, rather than a question of mistake. If Berliner was an inventor of a single-pin speech transmitter in spite of his belief on June 4, 1877, to the contrary, this would not have prevented him from making the statement that his instrument could not transmit speech, nor would this aid the complainant in showing that he intended to apply for a constant-contact speech transmitter. An invention which the applicant had not intended to include could not be introduced by amendment upon a change of intention.

Is the caveat inconsistent with the statement in the application upon a comparison of the two documents? The earlier, from its nature, "does not purport to be an account of a result accomplished, but of a result expected and desired." Robinson on Patents, Section 448. The latter purports to be a description of a completed invention, the expression of the matured and final opinion of the inventor. This caveat proves that on April 14, 1877, Berliner intended to use the instrument of the patent to alternately weaken and strengthen the current. The patent in suit follows closely the language of this caveat, though it differs in essential particulars. We may assume that it proves intention, and a project existing on April 14, 1877. The existence of this intention on April 14 is some evidence of the existence of a like intention on June 4. As a matter of fact, however, the document is not conclusive upon the question of constant contact of electrodes. "It does not state that the transmission of the electric force is to be made through a closed circuit, although this . . . is really the principle on which a successful working invention depends." See *United Telephone Co. v. McLean,* 20 Eng. Rul. Cases, 587. Though it says that the current is to be strengthened and weakened, it does not expressly state that the current must not be broken, but says:

> "Part 6. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point or points of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation."

The document affords no evidence of the amount of experimental basis for this statement, or whether it was based largely upon theoretical considerations. It would be obvious, perhaps, that a broken contact could not produce with the same accuracy as an unbroken contact sound-waves impressed upon the diaphragm; though it would not be so obvious that the louder and more audible effects were useless for speech transmission, and must be rejected. Had Berliner succeeded in transmitting speech by a composite operation of weakenings and breaks, that method could have been found in the caveat, which refers to a tone "much louder, though not as distinct, in regard to articulation," produced by a broken current. In the brief filed before the Commissioner on appeal from the primary examiner's rejection, it was stated by Berliner's counsel in reference to this language that "Berliner knew that any break would injure articulation, though there might, he thought, be some breaks which would not absolutely destroy it." This interpretation by Berliner's former counsel is much fairer than that of Professor Cross—"The caveat also states that under strong sounds the transmitter would break the current; but that, in so far as it broke, it would be useless for the transmission of speech." This is unwarranted. The caveat, therefore, does not prove that Berliner had learned that the breaks of contact were inadmissible, produced no articulation, and must form no part of the intended operation, and that in speech transmission he must discard his most conspicuous receiver effects; but suggests a doubt upon this subject. This doubt apparently ripened into an erroneous opinion as the result of experiments which led to the caveat of May 9, and to the double-pin instrument of the application of June 4, 1877. Whatever was his intention or opinion on April 14, the document of that date does not displace the statement in the application of June 4. They are reconcilable on the view that the caveat was the expression of a project formed after hasty experiments which showed only a few variations of current; not Bell's speaking current.

But this document does not stand alone. It is merely one of several documents; and it is the general rule that later expressions are of greater force than earlier. We must consider, in connection with the caveat, not only the application, but the other caveats of April 30, 1877, for a circuit breaker, and of May 9, for a circuit breaker. Berliner's model filed June 4 was based upon this caveat of May 9; and the application for a speech transmitter follows this caveat. Previous to June 4, then, we have as evidence of Berliner's intention and affecting the question of mistake, three documents: the first, showing an intention to use a weakening and strengthening of the current, but suggesting a doubt as to a breaking of the current, the other two showing most conclusively that between April 14 and June 4 Berliner intended to utilize a broken current. He testified also that, immediately before the preparation of his caveat of May 9, he thought that he "had a phenomena which apparently was different from Mr. Bell's conception of what an interrupted current might do, namely, since he said that an interrupted current could only produce pitch, while I had here something more than pitch, something of the combination and quality of sound." It was, of course, desirable to use an interrupted current, if possible, and thus avoid Bell's patent. The preponderance of documentary proof, as to intention on June 4, would overcome the caveat of April 14, even if we should regard it as complete evidence of Berliner's intention on that date to preserve constant contact of electrodes. We have also, in addition to the evidence of Berliner's intention prior to June 4, proof of an intention similar to that expressed in the application existing long after that date. The amendment of Aug. 8 left the description of a composite operation of breaks and weakenings of the electrical current still remaining. The erasure, in connection with the fact that his attention had been called to the matter and that he did not change his statement, is evidence that Berliner, on Aug. 8, did not intend constant contact as his normal mode of operation.

In his oral testimony he states that he thought that he had discovered greater capacity in a broken current than Bell attributed to it. In September, 1877, he issued a circular or memorandum to his co-laborers in science, describing his single-pin instrument, saying, "Any vibration of sound striking one of the plates will either weaken or interrupt the point of contact, and thereby the current, and will thus cause the other plate to vibrate in unison with the first, reproducing the same sound." In his substitute specification, filed in the Patent Office Oct. 27, 1877, he claimed a circuit breaker; and in a subsequent patent, No. 199,141, written by himself and applied for Oct. 16, 1877, he stated, concerning his application of June 4, 1877: "The transmission was made by either breaking the contact or by alternately weakening and strengthening the same at each vibration of sound affecting the plate. The reproduction of sound was effected by permitting such a current thus consisting of electric waves to pass through a similar receiving instrument . . ."

The intention expressed in the application, therefore, existed long after Aug. 8. It is certainly more probable, also, that Berliner intended to follow the later caveat of May 9 than the earlier caveat of April 14, for the instrument of the caveat of May 9, and of the application, has all the capacity of the single-pin instrument as well as such additional capacity as results from the addition of the second pin. As evidence of Berliner's accomplishment, the caveat is of slight value. It proves what he was trying to do. It does not prove that he had by experiment secured such an adjustment of his apparatus as enabled him to secure results inconsistent with what is set forth in his application of June 4, 1877. Counsel urge that "even in the double-pin instrument (of the caveat of May 9, 1877) which did make and break, the dominating principle was after all, as far as possible, to keep the contact, and to keep it in such a way as to vary the pressure so that even if there is an intermediate break, yet it is a break which is intermediate only, and takes place, if at all, only between two variable pressure periods of transmission."

This is inconsistent with the complainants' brief, but if this be true, we have strong evidence that Berliner abandoned the intention of April 14. Berliner states in his application of June 4 what he could accomplish with the double-pin instrument: "I have thus succeeded in reproducing a great many special sounds, such as the vowels and others." If it be said that this refers to the make-and-break method, we may refer to his oral testimony: "I continued to experiment with this apparatus for a few days, but could not possibly get anything else but these three vowel sounds, and generally only two, and nothing at all of consonants."

This caveat was filed May 9. Prior to May 13 he had consulted a solicitor, and had a model made at his request which he took to his solicitor on May 13. This model embodied both his single-pin instrument and his double-pin instrument. A certified copy of this model will transmit speech in the hands of experts. Will it now be said that Berliner's failure with a double-pin instrument was because its dominating idea was to make and break? This is inconsistent with the views of counsel on final argument. The simple fact, according to all probability, is that Berliner spoke to his double-pin instrument, adjusted it the best he could in the light of all he knew as to the capacity of the single-pin instrument, and "thus succeeded in reproducing a great many special sounds, such as the vowels and others," which he attributed to the second pin.

With this apparatus he had got more than with his single-pin apparatus, probably for the reason that under expert handling, the best operation of the instrument is when the contact is so weak that breaks are likely to occur with great frequency, and render the instrument impracticable for commercial use. His first approximation to speech was when he attempted to break his current and make contact with the second pin. Berliner, therefore, after experiment, arrived at the conclusion that his single-pin instruments were incapable of transmitting speech. He formulated clear and definite reasons for this opinion. He stated these clearly to his solicitor, who expressed them clearly according to his instructions. He also told his solicitor all that he had accomplished with the double-pin instrument, a drawing was made showing this double-pin instrument, provided with a speaking tube and an ear tube, and the solicitor clearly stated all that Berliner had accomplished; this was his best result. The application of June 4 clearly represents his last opinion, and shows conclusively that he had produced no experimental results to the contrary.

Even had this caveat made the express statement, "I have succeeded in transmitting the quality of sound, and I think I have obtained some words," the sworn statement in his application would not be inconsistent with the caveat. It would simply prove the insignificance of his results. There is no difficulty nor improbability in the supposition that, after the full preparation of his caveat, Berliner still had to ask himself the question, "Will it work?" It is in accordance with all the probabilities, with the experience of Reis and of Edison, that he found that it would not.

The complainant next contends that whatever may have been Berliner's opinion as to the capacity of the instrument, and even if he thought he knew that the instrument would not transmit speech, he had yet made the invention of the patent in suit because the caveat is a complete reduction to practice. As we have already observed, this would still be insufficient; for, in order to amend, he must both have made the invention and have intended to apply for it. But, as the contention may be renewed, it may be well to consider it. The contention that the caveat of April 14, 1877, counts as a full reduction to practice, irrespective of experimental results, is equivalent to a claim that, had Berliner stated in writing simply, "Reis's instrument operated by the Bell method will transmit any and all sounds," this constituted a complete reduction to practice, even were Berliner ignorant of the truth of his statement. There is inconsistency between this contention and the claim that there was invention in operating the Berliner-Reis instrument by Bell's method. If it was obvious, upon a reading of Bell's patent, and upon learning the capacities of an undulatory current, that the Reis instrument could be so operated as to produce Bell's undulatory current, then there would have been no invention in using the old method with an old instrument. The Supreme Court in 126 U. S., page 545, said, concerning Van der Weyde:

> "It is only necessary to say that he copied Reis, and it was not until after Bell's success that he found out how to use a Reis instrument so as to make it transmit speech. Bell taught him what to do to accomplish that purpose."

This raises a doubt whether the mere discovery that the Berliner-Reis instrument could be operated by the Bell method constituted a patentable invention. The Supreme Court also said, "With the help of Bell's later discoveries in 1875, we know now why he (Reis) failed." "It was left for Bell to discover that the failure was due, not to workmanship, but to the principle which was adopted as the basis of what had to be done." The argument that the caveat is a full reduction to practice, irrespective of experimental results, is based upon the assumption that Berliner, as an inventor, must have realized that what he had written down was necessarily true. If so, patentability must be denied on the ground that the caveat was a simple following of Bell. Mr. Storrow argued (126 U. S. 288), as to the operativeness of the Reis apparatus:

> "If this were true it would only show the perfection and the novelty of Bell's new method or mode of operation, which, when applied, would enable that which never had been a speaking telephone, to at once transmit speech."

There is force in this argument. The complainant's case as to invention, however, is based upon the contrary assumption and upon proofs to the contrary.

Professor Cross says:

> "There was certainly no reason to justify a scientific man in asserting that, under the slight change of pressure due to the voice, the variations of resistance correspond to and are approximately proportional to the variations of pressure, and are great enough to yield practical results. This," he says, "was not wholly unknown, but what was known on the subject tended to show that the operation expressed by this law was an impossibility."

How can it be claimed, then, that, aside from experimental results, a mere statement in writing, which was upon its face a statement of something that could be known only empirically, is equivalent to complete invention? Professor Wright says:

> "There is another principle which is utilized in the case of any microphonic transmitter transmitting speech, and that is the proportionality between the variations in the current strength and the variations in the pressure at the point of contact produced by the vibrations of the air caused by articulate speech or other sound. So far as I am aware, this principle of proportionality was not known and had not been utilized for any practical purpose before the time of Berliner's invention described in his caveat."

The contention that the caveat establishes invention because in some cases invention may be established by drawings and verbal descriptions fails to recognize the distinction between inventions dependent upon familiar facts or familiar mechanical principles, and an experimental invention based on the discovery of new facts. A drawing or words may or may not prove completed invention, according to the subject-matter. If common persons guided by common knowledge, or experts, or scientific men, guided by scientific knowledge, can say, upon reading text or examining a drawing, "this will necessarily work, it accords with what is known," then there may be reduction to practice by a drawing or by a verbal description.

If, upon reading a document or studying a drawing, scientific men and experts would say, "all that is known tends to show that this is an impossibility, or there is nothing in common experience or in expert or scientific knowledge which justifies this statement without experiment,"—if it will not be believed without experimental verification,—there surely is not patentable invention in the writing down of the project. It is bare hypothesis. The contention is based upon a quotation from the *Telephone Cases*, 126 U. S. 536:

> "The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is, and if he points out some practicable way of putting it into operation."

As the Supreme Court held that Bell's description of a process of treating an electrical current was sufficient to sustain his patent, though Bell had not transmitted speech prior to the date of his application, the complainant seeks to place Berliner on a par with Bell as the inventor of an art or process, and thus to avoid by the caveat the effect of the denial in the application and the imperfection of the evidence as to experiments. But there is no analogy between Berliner's secret caveat of April 14, 1877, and Bell's specification.

Bell made a most remarkable primary invention, and described exactly a process based upon a scientific conception—"a mathematical conception." 126 U. S. 539. His patent was "not to be confined to the mere means he improvised to prove the reality of his conception." The Berliner caveat does not purport to describe and does not describe a new process of treating a current, but upon the most favorable construction merely apparatus for practising Bell's art,—novel not as structure, but as an old structure applied to a new use. A structure that had failed as a speech transmitter under the efforts of Reis, Edison and others. It states that the pressure between the plate and the metal ball can be regulated by a thumb screw, but the success of the apparatus is dependent upon the operator's finding out for himself the exact adjustment of each instrument. It is clearly shown by the evidence that to obtain the exact adjustment and conditions necessary for the transmitter is a matter requiring great care and skill, and that the adjustment that is essential for the transmitter is unsuitable for the receiver. If this caveat is now a direction sufficient to a person skilled in the art, Berliner was not so skilled,—but an uninformed experimenter. The caveat may be followed as far as its directions go without success. A feat of experts must be added to what is shown. Professor Cross says:

> "With every microphone there is a certain 'normal pressure' as it is called, which should exist between the electrodes when at rest, in order to secure good microphonic action. . . . It is a well-known fact that the electrodes of an ordinary microphone transmitter will not operate to transmit speech if they are closely clamped together."

Professor Wright says:

> "When transmitting speech, the electrodes of the microphonic transmitter are brought together with a pressure that is very slight, and which has been determined by experiment to vary within a comparatively narrow range." He says, also: "I have ascertained by numerous experiments made with a great variety of microphonic joints that with all combinations which are ever practically used in transmitting microphones, there is a certain interval between the smallest pressure and the largest pressure practicable, within which the changes in the intensity of the current are very closely approximate to the changes in the pressure which produce them."

We have already referred to the evidence of Professor Wright, "that the mechanical conditions under which each best performs its functions are also very different." The caveat discloses nothing of all this, it does not prove that Berliner had found out the "certain interval between the smallest pressure and largest pressure practicable" for his transmitter, nor the suitable adjustment for his receiver. It affords less evidence, even, than his oral testimony, and certainly cannot mean anything more. Therefore, when we find that his caveat was based upon a single experiment with the two instruments; that he afterwards made the double-pin instrument and applied for a patent upon it, and declared the uselessness of his caveat transmitter, it becomes necessary to conclude that Berliner, as a matter of fact, did not accomplish what he hoped to accomplish; that he stopped where Reis did. And, in the face of such a conclusion of fact, there is no artificial rule of law that makes Berliner's caveat description a reduction to practice. It is merely a part of the evidence, one of several documents all equally relevant. In *United Telephone Co.* v. *Harrison,* 20 Eng. Rul. Cases, 602, it was said:

> "How can we, dealing with a subject like electricity (a subject which at the present moment is so obscure that I am not sure that scientific men would pledge themselves now to the exact way in which the transmitter works), and going back six years into the twilight of the discovery, say that an instrument which presents no means of knowing what the best adjustment was, is the same instrument as that which does."

How can we say that Berliner's caveat, which shows substantially the Reis apparatus and does not show what experts say is essential to make it transmit speech, is the equivalent of a reduction to practice? The evidence of the experts as to the absolute necessity for a loose contact accurately adjusted seems to establish the insufficiency of Berliner's caveat to prove that he had discovered any of "the remarkable properties of a loose joint."

So far as efficiency and difference in electrical effects are concerned, the caveat is silent. Berliner's problem, after receiving from the Morse key a suggestion, and after finding by galvanometer tests that a variation of current could be produced, was still before him. He had no theoretical grounds whatsoever upon which he could state anything more than that some variation of the current might follow.

Upon the evidence of complainant's experts, it was a known fact that changing the firmness of contact of solid electrodes would change a current, and the problem was to find whether it could be changed in a sufficient and proportional amount by the vibration of a diaphragm. If Berliner did not by experiment discover this his pretensions are baseless. Berliner's invention, if he made one, lay in experiment. He was entitled to formulate an expression of what he had found out by his experiments. He was not entitled, either scientifically or legally, to lay a claim to anything more. It was necessary, before the forecast expressed in the caveat was entitled to be called a conception from which invention could date, that Berliner should have found not only that he could produce some variations of a current, that he could get something of the quality of speech,—but that he should have produced substantial effects that were a demonstration to the ear of the truth of his project. Edison had changed a current with a Reis instrument and produced audible effects in 1876; Edison's attempt to operate a Reis transmitter without breaking the current anticipates Berliner's conception, and he had demonstrated that a current could be changed. If this is all Berliner did, if this is all the caveat proves, he is anticipated by Edison's experiments with the Reis transmitter.

In Robinson on Patents, Sect. 381, referring to inventions which are the result of experiment, it is said:

> "The production of a new means by this method is . . . . an inventive act, but at no instant before the experiment succeeds can it be said that the conception of the invention exists in the inventor's mind. Until that instant, it is mere speculation, as a probable deduction from facts already known; and the same act which reduces it to practice gives to the conception its definite and final form."

This I believe to be sound. One who should read this caveat would find in it nothing self-evidently true or conformable to experience. He would be obliged to take the author's word for it as a statement of fact resting on authority. Counsel contend that the belief of Berliner that he could not transmit speech would make no difference. They say:

> "He had invented, described and pointed out a mode of operation, a method of varying resistance in the circuit by varying pressure, which necessarily does result in a capacity to transmit speech. It is not the mere fact that speech is transmitted, which is the thing that is claimed in this patent. It is the discovery and invention of a method of varying resistance in a circuit which is of supreme value, because, whether known to the inventor or not, it will transmit speech and all other sounds, and will necessarily mold a battery current as is necessary to mold it to transmit speech."

Here counsel are claiming for Berliner what Bell's patent claim 4 covers completely. The only method of varying resistance, whatever its kind, is Bell's—to vary it by and proportionately to the pressure exerted by sound waves. Berliner, of course, knew what Bell's undulatory current could do if he could produce it,—his problem was either to produce it or to approximate it by a composite operation of breaks and weakenings; but he did not know, merely because he could produce deflection of a galvanometer, or something of quality, that he could produce Bell's speaking current (see 126 U. S. 299, 302, 303) any more than Reis did. It is here contended, practically, that if Berliner found out that, by pressing together two electrodes, he could change a current, he was entitled to leap to the conclusion that he could produce any and all changes of a current; that he could vary it in the required proportions, and that upon this he became entitled to lay tribute upon all practical experimenters. But the patent law affords no protection to speculators nor to prophets. If the conclusions of fact are sound, and Berliner's caveat—as upon the evidence I am forced to believe—was merely a clever hypothesis reduced to text and drawings, no case could present a more forcible example than this of the necessity of drawing the line between the speculator and the inventor. A failure to draw this distinction, and the apparent failure in the Patent Office to give to the caveat of May 9 the same force as evidence as that of April 14, together with the acceptance of insufficient evidence of mistake, has led to the conversion of an abandoned scheme into a patent that has for ten years been asserted unjustly against the public right. Edison by countless experiments succeeded in advancing the art. Berliner's secret caveat would never have given the world a speech transmitter. It was embryonic, inchoate, and rested in speculation. Because of his application of June 4, 1877, the authorities that the complainant's brief quotes against Edison are applicable with full force to Berliner and his caveat when it is resurrected and asserted adversely to Edison.

"The law requires not conjecture, but certainty." *Coffin* v. *Ogden,* 18 Wall. 124.

As skill in language and in scientific method becomes more common, it is easier for speculators to survey and cover the field opened by new discoveries; it is easier to generalize as to what may be done, and to mark out the general lines upon which progress must be made, than to accomplish practical results. But the work of practical men should not be hampered by finding a new, useful and practical device covered by some patentee who was able to make generalizations applicable to all that might be developed within seventeen years from the date of a paper patent. It surely was not the intention of the Supreme Court to decide, and the Supreme Court did not decide, that he who guesses is an inventor if he writes down in a secret memorandum clever guesses or projects which are verified by others. If this is the correct interpretation of the decision, the speculator has only to make broad and expansive generalization, and await the issue of the necessary labors of practical experimenters. If their efforts fail, he has lost his paper and ink. If their efforts succeed, he may exact tribute from those whose efforts have led to practical results.

The complainant's attempt to base the case upon this caveat, irrespective of Berliner's experimental results, involves it in a curious situation. Professor Cross says, in effect, that what was known on the subject tended to show that what Berliner wrote in his caveat was an impossibility. Counsel say it was "an invention until it had been accomplished, of incredible character." It is said that the invention was based upon Berliner's discovery of the availability of solid electrodes to effectively vary the current in the required way. By writing the caveat regardless of what he knew experimentally, Berliner made an invention because what he wrote was true in fact, and therefore necessarily true at the time it was written down. Although on its face an apparent impossibility, Berliner must have realized that what he wrote was true, even if he did not make the experimental discovery. That even if at a later time he became convinced that what he wrote was an impossibility, as it appeared on its face to be, and stated in his application that it was an impossibility, he was an inventor because other persons have made the discovery that his later statement was untrue and that his first statement was true, and therefore he was entitled to amend his application by striking out the major part of it, and inserting large portions of his caveat. To make a case, even upon such an argument, it must go one step farther and say that he might amend even if, at the time of making the application, he had not intended to claim what was in his caveat.

The real question is not whether this caveat would have been good as an application for this patent, but whether, as a matter of fact, Berliner had made any discoveries that render it probable that his application stated what he did not intend to state, or that he intended to claim his single-pin instrument for speech transmission. As we have said, if there is an artificial rule of law that makes this caveat an invention, though Berliner did not know it, there is no artificial rule of law that attributes to him an intention to make an application for a speech transmitter when he was of the opinion that he had not invented one. Therefore, the contention that the caveat is a reduction to practice, if established, would be insufficient to support the complainant's case.

When Berliner filed his application, he left it open to others to discover that speech could be transmitted with a diaphragm and a metal pin. The expert who first succeeded in doing so is entitled to the credit of making that discovery despite Berliner's caveat. The case cannot, upon any view, be maintained without proof of experimental success. I am of the opinion that this proof is necessary in order to establish invention; but, if this is not so, I think that there can be no doubt that it is nevertheless still absolutely necessary in order to show that Berliner, on June 4, 1877, intended to make application for what is covered by the patent in suit.

Even after the mind has been conciliated by the course of argument adopted in the complainant's brief, and if a comparison of Berliner's original application and his patent is preceded by the detailed statement of all the circumstances favorable to Berliner, and the argument of experts upon his application, yet, after all this, the conscience is shocked when Berliner's application and his patent are compared; and a shock to the intelligence also occurs when we are told that the clear, specific and detailed statements of Berliner's application were mistakes of a solicitor's clerk, who was ignorant of the subject, and therefore must have got all his information from Berliner.

The patent, then, is invalid: First upon the ground that it issued for an invention which Berliner had not made at the time of the application; and, second, upon the distinct ground that it issued for an invention not disclosed by or claimed in the original application, and not incorporated into it by legal amendments.

The next question affecting the validity of the complainant's title is the defendant's point that the patent in suit is void because of Berliner's earlier patent No. 233,969, of Nov. 2, 1880. This is known as the Receiver Patent, and was issued upon a division of the original application. It contains a sufficient description of the transmitter to sustain a claim if Berliner were seeking it. Counsel for the complainant concede this. It is sufficient to consider claim 4.

> "Claim 4. A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with the other, either or both poles of each instrument being connected with a vibratory plate so that any vibration which is made at one contact is reproduced at the other, substantially as set forth."

This claim is for two single-pin instruments in a system. Each is a relative part designed for and only useful in a system. They are system parts or relative instruments. In the system, each performs its whole function, and alternately the functions are reversed. We find, therefore, in this claim, the transmitter performing its entire function of producing electrical undulations similar in form to sound-waves, and applied to its appropriate use in connection with a receiver. This claim embodies the transmitter completely. Its intended function is in no way modified by the fact that it is united with a particular receiver. It performs with this receiver the same function as with any other receiver. The complainant contends that this claim is for a combination which is an invention distinct from either the transmitter invention or the receiver invention. I am of the opinion that this contention is unsound. As the transmitter is a system part or relative part, it does not constitute a combination in the sense in which that term is used in patent law, to put the system part into a system for which it is designed; to put a relative instrument into its intended relation. This is but application to appropriate use. No third person would have been entitled to a patent for a combination by uniting two of these instruments. There is no invention over and above that which is in the transmitter and that which is in the receiver. A "transmitter" implies a receiver, a "receiver" a transmitter.

The fourth claim, nevertheless, is not invalid, because Berliner was the inventor, we may assume, of both; and he might take a patent with such limitation upon the use of either as he saw fit. He could not, however, take a patent for his transmitter limited to its appropriate use with a single receiver, and subsequently take out a patent that would enable him to control any and all uses of the transmitter, since the latter patent would include the former use, for which he had already received a patent. It is a valid claim, because, as we may assume for this argument, the elements were novel, and Berliner was the inventor of both. The claim confers a monopoly of the transmitter with a restriction or limitation. The patent in suit confers a monopoly without restriction. The patents are, nevertheless, both for the "same invention," both in a legal and a practical sense. It presents the familiar case of an inventor taking a patent with an unnecessary limitation. The commissioner has exhausted his power and cannot afterwards give him a general grant for all uses. The argument that the use of the transmitter or of the receiver alone would not infringe claim 4 is immaterial; it does not prove that the claim is for a third invention, but merely that the claim does not cover all the uses which might have been covered, had the patentee not chosen to take a claim for a restricted use.

That the two patents are not co-extensive does not affect the application of the rule against double patenting. The patent of 1880 gives Berliner full protection for his transmitter in a particular application to an appropriate use. It is said that in electrical apparatus the word "system" has just the same meaning as the word "combination" in purely mechanical apparatus. Berliner's 1880 specification does not, however, disclose any invention in the coupling of his instruments, but merely elements united without invention. In *Palmer* v. *Brown Mfg. Co.*, 84 Fed. Rep., page 454, it was held that a claim purporting to be for a combination was, in fact, simply for an application to an appropriate use of what was claimed in an earlier patent, without the development of the inventive faculty in making the application. Though the Circuit Court of Appeals disagreed with the Circuit Court upon the question of whether or not there was a true combination, and sustained the patent on the ground that there was a true combination, it said, "The test of identity afforded by a comparison of the claims of the two patents, however, is not conclusive. We must be satisfied further that there are substantial differences, not merely varying descriptions of one invention, or descriptions of a single invention in different applications to use." There was no disagreement with the views of the Circuit Court upon the legal proposition that, where the difference between two patents was that one was for a specific device and the other for a specific device applied to its appropriate and intended use, the patents were for the same invention. *Palmer* v. *Brown Mfg. Co.*, 92 Fed. Rep. 925. See also *Palmer Pneumatic Tire Co.* v. *Lozier*, 90 Fed. Rep. 732. That the claim also covers the instrument when performing its functions as a receiver is immaterial. The reference in the 1880 patent to the application for the patent in suit, if intended as a reservation, does not avail.

Miller v. *Eagle Mfg. Co.*, 151 U. S. 186, 192, 201.
Palmer Pneumatic Tire Co. v. *Lozier*, 90 Fed. Rep. 745.

Without considering other grounds based upon other claims of the 1880 patent, I am of the opinion that, by granting claim 4, the Commissioner exhausted the power to issue the patent in suit.

I agree with the conclusion of Judge Carpenter upon this point, in *United States* v. *American Bell Telephone Co.*, 65 Fed. Rep. 86, 87. On appeal and in the Supreme Court, this finding was not overruled as erroneous, but only as unauthorized on a bill by the Government for the cancellation of a patent.

We have next to consider the questions arising on the work of Edison. Berliner's amendment of Aug. 8, 1877, must bear the date of filing. The date of the application for the patent in suit was not earlier than Aug. 8, 1877. On this view, Edison's application of July 20, 1877, for patent No. 474,231, is so clearly an anticipation of all that is claimed for Berliner by the complainant that we need not dwell upon it. Professor Cross says of the apparatus described in this application:

> "I have no doubt, therefore, that the apparatus . . . was in fact, what it has universally been admitted to be, a microphone."

See also 126 U. S., p. 278. Professor Cross says, also:

> "But although the apparatus . . . was a microphone in fact, my belief is, that Mr. Edison at the date of his application . . . and indeed long subsequently to this, believed that the apparatus operated by variations of the mass resistance of the material employed in the points."

But this, of course, is entirely immaterial. Here is the place for the proper application of the rule: "An inventor is not called upon to state and explain the principles of nature involved in the operation of his invention." Robinson on Patents, Vol. 1, Sect. 82; p. 124, Note 3.

Disregard all Edison's explanations or notions as to the scientific reasons for the success of his invention,—its success still remains. Edison's application describes and claims the invention; and does not, like Berliner's application, contain evidence that the applicant had not made and did not intend to claim it. Edison's application of July 20, 1877, throws upon the complainant the burden of proving that Berliner had made the invention of the patent in suit before July 20, 1877. This burden cannot be sustained.

But, if we assume that Berliner did make an invention, and that his caveat of April 14, 1877, counts as a full reduction to practice, the complainant has still to meet the defence of the priority of Edison.

It is impossible in this opinion to consider all the contentions that arise on Edison's work, or all the relevant experiments, patents and apparatus. It is proven, however, that before the event in the telegraph office that suggested to Berliner the possibility of employing in telephony variable pressure or variable contact of solid electrodes, Edison had been engaged for a long time in experiments to find means to mould a battery current into undulations similar in form to sound-waves; that he always used a continuous current and the vibrations of a diaphragm to control the approach and recession of conducting surfaces in constant contact. With various devices he had succeeded in getting some degree of articulation. As early as 1876 he had experimented with a Reis transmitter, and obtained results which he describes as follows:

> "Q. Did you succeed in transmitting any words with it at that time?
>
> "Ans. I cannot say; we generally knew what was coming, and, knowing what was coming, even a Reis transmitter pure and simple transmits and reproduces sounds which sound almost like that which is being transmitted; but when it was attempted to transmit something which the receiver did not know, it was very seldom that any word was recognized."

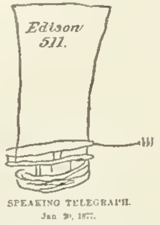
He rejected that as useless. By Jan. 20, 1877, he had thought of applying to the telephone the fact, discovered by him in 1873, that carbon placed in an electric circuit and subjected to varying pressure gave rise to remarkable variations of current. At this date he made an experiment which he says "was the first attempt to apply the property of carbon, of varying its resistance by pressure, which I discovered in 1873." This experiment was illustrated and explained by the following sketch and inscription:

> "Three platina points don't seem to work any better than one point; get it very good on a Western Union relay through my teeth, but I think that I

> could get it better if I had an adjustment to it, for Charley can't hold it steady enough."

Edison testified:

> "It consisted of a diaphragm and three platina points immersed in a dish containing loose carbon. The talking, though very poor in quality, was of a sufficient volume that it could be heard through the teeth when an ordinary Morse relay, the magnet of which was included in a circuit, was held against the teeth."



EDISON TRANSMITTER.

This preceded what counsel say was Berliner's date of conception, late in January, 1877.

It is clear, however, that Berliner's thought in the telegraph office was not a complete conception from which invention can date, but, as counsel say, "only an imagination of a possibility based upon analogy." He had merely found a line of investigation,—something worth looking into,—and conception was incomplete until experiment led to discovery. The conception could date only from such discovery. *Clark Thread Co.* v. *Willimantic Linen Co.*, 140 U. S. 481, 489; Robinson on Patents, § 381. Before this, even, Edison had made and recorded an experiment embodying the idea from which was developed the successful commercial telephone,—the use of a carbon electrode; and also, constant contact and variable pressure upon a solid.

The evidence of complainant's experts proves the importance of this experiment. In order to show that the defendant's carbon powder transmitter infringes, Professor Cross testifies that variations of current produced by varying pressure on a single contact and on a mass of powder were recognized by Du Moncel and Sir William Thomson as different examples of the same principle; and that "the mass of powder merely furnishes a large number of microphonic contacts." If Berliner is to be given a date of conception, "late in January, 1877," Edison surely, upon the same line of reasoning, must be given an earlier date. His conception was embodied in an experiment; and, following this, it appears that, during January, February and March, Edison and his assistants were busily engaged in taking advantage of the properties of carbon. This experiment, crude as it was, preceded Berliner's experiments to find whether pressure between a diaphragm and a metallic electrode would deflect a galvanometer. The importance of this experiment is that, if we adopt the complainant's view as to what constitutes a complete conception, we are obliged to give priority to Edison on this experiment alone, in the light of Professor Cross's testimony as to a mass of powder. By Feb. 9, 1877, Edison had succeeded in transmitting speech "commercially," as he says, by apparatus which we have already illustrated, and upon which was based his application of April 27, 1877, for patent No. 474,230. The complainant's brief says that "The question whether Edison or Berliner first made a variable-resistance transmitter with solid electrodes, in which the external resistance may be varied, as Bell's patent says, has never been presented to a court until now." That Edison did produce speech with solid electrodes before Berliner is clearly proven; and the invention described in his patent No. 474,230, applied for April 27, 1877, has as its true date Feb. 9, 1877. This was before the earliest date given by Berliner in his statement in interference, March 4, 1877, when, as he said, "a person heard sounds, but could not generally make out the words that I spoke," and concerning which the person testified that he heard no words.

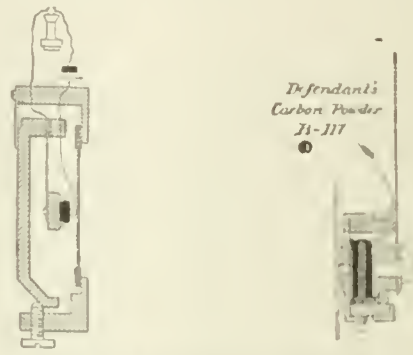
But upon no reasonable view of the testimony of Berliner himself can we give to him a date for the transmission of any words earlier than April 11 or 12, 1877—the second date given in the statement in interference." If Berliner made an invention his date is not earlier than April 11, 1877. Before this date and by April 3 or 4 Edison had successfully transmitted speech, with other apparatus already illustrated, consisting of a diaphragm and "five vertical springs, each provided with a sleeve carrying a cylinder or button of hard-pressed plumbago fastened to a bar of insulating material. All the plumbago buttons were in contact, and the one at the end rested against the diaphragm. The circuit was complete from the first spring through all the carbons to the last spring." The instrument transmitted ordinary speech perfectly.

The complainant's counsel admit that the apparatus of April 1, 1877, is a transmitter involving the conception that the extremely minute vibrations produced by the human voice could produce sufficient pressure of one electrode upon another to change the current, since they contend that it operates by compressing the mass of the second electrode.

Preceding Berliner's caveat and his earliest date are at least three operative constant-contact transmitters employing a battery current, using the sound-waves as the motive force, and producing electrical undulations of the kind described in Berliner's patent; two of them having solid electrodes, and all of them practising the variable-resistance method of Bell, and all causing the current to vary proportionally to the pressure exerted at the diaphragm, and also proportionally to the pressure exerted by one electrode upon another; strengthening and weakening the electrical contact according to the movements of a diaphragm, increasing it as pressure increases, decreasing it as pressure decreases; and all embodying what is said to have been Berliner's radically novel conception, e. e., that sound-waves could produce sufficient pressure between contact electrodes to produce an undulatory current.

Many difficulties in this case arise from the complainant's attempt to show that Berliner's patent embodies a conception that was a radical novelty, and a mode of operation that was novel and generic; and to frame a generalization broad enough to include the defendant's devices (by disregarding differences in structure that are so material and important as to render any comparison in respect to practical efficiency or commercial utility out of the question), and that also will escape anticipation by the devices of Edison. If Berliner's invention was in fact merely an invention of apparatus for practising Bell's method, and is to be considered merely as an improvement upon the apparatus of Bell and Edison, there is clearly no infringement

The defendants' "single contact transmitter" is substantially the well-known Blake transmitter, in which the contacts are of platinum and hard carbon, each supported on springs. This is described in Letters Patent to Blake, No. 250,128, dated November 29, 1881. The contacts are spring supported, so that they move with the diaphragm. The electrode of hard carbon shown in solid black in the drawing will demand particular attention. The second, or wall form, also employs carbon, powdered and enclosed in a cell, which cell is carried by a leaf spring. The cell is almost, but not quite, filled with granulated carbon, leaving room for motion and expansion of the particles of carbon Two conducting plates or carbon plates form the front and rear walls of the cell The movements of the diaphragm are communicated to the front wall of the cell, which presses more or less against the adjacent carbon particles, and likewise presses the numerous carbon particles within the cell into more or less intimate contact This is said by complainant's experts to be a "multiple contact" transmitter.



FORMS OF CARBON TRANSMITTER.

The use of carbon in a transmitter is beyond controversy the invention of Edison. Edison was the first to make apparatus in which carbon was used as one of the electrodes, and Berliner, in the course of proceedings in the Patent Office, disclaimed carbon as an electrode. Professor Cross testifies that "No metal contacts of which I know could compete with carbon for practical commercial use," and that "All commercial transmitters, as far as I know, have employed carbon as the material of at least one of the electrodes." The carbon transmitter displaced Bell's magneto transmitter; and, under several forms of construction, remains the only commercial instrument. A transmitter with metal electrodes was never in commercial use, the magneto instrument being a better instrument for the practical transmission of speech than a Berliner transmitter with metallic electrodes. The advance in the art was due to the carbon electrode of Edison. Edison's structure, then, is distinct from the structure of Reis or Berliner, and was patentable as apparatus, and was an invention of very great importance. The complainant is attempting to subordinate a great invention. It is contended, however, that Berliner's invention was generic, and that it both precedes and includes the carbon transmitter. To sustain this contention is essential to the complainant's case, for otherwise the disclaimer of carbon is fatal. Berliner's transmitter and the defendants' transmitters are classified by the complainant's experts under the name "microphone," a name which, so far as applied to telephonic apparatus in commercial use, signifies that one of the electrodes is of carbon. The term was applied by Hughes in 1878 to designate apparatus invented by him, having carbon contacts, and designed to render very feeble or inaudible sounds with such intensity that they would become audible. This apparatus rendered audible the tramp of a fly. Professor Brackett says: "In some loose sense, the term 'microphone' has come to be applied to any kind of a loose contact variable-pressure transmitter when employed for telephonic purposes. It is quite clear that such use of the term is not descriptively accurate." He refers also to confusion in discussions relating to telephony likely to arise from the use of this term.

As we have to consider whether or not apparatus with an electrode of carbon is similar in substantial respects and in mode of operation to one with electrodes of metal, and embodies the same invention, the constant use of the term "microphone" by the complainant as descriptive of Berliner's apparatus is somewhat confusing, since it involves a begging of the very question that we have before us; and assumes that Berliner's apparatus is substantially similar to that of Edison and of Hughes. It is apparent, however, that Berliner did not anticipate the remarkable discoveries which Hughes disclosed to the world in 1878, and that these discoveries of microphonic facts should not be read into the patent of Berliner. These discoveries were not due to a "conception" but to investigation by intelligent experiment. No preconception could have embraced what Hughes discovered experimentally. Moreover, the apparatus of Hughes did not include a vibrating diaphragm. Nor should we be misled by the complainant's statement that the instrument described and claimed in the patent "is the only instrument capable of successful use in the transmission of articulate speech by electricity over such distances and in such situations as those for which the telephone is most practically useful and has hitherto been chiefly used." This is true of transmitters with an electrode of carbon, but not of Berliner's instrument. It is true of the carbon "microphone transmitter," but not of the metallic "microphone." It does not follow, because there may be resemblances between the instruments of Berliner, Hughes and Edison, upon which, in the light of subsequent knowledge and disregarding questions of practical utility and substantial differences in structure as well as the history of the development of practically efficient apparatus, all, as well as the old Reis apparatus and the Morse key, may be classified ex post facto as "microphones," or because there may be scientific resemblances between them, that the instruments are to be regarded as substantially resembling each other in the practical sense of the patent law, which is governed by considerations of utility rather than by the classifications of science.

What, then, was Berliner's invention according to the complainant? "Berliner's inventions do not reside in the structure involved." This is one of the reiterated propositions of the complainant's brief and argument. It is said that Berliner, "using substantially the old Reis structure, produced a new mode of operation." It is this "mode of operation" which the complainant seeks to monopolize. Identity in respect to mode of operation is proposed as the test of infringement. The complainant's use of the term "mode of operation" requires most careful scrutiny. Counsel say that Berliner's invention may be phrased in many ways; that it may be called an instrument "characterized by its mode of operation," an art, or process, or method; and that these different expressions are essentially the same. The case of the complainant rests upon the proposition that Berliner invented a "mode of operation," or process, or art. It is necessary, however, to draw a careful distinction between the "mode of operation" or modus operandi of an instrument, and a process or mode of operating upon an electric current, and a way of operating a Reis machine in order to preserve constant contact of electrodes. What is Berliner's "mode of operation," art or process or method? The patent covers no new process to be practised upon an electric current. The process performed upon the current is Bell's and is disclaimed. Neither the caveat, application nor patent refers to any novelty in the treatment of the current. The patent covers no new method of varying resistance, disclaiming varying resistance by sound waves. We have seen the fallacy of contrasting Berliner's "mode of operation" with that of Reis, since by this means the Berliner patent is made to cover again a portion of Bell's field of invention. Berliner's mode of operation must be contrasted with that of Bell's liquid transmitter and of Edison's apparatus. I believe, however, that this fallacy is essential to the complainant's contention that Berliner invented more than a mere variation of apparatus, operating according to the general method invented by Bell and applied by Bell and Edison.

According to the complainant's evidence, when the electrodes of Berliner's instrument transmit speech there are two joint effects produced by the vibration of the diaphragm: 1. The varying pressure of the electrodes, one upon another. 2. The varying discontinuity of the joint: in other words, the weakening and strengthening of contact. Each of these effects is in turn abstracted and selected by the complainant as the cause or explanation of the variations of the current, and erroneously termed a process, art or method, and we find either two explanations or two modes of expressing the same thing: 1. The mode of operation by variable pressure. 2. The mode of operation by varying transition resistance, to wit, the resistance due to the discontinuity of a loose joint.

We will first consider the "mode of operation by variable pressure." The argument follows the language of the claims and specification. Counsel attribute to Berliner the following conception: "I have a solution. I am going to vary the battery current by varying the resistance of the circuit—how? By varying the pressure between the electrodes by the operation of sound vibrations." In other words, he says: "I propose, as a means of solving this problem that many men and many minds have been engaged in, the following solution. It is a simple one. It is a precise one. I will vary the pressure as such between the electrodes which form a part of the circuit. Your Honor will, I think, observe the precise and yet the satisfying character of that solution. It seems to me that it is neither too broad nor too narrow." The complainant's brief says:

> "Berliner's idea of using the extremely minute vibrations produced by the human voice to vary the pressure between contact electrodes, so as to produce an undulatory current, was radically and absolutely new."

Professor Cross states that the operation of the transmitter depends in part upon these facts: First, variation of contact pressure at the electrodes produces variation of electrical resistance; second, that under the slight changes of pressure due to the voice, the variations of resistance correspond to and are approximately proportional to the variations of pressure, and are great enough to yield practical results. The first fact, he states, was known but not utilized. The second, he says, was wholly unknown before Berliner. Counsel also describe Berliner's invention in the following language as "the discovery . . . of the availability of pressure, as such, between electrodes, when varied by sound-waves, to vary the electric current in the required way." All this is too abstract, indefinite and vague. It disregards essential conditions and does not escape anticipation by Edison. If this is a full expression of Berliner's conception or discovery, then it is clearly proven that it was an erroneous and inadequate conception. Unless by the words, "varying pressure" is meant varying contact, all this is proven to be erroneous by the complainant's own evidence. A turn of a screw disproves the variable-pressure "mode of operation." It is not true that when electrodes in contact are brought together with greater pressure the resistance proportionally decreases; and conversely, when the pressure is diminished the resistance proportionally increases. If the screw is tightened so that the electrodes are clamped closely together there will still occur changes of pressure "between" electrodes proportional to the pressure upon the diaphragm, but the current will not be affected as desired. Here we have the best example of pressure "as such," but the current does not change. It is only when the electrodes are placed in loose contact so that changes of contact occur, and so that the contact is loosened and tightened, that changes of pressure are accompanied by changes of current. Eliminate these changes of contact and the cause of the variation of the current disappears. The "law of variable-pressure" is unsound, practically, and logically is misleading. It gives a nominal pre-eminence to that condition which is present both when the instrument is operative and when it is not. It serves to divert attention from the essential condition—variation of contact—and from the general resemblance of Bell's, Edison's and Berliner's modes of operation. Counsel mean by "variable pressure" variable contact. Berliner's variable pressure is a species of variable contact, and variable contact produced by sound-waves is the invention of Bell, and was used by Edison before Berliner.

Professor Brackett says:

> "With the general statements of Professor Cross as to variations of pressure causing variations of resistance, I have no hesitation in agreeing if the intermediate results he kept in mind, or if need be carefully stated, otherwise not."

He says also:

> "I do not conceive that any special function is to be attributed to pressure merely as such, except in so far as it operates to produce a change in the amount of area in contact, or in the proximity of molecular areas which the electric current is to pass."

Professor Cross testifies:

> "If the instrument is described as working by variation of pressure, that itself is a description that the contact is constant. The instrument could not work by variation of pressure unless there was constant contact."

But the words "variation of pressure" must mean not only constant contact, but varying contact as well. The instrument cannot work unless the contact is both constant and variable. By its "mode of operation by variable pressure" the complainant seeks to cover all transmitters operating upon a battery current by constant but variable contact of solid electrodes, "solid" being the only limitation it contends for as implied in the word "pressure." Is the complainant entitled to hold these defendants as infringers because their transmitters operate by varying pressure or varying contact of solid electrodes, or because Berliner first discovered that the minute vibrations of a diaphragm could produce sufficient changes in the contact of solid electrodes to transmit speech, or because he was the first to invent apparatus embodying the conception that sufficient pressure could be produced between electrodes to vary the current in the required way, or in which the pressure was intentionally weakened in order to cut down the current? Edison's apparatus of February 9, 1877, and April 1, 1877, anticipates all this, and shows that Edison before Berliner had discovered "that a force so feeble as that of a sound wave" could so vary the pressure between electrodes in constant contact as to produce the electrical undulations required for the transmission of speech. If the variable-pressure operation can be saved from anticipation by Bell through a distinction between a solid and a liquid electrode it cannot thus be saved from anticipation by Edison. The variable-pressure mode of operation limited to solid electrodes is anticipated by Edison, and the claims limited to solid electrodes are also anticipated.

So long as the complainant's counsel persist in pointing out as Berliner's novelty a single aspect of what occurs in the operation of his transmitter, and which occurs in all constant-contact transmitters, to wit, "variable pressure between electrodes" and insist that this is the ground for comparison in determining whether other devices infringe; so long as counsel insist that they need give no further description of the necessary apparatus than "electrodes in constant contact" or "solid electrodes in constant contact," or such vague description of apparatus as may be implied in emphasizing the words "pressure as such,"—so long must they submit to anticipation and to the destruction of their argument by each device that comes within the natural meaning of the broad, general terms whereby they seek to include the defendant's transmitters as infringements. The complainant cannot identify the defendants' transmitters with the defendants through so broad a generalization as "variable pressure between electrodes" or "variable pressure between solid electrodes," for, in making these generalizations so broad as to encompass the defendants, they at the same time so broaden the field of anticipation that they include prior devices of Edison.

Edison's application of April 27, which goes back to February 9, 1877, showed a diaphragm of sheet metal, in front of which was a plate or disk of suitable material having a conducting surface. He says, "I found that a disk of hard rubber coated with plumbago answers well, but a disk or some conducting metal or substance may be employed." He describes the adjustment and operation. There are two alternative adjustments, by one of which the circuit wires are contacted at opposite sides of the disk, when the apparatus is not within the terms of Berliner's patent. Another adjustment shown, however, is one wire connected to a disk and the other to a diaphragm. This is the arrangement shown in the drawing previously shown in this opinion, and dated February 9, 1877. "The disk or plate is accurately adjusted to the proper proximity to the surface of the diaphragm so that in a state of rest there will be little or no current passing from the battery upon the line; but the vibrations that are received by the diaphragm from the voice cause the electric energy on the line to increase and decrease according to the *intimacy of contact* between the vibrating diaphragm and the surface of the adjacent disk, for if the electric conductors are connected to the diaphragm and disk respectively, the current that passes will be pulsated and raised by the intimacy of contact of the surfaces or the variable resistance where the conductors are in contact with the surface of plumbago or other poor conductor of electricity." Here the resistance of the circuit is varied: by diminishing and increasing the surface of contact, by varying the path of the current outside of the area of contact, and also by varying the intimacy of contact of the electrodes. Edison testifies to this. There can be no doubt that the inertia and solidity of the second electrode assists in bringing the electrodes into more intimate contact, exactly as in Berliner's apparatus. This is anticipation as to variable pressure. Here, also, is an example of apparatus "in which the pressure is intentionally weakened in order to weaken the current," which Professor Cross says was unknown at the date of Berliner's caveat of April 14, 1877.

The patent statutes require the patentee himself to claim and define his invention so that the public may know its rights, and so that there shall not be imposed upon the courts the burden of constructing upon a hearing new claims from the interpretations that experts may place upon language of the most general and sweeping character. It is for this reason that I am of the opinion, as before stated, that the claims of this patent should be held invalid, upon the concessions of the complainant. The court should not be compelled to attempt such an impossible task as that of finding out what kind of a contact is implied in the use of the word "pressure," when all substances are capable of sustaining pressure, and when anything which can be an electrode can undergo a variable-pressure operation. Nor should the court be required to solve such problems as What kind of material is it upon which pressure "as such," can be developed? and whether the pressure upon an electrode of hard pressed plumbago is pressure "as such;" or, what is the distinction between pressure of electrodes upon each other and pressure "between" electrodes. We have here in the solid electrodes of Edison the kind of pressure called for by the Berliner patent, and the exact method of operation called for by the Berliner patent, to wit, "By making the plate vibrate, the pressure at the point of contact becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly;" and if the complainant's case is to stand upon abstractions which disregard essential features of the structure involved, it is very clear that the defendants have completely met the complainant's case. Claim 1 and claim 2, the *prima facie* case, and the "variable pressure" arguments, are rendered invalid by the work of Edison as exhibited in his apparatus of February 9 and April 1, 1877.

To avoid anticipation by the devices of Edison, the complainant has been obliged to abandon, practically, its variable-pressure theory; and, it seems to me, has recognized its vagueness and insufficiency and the necessity for giving a more specific description of apparatus than solid electrodes in constant contact, by developing a second theory.

We have next to consider a second generalization—the "mode of operation by varying transition resistance." Upon this the complainant seeks to identify the defendants' transmitters with that of Berliner and to avoid anticipation by Edison, and also to avoid a concession that Berliner's invention was merely an invention of apparatus. The attention is now directed to the second of the joint effects following the movement of the diaphragm, to wit, the variation of discontinuity; the weakening and strengthening of the contact.

The language of the Government Bill is quoted with approval, and is adopted by the complainant:

> "The principle upon which such an apparatus operates is as follows: The discontinuity of conducting material at the point of contact between the electrodes creates a resistance to the flow of current, which resistance is increased by lightness or weakness of pressure between the electrodes, and decreased by closeness or force of such pressure. By increase of resistance in this manner the electric current flowing in the circuit is weakened, and by decrease of such resistance it is strengthened."

Professor Cross on rebuttal states the theory of transition resistance in the following language:

> "When two electrodes are in contact, and a current passes from one to the other, there is a certain resistance to the passage of the current offered at the joint which is constituted by the surface of contact of the two electrodes. It is a resistance of a different character from that of the body of the electrodes themselves, and is independent in its magnitude of the resistance of the material of the electrodes. Its precise cause is not known; but it occurs only when the current passes across such a joint as I have referred to. This resistance is varied enormously by variations in pressure, and practically disappears when the pressure is other than slight or moderate From the fact that this resistance manifests itself in the passage of the current from one electrode to the other, and that the phenomena relating to it are manifested only at the joining surface of the two electrodes when the current is in transit, as it were, from one to the other, it is very appropriately called 'transition resistance.'
>
> Variation in transition resistance is the basis of the action of the microphone. It . . . is caused to vary by properly varying the pressure between the two electrodes in contact. That is the only mode of operating a telephone transmitter by varying transition resistance which has ever been utilized, or which, so far as has ever been shown, is experimentally practicable."

It is necessary in this case to be carefully upon our guard against confusion by verbal differences. When we wish to say that a contact changes so as to afford a greater or lesser facility to the passage of the current, we may use a different but equivalent expression and say that the resistance changes. This introduces a verbal novelty, but no real difference. The circuit is continuous when the contact is so close that, so far as the phenomena of the current are concerned, the joint behaves as if the electrodes were unbroken, and is discontinuous when less than the full amount of current passes.

Transition resistance "is always dependent upon the presence of a break or joint whereby physical continuity of the contact is interrupted to some extent," as is stated by Professor Cross. This, of course, is merely descriptive of apparatus. The extent to which this break is lessened or increased determines the action of the current. But this general language of Professor Cross's descriptive of transition resistance is applicable to the Edison apparatus of February 9, 1877. Edison's patent, applied for April 27, 1877, contains a very much better description of "transition resistance" than does the Berliner patent. We have already quoted an extract from Edison's patent that shows a resistance to the current which results from an initial adjustment of electrodes "so that in a state of rest there will be little or no current passing." Here is "loose contact" and transition resistance between solid electrodes as defined by Professor Cross. As pressure increases the initial transition resistance existing in the apparatus in a state of rest and due to discontinuity of the joint is decreased. Edison has shown a much clearer conception of the resistance due to a break or joint or loose contact than Berliner discloses in those parts of his application which were not affected by any alleged mistake of his solicitor. Berliner gives no directions that the initial current shall be less than is able to pass with full contact; the only transition resistance that he contemplates, apparently, is that put in by the vibration of the diaphragm. His transition resistance consists in weakenings of the initial contact. This was the conception shown in that part of the application which relates to weakening the current. His caveat, claim 4, described the operation of the transmitter, "vibrating the plate and diminishing the amount of electricity passing as many times and as much as the vibrations will loosen the pressure of contact." The application discloses no conception of an initial resistance that can be diminished. Counsel have quoted scientific authority for the statement "that the gist of the invention (of the microphone) seems to lie in obtaining and perfecting that which electricians have hitherto most scrupulously avoided, namely, loose contact." This of course relates to apparatus.

In fact, the evidence of experts upon the subject of transition resistance and as to the absolute necessity for a loose joint properly adjusted comes very nearly to the point of proving the insufficiency of the specification of the patent in suit. But varying transition resistance is merely varying contact. The resistance is caused by the discontinuity of conducting material or by the joint, which must be loose. To change the resistance we must change its cause—change the discontinuity; to change the discontinuity is to change the continuity, that is, to change the contact. This follows from a mere interpretation of language. The experts for the defendants prove that in all transmitters the variation of current depends upon variation of contact. Professor Anthony says: "There is no other cause of variation of the contact resistance, except variation in the area of contact or variation in the proximity or what I have called the intimacy of contact, between the particles."

Professor Cross does not deny the evidence of the defendants' experts but says: "I believe that it (the change in resistance) does depend upon the proximity of the electrodes, and so upon the proximity of the particles of these. I know of no evidence to show that it depends upon the area of the electrodes in contact. I don't know anything about the number of particles of contact, and I don't believe that anyone does. Very likely variation in the transition resistance may depend upon this, it being, as I have said before, a plausible hypothesis, though an entirely unproved one." But for the purposes of this case we are obliged to hold that the defendants have shown by a preponderance of evidence that varying transition resistance does depend upon changes in area and intimacy of contact. Upon his whole evidence Professor Cross practically concedes it. Professor Cross was asked:

> "*X-Q.* In the case of two solid bodies constituting a loose joint in an electric circuit, is it your opinion that varying pressure between them does not vary the area and intimacy of contact of the two electrodes?
>
> *Ans.* It is not my opinion. I believe that it does.
>
> *X-Q.* Is it your opinion that such variation in intimacy and area of contact of such electrodes does not cause variations of resistance?
>
> *Ans.* I believe that variation of intimacy of contact, by which I mean merely the change which takes place when the electrodes are subjected to pressure, whose character I do not pretend to determine, does produce a variation in

> resistance. Whether variation in area of contact produces a sensible change or not in an ordinary microphone, I cannot say. Of course, theoretically, any change in the area of contact would be expected to produce some change in the resistance, but whether this is present to any material extent in the ordinary action of the microphone I cannot say."

Professor Cross finally says: "The actual cause of the existence and of the law of variation of the transition resistance has never been certainly proved."

Complainant's counsel and experts attempt to distinguish the prior apparatus of Edison having solid electrodes, by saying that it was Edison's intention to vary the density of the plumbago by mass compression, and to vary the area of contact as distinguished from the intimacy of contact. But no sound legal distinction can be based upon an assumed or expressed intention of Edison. The distinction must be made as to actual apparatus, and its actual manner of changing the current. Robinson on Patents, Vol. 1, Section 82; *Eames v. Andrews*, 122 U. S. 40, 55.

When counsel, upon the supplemental brief, say that Berliner's method is different from that of *merely* changing the surface area of contact, and from that of *merely* changing the molecular condition of one part of the circuit, they assume without sufficient warrant that Edison's apparatus did in fact so operate. They are "guessing at what occurs between the electrodes" of Edison. Both sides agree that this should not be done. Edison, before Berliner, was applying to the telephone the fact that when carbon was pressed a remarkable variation of current followed. If he did say he had discovered that plumbago had the property of changing its resistance under pressure, it does not follow that he thought that all the changes took place in the interior of the second electrode. If he thought that the instrument operated in any part by changes in the conductivity of the material of the circuit he had also conceived of cutting down the current by weakening the pressure so that a small amount of current would pass on the initial adjustment, and a greater would pass as the pressure became greater, and the contact more intimate. But more than this, he had made the instrument and described the mode of operation of the Berliner patent.

His evidence is that he employed varying "intimacy of contact" to vary the current; and his patent, applied for April 27, 1877, says so. But the complainant's experts do not avoid anticipation by Edison by limiting Berliner to transition resistance: for Professor Cross says of Edison's apparatus of the application of April 27, 1877:

> "If, however, the transmitter was purposely adjusted under very light pressure, so as to operate as a microphone, which of course it can be used to do, with our present knowledge, though ineffectively, the test circuit gave evidence of microphonic action."

But Edison describes an adjustment under very light initial pressure both in his application and in his sketch of Feb. 9, 1877. Another distinction upon which the complainant seeks to avoid anticipation by Edison is the evidence of Professor Wright that there is no sensible microphonic action in the apparatus of the patent No. 474,230, of April 27, 1877; and of Professor Cross, that with that instrument so adjusted "as best to secure the cutting in and out of resistance, ... no material microphonic action need be present; and, so far as I can ascertain from careful experiment, no microphonic action is sensibly present in its operation." It is here conceded that speech can be produced by solid electrodes without microphonic action. But absence of "microphonic effect" would not save a defendant from infringing the patent in suit, and does not prevent anticipation.

The patent is not limited to electric undulations that manifest microphonic action. If affords no basis for any discrimination in respect to quality of electrical undulations.

Neither the specification nor the course of evidence in this case will permit the patent to rest upon differences that an expert ear may detect betwen undulations similar in form to sound-waves. Upon Berliner's own evidence, it is apparent that he had not reached the point of discriminating between the quality or efficiency of tones produced. There is no evidence that such microphonic effect as may be produced by Berliner's metallic electrodes is of the slightest practical importance upon a comparison of his apparatus with the prior apparatus of Edison, or that it made any advance over the magneto instrument. Berliner was not the discoverer of any improved effects demonstrated to his ear. But this distinction is of little practical importance for the further reason that "transition resistance," localized at the contact of electrodes, and microphonic action, were in the Bell mercury—plumbago transmitter.

Professor Cross says:

> "If we immerse the plumbago more deeply, and exclude the immersion varying operation in this way, it is possible to transmit speech microphonically. That this is the case is shown not merely on theoretical grounds, but also by the peculiar harsh, scratchy character which characterizes a poor microphone . . . with a wire just touching the mercury surface, and particularly if the formation of a meniscus can be avoided, it is possible to transmit speech apparently by microphonic action. In this case the peculiar characteristic sounds of a poor microphone are evident." He says, "When plumbago is used with mercury, it is difficult to exclude the presence of microphonic action to a certain extent."

Professor Dunbar, defendant's expert, made experiments to show that the operativeness of the Bell mercury transmitter is not altogether dependent upon the amount of immersion of the wire, using as one electrode a conducting wire with the surface insulated except at the extreme point. He says:

> "With the platinum wire insulated on its sides and presenting a conducting surface only at its submerged end, and using mercury for the liquid, speech was obtained of good articulation, although fainter than when the sides were left uninsulated."

I am of the opinion that the defendants have proven that Edison is a prior inventor of the invention of the Berliner patent, even if we assume that it bears date June 4, 1877, and rests upon the caveat of April 14, 1877; and that Edison anticipated Berliner in the construction of apparatus having constant contact, variable pressure, and varying transition resistance. But it is not at all necessary for the defendants to prove that Edison was a prior inventor. The case might well be disposed of on one short ground, to wit, the variable resistance of Edison's apparatus is an invention distinct from the variable-resistance of Berliner's apparatus, and the method of operating upon each kind of resistance is Bell's. The carbon transmitter used by the defendants is the invention of Edison, and an invention substantially distinct from that disclosed in the Berliner patent; and whether it preceded or followed Berliner's caveat or application is immaterial. The thought that the Reis apparatus might be made to perform Bell's process upon a current cannot be regarded either as a conception that was radically novel, or as an intellectual solution of the practical problem of speech transmission. According to the view of the Supreme Court, Bell taught Van der Weyde what to do in order to use a Reis instrument so as to make it transmit speech. 126 U. S. 545, 544, 542. Edison, in 1876, had this thought, but its practical inadequacy is shown by the fact that so skilled an experimenter found the Reis transmitter useless without alteration; though he was able to change the current and produce audible effects. If it has since been found that the Reis transmitter can transmit speech; if it has been discovered that such minute changes of contact as can be produced between metallic electrodes are sufficient, it is this discovery, and not the thought of making and experimenting with apparatus that is substantially the Reis apparatus, which is the substance of the invention of the Berliner patent.

The discovery of what can be accomplished with metallic electrodes is not the discovery that is utilized in the carbon speech transmitter. Edison solved the problem in another way. He says:

> "I sought to devise a transmitter, or rather, an addition to the Reis telephone, which allowed me to talk low or to talk strongly, and have the same reproduced low or strongly. I felt certain that when this was accomplished speech could be transmitted and reproduced."

He found that carbon placed between the electrodes of the Reis transmitter makes it a very good transmitter. He thus dispensed with the necessity of employing such changes of contact as are used in the Berliner transmitter, and solved the problem by constructing new apparatus. Professor Brackett says:

> "The introduction of carbon as one of the electrodes at once resulted in a variable-resistance transmitter which was of practical use, as is universally conceded. The reason for this result, I believe, may be found in those peculiar properties of carbon which distinguish it from other solid conducting bodies, some of which I may specify. While it is classed among the conductors, it offers greater resistance, other things being equal, than do most of the solid metals. It presents a surface which unlike the surfaces of metals, is characterized by what may be perhaps termed 'fluffiness,' by which I mean its surface presents great numbers of irregularities, so that portions of it rise above other portions, and so present innumerable prominences or elevations fitting it to readily yield to pressure applied by other solids brought in contact with it, so as to produce very great variations in what I will call the molecular area, as contradistinguished from visible area. I mean, of course, that greater variations of the numbers of molecules confronting an opposing body, which is acting upon it by variable pressure, will be produced than would be produced under like circumstances in the case of a solid metal. This property alone would mark it as especially suitable for use in a loose-contact variable-pressure transmitter. Also, the oxidation products which are liable to be formed on the passage of a current, are a gaseous character, and so will be at once removed from the surface by diffusion, thereby leaving the surface practically unchanged in character; and again, when a current of electricity passes a carbon conductor, the heat thereby produced diminishes its resistance, and so allows the current to pass more freely. These three circumstances severally and jointly tend to produce a very considerable variation of resistance to the passage of a current, and thereby make the range of action, when small differences of pressure are applied, correspondingly considerable. Possibly and likely other properties of carbon which are not well understood may conspire to produce the result in question."

Professor Wright says:

> "I have spoken of the large range of carbon. By this I mean that the pressure upon the joints of the electrode may be varied within comparatively wide limits before the vibrations in the current which are produced by the pressure cease to be such as can be practically employed, in the transmission of speech. This has an important practical advantage in the fact that the adjustment of the instrument is much more easily obtained by simple mechanical arrangements than in the case of metal where this range is small.

Edison discovered that carbon alone possessed the necessary range of contact to make a practical variable-pressure transmitter. The peculiar characteristics of carbon have given carbon transmitters the entire commercial field. Edison found that the practical way of turning the Reis transmitter into a speech transmitter was not to invent a mode of operation new over Bell, but to invent the carbon electrode.

It is proved that the Bell magneto instrument is superior for practical purposes to Berliner's instruments with metallic electrodes, while the carbon transmitters are superior to the magneto instrument. The carbon transmitter could never have been found in the Berliner patent. It is not the fact that the commercial telephone was developed from a new conception disclosed to the world by the Berliner patent or caveat. Berliner's experiments and Berliner's patent conferred no knowledge as to carbon. It is not disputed that Edison's invention was developed by him independently; and it is also contended by the complainant that his invention was perfected without the conception which is said to constitute Berliner's novelty. Upon the complainant's contention, the conception of transition resistance was one that was not essential to the development of a microphone transmitter. An immense amount of painstaking and highly ingenious experiment preceded Edison's successful result. The discovery of the availability of carbon was unquestionably invention: and it resulted in the "first practical success in the art." The difference between carbon and metal is a difference that has made the advance in the art.

The actual uselessness of the Berliner transmitter, the limited character of the disclosures in the Berliner specification and of the experiments and discoveries of Berliner, and the independence of Edison's invention, prevent us from treating this patent as a document which disclosed to the world an idea from which resulted a practical success. It is conceded that the Edison transmitter as apparatus is a very important invention. All the encomiums bestowed upon Berliner are based upon what has been accomplished by Edison's carbon transmitters. It is contrary to common sense, and contrary to the spirit of the patent laws, that the work of Edison should, by virtue of after-acquired knowledge of skilled experts and by virtue of their use of the discoveries of Edison himself, be subordinated to the claims of Berliner's patent.

I think that the defendants have established the proposition stated under the fourth defence: "If Berliner had never experimented in telephony, that art in June, 1877, would have been precisely the same; and that art to-day would be precisely where it is," as the result of the work of Edison. If the Berliner patent, or the Berliner apparatus, is to be treated as a practical embodiment or disclosure of a discovery, what is this discovery? That a variation of pressure like that which was adequate in the case of liquid transmitters to produce the variation of resistance was also adequate to produce a variation of resistance between solid metallic electrodes; or that such minute changes of pressure or contact as could be produced with metallic electrodes would cause Bell's process to be practised upon the current. The patent, on its face, shows that Berliner claimed no novelty in the process performed upon the current, nor in the mode of operating upon the resistance of the circuit; that he disclaimed what counsel now claim for him—a new mode of operation. The discoveries of Berliner were so limited that upon summing up counsel for the complainant say:

> "We have, then, as the result of the proofs on the part of Mr. Berliner, that he not only had an inventive conception, but that he constructed a series of instruments to embody it, and that those instruments did transmit the quality of sound, and when tested at the present time demonstrate their own effectiveness to transmit speech."

The conception, however, when reduced to definite form, resulted in apparatus that was substantially the Reis apparatus. The fact that Berliner himself constructed this apparatus is of no consequence in determining the character or scope of the conception. This amounted to no more than a thought that old apparatus might be operated by Bell's method. The discovery was that the quality of sound could be transmitted, and that he "now and then thought he could make out the words of familiar sentences, but it was exceedingly faint." According to Berliner's own testimony, this was the limit of his discovery. These are the only microphonic facts that he discovered. The microphone was not the result of a conception, but of a discovery of facts. Berliner did not discover, nor did he state the principle of the microphone; for, according to the evidence of the complainant, this principle is unknown, and according to the evidence of the defendants it is Bell's principle of variable contact produced by the pressure of sound waves. The discovery that any new or improved effect upon the current would result was not made by Berliner. As a discoverer of microphonic facts, he made no practical advance upon Reis (126 U. S. 540, 541); and added little or nothing to what Edison had learned as to the capacity of the Reis apparatus. As a "conceiver," he conceived only what Edison had conceived and tried with similar results before him. Berliner did not conceive that solid electrodes would produce an effect such as was afterwards distinguished as a microphonic effect, and he did not discover any difference from the magneto transmitter in the effects on the current.

Edison, by independent investigation, made discoveries of very great importance as to the effects produced with different materials in different adjustments, and made over the Reis transmitter into a practical speech transmitter. The subsequent or previous discovery that the old Reis transmitter could be made to perform the operation may be of scientific interest, but upon no principle of common sense can it be made to control and anticipate the solution of the practical problem by Edison's different experimental method.

The utmost that Berliner can be entitled to is apparatus substantially like that disclosed in his patent, when used for the transmission of speech. So hopeless is the complainant's case, if Berliner's invention is to be considered merely an invention of apparatus for practising Bell's method, that the complainant persistently ignores all comparisons of Edison's and Berliner's transmitters in respect to practical utility, and insists that the test of infringement is comparison as to a method or process involved in the apparatus. It is clearly shown by the defendants that the Berliner patent does not disclose, and that Berliner did not invent, a new art or process.

Upon what is the Berliner process or art practised? Not upon the current; not upon the resistance of the circuit; for this is all disclaimed and is Bell's. Leaving out manufactures and compositions of matter, the patent law provides no middle ground between patents for an art and for a machine. Berliner's invention of a "new mode of operation" seems to be neither an art nor a machine, but an abstraction which may be described, in the language of Chief Justice Fuller, as "a disembodied shape in an intermediate state of ambiguous existence." See *Westinghouse* v. *Boyden Power Broke Co.*, 170 U. S. 555, 556. Having first in the patent and in the *prima facie* case claimed broadly the method of Bell's patent when practised between opposing electrodes, and every form of constant-contact transmitter that it is possible to make, the complainant seeks to save its broad generalization by excepting from it various kinds of apparatus that come within its terms; but, after all these exceptions are made, the complainant's claims still have a scope to which they are not entitled. The generalization can be corrected only by the admission that the method of operation is Bell's method, and that it does not constitute a new method to construct a new kind of circuit or to make a new kind of variable resistance.

As a matter of fact, the complainant's case on rebuttal shows a substantial departure from the contention that Berliner did invent a new art, process or method, and actually rests upon the proposition that the Berliner patent is to be construed as claiming and covering all telephonic apparatus having transition resistance. The new distinction introduced by the expert evidence as to transition resistance is an implied limitation as to apparatus. First claiming broadly all electrodes; then, by arbitrary exception not found in the terms of the claims, limiting itself to solids to avoid Bell's liquid transmitter; it now limits the apparatus to electrodes having transition resistance in order to avoid Edison's solid electrodes. We should remember that the fundamental proposition of the complainant, upon which learned and astute counsel have deliberately based this very important case, is that Berliner's invention does not reside in the structure involved,—"not in mere parts of metal or other conducting material so placed in an electric circuit as to serve as electrodes, but in a mode of operation whereby the sound-waves, by varying the pressure between these electrodes, vary the contact or joint between them." Transition resistance, however, does reside in the structure involved; and it is perfectly manifest that, assuming the existence of apparatus having transition resistance, the method of varying that resistance is the same as for varying any other kind of resistance, to wit, the method of Bell's patent, claim 4,—gradually increasing it and diminishing it by sound-waves.

Counsel say that the words "electric speaking telephone transmitter operated by sound-waves" obviously bring in the mode of operation and the force which operates. This is an exposure of a fundamental fallacy in complainant's case, to wit, the claim that the making of a new kind of circuit or a new form of resistance makes a new method or art that includes a novel relation of sound-waves to this new kind of resistance. Bell's art covers resistance of any kind, and only the new thing upon which his method of claim 4 is to be practiced is patentable after Bell. There is no shadow of invention in the use of the minute force of a sound-wave to effect changes in a circuit after Bell and Edison. There is no shadow of invention in using sound-waves upon an instrument for the transmission of sound, after Bell. Sound-waves as the motive force, and electrical undulations conforming thereto, were factors in the problem given by Bell. Bell's patent covers sound-waves brought into a new relation with an electric current, and also into relation with the resistance of a circuit, whatever its kind.

The complainant could not stand for a moment upon the proposition that Berliner made any new discovery as to the force that a sound-wave can exert upon a circuit. The only scope for invention, after Bell, is in the apparatus employed to obey his law. The vibrations of a diaphragm under the sound-waves involve no novel elemental action not previously in Bell and Edison. The patent disclaims novelty in the process practiced upon the current. The form of undulations, not their character, is all that is claimed. It was a known fact that the Reis apparatus could control the electrodes so as to strengthen and weaken the contact; that the vibrations of a diaphragm were of sufficient force to accomplish all that Berliner described in his application; that is, to weaken the initial contact of electrodes down to the breaking point. In the Reis musical transmitter, as well as in Bell's liquid transmitter, was shown all that Berliner needed to learn as to the power of sound-waves.

Some confusion has arisen from the fact that it is proven that the Reis apparatus, or Berliner's, is like a tool which, at the pleasure of the operator, may be made to perform the breaking operation of Reis or the variable-pressure operation of Berliner. The operator may turn the screws so that the contact will be broken, or so that it will be preserved, or he may drop his voice in order to preserve contact; but the patent covers no art or skill required to keep electrodes in constant contact, or if it does is not infringed in this respect. The "method" of claim 1, and which "characterizes" the instrument of claim 2, requires, as a condition precedent, electrodes in constant contact. Professor Cross says, "Constancy of contact will not transmit speech;" and that the variable-pressure operation is impossible when there is no contact. If there is an art or method of preserving the contact of electrodes which, in view of the experience of Edison and Berliner, and the evidence of experts as to experiments with metal electrodes, seems not improbable, it is not the method or art set forth in claim 1, and should not be confused with it. The method is "by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact." The patent sets forth, as the only means of securing constant contact, a screw. The "causing" is accomplished by placing the apparatus where there are sound-waves. This is a very different thing from Mr. Bell's "causing electrical undulations" as a method of transmitting sound, or of causing the resistance of a circuit to vary in accordance with sound-waves. Berliner's solicitor has not succeeded in paralleling Bell's claim 5. The production or selection of sound-waves is no part of a new art or process. When the exhibitor of the apparatus speaks, he is merely producing sound-waves, which is no part of the method of causing them to produce electrical undulations of similar form. If he drops his voice so that it will be a weak force, he is merely producing sound-waves appropriate to the particular form of apparatus. If he finds a weak voice coming through the air, that will answer. Dropping the voice to feeble tones is an equivalent to a turn of the screw which is set forth in the patent as the means of preserving the contact.

No new art or method can be practised in front of the diaphragm. Berliner's mode of operation cannot be brought in upon the sound-waves. It is all determined by the structure of the instrument. If the art is to be practised at the diaphragm, or if it is to be practised in putting a suitable amount of transition resistance into the circuit, the patent is certainly bad, since it leaves this art or method to be discovered by experiment. Professor Brackett truly says, "So far as the method of operation is concerned, there is no novelty over Bell." There is also no novelty in mode of operation over Edison, even assuming that there is a novelty in the kind of resistance operated upon. The fact is that the complainant's fundamental proposition that Berliner's invention resides in a new mode of operation is erroneous. Berliner's invention, assuming that he made one, does reside in and is limited by the structure involved; and amounts simply to a discovery of the capacity of a specific structure to obey Bell's law.

Berliner was not the first to introduce transition resistance into a circuit. The complainant concedes that Berliner was not the first to make the apparatus which it terms a microphone. The Reis apparatus is conceded to be a microphone, and to have such transition resistance that it is capable of transmitting speech. Reis's failure was due to the fact that, in operating his machine, he put in so much transition resistance that he interrupted his current. It is unjust to these defendants that this case should be tried upon the theory of transition resistance, or upon the German patent to Ludtge; but I am of the opinion that, even if Berliner's claims are to be interpreted in the light of expert evidence as covering all transmitters having transition resistance between electrodes, these claims are of excessive breadth, and go far beyond the scope of any conception or discovery of Berliner. If Berliner discovered that such transition resistance as existed ready to his hand in the Reis transmitter was capable of varying the current, this gave him no right to claim any and all apparatus having transition resistance. As he does not describe it, gives no specific directions as to the amount necessary, gives no evidence that he made any investigations in consequence of a conception of this character, his utmost claim to transition resistance is to such as was involved in the structure which he used, to wit, such transition resistance as is possessed by metal electrodes when properly adjusted. Professor Cross says, of the granules of the powder form transmitter: "The carbon employed is of such a character as to possess a high transition resistance at the contact points." The complainant cannot monopolize a resistance "possessed" by carbon.

It follows that the Berliner patent, if it is valid at all and discloses an invention, is nevertheless so limited that it does not include the defendants' devices. Claim 1 for a method is invalid. Counsel justly say of this claim, "We have claimed as a method the operation of the apparatus exhibited; nothing more."

Counsel for defendants contend rightly, I think, that the so-called "method" is mere phraseology, and merely an indirect description of apparatus. They say, "Why could not Mr. Hunnings have said, 'I claim the method of producing undulations in a circuit by causing the sound-waves to vary the pressure upon the flexible wall of a cell containing carbon powder included within the circuit, and thereby increase and diminish the resistance of the circuit?" If, after Bell, the Berliner method claim is good, every inventor of a new form of transmitter may base upon the peculiar features of his apparatus a new method claim for a process involved in the operation of his apparatus.

Berliner did not alter Bell's variable-resistance method by applying it to the Reis electrodes, which the Supreme Court said Bell had taught Van der Weyde how to use, and might himself have used instead of the apparatus which he adopted. 126 U. S. 540. *Westinghouse* v. *Boyden Power Brake Co.*, 170 U. S. 537, 554-557. Like the method of the patent, the mode of operation by variable pressure and the mode of operation by varying transition resistance are merely indirect and abstract descriptions of a part of what occurs in the operation of particular apparatus. We may test the identity of meaning conveyed by these various expressions by giving a Reis apparatus to three practical electricians; by telling the first to operate it according to Bell's method; the second, according to the variable-pressure method; and the third, according to the varying transition resistance method. If these persons are sufficiently intelligent to comprehend what is meant by these instructions, each will do exactly the same thing. If this cannot be done without further invention, then it seems that the Berliner patent is invalid for an insufficient specification.

It is furthermore important to observe that no method was claimed until 1880, after two years' public use. For this reason alone, claim 1 is invalid. The patent, therefore, must stand, if at all, upon claim 2. Taken literally, it is anticipated by the Bell mercury transmitter, and by Edison's devices of Feb. 9 and April 1. The patent confines itself to metal for the pin or second electrode, and carbon was disclaimed. Construed from the specification, the disclaimer of carbon and the experience of the patentee, as detailed in his testimony, it covers only its described electrodes and their known equivalents. Carbon was not a known equivalent. This claim cannot cover all solid electrodes, because, after Bell's invention, the problem was not to find a new method, but to discover a better material than Bell's mercury electrode. The claim cannot cover all solid material, for solidity of contacting surface is not in and of itself enough to make an apparatus practical or commercial.

In *Edison Electric Light Co.* v. *United States Electric Lighting Co.*, 52 Fed. Rep. 308, it was said:

> "The degree of difference between carbons that lasted one hour and carbons that lasted hundreds of hours seems to have been precisely the difference between failure and success, and the combination which first achieved the result 'long desired, sometimes sought and never before attained,' is a patentable invention."

The decision of the Supreme Court in The Incandescent Lamp Patent, 159 U. S. 465, 476, is exactly in point. There is was said:

> "Under these circumstances, to hold that one, who had discovered that a certain fibrous or textile material answered the required purpose, should obtain the rigbt to exclude everybody from the whole domain of fibrous and textile materials, and thereby shut out any further efforts to discover a better specimen of that class than the patentee had employed, would be an unwarranted extension of his monopoly, and operate rather to discourage than to promote invention."

In that case the patent was held void. Fibrous or textile material was "too indefinite to be the subject of a valid monopoly."

In the present case, we have not even an equal limitation, for claim 2 does not mention solid material for the electrodes, but simply electrodes in constant contact—language broad enough to include various transmitters which are acknowledged not to be within the scope of Berliner's invention.

I am, therefore, of the opinion, that even if the complainant were able to prove that Berliner had in fact made an invention; that his application upon its face disclosed this invention; that he was lawfully entitled to make the amendments; and that his previous patent of 1880 did not exhaust the power of the Commissioner to grant the patent in suit, and that he was not anticipated by Edison; that, even after all this, well-established rules of law would require us to hold that claim 1 of this patent is void, and that claim 2 is either void or so limited that it does not include the defendants' transmitters.

It has been impossible, in this opinion, to consider all the points of the very able arguments that have been presented, or all the important contentions that have arisen. The brief of the defendants has met the case of the complainant thoroughly and completely, and with very exceptional ability and commendable fairness has demonstrated, in my opinion, that the complainant's case rests upon a patent that should not have been granted, and which is void for error apparent upon the face of the records of the Patent Office; that as a matter of fact Berliner on June 4, 1877, the date of his application, had not made the discovery that speech could be transmitted with the apparatus of the patent in suit, and was at that time, and long after, like other unsuccessful experimenters, attempting to use a broken current. In addition to the fundamental defects in the complainant's title to the patent, it appears that the best argument that skilled experts and learned and ingenious counsel can base upon this patent is logically untenable and legally unsound.

The bills will be dismissed.

General News.

THE TELEPHONE.

SIDNEY, O.—The Sidney Telephone Company has been incorporated to build a local exchange. Capital stock, $10,000.

ELMWOOD PLACE, O.—The village council has granted a franchise to the City & Suburban Telephone Company of Cincinnati to build a local exchange connecting with the city.

NORTH LEWISBURG, O.—The North Lewisburg Telephone Company has been organized by local people to build exchanges in this place and in Lewisburg. Franchises have been secured in both villages.

NAPOLEON, O.—The Napoleon Home Telephone Company has been incorporated by James S. Brailey, James S. Brailey, Jr., H. A. Barber, Clive Chandey and W. C. Fink. Capital stock, $50,000. The company will maintain an exchange in Napoleon, with toll lines in Henry, Fulton, Defiance, Ottawa and Wood counties.

MARION, O.—The Marion County Telephone Company has abandoned hope of securing a franchise from the council and will apply to the Probate Court for a grant. The company has organized with the following officers: F. E. Guthery, president; C. H. Norris, vice-president; O. Wollenweber, treasurer, and French Crow, secretary.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—A route is being surveyed for an electric railroad from the Bully Hill mine, near Delamar, Cal., to a connection with the Southern Pacific Railroad near Kennettoo. The Shasta Electric Power Company is expected to supply power for the operation of the road this winter.

DANBURY, CONN.—Surveys for the electric railroad between Danbury, Conn., and Golden's Bridge, N. Y., have been completed, contracts have been awarded, and construction will shortly begin. The road will be about seventeen miles long, through a rich farming territory and several villages, and it is believed that the road, which is to be completed by September 1, will bring considerable trade to Danbury. The Danbury and Golden's Bridge Street Railway Company, which is to own and operate the road, was chartered in Connecticut in 1897.

COLUMBUS, GA.—The Drake & Stratton Company has sold its controlling interest in the Columbus Railroad Company, which embraces the electric lighting service here, to George J. Baldwin, of Savannah, and his associates, Messrs. Stone and Webster, of Boston, for $225,000. Fifty thousand dollars will be spent immediately on improvements.

MILFORD, MASS.—The Hopedale selectmen have voted to grant the Worcester & Milford Street Railway Company a location, one-fourth of a mile long, on the main road between Milford and Upton.

LENOX, MASS.—The Pittsfield Electric Railway Company wished to extend its lines to Lenox, and petitioned the General Court at Boston for certain rights. Influence was brought to bear, and the petition was withdrawn. Another electric railway company, the Berkshire, appeared in the field. During last winter the project began to be talked about of a trolley line to reach the entire length of the county, connecting the central towns. Nearly all the towns applied to have granted franchises. The Berkshire Electric Railway is thus an assured institution. It met with violent opposition in Stockbridge, because it insisted upon laying its rails in the main village street, one of the most beautiful streets in all New England. But the company failed in its attempt to secure legislative enactment, and will have to take whatever route the people of Stockbridge elect to give. As soon as the franchises from that town and Lanesboro are granted, the railway will be built. This road will enter Lenox on the extreme east, with a spur track up to the village.

SEDALIA, MO.—The Railway & Electric Company has been incorporated; capital, $250,000. Incorporators: W. B. Broomall, L. A. Duhring, Lewis Davis, W. S. Shirk and others.

WOODBURY, N. J.—A deal has been consummated by which the Gloucester and Salem Turnpike Company was merged into a trolley company, and a line is to be built from Woodbury to Swedesboro, and also connect with the Paulsboro Traction Company's line at Clarksboro. The directors of the new company are William H. Sayen, Barker Gummere, Jr., W. S. Hancock, of Trenton; J. J. Summerill, Charles W. Knight, of this city, and James J. Davidson and A. A. Bradshaw, of Swedesboro.

WATERTOWN, N. Y. The Watertown & Carthage Traction Company has been incorporated with a capital of $200,000 to build and operate a trolley line between Watertown and Carthage.

ALBANY, N. Y.—The Mohawk River Traction Company has been incorporated, with a capital of $160,000. The road will be 16 miles long and situated in Montgomery and Schoharie counties.

CANASTOTA, N. Y.—The Canastota & Morrisville Railway has been incorporated to build and maintain a surface road, to be operated by electricity, 15 miles long, in Madison County. Capital stock, $200,000.

NEW YORK, N. Y.—Beginning July 1, letter carriers in Brooklyn, wearing their uniforms and carrying their bags, may ride on the cars of the Brooklyn Rapid Transit Company without paying. The Government will pay a lump sum of $9,000 a year for the privilege.

NEW YORK CITY.—There is a widespread belief that electricity has about driven the horse out of the horse-car business in this city, with the exception, of course, of the few short crosstown lines down town. An officer of the Metropolitan Street Railway Company states that the company had about 6000 horses employed on its system. Not all of these were used in drawing cars.

NEW YORK, N. Y.—The Long Island Extension Railroad Company, which was incorporated at Albany last week, to construct and operate an underground tunnel from the Long Island Railroad property in the Borough of Queens under the East River to Manhattan, has been formally organized. Samuel Rea, fourth vice-president of the Pennsylvania Railroad and a director of the American Exchange National Bank, was elected president, and F. E. Haff was chosen secretary and treasurer.

ROCHESTER, N. Y.—The Monroe County Electric Belt Line Company is projecting a trolley road to connect with Rochester. It will run through Brighton, Fairport, Penfield, Pittsford and Despatch. It will be incorporated for $250,000. Among the incorporators are George W. Aldridge, Merto. E. Lewis, A. H. Bown, W. W. Bown, J. Breck Perkins, C. J. Brown, W. H. Rowerdink, D. C. Becker, P. R. McPhail, W. A. Parce, George K. Higbie, C. W. McKay, C. H. Judson, Ira M. Luddington and A. J. Grant.

TROY, N. Y.—The New York State Board of Railroad Commissioners gave a hearing last week on the application of the Troy, Rensselaer & Pittsfield Railroad Company, to operate an electric line between Rensselaer, Troy and Pittsfield, Mass. The application was opposed by the United Traction Company of Albany, the Boston & Albany Railroad, the New York Central Railroad and the Chatham & Lebanon Springs Railroad Company. The application was opposed on the grounds that the road would parallel the roads of the other companies. No decision was given.

LONG ISLAND, N. Y.—The Hempstead, Mineola & Freeport Traction Company, having obtained a franchise from the trustees of the village of Hempstead to build a trolley line in the village streets, has been given a franchise by the Nassau County Board of Supervisors permitting the use of certain county roads for a trolley line. This franchise will enable the company to extend its line from Hempstead village to this place over the costly macadamized highways. The company has also been voted a franchise in Freeport by the property owners. The village trustees there would not assume the authority to grant the franchise, so it was put to a vote, and carried by 7 to 1. The company is said to be backed by capitalists of Cleveland, Ohio, and it is promised that the work of building the new lines will begin during the present summer. Ten cents will be the fare between Freeport and Hempstead and five cents between Hempstead and this village.

PORT CHESTER, N. Y.—The State Railroad Commission met last week to consider the application of the New York & Port Chester Railroad Company for permission to construct and operate a railroad. The route the new company desires to cover is from 132d Street to the State line in Port Chester, through the towns of Rye, Harrison, Mamaroneck, New Rochelle and Mount Vernon. The opposition to the desired franchise included, for the Union Railroad Company, W. H. Page, Jr.; for the New York, New Haven & Hartford, H. W. Taff, for the New York City & Westchester, John McDonald; for the New York Central, W. Walker, and for the Port Chester & Larchmont line, F. W. Sherman. H. A. Gambleton, of the North Side Board of Trade, John F. Persons, for himself, and George Crawford, for the Crawford Real Estate Company, also entered formal appearance. Mr. Page objected to the manner of advertisement of the applicant company, and the Commission sustained his objection. Notice of the Port Chester Company's application was published in the *Law Journal*, and David Murray, of counsel for the road, contended that was sufficient publication. The Commission was unanimous in disagreeing with him.

HILLSBORO, O.—The Chillicothe-Hillsboro Traction Company has secured a franchise from the town of Hillsboro for its line on several streets and for furnishing light in the town.

DAYTON, O.—The Dayton & Germantown Traction Company has increased its capital stock from $450,000 to $500,000, and has amended its charter to permit the extension of the road from Germantown to Middletown.

LISBON, OHIO.—The Salem, Lisbon & East Liverpool Traction Company, of Lisbon, capital stock $10,000, has been incorporated by H. Whitford Jones, Fred W. Holt, Charles H. Taylor, George H. Billman and H. H. Poppleton.

JEFFERSON, O.—The Burton, Jefferson & Andover Electric Railway Company has organized as follows: Officers: President, Eugene Rowdon; vice president, W. H. Dodge; secretary, S. L. Osborn; treasurer, C. E. Meigs.

WARREN, OHIO.—The Cleveland & Eastern Electric Railway Company has applied for a fifty year franchise from the Trumbull county line, near Phalanx mills, to Leavittsburg. The company will probably come from Leavittsburg to Warren over private right of way.

TOLEDO, OHIO.—Negotiations are under way for the consolidation of the Toledo & Monroe Railway Company and the Toledo, Bowling Green and Southern Traction Company. The former is owned by a Detroit syndicate and the latter by George B. Kerper and others, of Cincinnati. This would complete a line from Toledo to Findlay, a distance of 64 miles. It is said that as soon as the consolidation is effected the line will be built into Detroit from Monroe.

GETTYSBURG, PA.—The Baltimore, Westminster & Gettysburg Electric Railway Company has secured control of the Baltimore pike from Reiterstown, 19 miles north of Baltimore, to a point near Chambersburg, Pa.

READING, PA.—The United Traction Company, of Reading, having secured control of the Neversink Mountain Railway, has elected these officers of that road: President, Walter A. Rigg; Secretary and Treasurer, T. W. Grooket; Directors, J. Milton Miller, Samuel E. Rigg, J. H. Bucher, W. A. Rosen and K. A. Fichthorn.

NORTH AUGUSTA, S. C.—The North Augusta Electric and Improvement Company has applied for a charter to construct an electric line from Hamburg to Aiken.

CHARLESTON, W. VA.—The West Fork Construction Company has been incorporated, to construct street railroads, etc. Capital, $250,000.

MANCHESTER, VA.—Since Judge Hancock has refused to enjoin the erection of a new electric railway from Manchester to Petersburg, the work is being pushed to completion.

GRAND RAPIDS, WIS.—D. O. Fisher, of this city, has petitioned the council for a franchise to build an electric railway here. It is to be part of the proposed electric railway from Stevens Point to Nekoosa.

General News.

THE TELEPHONE.

STOCKTON, CAL.- The Sunset Telephone Company has started work on a new line from this city to Fresno. The wire will be an aluminum cable of seven strands. The company has just completed a new line from San Diego, through Los Angeles to Bakersfield and repaired the system between the latter town and Fresno. By constructing a new line from here to Fresno a direct system will be opened.

SAN FRANCISCO, CAL.—Another attempt is being made to provide San Francisco with an independent telephone system. M. Adrian King has petitioned the supervisors, through his attorney, for a franchise granting him the privilege of laying conduits for telephone and telegraph use. Accompanying the petition for a fifty-year franchise was a draft of an ordinance providing that the city shall have free use of fifty telephones and shall share the use of poles and conduits of the new concern. Also, that the company shall have at least 5,000 telephones in use within three years from date of franchise and shall install switchboard and conduits for a capacity of 15,000 subscribers. Two per cent. of the gross receipts are to go to the city. It is said that Mr. King represents St. Louis capitalists, whose ultimate purpose is to establish a local and long distance telephone system to cover the Pacific coast. The same people have filed a request for a telephone franchise in Los Angeles, Cal.

DENVER, COLO.—The Western Slope Telephone Company will build 45 miles of new line to connect Leadville with its line at Wolcott. The Western Slope company now has lines connecting with the Colorado company's lines at Rifle and extending to Hahn's Peak, Steamboat Springs, Milner, Hayden, and remote sections of Routt county which has heretofore been without communication with the outside world except by mail. The company recently completed 100 miles of new line.

NEW BRITAIN, CONN.—The stock of the Farmington Valley Telephone Company of New Britain has been increased from $3,500 to $7,000.

WILMINGTON, DEL.—The Delmarvia Telephone Company contemplates resuming the work of building the extension from this city to Perryville, Md., where connection is to be made to Baltimore.

WASHINGTON, D. C.—The State Department is in receipt of interesting information concerning work on the British Pacific telegraph cable, which is to connect the Dominion of Canada with the Australian confederation. The new cable is to be 5834½ miles in length—the longest ever constructed—and will be transported and laid by one ship, which is now being built for that purpose. Consul Abraham Smith at Victoria, B. C., informs the State Department that a surveying party has located the landing site at the Canadian end of the cable, at a point on Kelp Bay, near Banfield creek. It is about seven miles from the entrance to Barclay Sound, and something over one hundred miles from Victoria. The location is reported as being admirably adapted for that purpose. The cable will run from Vancouver island to Fanning Island, which lies south of Hawaii—a distance of 3337 miles—before a landing is effected. Thence it is laid to the Fijis, to Norfolk Island and thence to Queensland.

ATLANTA, GA.—The Southern Telephone and Telegraph Company may erect a large addition to its telephone exchange. W. T. Gentry is superintendent of construction. The new addition will probably cost $20,000.

ATLANTA, GA.—A new and complete system of Bell telephones will soon be in operation at Anstell, connecting that city with Atlanta, in addition to Mableton, Lithia and other local stations. J. P. Woodson, an electrical engineer from Atlanta, will construct the line immediately and it is expected to be in operation at an early date. There will be about 25 subscribers to begin with.

OSKALOOSA, IA.—The Home Telephone Company has been succeeded by the Oskaloosa Home Telephone Company.

MAXWELL, IOWA.—Maxwell has a local telephone company with seventy instruments connected with the Independence lines.

LITERBERRY, ILL.—The Liter Arcadia Telephone Company, of Literberry, has increased its capital stock from $1,500 to $5,500.

ELIZABETH, ILL.—The Jo Daviess County Mutual Telephone Company of Elizabeth has been incorporated; capital stock, $2,500; incorporators, William Skine, Ernest Stadel and Rudolph Dittmer.

CHICAGO.—Miss May Schultz, who contends that she has been permanently injured by a telephone receiver, bas filed suit in the Superior Court against the Chicago Telephone Company for $30,000 damages. While she held a receiver to her ear on April 23, 1899, an unusually strong electrical current is said to have come over the wire. The force of the shock is said to have thrown the girl from her chair to tbe floor. Her face became black, and now retains a red tint on the left side. Several weeks ago an operation was performed on the injured left ear, and it is said that it showed that the bones on that side of the face were dead.

INDIANAPOLIS, IND.—The Millville Telephone Company, of Millville, has been incorporated; capital stock, $3,000. Directors: John J. Allen, Will. Wisehart, Joseph Bird, James A. Stafford, Martin Wood.

NASHVILLE, IND.—A local company is now constructing the first telephone exchange this town has ever had. It was only a few months ago that this town was entirely shut off from communication with the outside world, but since then a telephone line has placed the people in connection with several points in the State.

INDIANAPOLIS, IND.—The following telephone companies filed articles of incorporation with the Secretary of State during the past week: The Waveland Telephone Company, capital stock, $1,000; the Shannondale Co-operative Telephone Company, capital stock, $1,600; the Millville Telephone Company, capital stock, $3,000, and the Farmers' Mutual Telephone Company, of Hancock County.

WEST NEWTON, IND.—Farmers in this neighborhood and the adjoining valley mills neighborhood have constructed private telephone lines to their homes and are now preparing to connect them with an exchange that is to be established at West Newton by the New Telephone Company. The subscribers own their wires and poles, and pay the company [illegible]0 cents a month each for the connection. The plan is to establish the service on farms all over the county.

INDIANAPOLIS, IND. Mr. S. P. Sheerin, vice-president and manager of the New Telephone Company, contends that the country telephone line (and all other telephone lines which go along the country road) should be considered as part and parcel of the road itself. They should not be considered as tenants of the road, or as something that is there by sufferance, or by the permission—grudgingly given—of those who, for the time, do not appreciate its advantages, but it should be regarded as a part of the road itself. He said that the independent movement gives opportunity for self helpfulness and intellectual cooperation. That which a man can do for himself is most likely to be quickest done. The flexibility of the independent plan is its greatest recommendation.

BALTIMORE, MD. Mayor Hayes has sent a letter to the heads of all departments under the city government notifying them that the city has entered into a contract with the Maryland Telephone Company for all municipal telephone service, which is to be in charge of Mr. Charles E. Phelps, Jr., engineer of the Electrical Commission. They are instructed to notify the Chesapeake & Potomac Telephone Company to remove its instruments.

BALTIMORE, MD. The Maryland Telephone & Telegraph Company, of Baltimore, is securing rights of way in several towns of Cecil County to erect its line. The company proposes to erect a trunk line through the county, connecting the Baltimore system with a Wilmington telephone company.

HUDSON, MICH.- The Rollin Telephone Company has completed arrangements to extend its line to Hudson. The line will then connect with Rollin, Geneva, Manitou Beach and Addison. An effort is being made to extend the system all over southern Michigan. It is a farmer's system.

ST. PAUL, MINN.—The Fulda Telephone Company of Murray County, with headquarters at Fulda, has been incorporated. The residents of that village are the incorporators. The capital stock is $25,000. The Iron Range Telephone Company has increased its capital stock from $50,000 to $75,000.

BOONVILLE, MO.—A telephone line is being built to connect this city with Chouteau Springs.

KANSAS CITY, MO.—The public sale of the Standard Telephone Company's line by Clarence S. Palmer, receiver, brought $6,400. The majority stock of the Russell Telephone Company was sold to E. J. Douglass for $500. The Central Missouri Telephone Company, with 400 miles of line, was sold to J. A. Lander, of Yoakum, Texas., for $1,400.

ECONOMY, MO.—The Union Telephone Company has filed articles of incorporation. The capital stock is $1,000. The company already has seven different lines in operation of about 80 miles each. The headquarters are at Economy, and from there the company has an independent line running to each of the following named places: Macon, Atlanta, La Plata, Ten Mile, Nichelton, Redman and Sue City.

BUTTE, MONT.—The Rocky Mountain Bell Telephone Company filed its annual statement. It shows the capital stock of the company to be $1,222,200, all paid up; total assets, $1,674,926.73, of which $75,768.66 is in cash and $189,046.63 in real estate.

SOUTH OMAHA, NEB.—The Bradshaw Telephone Company, Bradshaw, Neb., has been incorporated; capital, $50,000. Incorporators: Daniel Graves, W. A. Wells, L. S. Loomis and others. The company will build an exchange and territorial lines at once. The Albion, Neb., Telephone Company has incorporated; capital, $20,000. Incorporators: A. Harris, President, S. F. Martin, secretary. This company will build an exchange and territorial lines.

RALEIGH, N. C.—The Board of Aldermen has granted a franchise to the Southern Bell Telephone Company to construct conduits for underground telephone wires within a prescribed limit.

NEW YORK CITY.—The telephone girls of the New York Bell Telephone Company are all being vaccinated.

ELMIRA, N. Y.—The Elmira Telephone Company has filed with the Secretary of State a certificate of increase of capital stock from $40,000 to $150,000.

NEW YORK, N. Y.—The Postal Telegraph Cable Company of New Jersey has been incorporated to operate the Postal Company's lines in New Jersey; capital stock, $50,000.

RICHFIELD SPRINGS, N. Y. The Richfield Springs Telephone Company has been incorporated. Capital, $5,000. Directors, M. A. McKee, John Gyer and F. E. Munger, all of Richfield Springs.

ALBANY, N. Y.—The Wharton Valley Telephone Company, of South Edmeston, Otsego County, has been incorporated; capital, $3,000. Directors: B. F. Bishop, of Garrattsville; Van Ness D. Robinson, of Edmeston, and Frank Harrington, of West Burlington.

NAPOLEON, O.—The City Council has granted a franchise to the Citizens Mutual Telephone Company.

PAULDING, O.—The Paulding Home Telephone Company has amended its charter to permit it to build toll lines through Scott, Hicksville, Ottawa, Cecil, Tipton, Grover Hill, Bryan and Defiance. John S. Snook, A. N. Wilcox and O. K. Dickinson are the owners.

YOUNGSTOWN, OHIO. Owsley & Boucherle, local architects, are preparing plans for a large office building for the Dollar Savings & Trust Company. An electric light plant will be installed. The upper floors of the building will be utilized by the Youngstown Telephone Company for its new exchange.

FINDLAY, OHIO.—The Home Telephone Company exchange has opened for business with about five hundred telephones in operation. The others of the total list of one thousand will be connected as fast as possible. The formal opening of the plant will be fittingly celebrated in a few weeks and be made quite a gala occasion.

COLUMBUS, O.—Representatives of the Bell Telephone Company have presented to the State Board of Appraisers, under the Nichols law, a request that in cases in which telephone operating companies rent their instruments the taxes on the telephones be assessed against the companies that control the instruments under the lease. Under a recent decision of the Supreme Court such instruments have been taxed against the owning company at a value determined by their earning-capacity. The Nichols law provides that local companies shall pay taxes on all lines owned by them or leased.

CLEVELAND, O. At the annual meeting of the Cleveland Telephone Company (Bell) directors were elected as follows: Philip Dexter, Reginald Foster, Chas. J. Glidden, Thomas Sherwin, of Boston; Frank F. Hickox, Lee McBride, A. B. Hough, William J. McKinney, J. P. McKinstry and E. P. Wright, of Cleveland. The directors organized by electing Chas. J. Glidden, president; J. P. McKinstry and H. J. Pettengil, vice-presidents; George B. Perham, secretary; Walter Abbott, treasurer; P. Yensen, general manager. Executive committee, Philip Dexter, Thomas Sherwin, Reginald Foster.

TOLEDO, O. Failing to get satisfaction out of the City Council, the Toledo Home Telephone Company has appealed to the Probate Court for a franchise to build its system in Toledo. The company offers a rate of $44 per year for business telephones and $26 for residences, and agrees to have its system in operation with 3,000 subscribers by December 31, 1903, work to begin within 60 days. Free telephones will be placed in all city departments and the company proposes to furnish two $10,000 surety bonds to guarantee the fulfillment of the contract. The company is promoted by Frank Graves and E. F. Seabolt.

WAXAHACHIE, TEX.—Representatives of an independent telephone company have filed an application with the City council for a franchise for the establishment of a new telephone system here.

LAKE CREEK, TEX.—The Southern Telephone Company of Lake Creek, Delta County, filed an amendment to its charter providing for an increase of its capital stock to $8,000.

CLEBURNE, TEXAS.—The Southwestern Telegraph and Telephone Company is building from its central office here a rural line to connect Bono, George Creek, Nemo, Wilson's Park and Mimm's ranch with the city by wire.

TEXARKANA, TEXAS.—The city council on the Texas side granted to S. F. Richardson and associates a franchise to build and operate a local and long distance telephone exchange for a period of thirty years. The city already has one such system, operated by the Southwestern Telegraph & Telephone Company.

SALT LAKE CITY, UTAH.—The Bell Telephone Company will build a line between Nephi and Tintic. The company has opened exchanges at Twin Bridges, Mont., where eighteen subscribers have been secured, and at Miles City, where there are seventy subscribers.

MILWAUKEE, WIS.—The Kurtz National Telephone Company, has been incorporated with a capital stock of $25,000.

MILWAUKEE, WIS. The Common Council has recommended the passage of an ordinance compelling all telephone and telegraph companies to place their wires underground in streets having permanent pavement.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA. Arrangements have been made for the consolidation of the Birmingham Railway, Light & Power Company, the Consolidated Electric Light Company and the Birmingham Gas Company. The capital stock of the new company will be $10,000,000. Isadore Newman, of New Orleans, Harry M. Atkinson, of Atlanta, and others effected the deal.

SAN FRANCISCO, CAL.—The new contract for lighting the public buildings of San Francisco was recently awarded to the Independent Electric Light & Power Company.

GAINESVILLE, GA.—A $100,000 company has been projected to develop the Chattahoochee River. Hon. Samuel C. Dunlap and F. S. Murray, of Chicago, are the principal promoters. The company will be known as the Gainesville Light and Power Company.

LA SALLE, ILL.—The Enterprise Heat, Light and Power Company, of La Salle, has been incorporated; capital stock, $25,000; incorporators, William B. Hummer, George A. Wilson and Timothy Lucey.

CARROLLTON, ILL.—The City Council and the Carrollton Electric Light and Power Company have failed to agree upon the terms of a new contract for street lighting, and as a result the city is likely to be in darkness within a few weeks. The present contract for street lighting and operating the water works plant expires July 7, and the bid of the Coal Company for service in the future was accepted by the council some weeks since. The company wants a thirty-year franchise and the council insists on a five-year franchise. Unless some agreement is reached before July 7 the lights and water will probably be shut off.

MONTICELLO, IND.—The Monticello electric light plant has changed owners, the Thorp brothers selling to A. T. Barnes and George A. Harris, of Antwerp, O., the consideration being $22,000.

CAMBRIDGE CITY, IND.—This city has tried municipal ownership and operation of electric lights for over a month, with most satisfactory results. There were in use during May thirty-seven arc lights and 500 commercial incandescents, and these, it is stated, cost much less than the old company charged for half night service.

BALTIMORE, MD.—Negotiations, it is said, are pending between the Consolidated Gas Company and the United Electric & Power Company, looking to a consolidation or joint ownership. The matter was held up pending an adjustment of the affairs of the Susquehanna Power Company, which is also involved.

PARIS, MO.—Contracts will be let on August 1 for the construction of a water and light plant at Paris, Mo.

ST. LOUIS, MO. There is a rumor in circulation to the effect that some Cincinnati capitalists are trying to buy the Imperial and Missouri Edison Electric Light Companies, with a view of ultimate consolidation with the Laclede Gas Light Company and Citizens Lighting Company.

ST. LOUIS, MO. The Imperial Electric Light, Heat & Power Company has asked for permission of the City Council to extend its system beyond its underground plant under the provisions of its original franchise. The reason for asking this additional privilege is thought to be a desire on the part of the company to be able to reach the World's Fair grounds, which its present franchise will not allow.

ST. LOUIS, MO. The fluctuations in the cost of city lighting in the last ten years are exhibited in the annual report of supervisor of lighting, submitted a few days ago. The cost of lighting streets, alleys and public places was $416,080.95 last year, $94,1[illegible] in excess of 1899-1900, and $107,312.38 in excess of 1889-90. The cost of lighting public buildings was $95,799.49 last year, $22,008.18 in excess of the previous year and $63,[illegible].37 in excess of 1889-90. The annual cost of street lighting was as follows: 1889-90, $308,768.57; 1891, $2[illegible]6,156.53; 1892, $2[illegible]3,[illegible]5.76; 1893, $2[illegible]3,5[illegible]; 1894, $230,005.63; 1895, $254,809.31; 1896, $269,986.30; 1897, $267,157.45; 1898, $305,877.97; 1899, $3[illegible]9.13; 1900, $3[illegible].41; 1901, $416,080.95. The cost for lighting public buildings was as follows: 1890, $3[illegible],514.12; 1891, $46,2[illegible].12; 1892, $44,186.45; 1893, $45,[illegible]; 1894, $48,3[illegible]5.79; 1895, $51,91[illegible].05; 1896, $58,120.80; 1898, $63,53[illegible]; 1899, $[illegible]; 1900, $72,891.31; 1901, $95,799.49. For lighting public buildings the Missouri Edison Electric Company receives 13 cents per 1,000 watt hour, and the Laclede Power Company 12 cents.

DULUTH, MINN. The Zenith City Electric Company and the Richardson Electric Company, Duluth, Minn., have been consolidated.

NIOBRARA, NEB. The plant of the Niobrara Electric Light Company has been sold to Randa & Greenberg.

FAYETTEVILLE, N. C. The Fayetteville Ice Company has made a proposition to the town to furnish lighting and power for fifty arc electric lights. Dr. J. W. McNeill, chairman of the electric light committee, recommends that thirty arc lights be used on the streets and that twenty be sold. He also asks for an expert to examine into the cost of installing the dynamos.

BAY HEAD, N. J. Mayor Pennington, William Packer, member of the Borough Council, and George N[illegible]maker, a prominent citizen, were arrested on June 22 and held in bonds to keep the peace. With the Mayor at their head and armed with an axe they made an assault on the poles and wires of the Point Pleasant Electric Light and Power Company, and were chopping away energetically when the hand of the law was laid upon them. This is the climax of a war that has been raging for a week between the Greenville Arms Hotel and the electric light company on the one hand and the Mayor and the Common Council of Bay Head on the other, there being opposition to the hotel, etc., on the part of the residents.

WATKINS, N. Y. The Watkins Consolidated Electric and Gas Light Company of Watkins has been formed. Capital, $1[illegible]. Directors, A. R. Horn, of Catasauqua, Pa., J. J. McKee, of Bethlehem, Pa., and Charles B. Reid, of New York city.

TARRYTOWN, N. Y.—The Hudson River Gas and Electric Company, of Tarrytown, has been formed. Directors, A. M. Young, H. G. Rinkle, B. W. Stillwell, W. W. Sorugham, L. A. Stratton, G. W. Curran, C. H. Werher, R. A. C. Smith, W. F. Sheehan, Walter Clark and L[illegible] Lillie.

DOYLESTOWN, O. Chas. F. Sturtevant, a Chicago engineer, is to prepare plans for a municipal lighting plant for this place.

HURON, O. The mismanagement of Huron municipal affairs has made it almost impossible to pay the bonds on the municipal lighting plant, and the plant may be sold.

MARYSVILLE, O. The village council has voted to employ an expert to examine the private lighting plant in this place, with a view to purchasing it for a municipal plant.

HUBBARD, O. At a recent special election the citizens of this place voted to issue bonds to the amount of $8,000 to rebuild the municipal lighting plant, which was destroyed by fire some time ago.

SANDUSKY, O. The Sandusky Gas & Electric Light Company has submitted a proposition for city lighting, as follows: Ten year contract, all night schedule, $80; five-year contract, $85. The city is now paying $87.50. A resolution has been presented to the council to build a municipal lighting plant.

TIFFIN, O. The Consolidated Gas & Light Company has been incorporated by M. B. Dailey, R. W. Kirley, C. F. N. Niles, of Toledo, J. M. Barr, of Findlay, and W. H. Dore, of Tiffin. Capital stock, $500,000. The company has absorbed the gas property owned by the Kerlin Brothers Company, the Tiffin Electric Light Company, and the Tiffin Light & Fuel Company. It is stated that $500,000 was paid for the properties. Coons, Barr & Co., Cleveland bankers, are financing the project.

HAMILTON, ONT. The Cataract Power Company, of Hamilton, has concluded negotiations with the Dundas Electric Light Company and will take over the business and rights of that company.

OTTAWA, ONT.—A proposal is made to transmit electric power from Nottawasaga River to the town of Stayner, Ont., six miles distant. The scheme would give enough power to induce manufactories to locate in that vicinity.

CHARLESTON, W. VA.—A company composed of West Virginia capitalists has been formed for the purpose of buying and operating under one management the Charleston (W. Va.) water works, the Charleston Electric Light & Power Company, the Charleston Gas Company and the Charleston Traction Company.

WAUSAU, WIS.—The plant of the Wausau Electric Company was damaged by fire on June 18 to the amount of $1,000.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—A deal consolidating the Birmingham Railway, Light & Power Company, the Consolidated Electric Light Company and the Birmingham Gas Company, arranged by Isadore Newman, of New Orleans; Harry M. Atkinson, of Atlanta, and the Old Colony Trust Company, of Boston, has been completed. The new corporation will have a capital of $10,000,000.

HARTFORD, CONN.—It is officially announced that when the through trolley line between Hartford and Springfield is completed, the running time between the two cities will be an hour and a half, and the fare 30 cents. The distance is about 30 miles.

NEW HAVEN, CONN.—It is reported that the Connecticut Railway & Lighting Company, which is controlled by the United Gas Improvement Company of Philadelphia, has just closed a deal by which it secures control of the entire electric railroad system of New Haven. It is said that the price paid was $3,000,000. Mr. A. M. Young, of Waterbury, Conn., is the moving spirit in the Connecticut Railway & Lighting Company. The company controls about half the entire trolley mileage in Connecticut.

DOVER, DEL.—The United Railway, Light and Charter Company, with a capitalization of $5,000,000, was incorporated. The company is authorized to purchase and acquire land and buildings for operating railways and heat, light and power plants.

ATLANTA, GA.—It is said that the electric railway between Atlanta and Marietta, Ga., is again being talked of and that right of way has been secured.

COLUMBUS, GA.—Geo. J. Baldwin, of Savannah, Ga., and Boston parties have secured a controlling interest in the Columbus Railroad Company, embracing electric and dummy lines and the electric power and lighting service. About $250,000 was represented by the deal.

SPRINGFIELD, ILL.—Articles of incorporation have been issued to the Cairo, Memphis & Southern Railroad Traction Company, with headquarters at Chicago. Capital stock, $40,000. The incorporators are Herman Paepche, C. Fred Yegge and W. B. Beckman.

CHICAGO, ILL.—The American Railways Company, incorporated in New Jersey, will build an elevated line in this city from Seventy-first Street to the Loop and will be a competitor of "Alley L." It will also absorb the Desplaines Valley and Blue Island Electric surface lines for feeders.

INDIANAPOLIS, IND.—A group of New York capitalists is considering the construction of a trolley road 100 miles long running through the centre of the Wabash Valley in Indiana. Options have been secured for all the necessary right of way. The proposed route runs through or very near to some of the most populous towns and cities, and it is predicted the road will prove very profitable. There is little competition in view.

CHICAGO, ILL.—Mr. George F. Harding has told the Chicago council committee on local transportation that the city has the right to buy the present street railway lines under the terms of the ordinance of 1858. He offers to pay all legal expenses if the city decides to buy out the companies' property. The proposition is novel to the committee. All its members believe in municipal ownership, but they have never taken up the question whether such ownership has been provided for in an ancient ordinance. Mr. Harding's offer has been referred to the sub-committee on franchises and ordinances. There is authority for the statement that the city will demand permanent compensation for street car franchises and will not accept a lump sum.

ANDERSON, IND.—The Merchants' Association to-day decided to build an electric railway from this city to Middletown, nine miles distant.

INDIANAPOLIS, IND.—An interurban franchise has been agreed upon by the Board of Public Works and the interurban roads now entering this city.

ANDERSON, IND.—The Union Traction Company, of this place, has sold its old power house plant at Marion, Ind. to a company that will build electric railways radiating from Richmond, Ind.

INDIANAPOLIS, IND.—The craze to secure electric railway franchises over public highways has ceased in this State. The reason is capitalists will not finance a road unless it secures a private right of way.

INDIANAPOLIS, IND.—The Central Traction Company, of this city, incorporated to build a line from here to Richmond, has changed its name to the Indianapolis & Eastern Traction Company. A company previously organized had taken the same name.

MUNCIE, IND.—The Union Traction Company announces that it will make a further reduction of fare to compete with the Big Four Interurban trains and the reduced fares on the same. The competition between electric and steam roads is growing bitter and the rates have already been cut in two.

ROAN, IND.—A monster railroad meeting was held here recently. The crowd that gathered listened to an address and arguments of Wabash business men in favor of voting a subsidy of $10,000 to build the Rochester-Wabash interurban road. The aggregate amount of subsidies asked along the entire route is $100,000.

LOUISVILLE, KY.—The Louisville Railway Company will on July 1 increase the wages of its 350 motormen and conductors from 17½ cents to 18½ cents an hour.

MAYSVILLE, KY.—The Maysville & Mt. Olivet telephone line has been sold to the company represented by Col. Jas. W. Chambers, superintendent of the Maysville system, and Dr. Edwin Matthews. Important improvements are being made.

LAPEER, MICH.—The village board of Imlay City, and the township board of Imlay township, have granted franchises to the Detroit, Utica & Romeo Railway for an electric road.

NEW YORK, N. Y.—Owing to the recent crippling of two of the electric power houses and the opening of the Manhattan and Brighton Beach lines, the Brooklyn Rapid Transit Company has found it necessary to temporarily discontinue the third rail system on some of the elevated lines and return to the use of steam. This will afford a more effective trolley service on the surface roads.

ALBANY, N. Y.—The Cortland County Traction Company was incorporated with a capital stock of $320,000. It has purchased the property and will operate the franchises of the Cortland & Homer Traction Company. The directors are C. D. Simpson, William B. Wait, of New York City, Frank Battles and George H. Fisher, of Philadelphia; Herman Bergholtz, of Ithaca; H. P. Simpson, of Scranton, Pa.; G. H. Garrison, of Troy, and B. T. Taylor, Edwin Duffy and E. H. Brewer, of Cortland.

NORWALK, OHIO.—The Norwalk, Ashland & Southern Railroad Company has applied for a franchise to enter the center of Norwalk.

CANTON, OHIO. The council has granted a franchise to the Akron Canton Railway Company enabling it to enter the center of the city.

CHILLICOTHE, OHIO. The Chillicothe & Hillsboro Traction Company has applied for a franchise enabling it to enter the center of Chillicothe.

PIQUA, OHIO.—The Miami Valley Railway Company has been granted a franchise to extend its road. The company may furnish light and power along the extension.

OTTAWA, OHIO. The city council has granted a franchise to the Defiance, Ottawa, Kenton & Columbus Traction Company. The road must be completed by December 31, 1903.

CINCINNATI, O. M. J. Mandelbaum, of Cleveland, denies that he is making an endeavor to secure, through the electric railway franchise, a new route for cars along the canal bank.

DEFIANCE, OHIO.—Citizens of Evansport have made a proposition to the Northern Ohio Electric Railway Company to locate its power house in that village. Defiance also wants the power house.

AKRON, OHIO.—The Summit County commissioners have granted a franchise to T. L. Childs for a road from Akron to Cleveland. He is supposed to be backed by the Haserot Brothers of Cleveland.

CINCINNATI, O.—The Board of Public Service of this city has approved the ordinance authorizing the Cincinnati & Northwestern Railway Company to change its motive power from steam to electricity.

CINCINNATI, OHIO. The Elkins-Widener syndicate, which owns the Cincinnati Traction Company's lines, has practically closed a deal for the purchase of the Cincinnati, Covington & Newport Street Railway Company.

URBANA, OHIO.—The Dayton, Springfield & Urbana Railway Company was unable to place its line through the northern section of this place, in operation at the time required by its franchise, and in order to hold the grant an ancient horse car is now being operated.

GALION, OHIO.—The Ohio Central Traction Company will extend its lines to Crestline, five miles north. The Mansfield, Crestline & Galion railway has secured a franchise between the two cities and proposes to build a line which will be part of the link to connect Cleveland and Columbus by an electric road.

CLEVELAND, OHIO.—The Cleveland syndicate, which has recently secured control of the Aurora, Elgin & Carpenterville Electric Railway, has placed a contract with Rossiter, McGovern & Company, New York, for 65 equipments of No. 68, 40-hp Westinghouse motors to entirely replace the present car equipment of the road.

TOLEDO, O.—The Consolidated Gas & Light Company has acquired the properties of the Kerlin Brothers Company, the Tiffin Light & Fuel Company, and the Tiffin Electric Light & Gas Company, at Tiffin, O., for $500,000. The new company is headed by M. B. Daly and C. F. M. Niles, of Toledo, and J. M. Barr, of Findlay.

ZANESVILLE, OHIO.—The Muskingum county commissioners have granted franchises to the following companies: Zanesville Electric Railway Company, Newark, Zanesville & Coshocton Traction Company, the Black Diamond Traction Company and Black & Taylor. The franchises are all for twenty-five years and work must commence by Jan. 1, 1902.

CLEVELAND, OHIO.—The Everett-Moore syndicate has consolidated the Detroit & Toledo Shore Line Company with the Toledo & Detroit Shore Line Company. The deal involves $800,000. The consolidation includes all the trackage, rolling stock, right of way and other equipment of the first named company between Toledo, Ohio, and Monroe, Mich.

CINCINNATI, OHIO.—It is stated that John G. Kilgour, formerly president of the Cincinnati Street Railway Company, is at the head of a company to be known as the Ohio Valley Interurban Railway Company, which will build a line following the Ohio River Valley from Cincinnati to Portsmouth, touching many towns not at present accessible by railway.

CLEVELAND, OHIO.—The Cleveland, Wadsworth & Southern Railway Company has been incorporated with $10,000 temporary capital stock by E. A. Akers, G. D. Hile, C. S. Horner, F. G. Anthony and W. H. Hill. It proposes to build a line from Cleveland to West Lebanon, Wayne County, with branches from Grange to Akron and from Dalton to Massillon.

CLEVELAND, OHIO.—The Columbus & Southern Railway Company has formally notified the Scioto Valley Traction Company, which is promoted by Cleveland people, that it has decided to withdraw from the field in the matter of building a road from Columbus to Circleville and Chillicothe, right of way over this route having been contested for some time by both companies.

CLEVELAND, OHIO.—The Xenia & Wilmington Traction Company has been incorporated by John P. Martin, Charles Orr, Eckstein Case, C. J. Dockstader, H. M. Yost and William E. Sage, of Cleveland. The company will build a line from Xenia to Wilmington, touching several good towns. It will be a part of the Southern Ohio system, which is owned by the Pomeroy-Mandelbaum syndicate of this city.

LIMA, OHIO.—The recently incorporated Lima, Lewiston & Bellefontaine Railroad Company has organized as follows: Directors, W. W. Fisher, C. D. Campbell, W. C. Huston, E. M. Hamilton, of Bellefontaine; W. P. Heston and Elias Barthomew, Toledo; A. F. McCormick, Columbus; Carl Wells, N. H.

Holler and S. M. Finch, of Lima; President, W. W. Fisher; Vice-President, W. P. Heston; Secretary, X. H. Holler; Treasurer, J. M. Boose; General Manager, H. F. McCormick; Assistant General Manager, Elias Bartholomew.

PHILADELPHIA.—Following up his offer of $2,500,000 for the new franchises, Mr. John Wanamaker has now offered $500,000 bonus to the owners of them as well, and has promised to charge 3 cent fares between 5 and 8 a. m. and 5 and 7 p. m.

CLEARFIELD, PA.—The Bituminous Street Railway Company of Clearfield, capital $180,000, has been chartered by the State Department to construct a line with 30 miles of track connecting Clearfield with Dubois Falls Creek and other thickly populated districts in Clearfield County.

HARRISBURG, PA.—The Sharon & New Castle Railway Company has been incorporated; capital, $500,000. The company will operate a railway between Sharon and New Castle, Pa. The incorporators are William W. Wherry, Jr., Leighton Calkins and K. K. McLaren, all of No. 15 Exchange Place, Jersey City.

RICHMOND, VA.—After months of contention a new era has been inaugurated in street railway traffic at Richmond, Va., by which the local railway companies will operate on certain streets on one another's tracks, each company having secured the privileges for which they have contended.

RICHMOND, VA.—The Lincoln Park Company, composed of W. B. Hoover, president; S. R. Reeve, secretary and treasurer, and other Newport News, Va., gentlemen, has been granted a charter; capital $50,000. Among the privileges enumerated are those of erecting street car and electric light systms.

CHARLOTTE, W. VA.—Representatives of a large Eastern syndicate are working on the details of consolidation of the electric light, street railway and water works plants into one system. Lines of the street railway will be extended into the Kanawha Valley in several directions. New equipment for the street car company is to be purchased.

GRAND RAPIDS, WIS.—D. O. Fisher, of this city, has petitioned the council for an electric railway franchise.

KAUKAUNA, WIS.—The Wisconsin Traction, Light, Heat & Power Company has been granted a franchise to build an electric railway in this city. This is an extension of the interurban line built two years ago from Neenah to Appleton.

EAU CLAIRE, WIS.—Arthur E. Appleyard, owner of the Dayton, Springfield & Urbana (O.) electric railway system, has made some preliminary surveys here with a view of incorporating a company to build an electric railway from Eau Claire to St. Paul.

SHEBOYGAN, WIS.—Senator Eaton, of Milwaukee, one of the incorporators of the Waukesha-Milwaukee electric interurban line, is reported to be at work on a plan for an electric interurban line to pass through this city and to connect Milwaukee and Green Bay.

MENOMINEE, WIS.—T. T. Frawley and D. Douglas, of Eau Claire, Wis., representing a syndicate, have offered to buy the Menominee street railway system. The same parties wish to purchase the Marinette street railway system and to build an interurban electric road between the two cities.

TWO RIVERS, WIS.—The village of Mishicott has granted Thomas Higgins a franchise to build an electric railway. This completes the last step toward securing the right of way between Two Rivers and Kewaunee. The building of the road north to Kewaunce is an important step to the peninsula cities, whose only outlet thus far has been by way of Green Bay. In all probability the road will be extended to Algoma and Sturgeon Bay.

MILWAUKEE, WIS.—The last link in the chain of electric railways to connect Milwaukee and Chicago has been arranged. The Chicago, Kenosha and Milwaukee Electric Railway Company has made a contract with the Kenosha Street Railway Company by which the new company will have the right to run its cars over the lines of the Kenosha Company. The line is now complete, from both Chicago and Milwaukee, as far as the city limits of Kenosha.

THE AUTOMOBILE.

ELECTRIC VEHICLE FOR FIRE DEPARTMENT CHIEF.—The Electric Vehicle Company has been awarded the contract to supply an electric vehicle for the use of Chief Sullivan, of the San Francisco Fire Department.

GREENSBORO, N. C.—It is stated that arrangements have been completed for the establishment of an automobile line in Greensboro. R. Dulaney Whiting, of New York, who visited this section last year, is interested. It is expected that the line will be in operation by August 1.

NEW INDUSTRIAL COMPANIES.

THE NEW JERSEY POWER STORAGE COMPANY has been incorporated with a capital stock of $100,000.

LIBBY TURBINE COMPANY, of Wilmington, has been formed to make and deal in water wheels and mill machinery. Capital, $250,000.

RANDALL ELECTRIC COMPANY, of New York City, has been formed. Capital, $10,000. Directors, P. M. Randall, N. E. Randall and J. G. Gorham, New York City.

THE GREENSBORO ELECTRIC COMPANY, Greensboro, N. C., has filed articles of incorporation with an authorized capital of $250,000. M. D. Barr and others are interested.

THE MALTBY AUTOMOBILE AND MANUFACTURING COMPANY, of Brooklyn, has been formed. Capital, $20,000. Directors, I. S. Cormer, F. E. Phillips, and C. C. Protheroo, of New York city.

PALMER & OLSEN, of New York City, have been incorporated to deal in electric vehicles and machinery. Capital, $20,000. Directors, C. A. Olson and H. B. Palmer, New York City; C. E. Francis, Brooklyn.

SPENCER ELECTRICAL COMPANY, of New York City, has been formed. Capital, $100,000. Directors, J. H. Spencer, of New York City; C. L. Child, of Montclair, N. J., and Henry Dawson, of Richmond Hill, L. I.

THE MANHATTAN CONSTRUCTION COMPANY, Cleveland, O., has been incorporated by Clement McMahon, Jr., S. B. Newman, Samuel Morris, S. A. Fallen and Chas. T. McKissen. The company will build steam and electric railways.

THE WHEELER-GREEN ELECTRIC COMPANY has been formed in Rochester, N. Y., to do a general contracting, jobbing and repairing business. The members of the firm are Clarence Wheeler, Thos. Green and Whiting J. Da Lee. Their place of business is at 22 North Water Street.

NEW DYNAMO MANUFACTURING COMPANY.—A company to make dynamos and motors will be incorporated at Milwaukee, by L. Federman, A. Ecke, C. Siebert and E. Kileber, former employees of the Allis-Chalmers Company. The capital stock will be about $5 ,000 and the parties are now looking for a site for the factory.

LEGAL.

DISSOLUTION.—The Electrical Engineering & Supply Company, Charlotte, N. C., has entered an application to the Secretary of the State for the dissolution of the company. The officers of the company are Dr. I. W. Faison, president; S. J. Smith, vice-president, and D. S. Yates, secretary and treasurer.

PERPETUAL FRANCHISE.—At Nashville, Tenn., Chancellor Cook has decided that the Nashville Railroad has a perpetual ownership in the streets of Nashville. Suits were instituted to obtain a revocation of the charter of the integral lines, on the ground that the consent of the city to a transfer of franchises had never been obtained as required by law. The Chancellor held that the consent of the city was not essential.

KINLOCH COMPANY'S SWITCHBOARD.—The United States Circuit Court at St. Louis, Mo., last week granted an order restraining the Kinloch Telephone Company from using the switchboard which is installed in its exchange. The telephone company is allowed thirty days in which to comply with the order. It is claimed by the complainants that the defendant company infringes on a patent switchboard controlled by the Western Electric Company and invented by John A. Seely.

PEORIA ELECTROLYSIS CASE.—In the well-known case between the Peoria Waterworks Company and the local Central Railway Company, the special master in chancery has decided in favor of the waterworks, to the effect that the trolley system with rail return has injured the water system and that the defendant ought to put in the double trolley, or some equivalent system of "completely insulated metallic circuit." The master concedes that the street railway company has done all that is possible in the present state of the art, but holds that an injunction should issue. This decision, as it stands, may be fraught with serious consequences to various trolley systems throughout the country.

TELEPHONE LIGHTNING ARRESTER.—The Circuit Court of the United States for the Eastern Division of the Eastern District of Missouri has handed down a decision against the Kinloch Telephone Company, of St. Louis, Mo., in a suit of the Western Electric Company for infringement of a patent granted October 21, 1890, to Anthony C. White for a telephone lightning and high potential current arrester. The points at issue were the use of a dielectric between roughened carbon plates, one of the plates having embedded a plug of easily conducting material. The alleged infringed device is described by the Court as similar to that of the plaintiff, with the exception that in it the carbon plates are held apart by a silk dielectric which is not slotted, and instead of the alloy plug of the White arrester each of the defendants' carbon plates contains, in a conical recess, a lead pellet or shot, held in place by a small quantity of beeswax. The opposing surfaces of the plates are not specially roughened, but are as smooth as the ordinary process of manufacturing permits. The use of the fusible substance in carbon plates is held to be an infringement, but not the use of carbon plates in themselves, if not roughened.

ELECTRIC RAILWAY STOCK.—An important decision has been handed down by Judge Phillips in Cleveland in one of the cases which has been hanging fire for several years bearing on the consolidation of several lines in that city into the Cleveland City Railway Company. At the time several of the lines, including the cable road, were consolidated in 1893, the cable company had a floating indebtedness of $421,621. The capital stock of the company was $4,000,000. According to the consolidation agreement, 18,250 shares of Cleveland City Railway stock were allotted to the holders of the cable stock and they were to pay their pro rata share of the floating indebtedness of the company. The new stock was turned over to J. J. Shipard and Frank De Hass Robinson, to be distributed, but a large share of it failed to reach the persons to whom it belonged because of the defalcation of J. J. Shipard. Those who failed to secure their stock brought suit against the Cleveland City Railway Company. This was the first of the cases, the amount involved being $10,000. The various cases aggregate over $500,000. The company lost every point. Judge Phillips held that the company was bound to see that the stock was issued and applied in faithful discharge of the trust. He held that Shipard and Robinson acted as agents for the company and were responsible to the company. He ordered the company to pay Fuller 20 per cent dividends upon the stock, dividends to that amount having been declared by the company since the suit was brought, and to turn over the full amount of stock or its value. The company will appeal the case.

OBITUARY.

MR. C. H. ROLLINS, an engineering student, graduate of the Maine State University, was killed by shock on June 22 at the Lynn General Electric Works, by accidental contact with wires from a bank of high voltage transformers.

MR. G. VAN GINKLE, recently president and chief owner of the Electric Street Railway, Dallas, Tex., was run over by one of the cars of that road on June 21 and killed instantly.

PERSONAL.

L. W. STANTON.

MR. L. W. STANTON, whose paper on exchange work, read at the recent Independent Telephone Convention, was one of the features and attracted much attention, is, as his portrait shows, still a young man, but has had a wide experience in electrical and telephone engineering. Receiving a thorough technical education, he has supplemented this with practical experience in almost every phase of electrical work. His first training was in an electrical supply store, in which he owned a half interest. After the expiration of the Bell Telephone patents in 1893 he assisted in the construction of one of the first independent telephone exchanges in the country, at Cambridge, O., and attended several of the meetings held at Columbus, O., by the pioneer independent telephone men. After completing the plant at Cambridge, he accepted a position to construct and manage the exchange at Barnesville, Ohio. Thence he went to St. Louis, Mo., secured a position with the local Bell Telephone Company, and worked in several departments during the construction of their fine new common battery plant, his aim being to become acquainted with every class of telephone engineering. After the completion of this plant he spent a few months with the National Conduit and Cable Company, surveying for and installing the conduit system for the Electric Light & Power Companies of St. Louis. He then became connected with the Standard Underground Cable Company while they were completing cable work for the Kinloch Telephone Company, and upon the arrival of the Kellogg Switchboard & Supply Company, helped to install the switchboard for the Kinloch Telephone Company. After the completion of this work he was sent by the Kellogg Company to Cleveland, O., to install the board for the Cuyahoga Telephone Company, which is said to be the largest board in the country. After completing this work he accepted the technical position which he still holds with the Federal Telephone Company, which controls a number of exchanges in Ohio, besides the U. S. long distance lines.

MR. THOMAS J. JOHNSTON, the patent lawyer, has removed his offices to 66 Broadway, New York city.

MR. ARTHUR WILLIAMS, of the New York Edison Company, sailed last week on the Oceanic for a European trip of some weeks.

COL. JAS. L. TAYLOR has resigned as third vice-president of the Consolidated Railway, Electric Lighting & Equipment Company, of this city, to engage in other work.

DR. K. AUER VON WELSBACH has been made a baron by the Emperor of Austria in recognition of his various remarkable inventions and contributions to science. He is only 42 years of age.

MR. A. V. ABBOTT, E. E., since resigning from the engineering staff of the Chicago Telephone Company, has been making a trip through the East visiting many old friends and various electrical plants.

DR. HENRY PRITCHETT, president of the Massachusetts Institute of Technology, has been appointed superintendent of awards at the Pan-American Exposition and will have the selection of all the juries of awards.

DR. LIONEL FLEISCHMANN, of the Union Elektricitaets Gesellschaft, of Berlin, who has been visiting this country again, and has made a long stay at the General Electric Schnectady shops, sailed for Germany this week.

MOODY-BAKER.—Vice-President W. H. Baker, of the Postal Telegraph Cable Company, and Mrs. Baker announce the marriage, on June 18, in Brooklyn, of their daughter, Miss Ethel Chandler Baker, to Mr. Harry Le Roy Moody.

MR. F. P. FISH, who is said to be making a flying trip to Europe, was duly elected president of the American Telephone & Telegraph Company at the meeting of the directors in Boston on June 19. His election, announced some time ago, takes effect on July 1.

MR. GRENVILLE A. HARRIS, formerly construction engineer with the Westinghouse Electric and Manufacturing Company, and now with the exporting firm of Takata & Company, of New York, was married on June 27 to Miss Blanche Sheffer, of Baltimore, Md.

CONGRESSMAN ROBERT H. FOERDERER, who may become head of the proposed new street railway company in Philadelphia, has, it is said, pledged himself to secure 3 cent fares provided that it can be demonstrated that dividends can be earned with fares at that low figure.

MR. B. KILGOUR.—The employes of the Cincinnati Street Railway Company recently presented to Mr. Bayard Kilgour, ex-president, a handsome oak desk, as a mark of their appreciation. Mr. Kilgour recently severed his connection with the company to go with a telephone company.

MR. JAMES BOYD, well known on the New York Stock Exchange as a leading specialist, and who has been identified with the Western Union, was the recipient, last week, of many attentions on his 70th birthday. He received floral congratulations and other marks of esteem from his broker colleagues.

MR. W. V. B. VAN DYCK, instructor in electrical science at Rutgers College, has tendered his resignation to the Board of Trustees. He is interested in an electrical company in New York city, and leaves Rutgers so as to be able to more fully look after his duties here. Mr. Van Dyck is a son of Prof. F. C. Van Dyck, of Rutgers.

MR. THOMAS I. STACEY, secretary and treasurer of the Electric Appliance Company, of Chicago, has been visiting Philadelphia, and has been entertained by Messrs. Charles M. and E. Ward Wilkins, of Partrick, Carter & Wilkins. Mr. Stacey returns to the West with a very pleasant recollection of Philadelphia, as Messrs. Wilkins Brothers are noted for their cordiality for entertaining strangers. Mr. Stacey was accompanied by his wife.

MR. F. BATHURST, of the Conduit and Insulation Company, Ltd., of London, is now on a trip to this country with his wife. He has not been in good health, and proposes to combine recreation with business while here. Mr. Bathurst spent some years in this country as an electrical engineer and has long been one of the foremost advocates in England of conduits for interior wiring. Much of the best work has been done under his supervision.

MR. NELSON PERIN.—It is officially announced that Nelson Perin, president of the United Railways & Electric Company, Baltimore, will retire at the next meeting of the directors, and will be succeeded by George R. Webb, who is also president of the Maryland Telephone Company. It is also asserted that Mr. Perin's holdings in the company, amounting to about 25,000 shares of stock, have been sold to a syndicate headed by Alex. Brown & Company, who financed the present combination.

MR. CECIL B. SMITH, Mem. Can. Soc. C. E., assistant engineer, City Engineer's Department, Toronto, Canada, and formerly assistant professor of civil engineering, McGill University, and Mr. Wm. S. Aldrich, Mem. Am. Inst. E. E., Mem. Am. Soc. M. E., Professor of Electrical Engineering, University of Illinois, have opened an office as consulting engineers, rooms 101-103, Mail and Empire Building, Toronto, Canada. As Prof. Aldrich has practiced and taught both mechanical and electrical engineering, and Prof. Smith has done notable work in civil engineering, the new firm is peculiarly well equipped for both general and special engineering practice.

POPE-RUSSELL.—The marriage was celebrated at Great Barrington, Mass. on June 12, of Franklin Judson Pope, son of Mr. R. W. Pope, the worthy secretary of the American Institute of Electrical Engineers, to Miss Mary E. Russell, daughter of Mr. and Mrs. P. A. Russell. The wedding ceremony took place at the Congregational Church and was largely attended, while the gifts were numerous and handsome, including one from Governor Crane of Massachusetts, of whose council the bride's father was recently a member. Another came from the bridegroom's associates on the editorial staff of the New York *Evening Sun*. The wedding was followed by an electric light fête at the residence of the bride's parents.

Trade Notes.

THE GOLD CAR HEATING COMPANY, New York, has recently equipped fifty cars of the Brooklyn elevated with its electric heaters. These cars will also be fitted out with the Gold gate locks.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is manufacturer of the Eaco visual signal switchboard, which it claims has all of the advantages of the flashlight board and without the aggravations caused by the burning out of the signal lamps.

SMITH & HEMENWAY COMPANY and the Utica Drop Forge & Tool Company have an exhibit in the Maryland collective exhibit, section S, Electricity Building, Pan-American Exposition. Printed matter and catalogues will be distributed by the Smith & Hemenway people.

THE C. C. CHESNEY CONTRIBUTION to "Lightning Protection," which appeared in the columns of the ELECTRICAL WORLD AND ENGINEER June 1, has been issued in pamphlet form. Copies will be mailed gratis upon request to Mr. Ray D. Lillibridge, 20 Broad Street, New York City.

MACHINE TOOLS.—In a neat pamphlet, the Becker-Brainard Milling Machine Company, Hyde Park, Mass., illustrates and describes its exhibit at the Pan-American Exposition. This kind of advertising literature is a pronounced improvement over the usual method of distributing general catalogues to those viewing an exhibit.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is in a position to make immediate shipments of large and small orders for telephone construction material. The Central is carrying large quantities of cross-arms, pins, brackets, insulators, telephone wires, etc., in Chicago stock in order to be able to make immediate shipment of this material.

DIAMOND PROSPECTING DRILL.—The M. C. Bullock Mfg. Company devote the latest of their catalogues (No. 46) to a detailed description of the Bullock "Diamond" drill, which is described and illustrated in all of its forms. Several views show the drill at work, one being a photographic reproduction representing a South African drilling plant.

MICA.—The Chicago Mica Company, Valparaiso, Ind., devotes a four-page sheet to an announcement to the electrical trade of its facilities for supplying mica. With a factory having 48,800 square feet of floor space, and in charge of a well-known expert in insulation, the sufficiency of its facilities and the character of its product cannot be questioned.

KENDRICK & DAVIS, Lebanon, N. H., are pushing a new gas engine igniter, pleasing in design and thoroughly well made. The brushes and holder are easily removed, without disturbing the connection. All the parts which are subject to wear have been made interchangeable, and great care has been taken to render all parts likely to give trouble so substantial and adapted to their function that defective working is reduced to a minimum.

FORD AUTOMATIC BOILER CLEANER COMPANY, of St. Louis, report business good. They are working their plant to its full capacity. Last week they received orders for fifteen cleaners from the Morris-Butts Company, owners of the Kansas City Ice & Cold Storage Company; four from the Baltimore Hotel, Kansas City; eight from the East St. Louis Ice & Cold Storage Company; three from the Woodward & Tiernan Printing Company, St. Louis, and several others.

THE GOULD STORAGE BATTERY COMPANY reports good progress in the storage battery arena. Its recent installation for the Canton Electric Illuminating Company, of Canton, Pa., is one of its latest successes, while a letter just received from the Lansing Street Railway Company tells how Gould batteries brought sunshine to a dark corner. The Lansing battery plant is said to reduce the generator requirement one half. The Gould automobile battery in Baker vehicles is making a record.

NIAGARA POWER.—The General Electric Press has scored another triumph in a beautiful pamphlet entitled "Niagara Power on the Street Railways of Buffalo and Vicinity." The illuminated cover is an artistic production such as one scarcely expects to find in connection with trade literature, and yet the design makes it entirely appropriate for this use. The pamphlet illustrates and describes various details of Buffalo electric railway plants, the half tone cuts being fine specimens of the engraver's art.

THE WARD LINE STEAMSHIP SANTIAGO was recently equipped with Sturtevant fans for forced draft. As a result, two Scotch boilers under forced draft are now doing the work which originally required four similar boilers under natural draft, and further, a fuel saving of four tons of coal per day has been made. The average revolutions have been increased by three per minute and a considerable portion of the space originally occupied by coal bunkers has now been converted into valuable freight space.

CONVERTIBLE STREET CARS.—The J. G. Brill Company, Philadelphia, Penn., in a 24-page pamphlet describes in detail the Brill convertible street car, a new form of car for use all the year around. The Brill company more than 20 years ago designed, patented and built a convertible car, but owing to limited demand its manufacture was dropped after a few years. About two years ago Mr. John A. Brill took up the problem again, and the present car is the result, which is claimed to be an entirely satisfactory solution. Many cuts show every detail of the car.

GENERAL ELECTRIC BULLETINS.—Among recent General Electric Bulletins is one dated May 7, on small alternating current motors; another dated May 10, on small direct current stationary motors, and four dated May 15, on belt driven railway generators, small plant switchboards, the "tub" arc lamp system, and slow and moderate speed belt driven generators, respectively. The first mentioned bulletin is of special technical interest, as it gives full details of a line of small single-phase self-starting motors, all of the parts being illustrated in details, and illustrations included of the condenser compensator. This latter apparatus consists of a condenser in connection with a transformer for raising the voltage and thereby reducing the condenser capacity. The line of small direct current motors described in the bulletin of May 10 are of the so-called ironclad type, and range from 1/8 to 2-hp, the speeds ranging from 2,300 to 1,800 r. p. m.

CHANGE IN SIXTY-NINE YEARS.—A writer in the New York *Press* says: I have just looked upon two pictures, one entitled "DeWitt Clinton and Train—1831" and the other "Empire State Express—1900." The former shows the primitive locomotive DeWitt Clinton, belonging to the New York Central Railroad, drawing a train of three old Concord stage coaches at its top speed of 15 miles an hour over the 17 miles of track which constituted the New York Central System sixty-nine years ago. It is most comical. The latter exhibits the Empire State Express, going 65 miles an hour with its splendid train of rolling palaces on a part of the same "system," now grown from 17 miles to 10,453. The road's equipment in 1831 was one engine and three made-over stages; to-day it is 3,580 locomotives, 185 sleeping and parlor cars, 3,600 passenger, baggage, mail and express cars, and 150,400 freight cars. This equipment carried over 52,000,000 passengers in 1899, and more than 103,000,000 tons of freight. Something of a contrast.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 18, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

676,426. RHEOSTAT CONTROLLER; J. Dillon, Milwaukee, Wis. App. filed Mar. 22, 1901. A combination of levers, latches, dash-pot and spring.

676,436. TELEGRAPHIC INSTRUMENT; H. T. Johnson, Jersey City, N. J. App. filed July 5, 1900. The key helps move the lever of the sounder so as to improve the sluggish action of the latter.

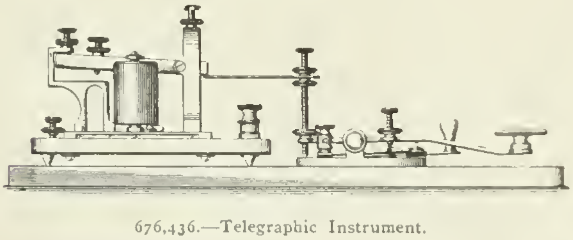
676,439. POLE PIECE FOR DYNAMO ELECTRIC MACHINES; F. A. Merrick, Johnstown, Pa. App. filed Mar. 20, 1901. The pole piece is built up of laminations, the ends or horns being of slightly greater distance from the armature surface than the middle portion.

676,441. FAN SUPPORT; F. P. McBerty, Warren, Ohio. App. filed June 12, 1900. A universal joint is inserted between the motor frame and standard.

676,514. PROCESS OF MAKING CARBIDE OF CALCIUM SIMULTANEOUSLY WITH SILICIDE OF IRON; Walther Rathenan, Berlin, Germany. (See p. 1115.)

676,517. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Aug. 15, 1898. The present invention contemplates the use of electromagnetic supervisory signals controlled by the relays, each signal having two windings differently disposed, one of which is in a local circuit closed in making connection with a line, and the other of which is in a branch of the local circuit controlled by the supervisory relay, to be closed when the relay is excited.

676,520. ELECTRIC MOTOR; A. P. Warner, Milwaukee, Wis. App. filed Oct. 22, 1900. An electric motor, comprising an armature, a shunt field-winding around the armature, a starting-resistance in the armature circuit, and an additional field-winding in shunt around a part or all of the starting resistance.



676,436.—Telegraphic Instrument.

676,524. ELECTRODE FOR SECONDARY BATTERY; Wilson H. Abbey and Jacob Altmos, Cleveland, Ohio. App. filed Aug. 25, 1900. (See p. 1108.)

676,575. ELECTRIC FURNACE; Alfred H. Cowles, Cleveland, Ohio. App. filed July 6, 1895; divided and present application filed Apr. 9, 1897. (See page 1115.)

676,576. ELECTRIC SMELTING PROCESS OF REDUCING SODIUM COMPOUNDS; Alfred H. Cowles, Cleveland, Ohio. App. filed June 18, 1901. (See p. 1115.)

676,577. ELECTRIC SMELTING PROCESS OF REDUCING SODIUM COMPOUNDS; Alfred H. Cowles, Cleveland, Ohio. App. filed July 20, 1895; divided and present application filed Sept. 27, 1900. (See page 1115.)

676,583. ELECTRICAL APPARATUS; T. B. Kinraide, Boston, Mass. App. filed Aug. 13, 1900. Means for producing a continuous or unidirectional discharge, consisting of electrodes, one of which has a discharge point and is provided with means for cutting off the receptive area about said point, and another of which has a large receptive area provided with means for preventing the tendency to discharge.

676,604. MASSAGE INSTRUMENT; L. S. Fritze, New York, N. Y. App. filed Mar. 19, 1900. A fat casing containing a battery and having an operating surface, consisting of a number of metal balls, through which the current passes to the body when the instrument is rubbed over the surface of the body.

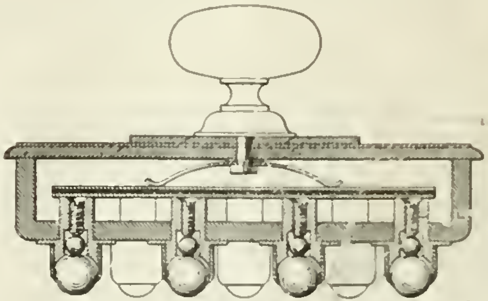
676,618. MAGNETIC SEPARATOR; Thomas A. Edison, Llewellyn Park, N. J. App. filed July 16, 1897. A series of bar magnets are arranged in a stack and ore is fed by gravity on two vertical faces of the magnets. The material rejected from the uppermost magnet passes to the magnet below, and so on to the lower magnet, the final tailings being carried off by a belt. The magnetic ore at each magnet passes into a chute, the several chutes delivering to a conveying belt.

676,738. ELECTRICALLY PROPELLED BOAT; W. R. Edwards, Weybridge, Wyo. App. filed Mar. 2, 1901. A handle by which the direction of rotation of the propeller can be changed and the current to the motor controlled.

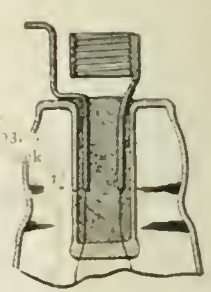
676,739. SPEED GOVERNING SYSTEM; S. S. Ekman, Pittsburg, Pa. App. filed Mar. 7, 1901. A speed governor for a prime mover having connections for driving the same separately from the prime mover, the speed of the governor being controlled by the number of alternations of an alternating electric current.

676,744. BURGLAR ALARM; O. J. Gatten, Columbus, Ohio. App. filed Feb. 4, 1901. Details.

676,840-1. MAGNETIC SEPARATING APPARATUS; Thomas A. Edison, Llewellyn Park, N. J. Apps. filed Jan. 9, 1901, and June 18, 1901. A circular magnet forms a pulley over which a conveying belt passes, to which ore is fed. The magnetic particles adhere to the belt and drop off on one side of a partition, the non-magnetic particles dropping off earlier on the other side of the partition. Several of these elements are arranged one above the other, and the rejected material of an upper belt becomes the working material of the belt below.



676,604.—Massage Instrument.



676,842.—Incandescent Lamp.

676,842. INCANDESCENT LAMP; C. Hoelscher, Warren, Ohio. App. filed May 25, 1900. The metallic terminals which engage with the lamp socket are anchored in cement contained in the neck or mount of the lamp.

676,849. CIRCUIT BREAKER TRIP; A. J. Purinton, Waterbury, Conn. App. filed May 9, 1900. Details.

676,853. ELECTRICALLY ILLUMINATED CROSS; H. J. Schlacks, Chicago, Ill. App. filed Apr. 22, 1899. A skeleton frame in the shape of a cross supports tubular lamps, which at night define the shape of the cross.

676,854. AUTOMATIC TELEGRAPH; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 12, 1901. Quick action of the magnets is obtained by means of a short reversing circuit, which helps to kill the magnets immediately after they have attracted an armature.

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